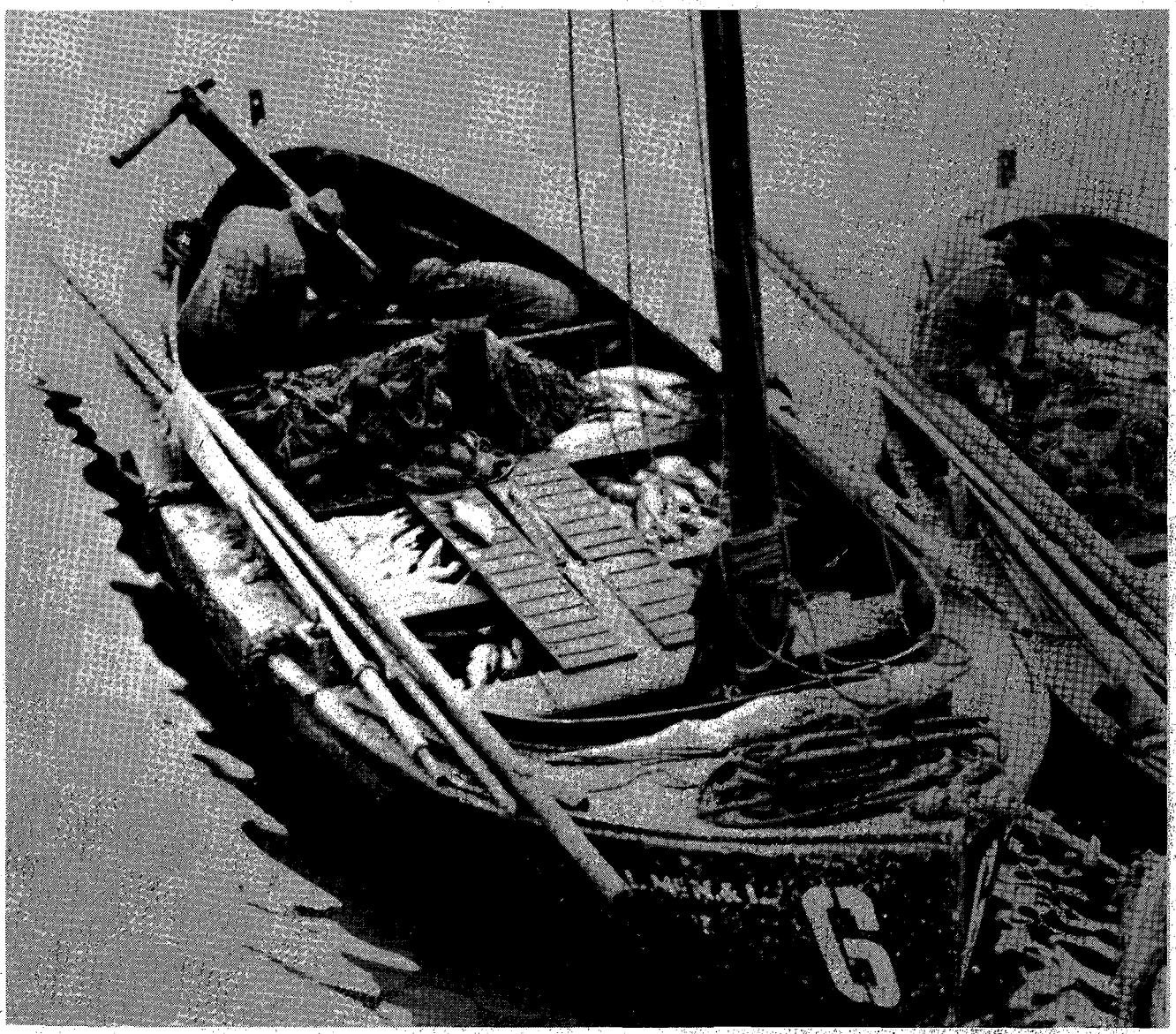
BRISTOL BAY COMPREHENSIVE SALMON PLAN



Developed by the Bristol Bay Regional Planning Team

for the

Department of Fish and Game

Don W. Collinsworth
Commissioner
April 1989

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For the

Alaska Department of Fish and Game

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Commissioner

P.O. Box 3-2000

Juneau, Alaska 99802

April 1989

STATE OF ALASKA

DEPARTMENT OF FISH AND GAME

OFFICE OF THE COMMISSIONER

STEVE COWPER, GOVERNOR

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December 13, 1988

Mr. Lance Trasky
Chairman
Bristol Bay Regional
Planning Team
333 Raspberry Road
Anchorage, AK 99518-1599

Dear Mr. Trasky:

I was pleased to receive for review and approval the completed Bristol Bay Comprehensive Salmon Plan prepared by the Bristol Bay Regional Planning Team. The care and professionalism exercised in developing the plan is indicative of the effort made by the team to address the unique salmon production needs and environment in Bristol Bay.

Because the sockeye salmon produced in the Bay area is so important not only to the Alaskan but also to the world economy, exercising meticulous and considerate approaches to the planning process was essential.

I believe, given the constraints and importance of the salmon resource in Bristol Bay, that the plan emerges as a critical document for ensuring the long-term vitality of these fish stocks. Thank you and the other team members for your dedication to the planning process.

Sincerely,

Don W. Collinsworth
Commissioner

cc: Bristol Bay Regional
Planning Team Members

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GLOSSARY

ADF&G: Alaska Department of Fish and Game

ALASKA STATUTE 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 Section 380 of this chapter."

ANILCA: Alaska National Interest Lands Conservation Act of 1980.

AQUACULTURE: Culture or husbandry of salmon (or other aquatic fauna/flora).

CARRYING CAPACITY: The maximum number of salmon fry or juveniles (individual organisms) that a stream or ocean (closed system) can support.

ELECTROPHORESIS: A biochemical technique useful in establishing genetic differences of fish. The technique is used to help separate different stocks of fish from a mixed stock.

ENHANCEMENT: The application, to a stock already at natural capacity, of procedures designed to increase the numbers of harvestable fish to a level beyond that which could naturally be produced. This may be accomplished by using artificial or semi-artificial production systems or by increasing the natural productive habitat by physical or chemical modification.

ESCAPEMENT: Unharvested fish returning to spawning area for reproductive purposes.

EX-VESSEL VALUE: Value of the catch when delivered from the fishermen to the first buyer.

FINGERLING: A young salmon that has doubled its weight at emergence from gravel but has not begun its seaward migration.

FRY: A young salmon that has emerged from the gravel but has not yet doubled its emergence weight.

HABITAT PROTECTION: Maintenance of current fishery spawning and rearing areas through use of environmentally sound measures.

HARVEST MANAGEMENT: Assuring adequate escapement yet allowing for optimimum harvest levels.

INCIDENTAL CATCH: Harvest of a salmon species other than the target species for which the fishery is managed.

INSTREAM INCUBATOR: A device located adjacent to a stream that is used to contain, incubate, and hatch salmon or trout eggs.

INTERCEPTIVE FISHERY: The harvest of migratory salmon outside of and prior to arrival at the spawning area.

MITIGATION: The use of compensatory techniques to replace a loss of fish that resulted from habitat alteration.

MIXED-STOCK FISHERY: Harvest of salmon at a place and time when several species and/or stocks are intermingled.

NATURAL PRODUCTION: The spawning, hatching, and rearing of fish in a natural stream environment without human intervention.

NET VALUE: Total value of fish produced after costs of an improvement or investment have been subtracted.

PERSON YEARS: The number of full-time, year-round job equivalents derived from an actual number of part-time, seasonal jobs.

PLAN: An analysis of the structure and state of an existing system and determination of a future objective to be fulfilled, actions to be performed, their timing, and their quantity (i.e., a program or a schedule) to move the system toward the objective.

POTENTIAL HARVEST: Total run size less the number needed for escapement.

PRODUCTION: Adult harvest and escapement, or total run size, measured by weight or number of adults.

REAL PRICE: Money received for catch per unit of effort expended in a fishery, adjusted for inflation.

REARING AREAS: Waters used by juvenile salmon for freshwater development.

REHABILITATION: The application, to a depressed stock or endangered habitat, of management, fish propagation, or habitat restoration techniques to return them to a previously recorded level of production.

RESTORATION: Increasing the annual production of salmon to historic levels by using rehabilitation strategies.

RUN: Returning salmon stock(s) bound for a spawning area. A run may also be described by stock timing and numbers.

SALMON STOCK: A genetically similar group or population of salmon generally identified with a specific water system, or portion thereof.

SCALE ANALYSIS: Study and measurement of annular growth of fish scales. Because different salmon stocks in a mixed-stock fishery have different growth rates, measurement of annular growth can be useful in population differentiation.

SMOLT: A young salmon that has completed its freshwater rearing period and is migrating to an estuarine environment.

SPAWNING CHANNELS: Man-made additions to salmon spawning habitats that can control water flow, substrate, sedimentation, and predation to improve egg-to-fry survival averages.

STRATEGY: A method or technology, for example, the use of spawning channels, to mitigate, restore, or enhance fisheries.

SUPPLEMENTAL PRODUCTION: The use of salmon enhancement techniques and aquaculture science to stabilize or augment natural production.

SUSTAINABLE HARVEST: The harvest level at which equilibrium is achieved between optimal escapement and maximum harvest.

TERMINAL FISHERY: Harvest of salmon in a spawning area where a segregated stock can be discretely identified and removed.

USFWS: United States Department of Interior, Fish and Wildlife Service

USNPS: United States Department of Interior, National Park Service

WEIR: Device used to control fish migrations so that the fish can be enumerated or captured.

ACKNOWLEDGEMENTS

The Bristol Bay Comprehensive Salmon Plan was written by the Bristol Bay Regional Planning Team (BBRPT). Due to shortage of planning resources, development of the plan extended over a period of approximately four (4) years from 1985-1989. The BBRPT, unlike the other regional planning teams in the state, had very little assistance from the ADF&G in paying expenses for members to attend meetings and did not have a full-time planner assigned and paid by ADF&G.

The Alaska Department of Fish and Game (ADF&G) members were: Chairman Lance Trasky, Habitat Division; Jim Fall, Subsistence Division; Chuck Meacham, Commercial Fisheries; and Paul Krasnowski, Sport Fish. Representing the Bristol Bay Salmon Enhancement Association (BBSEA), previously known as Imarpik, were Stosh Anderson and Jim Bingman. Also serving on the team were Ross Kavanugh of the National Park Service (NPS) and Jon M. Nelson, United States Fish and Wildlife Service (USFWS).

Regional aquaculture association participation began with members of the Imarpik Aquaculture Association which was in a period of transition and has been replaced by the BBSEA. Special acknowledgement is made of efforts by BBSEA officers Stosh Anderson and Jim Bingman who actively represented the fishermen of the Bristol Bay area during the entire planning effort. Also specially acknowledged are NPS and USFWS. Both agencies are major land managers in the Bristol Bay region, and their contributions to the plan were invaluable.

Participating in drafting the plan were Chris Pace, Sid Morgan, Steve McGee and Jerry Madden of the ADF&G Private Nonprofit (PNP) Program. Editorial review was by Sid Morgan. Shaleen Harrison, and Jeri Museth of the PNP program prepared the document. Gene Walsh of Juneau designed the cover based upon Alaska Historical Library photographs of early day Bristol Bay fishing activities. The team recognizes the support of other individuals and organizations, including the University of Alaska Marine Advisory Program, the Bristol Bay Native Association, and the ADF&G Dillingham Office staff who participated in meetings, provided program information and cooperative data preparation.

CHAPTER 1

INTRODUCTION

Under the auspices of the Commissioner of the Alaska Department of Fish and Game (ADF&G), the Bristol Bay Regional Planning Team has drafted a comprehensive salmon plan for the Bristol Bay Region, which is the coastal region between Cape Newenham and Cape Menshikof, Alaska. The plan considers all relevant factors of the physical, social, and economic environments as they relate to the biology and production of Pacific salmon in the region. Long-range harvest and production goals for each of the five species of salmon have been set with reference to recent levels of production. The plan recommends a strategy necessary to maintain or achieve these production goals by the year 2005.[1]

The planning team identified the following user and interest groups that are affected by regional salmon production:

1. User Groups
   a. Commercial fishermen
   b. Subsistence fishermen
   c. Sport fishermen
   d. Processors
   e. Lodge owners, guides
   f. Non-consumptive groups

2. Interest Groups
   a. Federal government
   b. Private landowners
   c. Service industries (e.g., air taxi operators)
   d. Conservation organizations
   e. Domestic interception fisheries (e.g., those on the Alaska Peninsula)
   f. State government
   g. Local governments

The maintenance of salmon runs from one season to the next requires that the identified users understand the resources' ability to respond to their needs. To measure this response, production goals must be determined and established by the plan.

Background

Statute requires that a comprehensive salmon plan be prepared for the Bristol Bay salmon production region. The legal requirement for regional salmon planning was established by AS 16.10.375 in 1976. This statute authorized the Commissioner of Fish and Game to "designate regions of the state for the

[1] All data is baseline 1987.

purpose of salmon production and have developed and amend as necessary a comprehensive salmon plan for each region. . . ."

The law was enacted to establish methods to address salmon production and alleviate fishery crises such as occurred during the early 1970s in Bristol Bay, when salmon returned in catastrophically low numbers. These depleted runs threatened the maintenance of existing stocks as well as the regional economy. To assist the salmon industry, decision makers in both the public and private sectors joined in supporting legislation that provided the legal and fiscal resources to address the problem. This legislation provided for (1) limited entry (AS 16.43.010); (2) general obligation bonds for public hatcheries (1974, 1976, 1978, 1980); (3) a permitting system for the private sector to develop private nonprofit (PNP) salmon hatcheries (AS 16.10.400); and (4) a state loan fund to provide financial assistance to those seeking to develop private hatcheries or to construct salmon enhancement and rehabilitation facilities (AS 16.10.500).

A regional aquaculture corporation, comprised of fishermen and other users of the Bristol Bay salmon resource, was organized in 1977. On May 16, 1978, the Commissioner of Fish and Game determined that corporation, Imarpik Regional Aquaculture Corporation, qualified under the terms of Alaska Statute 16.10.380 to:

1. Appoint members to the Bristol Bay Regional Planning Team (AS 16.10.375);

2. Seek enactment of a Salmon Enhancement Tax in the Bristol Bay region (AS 43.76.025c);

3. Receive a $100,000 organization and development grant from the Department of Commerce and Economic Development (AS 16.10.510.9);

4. Receive a $100,000 matching funds grant from the Department of Commerce and Economic Development (AS 16.10.510.9);

5. Have a preference right to a permit for a PNP hatchery site, if the site was provided for in the region's comprehensive salmon plan (AS 16.10.400); and

6. Grant approval of fisheries enhancement loan amounts sought by local nonprofit corporations in the region (AS 16.10.520).

The Planning Process

This plan outlines the issues, goals, and strategies for the region. The planning process analyzed the fishery, its species, habitat, user groups, costs, benefits, and the other issues that are relevant to the fishery's current status. Goals were

established based upon this analysis. These goals were clear, specific, practical, and resulted from realistic assessments of conditions. Strategies to attain the goals were developed. Any pending or potential developments or constraints that could affect the plan were considered.

After the plan's goals and strategies had been set, quantifiable objectives were established to evaluate plan progress. Based on this review, issues, goals, and the anticipated strategies may be updated or revised, and effectiveness of the plan should eventually be reflected in the region's annual harvest statistics.

Planning Team Composition:

The Bristol Bay Regional Planning Team (RPT) was appointed by the Commissioner of ADF&G to develop a comprehensive salmon plan to serve as a basis for decisions affecting current and future salmon production. The RPT is the only statutorily created salmon planning group with legally mandated ADF&G and private sector participation. It is comprised of representatives from the Sport and Commercial Fisheries, Subsistence, and Habitat Divisions of ADF&G and from the U.S. Department of Interior's National Park Service (USNPS) and Fish and Wildlife Service (USFWS). The users of Bristol Bay's salmon resource are represented, along with the Imarpik Regional Aquaculture Corporation, the local Fish and Game Advisory Committees, and the Bristol Bay Native Association. The RPT is staffed by the PNP Program of ADF&G.

State statute defines certain duties of the RPTs. They are: (1) plan development and amendment; (2) review of PNP hatchery permit applications and recommendations to the Commissioner; and (3) review and comment on proposed PNP hatchery permit suspensions or revocations by the Commissioner.

Regional Planning Boundaries:

In 1978, the Commissioner of ADF&G established the Bristol Bay salmon planning region as the coastal area east of a line from Cape Newenham to Cape Menshikoff, including all freshwater drainages flowing into the bay between these two landmarks (Figure 1). These boundaries were chosen primarily because they coincide with the commercial fisheries management area specified in 5 AAC 06.100.

In addition, all pre-statehood and recent commercial and subsistence harvest records are reported for this same region. These records served as the basis for the long-term production goals and objectives stated in this plan.

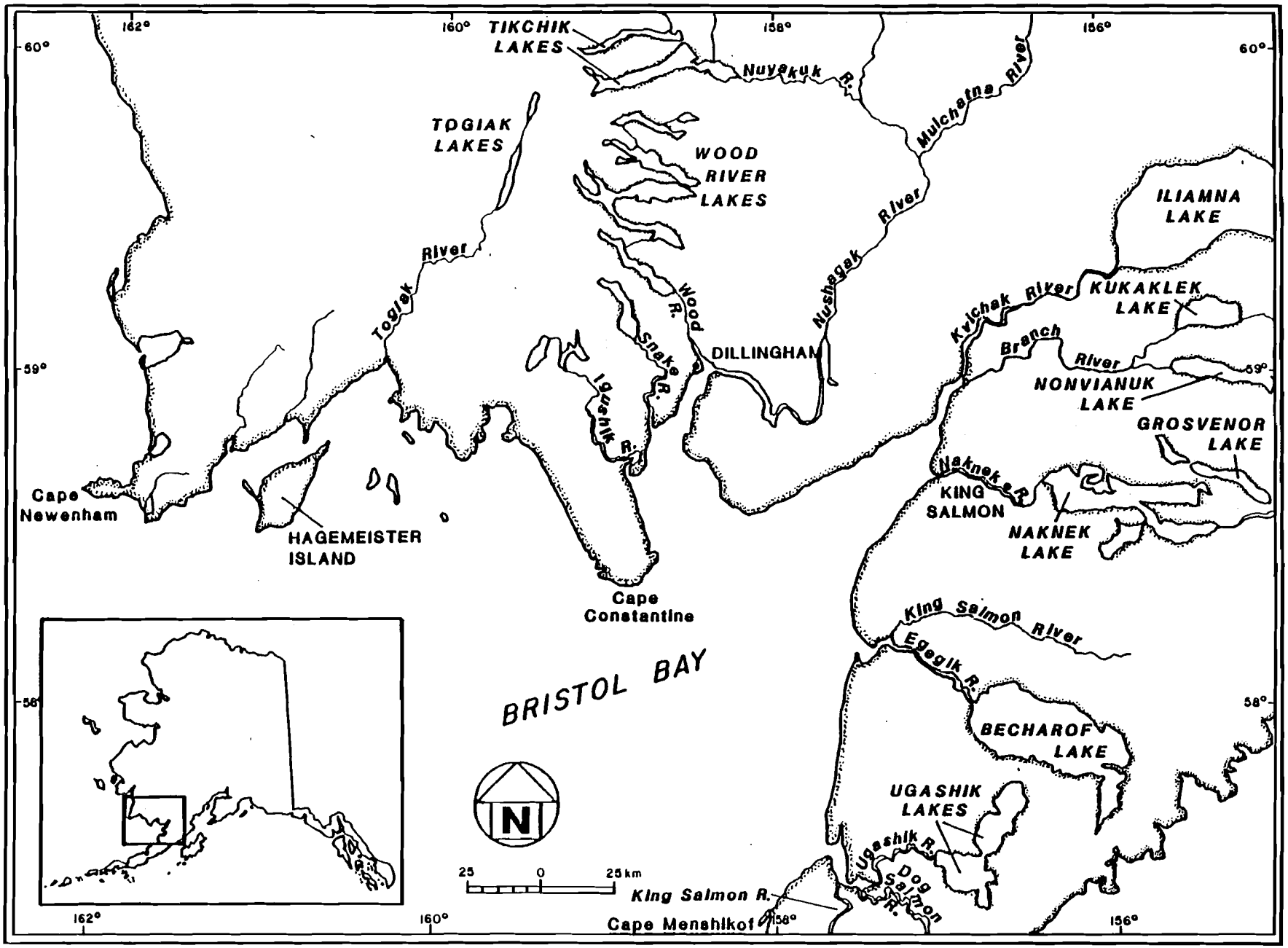


Figure 1. Bristol Bay area.

Purpose of the Plan:

To guide the RPT in the planning process and the development of the Bristol Bay Comprehensive Salmon Plan, the following mission statement was adopted: "To promote, through sound biological and ecological practices, long-range activities to maintain and protect salmon-producing habitat and the salmon resource for the optimal social and economic benefit of all the region's salmon-user groups."

In general terms, the goal of the plan is to maintain the optimum yield without large annual variation. The plan recognizes the need for long-range planning as well as the desire for concrete accomplishments in the short term. This document represents the initial phase of a continuing planning effort and establishes an outline within which future projects may be implemented. The plan will provide guidance to the public and private sectors in the selection and development of fisheries investments responsive to the needs of the region's users and the salmon resource.

Public Participation:

The members of the RPT were selected to provide a broad cross section of user interests so that the public could have multiple points of access to the planning process. The draft comprehensive salmon plan was distributed for public review and comment prior to its submission to the Commissioner of ADF&G. All RPT meetings were advertised and open to the public, and public participation in the planning process was encouraged.

Authority of the Plan:

Regional comprehensive salmon planning is authorized in AS 16.10.375-400 and in 5 AAC 40.300-370 (see Appendix E). After a plan for a region has been developed by the team and formally approved by the Commissioner, it is then used as the official guideline for efforts to rehabilitate, enhance, conserve, and protect the region's salmon resources.

Effective Life of the Plan:

The Bristol Bay comprehensive salmon plan is designed to guide salmon production activities in the Bristol Bay region for 20 years. The planning document is meant to be dynamic and interactive. It is expected that the assumptions, issues, goals, strategies, and the review of the present status of the fisheries resource contained herein will be reviewed and updated at least every five years. At the time of each update, the planning group will evaluate user-group needs and new data, and will incorporate them into the the revised plan. The plan's status will also be discussed at an annual meeting of the RPT.

Key Assumptions

Planning requires that certain assumptions be made and accepted. In writing this comprehensive salmon plan, the Bristol Bay RPT made the following assumptions:

1. The plan makes use of the best data available and makes valid interpretations of the information.

2. Not all aspects of the physical/biological interactions occurring in the Bristol Bay planning area are included in this document. In fact, the plan recognizes the necessity of developing a better and more comprehensive understanding of those processes and interactions.

3. Funding will be available to finance projects and to fund research programs. Such programs are needed to optimize salmon productivity using management, research, habitat protection, enhancement, and rehabilitation technologies.

4. As statewide salmon production increases, the State of Alaska and the salmon industry will continue to support an active salmon marketing program. National and world markets will absorb long-term increases in salmon production without a reduction in real price.

5. User groups and state, federal, and private agencies will continue to cooperate toward a common goal of providing the optimum yield of salmon resources.

6. Conservative management and habitat protection strategies will be used to achieve the desired salmon harvests. This is based on the assumption that marine survival and marine food species are not the limiting factors in fish production and that the freshwater habitats and carrying capacities will remain stable. The plan also assumes that, where feasible and appropriate, manipulation of freshwater habitat through fisheries enhancement techniques may also contribute to desired salmon harvests.

7. If a stock were substantially reduced due to unforeseen circumstances, an aquaculture program might be implemented by the qualified regional aquaculture corporation in accordance with AS 16.10.400.

CHAPTER 2

REGIONAL PROFILE

This chapter highlights those elements of the natural and socio-economic environment that have clear and potentially significant relationships to one or more phases in the annual life cycle of the salmon of the Bristol Bay area. The Bristol Bay watershed produces abundant salmon harvests because of numerous large rivers and lakes, favorable climate, and pristine habitat.

Habitat

Geography:

The terrestrial portion of the planning area is a mountain-bordered basin facing Bristol Bay, a large, comparatively shallow bay of the Bering Sea. The planning area encompasses approximately 26 million acres and includes all waters and drainages east of a line from Cape Newenham to Cape Menshikof (see Figure 1). The coastline between these points is approximately 600 miles in length and is generally regular and composed of numerous sandy beaches, spits, and bars. A few cliffs, ridges, and hills meet the shore between Cape Newenham and Kulukak Bay. Low terraces and alluvial fan deposits occupy sites along the modern floodplains of the lowland rivers, and the mouths of many rivers are tidal estuaries.

The region's topography is extremely varied, ranging from the coastal lowlands of Kuskokwim Bay on the Bering Sea to the Kilbuk and Ahklun Mountains, whose summits rise from 2,000 to 5,000 feet. From these mountain ranges, which are separated by broad, flat valleys lying in a northeast/southwest alignment, the Togiak River and its tributaries flow south into Bristol Bay.

The Wood River-Tikchik Lakes system at the western boundary of the planning area is composed of long, narrow glacial lakes separated by steep-walled mountains ranging in elevation from 3,000 to 5,000 feet. The lakes and rivers of this area drain into Bristol Bay via the Wood, Nuyakuk, and Nushagak Rivers. The Nushagak Hills, Taylor Mountains, and Big River Hills are low, rolling hills that form the northern border of the region. These hills and the Alaska-Aleutian Mountain range within Lake Clark National Park and Preserve surround the Nushagak and Kvichak River basins that drain into Bristol Bay. The Nushagak River basin is broad and relatively flat and contains many shallow ponds and lakes, which get more and more dense closer to the coast. The Kvichak River drains Iliamna Lake and all its tributaries. Iliamna Lake is the largest lake in Alaska, 80 miles long by 20 miles wide.

The Alaska Peninsula consists of coastal lowlands on the Bristol Bay side which rise into the Aleutian Mountains on the Pacific Ocean side. These coastal lowlands are dotted by thousands of small ponds and lakes and are laced with rivers that meander into extensive estuaries before they meet Bristol Bay. Naknek, Becharof, Upper Ugashik, and Lower Ugashik Lakes are four large bodies of water on the northern peninsula. The peaks of the Aleutian Mountains generally average up to 4,000 feet, but occasionally volcanic peaks rise in excess of 8,000 feet. Several active and inactive volcanoes are also found along the peninsula.

Geology:

Like most of Alaska, the continental land mass of the Bristol Bay region, which includes the Bering Sea shelf and extends southward to the Aleutian Trench, was reformed as a result of continental drift. Over the past 200 million years, successive pieces of the earth's crust have drifted and accreted to North America, forming the Alaska Peninsula into a kind of continental appendage.

The Alaska Peninsula and Aleutian Island chain comprise an area of considerable volcanic and tectonic activity. The Alaska Peninsula has 10 volcanoes that have erupted during historic times and 11 more that are considered to be active. In addition to numerous eruptions in Katmai National Park, 74 volcanic eruptions have been recorded since 1775 on the Alaska Peninsula and Unimak Island.

Earthquakes are another major geologic phenomenon in Bristol Bay. Tectonic activity along the Alaska Peninsula and Aleutian Island chain is extremely high. The Aleutian Trench, one of the most active seismic belts in the world, parallels the south side of the Alaska Peninsula and Aleutian chain offshore in the Pacific Ocean. The Bristol Bay region falls within the major seismic zones of Alaska. Structural damage caused by earthquakes can be great. Earthquakes having magnitudes of 6.0 or greater on the Richter Scale have been recorded and can be expected to occur in this region in the future.

The 1919 eruption of Katmai volcano deposited large volumes of ash into the Knife River and probably reduced salmon habitat. Other tectonic events, such as the 1964 earthquake, have demonstrated the extent to which salmon habitat can be changed or damaged as a result of geologic processes.

Climate:

The Bristol Bay region has three climatic zones--maritime, continental, and transitional. Although the coastal areas are influenced by the waters of Bristol Bay, it does not experience the moderating effect of the Japanese current in its maritime zone, as do the Aleutian Islands. Dillingham has recorded

temperatures from -41°F to 92°F and has an annual average of 26 inches of rain and 65 inches of snow. Aleknagik has records of from -36°F to 88°F, with 34 inches of rain and 81 inches of snow. Winds are generally from the northeast from October to March and most frequently from the southwest during late spring, summer, and early fall. Lakes throughout the Bristol Bay region can be expected to freeze up between November and early April. The bay itself never freezes up but becomes impassable due to packed ice.

The continental climate zone includes most of the northern and interior parts of the region. It is characterized by relatively warm summers, cold winters, and less precipitation than the maritime zone.

Weather in the transitional zone, as the term implies, modulates between the maritime and continental zones. Its temperature, precipitation, and wind conditions are intermediate to those of the other two zones. Most of the coastal areas along Bristol Bay are in this transitional zone.

Water Resources:

Bristol Bay and its associated bays, estuaries, and tidelands are among the most productive waters in the world. Tides in the shallow bay are influenced by the strong Bering Sea currents, and a significant portion of the bay's water is exchanged daily. In addition, the many freshwater systems that discharge into the estuary bring with them a rich nutrient load.

Freshwater systems of the area include the following river systems: Nushagak/Mulchatna, Kvichak (which includes the Newhalen, Iliamna Lake, and Lake Clark), Togiak, Naknek, Egegik (which includes Becharof Lake), and Ugashik. Iliamna Lake has a surface area of 1,115 square miles. Other major lakes include Becharof (450 square miles), Naknek (239 square miles), upper and lower Ugashik Lakes (160 square miles), and Lake Clark (143 square miles). Smaller lakes include the Wood/Tikchik Lakes, Togiak Lake, Lake Nunavaugaluk, Brooks Lake, Lake Colville, Kukaklek Lake, and Nonvianuk Lake. The low elevation of the lakes is conducive to salmon rearing because they thaw relatively early in the spring. The number of large lakes and rivers is an important factor in salmon production in Bristol Bay.

Vegetation:

Over 56% of the uplands in the Bristol Bay region is covered by shrub/grass, grass, or lichen/shrub tundra. Another 10% of the area is vegetated by miscellaneous deciduous trees such as birch, cottonwood, and willow. Most of the areas of forest (less than 5% of uplands) occur along major lakes and rivers in the Nushagak-Wood River drainages and in the eastern Iliamna Lake and Lake Clark drainages. Common species include black spruce, white

spruce, quaking aspen, balsam poplar, and white birch. Another 7% of the area is marsh/very-wet bog or wet-bog/meadow. The remaining uplands are either lichen- or snow-covered, barren, or have not yet been surveyed.

Fishery Resources:

Important near-shore marine fish species include Pacific herring, capelin, rainbow smelt, sandlance, and five species of salmon: sockeye (red), coho (silver), chum (dog), chinook (king), and pink (humpback). Freshwater species include northern pike, Arctic char, lake trout, Dolly Varden, rainbow trout, several species of whitefish, and Arctic grayling.

Between late April and early June, Pacific herring move into the coastal waters of the Bristol Bay region to spawn. Some productive spawning area within this region is located near Togiak. This is the largest sac-roe herring fishery in Alaska. Both adult and juvenile herring are thought to remain in waters within 30 to 35 miles of the coast through late summer to feed on phytoplankton blooms. In August or September the adults begin to migrate back along the Alaska Peninsula to wintering areas.

Important species of offshore fish in the region include halibut, sole, pollock, codfish, flounder, sandlance, and capelin. Shellfish include cockles; soft-shell, butter, and razor clams; king, tanner, Dungeness and hair crabs; and shrimp.

Bristol Bay is a halibut nursery area. Bristol Bay's offshore fisheries resources can provide important alternatives to the harvest of salmon. They are also an important part of the complex ecosystem of the area.

Bristol Bay supports the largest sockeye (red) salmon run in the world. As many as 62 million sockeye salmon return annually to the lakes and rivers of the region. The sockeye salmon spend their early life in the region's rivers and lakes, principally in the Togiak, Nushagak, Kvichak, Naknek, Egegik, and Ugashik River drainages, and eventually return, in June and July, to spawn in their natal waters. The Kvichak River, with headwaters in Iliamna Lake and Lake Clark, is one of the world's most productive spawning grounds for sockeye salmon. The Wood, Nuyakuk, Egegik, Naknek, and Ugashik Rivers also support sizable runs of sockeye salmon, with the Alagnak (Branch) and Igushik Rivers supporting smaller runs.

Chinook salmon are found chiefly in the Nushagak, Alagnak, Naknek, Togiak, and Ugashik Rivers, generally preferring to colonize the region's larger river systems. Chum, pink, and coho salmon are distributed throughout most of the Bristol Bay streams. The Nushagak-area and Togiak-area streams are the major

producers of coho and chum salmon. Streams in the Nushagak River area, primarily the Nuyakuk, are the major producers of pink salmon, with occasional strong runs to streams and rivers of the Naknek-Kvichak area.

Arctic char and Dolly Varden are both present in streams throughout the Bristol Bay area and are quite similar in their distribution. Typically, they both inhabit all of the clear, freshwater lakes and river systems as well as the glacial streams and brackish intertidal areas of the region. Lake trout are found in a number of deep lakes in the mountain regions bordering Bristol Bay and in the tributaries and outlet streams of these lakes. Rainbow trout are native to the area and are found in every major drainage north of Becharof Lake. Populations of Arctic grayling are found in Bristol Bay drainages from Cape Newenham on the north to Port Heiden on the peninsula. Grayling prefer fairly cold, clear water.

Birds:

Bristol Bay not only provides rich marine life to support millions of sea birds and other water birds, it also affords them protected nesting sites. Its productive coastal lagoons and estuaries support spectacular concentrations of migrating waterfowl and shore birds every spring and fall. The Bristol Bay region, particularly the estuaries on the north side of the Alaska Peninsula, provide an important component of the Pacific Flyway. Many seabirds, including terns, puffins, and cormorants, prey on juvenile salmon. Adult salmon and salmon carcasses provide important forage for ravens and raptors (eagles and hawks).

Terrestrial Mammals:

The Bristol Bay region is home to one of the largest brown bear populations in Alaska. Bears are found in all Alaskan habitat, but are concentrated in the coastal lowlands and mountain valleys of the Alaska Peninsula and, particularly during the summer and fall, along salmon-spawning streams. Another important carnivore is the land otter. Consumption of salmon by carnivores helps to transfer nutrients from the streams and oceans to terrestrial habitats undergoing colonization, particularly following glacial retreat.

Marine Mammals:

A small herd of sea lions lives on Cape Newenham and Hagemeister Island. Five species of seal (harbor, ring, bearded, ribbon, and fur) winter in Bristol Bay along the packed ice edge. Harbor seals are the most common. Some of the world's largest haul-out areas for harbor seals are located along the Alaska Peninsula. Harbor seals often follow salmon runs into rivers. Iliamna Lake

has a resident population of harbor seals, one of the few populations of freshwater seals in the world.

A 1983 estimate indicated that approximately 1,500 belukha whales were year-round residents of the shallow waters of Bristol Bay (Frost et al. 1983), although local residents think they are in excess of this number. Important feeding and calving habitat is found in the estuaries of Nushagak and Kvichak Bays. In the winter, belukhas move out as far as the ice edge. Concentrations of belukhas have been observed in the Snake, Igushik, Wood, Nushagak, and Kvichak Rivers; they feed on both migrating salmon smolts and adults.

Socioeconomic Factors

Historical Perspective:

In aboriginal times the coastal region of Bristol Bay was inhabited by the Aglegmiut and Togiamiut (Yup'ik) Eskimos. Upriver, the Nushagagmiut Eskimos settled in the interior Tikchik Lakes-Wood River areas, venturing to the bays during the fishing seasons, and the Kiatagmiut of the Kvichak and Iliamna Lake region likewise descended to the coastal regions to trade and fish. Inland, the Tanaina Athabascans of the great northern lakes, rugged glacier country, and barren hills became the only interior Indians to reach the sea. In historic and late prehistoric times, portions of the upper Alaska Peninsula within the Bristol Bay region were inhabited by Sugpiaq Eskimos, locally referred to as "Aleuts". These indigenous peoples lived off an abundance of salmon, sea mammals, and upriver land mammals (Alaska Geographic 1978).

The Bristol Bay area, which was to become the site of flourishing Russian missions and trading activities between 1818 and the purchase of Alaska by the United States in 1867, was first visited by an Englishman, Captain James Cook, in 1778. The Russian penetration under the auspices of the Russian-American company occurred in 1792 with the expedition of Demitri Ivanovich Bocharov. The company's first trading post was established on the Nushagak River in 1818 (VanStone 1967). The Russians, who had been preoccupied with the lucrative fur trade, had been slow to realize the food potential of the bay and had just begun to gear up for commercial fishing when the territory was sold. John W. Clark, chief of the Nushagak trading post under early American ownership, may have operated a saltry at Clarks Point, but the first major enterprise was that of the schooner Neptune, which prospected Nushagak Bay in 1883 and salted a large quantity of fish.

The Arctic Pack Company built a cannery at Nushagak that same year and in 1884 produced 400 cases of salmon. In 1885, Alaska Packing Company established a cannery with a capacity of 2,000 cases per day on the west side of Nushagak Bay. By 1897 the fishing industry had invested $867,000 in the bay, and in 1908

there were ten canneries in operation around Nushagak Bay and others at Naknek, Egegik, Ekuk, and Togiak (Alaska Geographic 1978).

Initially, salmon were harvested with gill nets and traps. Salmon fishing with seines was tried only briefly and was prohibited soon after their introduction in 1922. Similarly, fish traps were eliminated in 1923. Power boats, first introduced in 1922, were outlawed from 1923 until 1951. Sailboats were the predominant method of fishing in Bristol Bay during this period, with the exception of staked or set gill nets along the beaches and estuaries. The total shoreside work force was initially made up of Chinese transported from California each season by sailing ships. These ships also brought cannery supplies and returned to California at season's end with a canned salmon pack and the Chinese workers. Fishermen were predominantly Italians, Yugoslavians, and Scandinavians from California and the Pacific Northwest. It was not until the 1920s that local residents began to become involved in the commercial fisheries.

The principal fisheries management policies prior to World War II were simply to prohibit the use of motorized vessels and to force the fishing effort far offshore, thus imposing gross inefficiency on harvesting activities in the interest of conservation. World War II had important impacts on the regional fishery. War manpower restrictions drastically curtailed the number of fishermen, while price inflation and relaxed regulation intensified the fishing effort. Large canned salmon inventories were perceived to be in the national interest. The change of management philosophy and equipment resulted in harvest levels which were too high for escapement levels during 1942-1945. The resulting high harvests may have contributed to the logic for limited entry.

The collapse of the salmon runs and a drop in market demand in the late 1940s closed down many of the huge cannery operations throughout the bay. Under high-seas fishing pressures by the Japanese, salmon harvests continued to decline throughout the 1950s, and they dipped quite low during the 1960s. The hardest times came during the early 1970s, when two consecutive severe winters killed hundreds of millions of vulnerable eggs and fry. Sockeye harvests hit rock bottom in 1973, and in 1974 President Richard Nixon and Alaska Governor William Egan jointly declared Bristol Bay an "Economic Disaster Area."

Since 1974, restrictions have been placed on the Japanese high-seas mothership gillnet fishery as a result of negotiations between Japan and the United States under the auspices of the International North Pacific Fisheries Commission (INPFC) Treaty. The restrictions imposed by the treaty have resulted in a lower rate of high-seas exploitation of Bristol Bay sockeye. The mothership fleet continues to be restricted by area and time restraints that alter past fishing patterns and further reduce the interception rate of Bristol Bay sockeye. Limited entry to

the domestic salmon fishery, initiated in 1974, complements the high-seas regulation.

The phenomenal recovery of the Bristol Bay sockeye salmon runs from the depressed levels of the 1970s can be attributed to a combination of factors: (1) favorable environmental conditions, (2) good escapements and scientific management, (3) the restrictions placed on the Japanese high-seas land-based and mothership gillnet fishery, and (4) the reduction in incidental take in the high-seas trawl fisheries on the Bering Sea.

Population:

The Bristol Bay region includes 27 communities with a total 1980 population of 5,214 (U.S. Census). In 1980, the area had about 2% of Alaska's total population. From 1970 to 1980, the population of some of the smaller communities dropped, while several others made notable gains. The region as a whole showed an increase between 1970 and 1980 (Table 1). In general, there has been a regional population shift from smaller, outlying villages to large communities, especially Dillingham. The dominant ethnic background is Native (Aleut, Yup'ik Eskimo, and Athabascan Indian). The non-Native population is concentrated in Dillingham, Iliamna, Naknek, and King Salmon.

Bristol Bay's economic structure consists of (1) small village economies with varying seasonal cash flows and significant reliance on subsistence and (2) larger communities with larger, more diversified economies that have steady, year-round employment and cash flows. In a few of the larger communities, government and support services employment provide permanent jobs for many local residents.

Commercial Fishing:

The single largest employment source for Bristol Bay residents is the fishing industry. During peaks of salmon and herring seasons, many transient people enter the region to fish or work in the processing plants, and at these times up to 10,000 people may be employed in harvesting, processing, and distribution (Fay 1986). About 65% of the commercial salmon fishing permit holders are Alaska residents, and 70% of these are Bristol Bay residents.

Subsistence:

As defined by state and federal statutes, subsistence use means the customary and traditional utilization by rural Alaska residents of wild, renewable resources for direct personal or family consumption as food, shelter, fuel, clothing, tools, or transportation; for the making and selling of handicraft articles out of nonedible byproducts of fish and wildlife resources taken for personal or family consumption; for barter or sharing for personal or family consumption; and for customary trade.

Table 1. Bristol Bay historical population estimates.

Subregions/Communities	Civilian Population 1960	1970	1980
Togiak/Kuskokwim			
1. Quinhagak	228	340	412
2. Platinum	43	55	55
3. Goodnews Bay	154	218	168
4. Togiak	220	383	470
5. Twin Hills	NA	67	70
6. Manokotak	149	214	294
Subtotal	794	1,277	1,469
Nushagak River			
7. Aleknagik	231	128	154
8. Dillingham	424	914	1,563
9. Clarks Point	138	95	79
10. Ekuk	40	51	7
11. Portage Creek	0	0	48
12. Ekwok	106	103	77
13. New Stuyahok	145	216	331
14. Koliganek	100	142	117
Subtotal	1,184	1,649	2,376
Iliamna Lake			
15. Nondalton	205	184	173
16. Newhalen	63	88	87
17. Iliamna	47	58	94
18. Pedro Bay	53	65	33
19. Kakhonak	57	88	83
20. Igiugig	0	35	33
21. Levelock	88	74	79
Subtotal	513	592	582
Upper AK Peninsula			
22. Naknek	249	178	318
23. King Salmon[1]	227	202	170
24. So. Naknek	142	154	145
25. Egegik	150	148	75
26. Pilot Point	61	68	66
27. Ugashik	36	NA	13
Subtotal	865	750	787
TOTAL	3,356	4,268	5,214

[1] Excludes 375 active-duty armed forces personnel in 1980.

SOURCE: U.S. Bureau of the Census, 1960, 1970, 1980; Adapted from Nebesky et al. (1983).

Subsistence use of fish and wildlife in Bristol Bay communities is among the highest in Alaska. Besides fish and game, subsistence harvest includes marine mammals and plants. As measured by pounds of edible foods, the most important subsistence resources are salmon and caribou, which are taken in substantial quantities by residents of nearly every community.

Moose is a third resource of major importance in the Nushagak River, Iliamna Lake, and upper Alaska Peninsula areas. Marine mammals are of major importance to residents of the Togiak area.

Other Regional Characteristics

There is no road access to the region. Airplanes and boats are the only ways to reach the Bristol Bay region from the outside. Only three intercommunity roads exist, although during the winter travel can occur between communities by snow machine or all-terrain vehicles. Most communities have at least a small gravel airstrip, and the major air and water transportation centers are located at Dillingham, Naknek, and King Salmon.

Energy is a major concern in the Bristol Bay region. Most energy is produced by noncentralized, diesel-powered generators. Three small utility companies supply power to more than one community: Nushagak Electric Cooperative, Inc. supplies Dillingham and Alegnagik; Naknek Electric Association supplies a number of users in the Bristol Bay Borough; and the villages of Nondalton, Newhalen, and Iliamna have an electrical cooperative. The cost of power in the Bristol Bay area is five to eight times as high as in urban areas such as Anchorage. Home heating is mainly by fuel oil, with some use of electric space heaters and wood. The Alaska Power Authority and Army Corps of Engineers have undertaken extensive studies to assess the feasibility of developing hydroelectric systems in the region.

The region has long been known by sportsmen for its trophy fishing and big game hunting opportunities. A number of commercial guiding operations use the Bristol Bay area; most of the activity is concentrated in the spring, summer, and fall months.

During 1986, sport fishermen in the Bristol Bay area harvested an estimated 30,390 salmon. In addition, sport fishing for trophy rainbow trout and grayling is very popular in the area. Sport hunting for big game species, such as brown bear, moose, and caribou, occurs throughout much of the area.

Congressionally-designated wild and scenic rivers in the region, as well as other nondesignated rivers, have become increasingly popular for river floating. The area has many commercial lodges catering to hunters and fishermen. Recreational cabins and campsites are also spread throughout the area. Maintained and unmaintained airstrips abound, and float planes make use of the lakes and larger rivers. The recreational services industry in

Bristol Bay is growing rapidly. ADF&G estimates that it provides $25-$40 million a year to the state's economy.

Land Status

Because salmon production is dependent upon the quality and quantity of marine and freshwater habitat, this plan and its intended accomplishments are partially dependent on land ownership and the spirit of cooperation that may be expected from the landowner. Preserve, refuge, monument, park, and private landowners may not permit some fisheries-related projects, such as spawning channels. Such projects may be allowed on state and Bureau of Land Management (BLM) lands. Federal park lands are protected from destruction of salmon habitats. Private owners may sell or allow access to land holdings for development or for fisheries projects.

Land ownership in the Bristol Bay region, for purposes of this plan, is divided as follows:

	Percentage of Total	Acres Owned
State	47.2	12,097,574
Native/private	10.3	2,627,317
Federal		
BLM	4.6	1,188,841
Parks	18.2	4,657,790
Refuges	19.7	5,032,948
Subtotal federal	42.5	10,879,579
Total	100	25,604,470

Figure 2 shows the location and size of land owned or selected by each of the major landholders in the region. Most land status information was current as of April 1986. The BLM is conveying land to the Native corporations and the state and is adjudicating land claims; however, land ownership is still unsettled in some areas.

Most village corporations have received interim conveyance of 90-95% of their land entitlement. Federal lands that are not parks or refuges are managed by BLM. Most BLM lands are located to the west of Togiak and southwest of Iliamna Lake. BLM is responsible for managing land selected by the state or Native corporations until these lands are conveyed to the selector.

The USNPS manages Lake Clark National Park and Preserve and the Katmai National Park and Preserve, as well as the Aniakchak

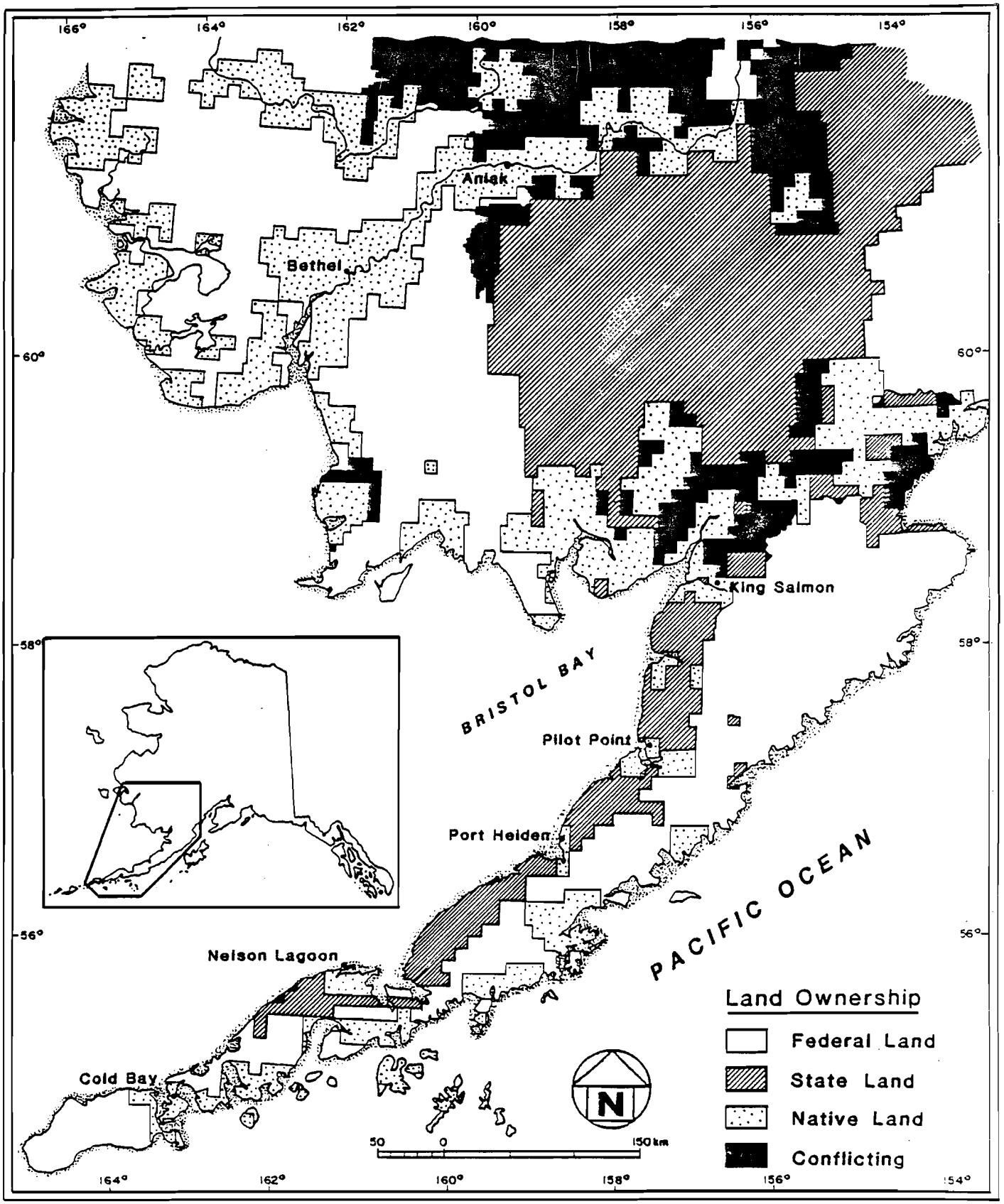


Figure 2. Land status in Bristol Bay region.

National Monument and Preserve. The Congressional Record of August 19, 1980, records the following statement:

> "Within National Parks, Monuments and Preserves, it is the intent of Congress that certain traditional National Park Service management values be maintained. It is contrary to the National Park Service concept to manipulate habitats or populations to achieve maximum utilization of natural resources."

The USFWS manages three national wildlife refuges in the region: Togiak, Becharof, and Alaska Peninsula. USFWS policy does not exclude fish and habitat enhancement or manipulation, but requires a compatability determination and precludes construction of permanent facilities in the established wilderness.

Most state lands are open to habitat enhancement. The state legislature has established a game refuge at Cape Newenham and critical habitat areas at Egegik, Pilot Point, and the Walrus Islands Game Sanctuary. It also created the 1.428 million acre Wood-Tikchik State Park. Most of the park is in state ownership, except for small privately owned tracts and Native allotments. Kvichak Bay has been legislatively designated a fisheries reserve by the State of Alaska, and no oil or gas leasing may occur there without approval of the state legislature.

Nonrenewable Resources

The mineral potential of the Bristol Bay region is not well understood. The world energy crisis and the national goal of energy independence have aroused interest in searching for oil and gas there, and industry and government rate the region's oil and gas potential as moderate although no commercial discoveries have been made. While some local residents want the economic stimulus of oil and gas development, many have reservations about possible impacts on fish and wildlife. Potential conflicts with the commercial and subsistence fisheries are a paramount concern of the residents. In December 1985, the State of Alaska, together with five other coastal states, filed suit in federal court to block federal oil and gas lease sales scheduled for sensitive coastal areas.

Small amounts of mercury, platinum, and gold have been mined in the region. Extraction of coal deposits may prove commercially feasible in some areas. However, mineral development in the region is currently hampered by the high cost of extraction and the lack of infrastructure and transportation. Residents, fishermen, conservation groups, and government agencies have voiced apprehension that mining, particularly in anadromous streams, would conflict with the salmon fisheries. Sixty-five anadromous streams have been closed to mineral entry, and mineral claims on 2 million acres have been limited to lease-hold location to conserve salmon production as a result of the state

Bristol Bay Area Plan and the Bristol Bay land-use planning process, mandated by Alaska National Interest Lands Conservation Act (ANILCA).

Status of Fisheries

Sport Fishery:

The Bristol Bay sport fishery began in the early 1900s. In the early years of statehood, good, uncrowded sport fishing was accessible, large sport fisheries were few and easily monitored, and sport fishing was considered to be a minor factor in management of a commercially exploited species. While sport fishing harvest is still only a fraction of one percent of the total salmon harvest, it, along with increasing tourism, mineral, petroleum, and associated governmental development, has caused an increase in the recreationally oriented population. New sport fisheries have developed because of a mobile population. Native land allotments, national interest lands legislation, subsistence issues, state-legislated land conveyance quotas, and problems of access have complicated maintenance and expansion of sport fishing opportunities. A recreational management plan, mandated by the Bristol Bay Area Plan was initiated in 1987 for the Nushegek/Mulchatna drainages. The purpose of the plan is to determine future recreational and sport fishing uses of state lands in this area. Fishery management and public use management plans are being completed for Togiak, Alaska Peninsula, and Becharof Refuges.

Most sport fishing is targeted toward rainbow trout, grayling, Dolly Varden, Arctic char, northern pike, lake trout, and chinook salmon, but increasing numbers of coho and sockeye salmon are also being taken.

Table 2 shows the estimated Bristol Bay salmon sport fish harvest by salmon species for 1977 to 1986 (Mills 1985, 1988).

Key points concerning the sport fishery in Bristol Bay are:

1. It is growing rapidly;

2. A great deal of sport effort is directed at rainbow trout; however, salmon fishing is becoming increasingly popular;

3. The sport fishery and tourist industries are becoming a major economic force in Bristol Bay; and

4. The present sport fish estimated harvest is small in relation to the commercial fishery, but sport fishing is perceived by some as a source of conflict.

Many commercial fishermen consider that the sport fishery is taking salmon escapement. If sport harvest continues to increase, it may pose an allocative problem.

Table 2. Sport fish catch of salmon by species, Bristol Bay, 1977-1986.[1]

Species	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986
Chinook Salmon[2]	2,733	3,932	3,498	4,174	2,387	4,016	5,275	4,593	5,036	7,598
Coho Salmon	2,145	2,582	2,161	3,761	3,458	4,851	5,629	7,209	4,421	15,468
Sockeye Salmon	3,837	4,880	6,117	5,105	6,633	7,904	9,296	8,041	9,064	5,699
Pink Salmon[3]	115	3,998	3,827	12,523	8,391	12,754	3,934	1,097	43	437
Chum Salmon	372	1,064	273	956	908	2,054	985	1,521	585	1,188
TOTAL	9,202	16,456	15,876	26,519	21,777	31,579	25,119	22,461	19,149	30,390

[1] Source: Statewide Harvest Survey (Mills 1985, 1988).

[2] Estimates exclude harvest of small (under 28 inches) chinook.

[3] Estimates exclude harvest from Naknek River and Alaska Peninsula.

Subsistence Fishery:

The subsistence fishery, which began in prehistoric times, continues to be important in the region. Despite the social and economic changes that have occurred in recent decades in Bristol Bay, fish continue to be an important food for most residents of the region. Large numbers of all five species of Alaskan salmon, as well as some 20 other anadromous, freshwater, and marine fish species, are used for subsistence (Table 3).

Sockeye salmon are harvested in the greatest numbers throughout the whole region, but other fish species are also important. The timing of fish movements, weather, characteristics of different species, harvest, storage and transportation technology, along with food preferences, economic situation, regulations, and assessments of alternative opportunities all influence the choice of species, timing, and locations of fishing effort. Therefore, there is considerable variation in patterns of subsistence fishing between the subregions of Bristol Bay and between the different groups of people who harvest Bristol Bay fish.

Many methods are used to harvest fish for household use in the region. Gillnetting is the primary method used for harvesting salmon, and the only technique recognized by regulation, but fish are also taken for household use by hook, seine, dip net, spear, and trap. Subsistence harvests provide nutritional, economic, and social benefit to most households. Smoked and dried fish, primarily salmon, is a staple food for villagers throughout the bay. Fish are also frozen, canned, salted, pickled, and utilized fresh. A few species are used raw. Traditionally, families in many of the communities have harvested salmon for dog food. Although there are presently no data on the proportion of the subsistence salmon harvest used to support dog teams, this use continues.

Each user group in Bristol Bay tends to have distinctive patterns of harvest, preparation, and consumption of fish. The people of the smaller villages of the Kvichak and Nushagak Rivers, for example, tend to take large numbers of sockeye salmon to smoke and dry for family use and dog food. In areas where chinook salmon are available, people take large numbers for family use.

In part because they do not keep dog teams, the people of Togiak and Manokotak take smaller numbers of salmon, but they harvest large numbers of other freshwater and marine species, including char, pike, smelt, and herring. Like their neighbors in other Bristol Bay villages, residents of these communities harvest fall salmon in spawning areas to dry for later use. In the larger communities of Dillingham, Naknek, and King Salmon, on the average, families tend to take smaller quantities of salmon, and they are more likely to preserve it by canning, smoking, or freezing than simply by drying it. Smelt, trout, char, and other species are also harvested in these areas, but they are generally

Table 3. Subsistence catch of salmon by species, Bristol Bay, 1965-1986.

Year	Permits Issued	Number of Fish 1/ Sockeye	King	Chum	Pink	Coho	Total
1965		119,400	5,100	18,500	200	5,700	148,900
1966		99,100	4,300	6,300	7,600	2,800	120,100
1967		104,100	4,200	14,200	800	5,000	128,300
1968		101,300	7,100	8,800	6,100	2,400	125,700
1969		104,100	7,500	8,300	100	7,700	127,700
1970	301	150,700	6,600	10,100	1,600	1,100	170,100
1971	310	109,100	4,600	4,200	N/A	2,500	120,400
1972	353	76,500	4,500	8,700	1,900	1,400	93,000
1973	452	69,800	7,200	8,000	100	3,300	88,400
1974	607	151,700	10,200	13,300	6,400	7,200	188,800
1975	686	175,400	8,600	7,500	1,300	8,500	201,300
1976	716	120,900	8,400	9,100	4,400	3,500	146,300
1977	738	127,900	7,000	9,100	300	6,600	150,900
1978	773	127,600	8,100	16,200	12,700	4,400	169,000
1979	829	116,500	10,300	7,700	500	7,300	142,300
1980	1,243	168,600	14,100	13,100	10,000	7,300	213,100
1981	1,112	132,100	13,000	11,500	2,600	12,200	171,400
1982	806	110,800	13,700	12,400	8,600	11,500	157,000
1983	834	149,400	13,500	10,500	900	7,100	181,400
1984	893	163,000	11,300	12,700	8,400	13,000	208,400
1985	1,032	149,800	9,700	5,600	700	9,000	174,800
1986	930	131,100	14,800	11,600	7,500	11,100	176,200
22 Year Average	742	125,405	8,809	10,336	3,759	6,391	154,705
1966-75 Average	452	114,180	6,480	8,940	2,590	4,190	136,380
1976-86 Average	901	136,155	11,264	10,864	5,145	8,455	171,891

1/ Catches rounded to the nearest hundred fish; the sum of the columns may not equal the total due to rounding.

used fresh rather than stored in quantity. People from outside the region who come to Bristol Bay to subsistence fish tend to take sockeye salmon, harvest relatively few fish, and preserve their harvest by canning or freezing.

Since the mid-1960s, Bristol Bay subsistence fishermen have been required to obtain a permit to harvest salmon and to report their catch at the end of the season. Much of the growth in the number of permits issued during these years reflects increasing compliance with the permitting and reporting requirement.

Relatively few regulations have been imposed upon the subsistence fisheries of Bristol Bay. The regulations which do exist deal primarily with salmon and have evolved to meet administrative and enforcement needs in the larger communities, where commercial fishing activity and population are centered. The regulations are intended to prevent waste and/or the sale of subsistence-caught fish.

Although regulations providing for methods and means for subsistence fishing in Bristol Bay permit most traditional fishing techniques in use today, drift gill nets may not be used for subsistence harvest of salmon outside of commercial fishing districts (5AAC 01.320(a) and (b)).

In several areas near Dillingham, Naknek, Egegik, and Ugashik, subsistence fishing time is restricted during the peak of the sockeye run, largely to reduce the chances of waste. These fishing periods appear to meet the needs of most subsistence users, considering the large number of salmon that go past these communities. Subsistence catches of salmon normally range between 100,000 and 200,000 fish and have gradually increased in recent years (Nelson et al. 1983). Local population increases, better reporting, and a yearly influx of participants from outside the region have contributed to this increase (see Table 3). The variations in the subsistence harvests indicate a use level that is independent of fish abundance (Behnke 1980).

Commercial Fishery:

The commercial salmon fishery began in 1884 and remains the primary economic factor in the area. Two gear types are used in the limited entry commercial salmon fishery: drift and set gill nets. Since 1960, registration by gear type has averaged 1,738 drift gill net permits, with a range of 872 to 3,203, and 855 set gill net permits, with a range of 345 to 1,010 (Table 4). Drift gillnet gear accounts for 90% of the annual catch and set gill nets account for the remaining 10%. The average number of boats registered for the fishery is 1,740 per year.

The Bristol Bay salmon fishery provides the State of Alaska with a major portion of all salmon harvested annually. For instance, in 1984 it accounted for 23% of the statewide commercial catch

Table 4. Commercial salmon fishing licence and entry permit registration by gear type and residency in Bristol Bay, 1960-1986.

	Drift			Set			
Year	Resident	Non-Resident	Subtotal	Resident	Non-Resident	Subtotal	Total
1960	650	364	1,014	345	0	345	1,359
1961	780	638	1,418	496	10	506	1,924
1962	791	400	1,191	619	20	639	1,830
1963	914	545	1,459	773	116	889	2,348
1964	947	689	1,636	793	137	930	2,566
1965	916	677	1,593	868	125	993	2,586
1966	1,019	846	1,865	826	139	965	2,830
1967	965	734	1,699	686	144	830	2,529
1968	973	711	1,684	722	117	839	2,523
1969	1,110	818	1,928	804	166	970	2,898
1970	1,057	824	1,881	747	143	890	2,771
1971	1,034	831	1,865	710	136	846	2,711
1972	993	771	1,764	722	132	854	2,618
1973	2,041	1,162	3,203	902	108	1,010	4,213
1974	634	238	872	475	55	530	1,402
1975	1,216	843	2,059	751	169	920	2,979
1976	987	734	1,721	624	139	763	2,484
1977	999	729	1,728	683	156	839	2,567
1978	1,039	737	1,776	748	161	909	2,685
1979	1,046	754	1,800	763	170	933	2,733
1980	1,060	767	1,827	760	187	947	2,774
1981	1,055	771	1,826	754	202	956	2,782
1982	1,047	775	1,822	735	212	947	2,769
1983	1,071	750	1,821	740	220	960	2,781
1984	1,050	768	1,818	744	218	962	2,780
1985	1,061	772	1,833	733	217	950	2,783
1986	1,059	775	1,834	727	223	950	2,784
Average	1019	719	1738	713	142	855	2593

(Nelson et al. 1984). The commercial fishery was initially developed as a canning industry, but in recent years processing has diversified. From 1978 to 1982, 15% of the Bristol Bay catch was canned, 21% sold fresh, and 61% frozen (Middleton 1983). The annual catch of salmon since the early days has varied widely, reaching an historic high during the 1983 and 1984 seasons of nearly 39.1 and 30.6 million salmon, respectively (Table 5).

The economy of the Bristol Bay area is almost entirely dependent upon the commercial fishery. The monetary value of the fishery has been greatly influenced by both increased prices and the abundance of sockeye salmon in the late 1970s and early 1980s. For instance, the average ex-vessel value for the years 1978-1984 was $135 million, compared to an average of $14 million for 1973-1977.

Limited Entry:

On August 22, 1972, Alaskans voted to amend the state constitution to allow the legislature to develop a limited entry program for the state's fisheries. Thus, the first comprehensive limited entry program in the United States became law in 1973. These actions were the result of the steadily declining economic health of Alaska's fishing industry and the depressed condition of many of the state's salmon runs. Increasing numbers of commercial fishermen and declining stock levels had created a financially distressed industry. In Bristol Bay, the continuation of commercial fishing was threatened because salmon stocks had been reduced to critical levels. Effective and economically rewarding resource management became essential, and limited entry was introduced to provide managers with an additional tool.

The Limited Entry Act (AS 16.43) created the Commercial Fisheries Entry Commission. This regulatory, quasi-judicial commission consists of three full-time members (Commissioners) whose primary responsibility is adjudicating applications for permanent entry permits. The commission was given specific authority to implement the new limited entry program to stabilize the amount of gear in each fishery at levels that would allow for fair dollar returns to the fishermen, aid in effective fisheries management, and promote professional and diversified commercial fisheries.

Beginning in 1974, the commission initially adopted regulations establishing maximum numbers of permits to be issued (1,669 drift gill net and 803 set gill net), application periods, and point systems for the salmon fisheries of the Bristol Bay region, thus limiting entry into that fishery. However, since that time additional permits have been issued.

Present-Day Fishery Management:

With such large numbers of fish passing through rather small fishing areas in such a short period of time, it has been necessary to develop special management techniques to gauge and

Table 5.
Bristol Bay commercial salmon catch, in thousands of fish, by species and year, 1884-1987.

Year	Chinook	Sockeye	Coho	Pink	Chum	All Species	
1881							
1882							
1883							
1884						4.2	Estimated from canned production
1885						146.0	Estimated
1886						509.1	Estimated from canned production
1887						758.2	Estimated from canned production
1888						937.4	Estimated from canned production
1889						1,209.6	Estimated from canned production
1890						1,234.6	Estimated from canned production
1891						1,391.4	Estimated from canned production
1892						662.2	Estimated from canned production
1893	44.0	940.0	74.0			1,058.0	
1894	10.5	1,235.4	47.0			1,292.9	
1895	19.9	1,472.1	28.1			1,520.1	
1896	17.3	2,099.7	245.1	2,362.1		2,362.1	
1897	19.9	3,317.5	150.0	35.3		3,522.8	
1898	19.3	4,927.8	55.7	59.8		5,062.6	
1899	38.3	5,112.7	100.4	16.8		5,268.2	
1900	58.3	8,547.3	7.8			8,613.4	
1901	106.0	10,220.6	4.2	231.2		10,562.0	
1902	109.1	12,808.5	193.8	502.3		13,613.7	
1903	86.5	16,320.1	60.1	241.5		16,708.2	
1904	98.0	11,903.4	129.5	398.1	37.3	12,566.2	
1905	116.9	14,834.0	78.3	291.0	59.0	15,379.1	
1906	143.2	10,823.4	207.3	1,901.9	253.5	13,329.4	
1907	137.7	10,193.4	129.1	344.1	508.7	11,313.0	
1908	90.0	16,233.8	103.0	399.3	459.9	17,286.0	
1909	130.5	15,497.9	80.5	101.3	378.1	16,188.3	
1910	101.8	11,593.6	139.2	652.1	310.2	12,796.9	
1911	113.2	8,815.1	130.0	91.8	347.9	9,497.9	
1912	97.7	19,696.3	195.1	1,680.7	354.6	22,024.4	
1913	74.2	20,581.8	66.8	425.5	284.7	21,433.1	
1914	101.0	20,195.1	98.9	565.0	566.9	21,527.0	
1915	148.0	14,787.7	130.4	134.8	593.1	15,794.0	
1916	105.1	17,521.9	293.5	683.8	1,489.6	20,093.9	
1917	91.1	24,513.5	62.3	37.1	356.2	25,060.2	

Table 5.
Bristol Bay commercial salmon catch, in thousands of fish, by species and year, 1884-1987.

Year	Chinook	Sockeye	Coho	Pink	Chum	All Species
1918	87.0	23,090.7	108.6	619.3	745.8	24,651.4
1919	202.0	7,161.4	46.7	0.5	204.5	7,614.9
1920	127.4	8,897.9	153.3	2,045.4	434.3	11,658.3
1921	92.0	15,680.1	84.6	0.9	355.3	16,212.9
1922	74.0	23,632.1	160.0	289.8	515.9	24,671.8
1923	67.0	18,182.0	9.3	0.0	184.9	18,443.2
1924	71.7	10,302.1	40.4	103.1	285.5	10,802.6
1925	97.4	7,909.5	16.6	0.0	231.8	8,255.4
1926	74.6	19,414.1	13.3	288.0	326.0	20,116.1
1927	83.8	11,071.8	0.1	0.0	195.8	11,351.6
1928	66.1	19,710.0	4.8	46.7	396.6	20,224.2
1929	150.7	12,188.6	58.6		621.6	13,019.5
1930	105.4	4,259.2	34.2	248.7	226.9	4,874.4
1931	47.2	12,790.6	0.9		635.7	13,474.4
1932	68.3	14,939.6	4.6	172.4	908.5	16,093.4
1933	49.3	23,709.0	15.8	0.2	255.7	24,029.9
1934	45.9	20,600.5	12.2	33.3	332.1	21,024.0
1935	3.6	3,023.0	2.2		72.0	3,100.8
1936	21.7	20,586.9	24.3	523.8	259.0	21,415.7
1937	36.6	21,257.8	1.7		302.2	21,598.4
1938	45.9	24,699.8	4.8		545.4	25,295.9
1939	33.4	13,335.3	0.3	0.0	934.7	14,300.8
1940	15.3	4,726.7	25.0	258.3	293.2	5,318.5
1941	30.7	7,153.7	34.6		524.3	7,743.3
1942	19.0	6,343.4	29.3	171.9	169.0	6,732.5
1943	41.1	17,330.2	1.7		376.8	17,749.8
1944	16.4	11,545.6	24.5	55.3	315.5	11,957.2
1945	26.6	7,300.2	16.4	0.0	635.3	7,978.6
1946	27.4	8,051.2	51.0	41.3	236.0	8,406.9
1947	41.6	18,642.0	9.6	0.4	215.7	18,909.4
1948	49.1	14,544.4	11.8	53.2	496.7	15,155.2
1949	50.3	6,449.3	26.3	0.0	269.1	6,795.5
1950	45.3	7,157.3	28.7	32.2	146.4	7,409.9
1951	40.2	4,326.5	42.5	0.0	156.8	4,566.0
1952	52.9	11,266.1	5.0	14.1	249.4	11,587.5
1953	42.6	6,111.5	4.6	0.0	387.3	6,546.0
1954	56.0	4,652.6	23.5	103.0	400.6	5,235.8

Table 5.
Bristol Bay commercial salmon catch, in thousands of fish, by species and year, 1884-1987.

Year	Chinook	Sockeye	Coho	Pink	Chum	All Species	
1955	75.4	4,549.1	21.0	0.0	212.2	4,357.8	
1956	66.4	8,881.5	63.5	92.0	315.5	9,413.8	
1957	91.4	6,275.5	68.7	0.0	259.3	6,695.0	
1958	103.2	2,985.7	135.8	1,135.5	358.1	4,718.3	
1959	84.3	4,608.1	17.3	0.3	481.5	5,191.6	
1960	111.7	13,705.0	16.1	302.0	1,316.0	15,450.8	
1961	88.7	11,913.9	20.6	0.5	727.9	12,751.7	
1962	84.0	4,718.0	39.3	913.9	677.5	6,432.8	
1963	62.3	2,871.1	41.3	0.5	370.1	3,345.2	
1964	139.5	5,596.1	36.6	1,549.6	802.5	8,124.3	
1965	113.0	24,255.2	8.1	0.7	360.5	24,737.5	
1966	77.5	9,314.2	33.9	2,492.9	343.2	12,261.7	
1967	117.2	4,330.7	53.8	1.1	476.4	4,979.2	
1968	103.7	2,792.8	93.4	1,935.7	363.8	5,289.5	
1969	124.9	6,621.7	81.4	1.9	333.0	7,162.8	
1970	140.5	20,720.8	14.5	456.9	717.8	22,050.5	
1971	123.0	9,584.0	12.7	0.2	676.9	10,396.8	
1972	69.5	2,416.2	14.0	127.0	656.6	3,283.4	
1973	44.0	761.3	57.0	0.4	684.5	1,547.3	
1974	45.7	1,362.5	43.7	940.0	286.4	2,678.2	
1975	30.0	4,898.8	46.3	0.4	325.4	5,300.9	
1976	96.0	5,619.3	26.6	1,036.5	1,329.1	8,107.5	
1977	130.5	4,877.9	107.2	4.5	1,598.2	6,718.3	
1978	191.5	9,928.1	94.3	5,152.7	1,158.1	16,524.7	
1979	212.9	21,428.6	294.4	3.8	906.8	22,846.5	
1980	95.5	23,761.7	348.5	2,563.5	1,301.0	28,070.3	
1981	237.3	25,603.1	376.3	7.3	1,504.8	27,728.8	
1982	253.5	15,104.4	619.8	1,492.4	921.4	18,391.5	
1983	201.2	37,277.0	116.0	0.4	1,467.0	39,061.6	
1984	101.7	24,684.0	580.3	3,388.6	1,839.2	30,593.8	Preliminary
1985	121.2	23,473.6	160.8	0.5	863.2	24,619.3	Preliminary
1986	93.0	15,889.0	177.0	394.0	1,131.0	17,684.0	Preliminary
1987	75.9	16,047.8	69.7	0.1	1,510.1	17,703.6	Preliminary

* Individual species catches may not add up to the all-species total because of rounding.

** SOURCES: Edfelt, Larry. STATISTICAL HISTORY OF ALASKA SALMON CATCHES. 1973. ADF&G. Juneau. (through 1971); ADF&G Statistical Leaflets 25 through 31 (1972-1978); ADF&G Informational Leaflet No.259 and No.5J88-1 ADF&G Computer summaries (1979-1983); and ADF&G Annual Management Reports 1985-1986.

control the exploitation rate to achieve escapement goals in the various river systems. An unusual feature of this fishery is that from mid-June to mid-July the fishing periods are regulated by emergency order. Openings, rather than closings, are announced. Rather than operating on fixed fishing schedules of a set number of days or hours per week, the fishery has closures and openings of variable duration (usually 12 or 24 hours) that are announced on a day-by-day basis, as the individual district and daily situations dictate. Each of the five districts is managed independently to conform to the run characteristics of individual stocks.

Because the Bristol Bay fishery is based on the world's largest run of sockeye salmon, it is very valuable, and it has historically been managed primarily through gear and vessel restrictions designed to limit the effectiveness of each fisherman, thereby increasing employment in the fishery. However, limiting entry to the fishery is a different approach and has, thus, been widely debated. An effort was made to incorporate both social and economic criteria in determining eligibility for permit holders under the Alaska Limited Entry system. Residence (rural versus urban) and dependence upon fishing income, as well as experience in the fishery, were used as criteria in awarding permits. While the system has been highly controversial, it has generally been considered successful by its managers.

Processing and Marketing

Processing:

Until the late 1970s, most of Bristol Bay's salmon were canned. The mainstay of the region's seafood industry had been the large, self-sufficient cannery operation that employed local fishermen in a traditional company-store relationship. Fishermen would fish for a single cannery in return for the assurance of a dependable fish buyer, fishing gear, vessels, fuel, and equipment storage.

In 1986 there were 12 shore-based canneries operating in Bristol Bay that employed more than 2,000 cannery workers each season. However, not all these canneries are operational each year because in low production years some of the plants consolidate their canning operations with other companies to save on the seasonal operation costs.

There has been a dramatic shift to frozen processing in recent years, and a large number of floating processors anchor in the larger fishing districts. These newer processing operations employ an additional 500-700 workers. Air freighting fresh fish for processing elsewhere has become a major enterprise, particularly during high-production seasons.

Historically, the commercial harvest and production of Bristol Bay salmon have been cyclical: healthy and poor returns have alternately occurred at approximately five-year intervals. Many of the local cannery operations were closed down in the late 1930s because of drastic declines in salmon returns; however, canned production continued to dominate the industry until the 1970s. In 1974 the severe declines in returning salmon stocks adversely affected the processors.

The commercial seafood industry recovered following a transition that was aided by foreign investment in processor operations and the increasing strength of the salmon runs. It was during this period that the current level of production capability of the region's shore-based facilities was reached.

A significant shift within the local industry away from canned production has largely precluded cannery expansion beyond the level reached during the 1970s. This shift has been attributed to several market changes: (1) an increased demand for frozen Alaska salmon within the Japanese market; (2) a relatively low harvest of pink and sockeye salmon in some years that made opening a cannery economically infeasible; (3) competition from processors purchasing salmon for the fresh/frozen market; (4) cash buyers who purchase salmon to export to processing plants outside the region; and (5) a generally depressed market for canned salmon that was fueled by quality-control problems, and a transitory botulism scare.

These conditions, in combination with a history of lengthy price disputes between local fishermen and shore-based processors, have greatly diminished the historical influence of cannery operations over the local seafood industry. In recent years, frozen production and fresh salmon export have increased dramatically. Floating processors have assumed an ever-increasing proportion of the region's processing capability. In 1978 only slightly over 10.5 million pounds of salmon were frozen in the region. By 1982, production of frozen salmon had increased to almost 68 million pounds; 70%-75% of the production was performed on floating processors.

Marketing Salmon:

The Bristol Bay fishery involves a harvesting, processing, and distribution chain that reaches all over the world and is influenced by worldwide preferences and market conditions. According to 1982 data (TAMS/Frank Orth and Associates 1984), domestic markets accounted for about 35% of overall sales of canned salmon. Since the export of canned products absorbs less than 40% of the total Bristol Bay pack, the purchasing patterns of the major market areas have less influence over the industry than those of the fresh/frozen markets.

Because a substantial portion of the region's fresh/frozen commercial salmon harvest is exported to Japan, this segment of

the industry is extremely sensitive to exchange rates, buyer bargaining postures, and a number of buyer-controlled factors in Japan that dictate ex-vessel price, quality standards, and the general health of the fishery.

Most of Bristol Bay's fresh salmon is marketed domestically. This product (chinook, coho, and on some occasions high-grade chum and sockeye) begins to move through the distribution network via in-house sales departments of the processors and independent brokers and traders. Fresh salmon is destined for three markets: retail stores and food chains, restaurants, and smoked salmon processors. In all cases, it is shipped by air from Bristol Bay to the city of destination or closest major airport. A modest amount of fresh production is transported by air to markets in Canada and Europe.

Economic Analysis

There are two basic ways to express fishery values: (1) wholesale value of the processed product and (2) ex-vessel value, or the value to the fisherman. There are also several variables associated with each of these values. This discussion will address ex-vessel value. Normally, there are two different prices each season in Bristol Bay: these reflect price agreements by two different marketing associations. The values listed in Table 6 are estimates based on an average price per fish (or pound) multiplied by the catch (by average weights by species in the latter instance).

Ex-vessel value reflects the price paid to the fishermen and the numbers of salmon caught. From 1960 to 1968, when fish were purchased on a per-fish basis, the price for sockeye salmon averaged $1.10 per fish and only varied from $.95 to $1.18 for independent fishermen. Company fishermen (i.e., those fishermen whose boat, fishing nets, and fuel were supplied by the processor) were paid less, usually about 62% of the independent price. Company fishermen were phased out of the fishery by 1975.

Beginning in 1969, fish were purchased on a price-per-pound basis. Prices remained fairly stable until 1973, and in 1979 reached a peak of $.80 per pound for canned sockeye salmon and $1.25 per pound for frozen sockeye salmon. This also marked the first time that a canned/frozen price differential was established. These high prices, coupled with an exceptionally strong sockeye salmon run and resultant catch, plus record chinook and coho salmon catches and one of the larger chum salmon catches in history, produced a 1979 fishery worth $138 million to the fishermen, five times the average value. This value was exceeded in 1986 when the total harvest was 17.6 million fish, worth an estimated $141.9 million.

From 1960 to 1985, the average annual value to the fishermen was $41.0 million. This value ranged from $3.1 million in 1973 to

Table 6. Ex-vessel value of Bristol Bay commercial salmon harvest in thousands of dollars, by species, 1960-1986.

Year	Chinook	Sockeye	Coho	Pink	Chum	Total
1960	$342	$13,020	$15	$88	$671	$14,136
1961	$285	$11,914	$21	$0	$393	$12,613
1962	$276	$4,907	$41	$283	$379	$5,886
1963	$204	$3,101	$45	$0	$215	$3,565
1964	$458	$6,100	$40	$496	$465	$7,559
1965	$371	$26,438	$9	$0	$209	$27,027
1966	$262	$10,525	$38	$823	$206	$11,854
1967	$336	$5,110	$63	$0	$286	$5,795
1968	$357	$3,296	$110	$639	$218	$4,620
1969	$443	$8,423	$103	$0	$216	$9,185
1970	$465	$24,368	$18	$151	$466	$25,468
1971	$652	$14,951	$16	$0	$528	$16,147
1972	$339	$3,914	$20	$47	$512	$4,832
1973	$284	$1,892	$115	$0	$829	$3,120
1974	$460	$3,793	$142	$1,053	$567	$6,015
1975	$214	$11,047	$151	$0	$615	$12,027
1976	$742	$17,139	$82	$1,093	$2,892	$21,948
1977	$1,940	$19,434	$445	$50	$4,275	$26,144
1978	$3,206	$40,034	$435	$5,424	$3,173	$52,272
1979	$4,541	$128,992	$2,387	$5	$2,480	$138,405
1980	$1,881	$76,118	$1,392	$2,173	$2,738	$84,302
1981	$5,557	$120,907	$1,461	$7	$4,106	$132,038
1982	$6,088	$68,122	$3,199	$1,111	$2,145	$80,665
1983	$2,853	$129,900	$337	$0	$3,216	$136,306
1984	$2,152	$94,713	$3,092	$2,430	$3,700	$106,087
1985	$2,204	$114,256	$916	$0	$1,812	$119,188
1986	$1,789	$136,707	$854	$203	$2,326	$141,879

1984-1986: Preliminary Data
Source: ADF&G, Division of Commercial Fisheries.

the 1986 high of $141.9 million. During this period, sockeye salmon accounted for 90% of the value, chum and chinook salmon for approximately 4% each, and coho and pink salmon, for 1%. Unstable market conditions in 1980 led to a sharp reduction in value. A negotiated price of $.57 per pound was paid for sockeye salmon by most processors, without a differential for fish that were frozen. Table 7 shows the Bristol Bay salmon prices from 1977 to 1983.

Table 7. Bristol Bay product prices, 1977 to 1983[1].

Species/form	1977	1978	1979	1980	1981	1982	1983
Sockeye/canned ($/lb)							
Ex-vessel	0.60	0.68	0.80	0.57	0.70	0.67	0.61
Proc/broker	1.85	1.93	2.01	2.26	2.32	2.36	2.42
Export	NA	NA	NA	NA	2.41	2.33	2.28
Retail	2.68	2.83	3.00	3.23	3.40	3.46	3.86
Sockeye/frozen ($/lb)							
Ex-vessel	0.60	0.68	1.25	0.57	0.75	0.70	0.61
Processor	2.36	2.94	2.01	2.10	2.25	2.00	1.75
Export	NA	NA	2.40	1.75	2.02	1.84	1.58
Whole-Japan	2.52	3.51	3.27	2.41	2.89	2.80	2.72
Retail	NA	NA	NA	NA	2.80	2.65	2.50
Pink/canned ($/lb)							
Ex-vessel	0.34	0.33	0.33	0.25	0.25	0.22	0.18
Proc/broker	1.40	1.36	1.46	1.63	1.76	1.53	1.40
Export	NA	NA	NA	NA	1.73	1.35	1.41
Retail	2.03	2.02	2.05	2.28	2.46	2.39	2.24
Pink/frozen ($/lb)							
Processor	0.89	1.18	1.25	1.15	1.10	1.00	0.90
Export	NA	NA	NA	NA	1.06	0.85	0.88
Retail	NA	NA	NA	NA	1.49	1.99	1.49
Chum/canned ($/lb)							
Ex-vessel	0.37	0.39	0.48	0.34	0.40	0.32	0.30
Proc/broker	1.23	1.20	1.30	1.49	1.53	1.33	1.19
Export	NA	NA	NA	NA	1.53	1.17	1.18
Retail	NA	NA	NA	NA	2.10	1.76	1.78
Chum/frozen ($/lb)							
Ex-vessel	0.37	0.39	0.55	0.34	0.40	0.32	0.30
Processor	1.96	2.54	1.79	1.90	1.65	1.30	1.20
Export	NA	NA	NA	NA	1.52	1.40	1.11
Retail	NA	NA	NA	NA	2.39	2.35	1.39
Coho/frozen ($/lb)							
Ex-vessel	0.53	0.65	1.03	0.57	0.75	0.70	0.40
Processor	2.16	2.74	2.09	1.92	2.10	1.80	1.70
Export	NA	NA	NA	NA	1.88	1.75	1.44
Retail	NA	NA	NA	NA	3.47	2.45	2.75
King/frozen ($/lb)							
Ex-vessel	0.65	0.60	0.78	0.51	1.20	1.10	0.70
Processor	3.00	3.38	3.00	2.90	3.05	2.60	2.10
Export	NA	NA	NA	NA	2.56	2.46	1.98
Retail	NA	NA	NA	NA	3.62	3.55	3.50
Salmon roe ($/lb)							
Export	NA	NA	NA	NA	4.81	4.30	3.82
Whole-Japan	8.04	10.06	9.31	7.38	7.01	7.15	6.00
Herring ($/ton)							
Ex-vessel	NA	400.00	680.00	260.00	360.00	400.00	360.00
Processor	NA	NA	15.00	NA	1,200.00	1,200.00	1,250.00

[1] Compiled by Frank Orth & Associates, Inc.

CHAPTER 3

ANALYSIS OF THE REGION'S SALMON PRODUCTION STATUS

The identification of issues and the selection of goals and strategies for optimum salmon production in the Bristol Bay region must be based, in part, on an evaluation of current production levels. Other regional salmon plans written in Alaska have used recent, short-term harvest averages to derive the production status of the fishery for individual species. This plan will consider the most recent, five-year average harvest (1983-1987) to be the present level. In addition, some comparisons may require the use of a ten-year average harvest (1978-1987). The five-year average includes at least one entire life cycle for most species, while the ten-year average includes two cycles of chinook, sockeye, and coho salmon to as many as five cycles of pink and chum salmon.

Information Sources

Pacific salmon stocks originate from two sources: wild and supplemental production. At present, Bristol Bay has no supplemental production. Substantial quantitative data on the status of the region's wild salmon stocks are available. The ADF&G is the agency with primary responsibility for the collection, interpretation, and dissemination of the present-day data base, which contributes to the assessment of the production level and potential of the Bristol Bay region.

A variety of information sources, discussed briefly below, provide data for an evaluation of current production. These include commercial, sport fish, and subsistence harvest reports; escapement monitoring reports; management reports; and historical production and catch trends.

Commercial Harvest Reports:

The first records of commercial harvest of salmon in the region date back to 1884 and consist of reports on the number of cases of canned salmon produced by local canneries. Between 1884 and 1892, canned salmon production records were maintained generically. After 1892, harvest records were kept for individual species.

Following statehood, Edfelt (1973) reviewed the early state and federal harvest records and standardized the present historical data base. Recent data provide an accounting of commercially caught salmon that is highly accurate in terms of species, locations, numbers, and pounds of fish harvested. Commercial fisheries data are presently maintained by the Division of

Commercial Fisheries, Computer Services Section, and the Commercial Fisheries Entry Commission.

Data from the commercial fisheries catch generally provide the best information with which to reconstruct the strength of salmon stocks during a given period. Historically, subsistence and recreational harvests have comprised a much smaller portion of the catch. The commercial harvest data from 1956 to 1987 can be supplemented with estimates of stream escapement and incidental high-seas harvest of sockeye production. However, these data are not available for other species contributing to the commercial harvest in the bay. This deficiency is one of the critical research and data shortfalls that will need to be addressed in the later stages of the planning and implementation process.

Increases or decreases in harvests may also be influenced by factors other than run size, such as the number of participants in the fishery, the effectiveness or efficiency of the gear used for fishing, the number of openings, the weather during the openings, and human factors such as wars, price disputes, or other marketing conditions.

Sport Fish Harvest Reports:

Sport fishermen also harvest Bristol Bay salmon. Since 1979, an annual census has been conducted to help estimate the sport fish harvest. These data are obtained by using a mail questionnaire to solicit information on effort expended and the resulting harvest. This questionnaire is sent to a sample of resident and nonresident sport fishery license holders. Nonconsumptive uses are not measured. The Sport Fish Division of ADF&G annually publishes a statewide harvest report, which includes the Bristol Bay region, summarizing the responses to this questionnaire. Current sport fishing harvest estimates are comparatively small in relation to the subsistence and commercial catch. However, the chinook salmon sport fishery has the potential to grow to significant levels in accessible locations.

Subsistence Harvest Reports:

Although considerable subsistence harvest has occurred in the Bristol Bay region, very little is known about the actual numbers of fish taken for subsistence purposes prior to 1963, when the state began keeping records on subsistence fishing in the area. Because of the small portion of the catch clearly attributed to subsistence fishing, it has relatively little impact on evaluation of stock status. For the purposes of this plan, it is assumed that the subsistence use of salmon has been, and will remain, relatively stable.

Escapement Monitoring:

Escapement monitoring is essential for estimating the overall stock strength. When coupled with harvest information, accurate escapement information can provide an estimate of the total run strength. Because these data are system specific, they provide the best information on individual stocks and their relative strength. Escapement monitoring in Bristol Bay has been maintained for sockeye since 1956 and for chinook since 1966. Other salmon species have been surveyed to a lesser extent.

Management Reports:

An annual management report is prepared for the Bristol Bay Management Area by the Commercial Fisheries Division of ADF&G. This report contains a synthesis of salmon harvest and economic data. Tables and figures are included which allow current information to be assessed in a historical context. The data base does not include all drainages and does not contain complete information for some species such as chinook salmon.

Historical and Current Catch Trends:

In the 103 years that Bristol Bay salmon harvest data to 1987 have been recorded, annual harvests of all species of salmon have averaged 11.9 million fish per year. In terms of international and national significance, the region has accounted for 24% of the entire sockeye salmon production for the Pacific Rim, 48% for the United States, and 63% for Alaska. Moreover, the Nushagak District in Bristol Bay produces the state's second largest chinook salmon fishery, which nearly matches that of the Yukon River. This fishery normally accounts for 18% of Alaska's total chinook salmon production.

The Bristol Bay Salmon Fishery

The ADF&G Division of Commercial Fisheries has prepared the definitive stock status report for the Bristol Bay salmon fishery entitled Bristol Bay Salmon and Herring Fisheries Status Report through 1982, by Kenneth R. Middleton. The report describes in extensive detail the recent and historical status of the important stocks of salmon in the region. The following sections are largely excerpted from Middleton's report; however, the data have been updated, where necessary, by the RPT in order to reflect current stock status.

Five species of Pacific salmon are indigenous to the Bristol Bay area. The sockeye salmon run is the most significant, but there are also significant runs of chinook, chum, and coho salmon, and, in even years, pink salmon. Based on the 1962-1987 data, the average annual catches are as follows: 12.5 million sockeye salmon; 1.7 million even-year pink salmon; 869,400 chum salmon; 118,700 chinook salmon; and 136,400 coho salmon (see Appendix A).

The average harvest for all species for this period is 14.5 million salmon, an increase of about 12% over the 100-year average. This reflects a general increase in salmon production over recent years as well as better harvest and recordkeeping techniques.

The seasonality of the salmon runs is typical for this latitude. Chinook salmon arrive in the fishing districts in late May to early June. The run peaks in mid June, but they are still taken in good numbers in early July. The sockeye and chum salmon runs coincide, entering in late June and peaking in early July. Pink salmon follow closely, entering in mid July and peaking in late July. Coho salmon enter the fishery about mid July and peak in August.

Although the salmon fishery extends from late May through September, the dominant sockeye fishery occurs over a relatively short time frame, with the bulk of the run passing through the fishing districts in a two-week period during the first half of July. The fishery is normally quite consistent in timing; its peak occurs around the 4th of July.

Bristol Bay is divided into five major and discrete fishing districts that are related to major river systems entering the bay (Figure 3). Consequently, these are also the primary migratory routes through which salmon must pass to ascend these rivers. The fishing districts are intentionally confined to areas as near as practical to the river mouths to minimize the interception of salmon stocks destined for other adjacent river systems.

Sockeye Salmon:

Bristol Bay is the largest sockeye salmon-producing area in the world. The sockeye salmon runs are characterized by a distinctive, five-year cyclic pattern of peak abundance (e.g., 1965, 1970, and 1975), interspersed by years of decreased production. Historically, large runs have occurred in three years of every five-year cycle. Annual harvests have ranged from 800,000 to 37.3 million fish.

Certain patterns are exhibited in the historical catch records. The first, most notable pattern is a sustained high catch averaging 13 million salmon for ten consecutive years (1901-1910) (Table 8). From 1911 to 1940, the pattern was one of continuing high catches that averaged 16 million sockeye salmon per year, but the sustained periods became shorter and the intervening years' production smaller. The production pattern from 1940 to 1960 changed dramatically. Not only did the overall production decrease 54% during this 20-year period, but the production sequence changed significantly. Instead of following a five-year cycle, production peaks occurred every four years in a pattern that was primarily related to the the Kvichak production cycles,

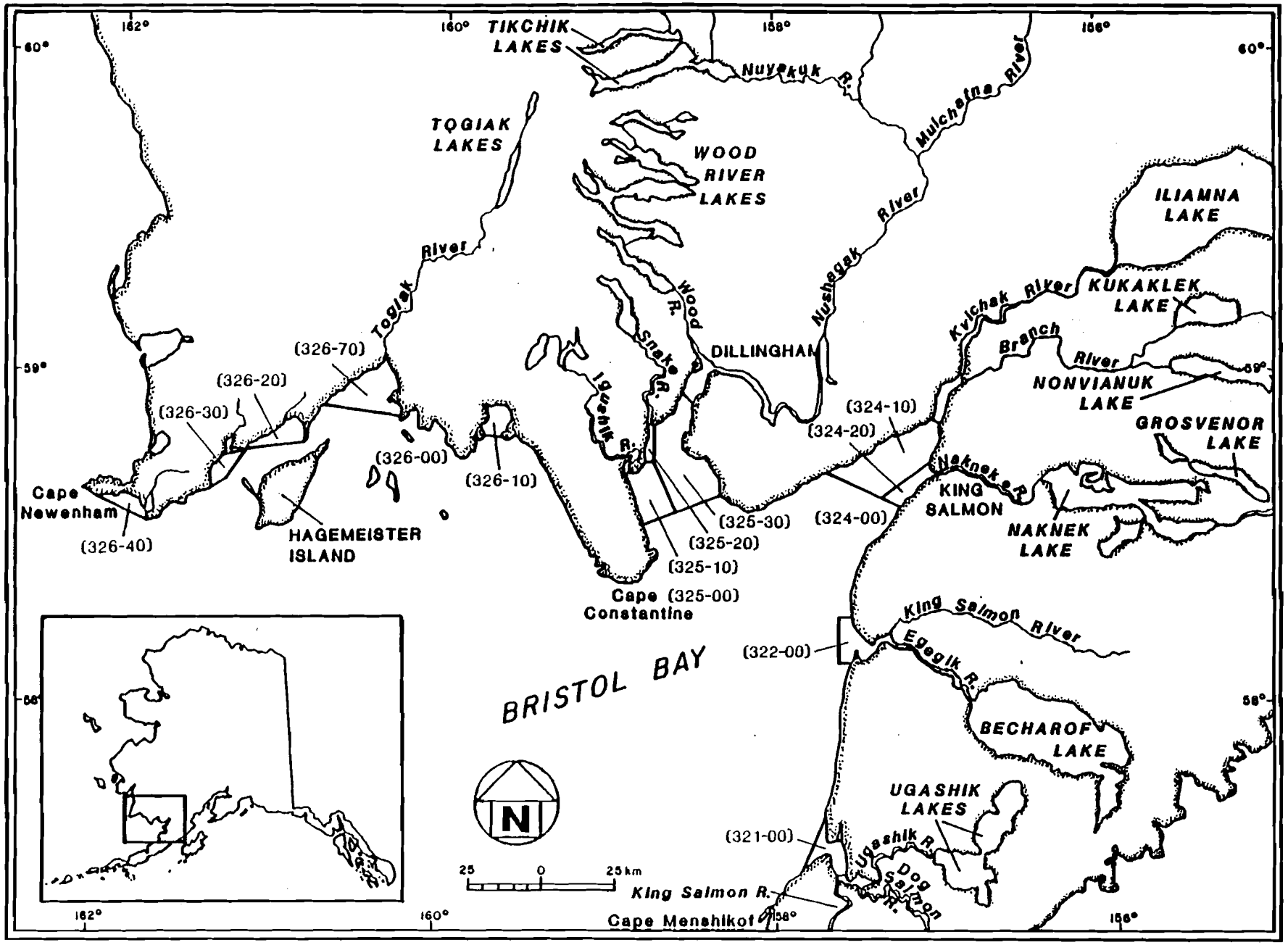


Figure 3. Bristol Bay commercial fisheries salmon management districts.

Table 8. Commercial catch of Bristol Bay sockeye salmon in numbers of fish, by district, 1893-1986.

Year	Naknek-Kvichak	Egegik	Ugashik	Nushagak	Togiak	Total
1893	100,000	0	200,000	640,000	0	940,000
1894	262,550	0	112,850	860,000	0	1,235,400
1895	413,651	54,321	65,219	938,946	0	1,472,137
1896	512,015	21,420	240,472	1,325,833	0	2,099,740
1897	1,410,287	203,458	463,698	1,240,080	0	3,317,523
1898	2,241,113	247,842	548,793	1,890,092	0	4,927,840
1899	1,649,127	284,650	661,524	2,517,436	0	5,112,737
1900	3,208,263	307,574	796,965	4,234,533	0	8,547,335
1901	3,622,638	427,886	769,002	5,401,051	0	10,220,577
1902	6,038,386	403,444	1,640,973	4,725,715	0	12,808,518
1903	7,516,329	781,038	1,703,536	6,319,189	0	16,320,092
1904	5,856,442	136,759	564,492	5,345,659	0	11,903,352
1905	6,773,275	140,000	532,779	7,387,935	0	14,833,989
1906	4,954,905	238,000	203,014	5,427,512	0	10,823,431
1907	6,782,072	481,578	302,402	2,627,351	0	10,193,403
1908	9,088,285	781,131	272,355	6,092,031	0	16,233,802
1909	9,532,722	840,620	218,223	4,906,318	0	15,497,883
1910	6,336,382	619,001	168,471	4,469,755	0	11,593,609
1911	4,587,344	1,158,176	112,521	2,957,073	0	8,815,114
1912	13,821,905	1,455,247	425,763	3,993,428	0	19,696,343
1913	13,691,550	902,728	577,615	5,409,933	0	20,581,826
1914	12,584,809	897,767	254,716	6,457,815	0	20,195,107
1915	7,156,488	1,217,252	509,076	5,904,862	0	14,787,678
1916	11,551,086	1,578,862	647,422	3,744,551	0	17,521,921
1917	15,762,582	1,856,600	1,047,111	5,847,239	0	24,513,532
1918	14,219,536	1,818,218	756,206	6,296,705	0	23,090,665
1919	4,929,761	607,688	146,590	1,477,336	0	7,161,375
1920	5,275,140	498,949	441,770	2,682,056	0	8,897,915
1921	9,690,857	1,136,670	1,135,265	3,717,284	0	15,680,076
1922	15,766,366	2,550,068	1,879,067	3,436,576	0	23,632,077
1923	14,361,488	1,116,057	782,545	1,921,874	0	18,181,964
1924	6,813,083	874,019	446,810	2,168,154	0	10,302,066
1925	3,355,293	212,987	438,103	3,903,125	0	7,909,508
1926	12,717,504	1,522,721	1,151,541	4,022,328	0	19,414,094
1927	8,917,893	1,285,059	211,409	657,467	0	11,071,828
1928	12,200,000	1,300,000	500,000	5,710,000	0	19,710,000
1929	6,711,975	1,107,325	445,673	3,923,675	0	12,188,648
1930	2,334,138	373,250	111,150	1,440,650	0	4,259,188
1931	8,845,850	1,203,063	639,263	2,102,438	0	12,790,614
1932	10,203,563	1,342,913	526,988	2,866,088	0	14,939,552
1933	16,944,386	1,780,344	611,347	4,372,873	0	23,708,950
1934	13,339,666	1,871,974	750,602	4,638,268	0	20,600,510
1935	1,703,568	416,127	0	903,264	0	3,022,959
1936	16,778,943	1,432,588	815,215	1,560,138	0	20,586,884
1937	13,957,327	2,221,161	518,027	4,561,299	0	21,257,814
1938	20,967,834	1,112,759	296,491	2,322,704	0	24,699,788
1939	7,773,909	750,098	639,217	4,169,121	0	13,332,345
1940	2,960,644	210,939	36,022	1,519,082	0	4,726,687
1941	4,966,660	342,900	65,806	1,778,338	0	7,153,704
1942	3,224,192	0	653,392	2,465,779	0	6,343,363

Table 8. Commercial catch of Bristol Bay sockeye salmon in numbers of fish, by district, 1893-1986.

Year	Naknek-Kvichak	Egegik	Ugashik	Nushagak	Togiak	Total
1943	12,874,650	0	1,081,925	3,373,643	0	17,330,218
1944	6,626,906	363,854	1,041,603	3,513,241	0	11,545,604
1945	4,195,431	0	808,797	2,296,019	0	7,300,247
1946	5,077,859	327,208	617,995	2,028,144	0	8,051,206
1947	13,965,201	995,745	913,795	2,767,287	0	18,642,028
1948	9,182,953	1,092,590	1,463,048	2,805,798	0	14,544,389
1949	3,941,568	1,016,115	691,515	800,123	0	6,449,321
1950	4,366,471	791,329	787,384	1,212,091	0	7,157,275
1951	2,926,413	644,551	318,629	436,950	0	4,326,543
1952	9,401,060	886,852	280,146	698,071	0	11,266,129
1953	3,738,839	1,234,600	688,720	449,341	0	6,111,500
1954	1,819,666	1,437,791	1,067,531	315,357	12,280	4,652,625
1955	2,564,341	622,885	240,817	1,054,978	66,085	4,549,106
1956	5,987,750	1,187,099	341,499	1,263,186	101,933	8,881,467
1957	4,578,643	814,459	350,858	491,498	40,044	6,275,502
1958	922,611	500,684	433,813	1,092,156	36,402	2,985,666
1959	1,689,425	662,391	423,414	1,719,687	113,202	4,608,119
1960	9,847,848	1,446,884	752,634	1,517,988	139,648	13,705,002
1961	8,166,983	2,686,076	357,223	511,483	192,161	11,913,926
1962	2,281,284	638,862	243,159	1,461,766	92,945	4,718,016
1963	957,902	695,582	188,695	842,744	186,213	2,871,136
1964	2,243,701	1,103,935	576,768	1,420,941	250,775	5,596,120
1965	19,139,567	3,179,559	925,690	793,323	217,100	24,255,239
1966	5,397,538	2,101,174	445,458	1,170,271	199,799	9,314,240
1967	2,337,226	1,070,942	163,744	657,711	101,107	4,330,730
1968	1,216,858	671,554	82,457	749,281	72,699	2,792,849
1969	4,655,072	889,322	169,845	773,207	134,252	6,621,698
1970	17,803,805	1,403,509	171,541	1,188,534	153,377	20,720,766
1971	5,857,378	1,306,682	954,068	1,256,799	209,060	9,583,987
1972	1,102,365	839,820	17,440	381,347	75,261	2,416,233
1973	168,249	221,337	3,920	272,093	95,723	761,322
1974	538,163	172,253	2,151	510,571	139,341	1,362,479
1975	3,085,416	964,024	14,558	645,903	188,914	4,898,815
1976	2,547,276	1,329,788	174,923	1,265,422	301,883	5,619,292
1977	2,167,214	1,780,567	92,623	619,025	218,451	4,877,880
1978	5,123,668	1,207,294	7,995	3,137,166	452,016	9,928,139
1979	15,449,199	2,254,067	392,833	3,382,538	479,382	21,958,019
1980	15,123,727	2,613,330	925,398	4,403,652	607,874	23,673,981
1981	10,992,809	4,361,406	2,116,066	7,493,093	639,707	25,603,081
1982	5,005,802	2,447,514	1,139,192	5,916,187	595,696	15,104,391
1983	21,314,327	6,740,310	3,341,978	5,296,322	584,092	37,277,029
1984	14,237,955	5,301,198	2,661,330	2,164,667	318,863	24,684,013
1985	8,135,810	7,457,295	6,346,489	1,323,492	210,470	23,473,556
1986	2,889,894	5,008,779	4,928,502	2,757,730	303,677	15,888,582

Source: ADF&G, Division of Commercial Fisheries, Central Region Office, Anchorage. 1984-1986 preliminary data.

and production in other years dropped dramatically. The lowest period occurred from 1953 through 1959, when the average annual catch of sockeye salmon dropped to 5.4 million.

Beginning in 1960, production, especially in the important Kvichak River system, increased significantly. This was due in part to the large 1956 escapement of 9.4 million sockeye salmon to the Kvichak River. The 1960 parent year (with a Kvichak River escapement of 14.6 million) reestablished the historic five-year peak cycle pattern. Production, in terms of the total number of returning adults, increased. However, overall production, particularly for years adjacent to the peak year, was still well below historic levels (Table 9).

In 1969, the forecasted Kvichak River run was large enough so that a significant escapement for the cycle year preceding the peak year was a possibility. Unfortunately, the production from both the 1969 and the 1970 escapements was relatively poor because of extremely cold winters in 1970 and 1971. As a result, commercial fishing time was severely restricted in both 1974 and 1975 to secure escapement goals for these two critical brood years. Catches during the 1972 to 1977 rebuilding period dropped to an all-time average low of only 3.3 million fish per year.

The restraints imposed on the fishery during 1974 and 1975 and the sacrifices borne by the fishermen and the industry began to pay dividends in 1978. Unusually good survival rates also aided in boosting production throughout Bristol Bay. The 1980 sockeye salmon catch might have broken the previous record, set in 1938, had there not been a price dispute. Escapement totals in 1980 were the highest on record. The strong run of 1981, which was not burdened by a price dispute, brought a record harvest of 25.7 million sockeye salmon, breaking the previous record (see Table 8). Production throughout the 1978 to 1985 period was high, culminating in 1983 with a harvest of 37.3 million sockeye salmon.

Historically, the Nushagak District was the second most productive system in Bristol Bay, averaging a catch of 5 million sockeye salmon for 20 years (1899 to 1918), nearly 2.8 million for the following 30 years, and finally dropping to an 882,000 average from 1949 to 1977. Only from 1978 to 1983 did the Nushagak District catch again reach the historical sustained level. The 1980 and 1981 total adult production of 12.8 and 10.3 million sockeye salmon, respectively, was exceptional (Table 9). However, since then the average run size in the Nushagak has declined again.

Except for a period during World War II when fishing effort was down, the Egegik District has demonstrated relatively stable production throughout its history. The drastic decline of 1972 and 1973 was reflected in the district as it was throughout

Table 9. Total run of Bristol Bay sockeye salmon by district (1/), including estimates of high seas interception, 1956-1986.

Year	Naknek-Kvichak	Egegik	Ugashik	Nushagak	Togiak	Subtotal	High seas catch est.	Total
1956	17,987,663	2,291,367	766,794	2,435,287	326,933	23,808,044	2,431,000	26,239,044
1957	8,182,693	1,205,666	565,660	990,225	65,044	11,009,288	7,349,000	18,358,288
1958	1,830,164	747,038	713,359	2,370,089	108,402	5,769,052	377,000	6,146,052
1959	5,426,663	1,734,850	642,642	4,761,572	322,842	12,888,569	589,000	13,477,569
1960	26,546,759	3,245,648	3,094,034	3,191,246	331,658	36,409,345	3,727,000	40,136,345
1961	12,313,946	3,387,614	723,662	1,371,116	319,615	18,115,953	6,129,000	24,244,953
1962	5,675,864	1,666,344	517,185	2,399,464	164,497	10,423,354	960,000	11,383,354
1963	2,405,324	1,693,184	585,699	1,906,600	313,809	6,904,616	1,001,000	7,905,616
1964	4,799,125	1,935,511	1,059,538	2,759,945	365,449	10,919,568	314,000	11,233,568
1965	44,358,311	4,624,167	1,923,552	1,892,589	329,886	53,128,505	6,943,000	60,071,505
1966	10,363,503	2,905,420	1,160,294	2,800,997	332,797	17,563,011	1,935,000	19,498,011
1967	6,511,700	1,707,806	407,674	1,533,163	192,437	10,352,780	922,000	11,274,780
1968	4,991,392	1,010,208	153,353	1,725,945	129,117	8,010,015	885,000	8,895,015
1969	14,562,968	1,904,876	330,225	1,985,793	259,318	19,043,180	2,031,000	21,074,180
1970	32,648,673	2,323,243	906,565	3,154,690	366,273	39,399,444	3,968,000	43,367,444
1971	9,367,826	1,940,696	1,483,820	2,610,181	422,302	15,824,825	2,049,000	17,873,825
1972	2,850,033	1,386,222	96,868	909,997	157,231	5,400,351	1,302,000	6,702,351
1973	786,759	550,179	42,908	853,400	210,653	2,443,899	839,000	3,282,899
1974	6,427,913	1,447,883	64,005	2,778,039	247,833	10,965,673	510,000	11,475,673
1975	18,353,032	2,137,864	443,894	2,918,940	378,076	24,231,806	1,353,000	25,584,806
1976	5,915,130	1,838,948	531,231	2,751,698	502,473	11,539,480	1,001,000	12,540,480
1977	4,694,214	2,473,081	294,143	1,839,081	421,085	9,721,604	768,000	10,489,604
1978	10,315,734	2,102,992	90,429	6,662,698	792,092	19,963,945	452,000	20,415,945
1979	27,429,822	3,289,374	2,098,022	6,400,917	685,227	39,903,362	304,000	40,207,362
1980	40,568,323	3,683,926	4,221,159	12,808,225	1,207,011	62,488,644	590,000	63,078,644
1981	14,625,597	5,056,086	3,443,765	10,343,730	1,005,617	34,474,795	818,000	35,292,795
1982	7,535,494	3,482,142	2,324,743	7,925,929	937,120	22,205,428	443,000	22,648,428
1983	25,868,823	7,532,592	4,343,342	7,244,814	823,702	45,813,273	324,000	46,137,273
1984	26,186,469	6,466,518	3,931,648	3,979,353	519,641	41,083,629	291,000	41,374,629
1985	17,314,834	8,552,499	7,344,721	3,008,108	355,812	36,575,974	264,000	36,839,974
1986	6,277,041	6,160,959	5,944,084	4,891,128	574,861	23,848,073	298,000	24,146,073
Average	13,649,090	2,918,868	1,620,936	3,651,773	424,800	22,265,467	1,650,548	23,916,016

1. Based on maturing fish caught in year of inshore run plus immature catch in preceeding year.

Bristol Bay. The highest recorded catches occurred in 1983 and 1985: 6.7 and 7.5 million fish, respectively (see Table 8). The average total sockeye salmon run to the Egegik District from 1956 to 1982 was 2.3 million. The district has produced runs exceeding this average since 1982 (see Appendix B). Overall, the Egegik system seems to be in healthy condition and fairly stable.

Production in the Ugashik system fluctuates for unknown reasons. As can be seen in Table 9, production was especially depressed from 1972 through 1978 when, for four out of seven years, the total runs (catch plus escapement) were less than 100,000 sockeye salmon. In spite of such depressed conditions, the 1975 and 1976 escapements of 429,336 and 356,308 fish, respectively, produced runs in 1979 and 1980 of 2.1 and 4.2 million (see Table 9). However, even with periods of fairly high sustained levels of escapement (e.g., 1946 to 1954 [Appendix B]), catches in subsequent years were low. The production increased in the Ugashik system from 1979 to 1985.

In fact, throughout the entire region sockeye salmon production increased dramatically during the late 1970s. Of particular note, however, is the strength recently demonstrated by "off-cycle" years, a feature that has not been prevalent in this fishery for the past 40 years.

Sockeye escapement goals are relatively new to Bristol Bay, having evolved over the last 20 years. The goals have also changed in several instances as the data base has expanded to enable better analyses. Over the years there has been much debate about escapement goal levels, particularly in the 1960s when information on the total run size produced from known escapements was limited. Escapement goals are constantly being reevaluated based on new information and analysis of historical data. The current approach is to increase production and reduce fluctuations in run size by increasing escapement goals for most river systems. Escapement goals are actually set based upon results of past escapements as measured by subsequent total adult returns (catch plus escapement) and by estimates of smolt production. Escapement goals for most systems were increased in 1984.

The current ADF&G management policy is to increase Kvichak River system escapement goals for the low-cycle years (1986, 1987, and 1988) from 2 million to some higher level and to adjust goals for other years to even out the cycle. The 1984 (pre-peak year) goal was increased from 6 to 10 million spawners, and the 1985 (peak year) goal reduced from 14 to 10 million. The 1986 escapement goal was set at 4 to 6 million spawners. The Alaska Board of Fisheries is routinely apprised of results of department analysis and provided with recommended changes to escapement goals to allow public comment and input prior to implementation. This process allows for weighing the cost to the fishery of short-term "investment" through increased escapements against long-term benefits of increased production.

Estimates of total adult sockeye salmon production for the Bristol Bay region include harvests from high-seas foreign interception, other Alaskan interception fisheries, inshore commercial fisheries in the Bristol Bay Management Area, subsistence fisheries, sport fisheries, and, finally, observed escapements. Unfortunately, the data for commercial harvest and escapement for the runs covers only the last 30 years. Table 9 clearly demonstrates the significance of recent production. The combined 1980 through 1985 runs total 246 million sockeye salmon. The recent ten-year-average production has increased to 33 million sockeye salmon.

The long-term outlook for Bristol Bay sockeye salmon production remains encouraging. Although it is apparent that exceptional survival conditions have greatly aided in boosting production in recent years, the development and implementation of an escapement strategy for the Kvichak River system has apparently paid off in terms of greater production. Increased and consistent escapements to major contributing Nushagak District river systems appear to be essential to increased and sustained production for this important fishery. In summary, the present status of Bristol Bay sockeye salmon status is strong; generally, it approximates the largest levels that have been observed during this 100-year-old fishery.

Pink Salmon:

Pink salmon is the second most abundant species in the Bristol Bay region during even-numbered years. Odd-year production is almost nonexistent. Pink salmon are also the least valuable on a per-fish or per-pound basis. Although historical harvest data show a fairly level odd-year pink production, these figures are suspect because no similar occurrence has been recorded since 1913.

The historical harvest data actually have to be viewed in three separate time frames because of significant changes in gear use. Harvests prior to 1923 were largely from traps in the Nushagak District. The average harvest during this 24-year period (omitting 1919 and 1921) was 490,000 fish. From 1923 to 1956 (even years only), pink salmon, or small-mesh, gear was prohibited, as were traps, and the average pink salmon catch was 140,000 fish (even years only). Small-mesh gear was allowed by regulation in 1958, and the average even-year catch from 1958 to 1986 was 1.6 million fish. Because of the changes in gear types allowed and because the fishery normally closed about the time pink salmon runs were getting underway, data on the pink salmon catch cannot realistically be used as a gauge of production for years prior to 1958.

The 1978 pink salmon catch of 5.2 million was three-and-a-half times greater than the 1958 to 1982 average and 52% greater than the second highest record, 3.4 million fish, set in 1984. The escapement for 1978 was a staggering 11.5 million. The 1980 return from this enormous 1978 run was not nearly as large, but it still produced a catch of nearly 2.6 million (Table 10).

The vast majority of pink salmon are produced from river systems entering the Nushagak District, and the bulk of this production comes from the Nuyakuk River, a tributary to the Nushagak River. The Nushagak District has accounted for 86% of the Bristol Bay pink salmon catches since 1958. Pink salmon runs to other districts tend to be small, and most catches are taken incidentally in sockeye salmon gill-net gear.

As stated, the primary pink salmon system in Bristol Bay is the Nuyakuk River. Over 90% of the observable pink salmon in this area are found in that system. In most years, the bulk of the spawners concentrate in a 30-mile stretch of the river from the ADF&G counting towers upstream to the rapids at the outlet of Tikchik Lake. Therefore, the counting station, which is designed mainly for sockeye salmon, also serves to count the pink salmon spawning population in this river.

Smaller populations of pink salmon also exist in the Wood, Igushik, Nushagak, and Mulchatna Rivers. These populations are estimated by aerial surveys, as is the number of spawners that are located below the Nuyakuk counting towers. Since the counting towers are located 100 miles from the fishing district, these counts cannot be used for in-season management purposes.

From 1958 through 1984, the production (catch plus escapement) of pink salmon to the Nushagak District has averaged 4.0 million fish. This includes one very depressed cycle year (1972), which produced a total run of only 126,000 pink salmon. Presumably, this was a result of the severe winters of 1970 and 1971 that also affected sockeye salmon production. However, the 1976 escapement of 863,000 to the Nushagak District produced the enormous run of 13.7 million in 1978, for a 16 to 1 return per spawner.

Chum Salmon:

The current status of Bristol Bay chum salmon is well above average in terms of catch, escapement, and total estimated runs. In terms of total production, recent years have been extraordinary relative to years such as 1966 to 1975 for the Nushagak and Togiak Districts, where such data are available (see Appendix C). Overall, production from 1976 to 1985 averaged 1.5 million chum salmon for these two districts, compared to the previous ten-year (1966-1975) average of 699,000.

Table 10. Inshore catch, escapement, and total run of Bristol Bay pink salmon, in numbers of fish, during even years, 1958-1986[1].

Year	Catch	Escapement Estimates[2]	Total Run
1958	1,114,000[3]	4,000,000[4]	5,114,000
1960	302,000	146,000	448,000
1962	914,000	543,000	1,457,000
1964	1,550,000	911,000	2,461,000
1966	2,493,000	1,442,000	3,935,000
1968	1,936,000	2,161,000	4,097,000
1970	457,000	153,000	610,000
1972	127,000	59,000	186,000
1974	940,000	986,000	1,926,000
1976	1,037,000	1,040,000	2,077,000
1978	5,153,000	11,492,000	16,645,000
1980	2,563,000	3,317,000	5,880,000
1982	1,492,000	1,806,000	3,243,000
1984	3,154,000	2,926,000	6,081,000
1986[1]	394,000	72,000	466,000

[1] 1986, preliminary data.

[2] 1960-1972, Nushagak District estimates only; 1974, Nushagak and Naknek-Kvichak estimates; 1976-1982, Nushagak, Naknek-Kvichak, and Togiak estimates; 1980-1982, Ugashik; 1982, Egegik; 1986, Nuyakuk, Nushagak, and Mulchatna estimates.

[3] Nushagak District catch only.

[4] Aerial estimates, Nuyakuk River.

Chum salmon have experienced exceptional survival rates, and recent escapement levels should result in above-average production for the next several years. Chum salmon populations can generally be expected to be similar to those of sockeye, although they do not exhibit the dramatic ups and downs of sockeye salmon. However, since chum salmon stocks cannot presently be managed independently of the far more numerous sockeye salmon runs, it is not possible to project long-term possibilities for this species.

Chum salmon return at the same time as sockeye, but the pattern of chum harvest has been quite stable throughout the history of the fishery. Bristol Bay chum harvests have averaged about 539,000 fish annually, with a range of 146,500 in 1950 to 1.8 million in 1984 (Table 11).

Chum salmon in Bristol Bay are produced largely in the Nushagak District, which has accounted for 52% of the total production since 1960. The Togiak and Naknek-Kvichak Districts rank second, producing 20%. The remaining 28% are somewhat evenly divided between the Egegik and Ugashik Districts. Harvests have increased rather significantly in the past ten years (1978-1987) averaging 1.3 million fish, or nearly 2.5 times the historical average of 539,000 fish. This reflects the additional fishing time directed at the record sockeye runs; increased effort directed at chum because of improved pricing, handling and marketing; and generally favorable conditions for natural production.

Efforts to determine chum salmon escapements have been centered in the Nushagak and Togiak Districts of Bristol Bay, where 75% of the commercial catch has been produced since 1960. Chum salmon escapement estimates from the mid-1960s were based upon extensive aerial survey methods. Since 1979, chum salmon estimates for the Nushagak have been based on sonar counts.

Escapement estimates in the Nushagak District have averaged 268,000 fish since 1966, with a range from 80,000 in 1966 and 1975 to 969,000 in 1980. Escapement estimates have averaged 234,000 in the Togiak District, with a range from 85,000 in 1969 to 496,000 in 1977 (see Appendix C). Since escapement estimates are based on aerial survey methods, it is probable that these estimates are low; however, they reflect the relative magnitude of escapement levels.

It appears that chum salmon runs to the Nushagak and Togiak Districts have been commercially exploited at about 50% of total run size. If this exploitation rate is applied to other Bristol Bay districts, the probable aggregate escapement for chum salmon in Bristol Bay is estimated to have averaged approximately 750,000 fish per year since 1960.

Escapement goals have not been formalized for chum salmon, but minimal escapement levels of 200,000 for the Nushagak District

Table 11. Commercial catch of Bristol Bay chum salmon in numbers of fish, by district, 1893-1986 1/.

Year	Naknek-Kvichak	Egegik	Ugashik	Nushagak	Togiak	Total
1893	0	0	0	0	0	0
1894	0	0	0	0	0	0
1895	0	0	0	0	0	0
1896	0	0	0	0	0	0
1897	0	0	0	0	0	0
1898	0	0	0	0	0	0
1899	0	0	0	0	0	0
1900	0	0	0	0	0	0
1901	0	0	0	0	0	0
1902	0	0	0	0	0	0
1903	0	0	0	0	0	0
1904	1,138	0	1,600	34,570	0	37,308
1905	4,946	0	19,105	34,933	0	58,984
1906	24,000	0	60,000	169,541	0	253,541
1907	45,458	20,925	26,972	415,372	0	508,727
1908	5,024	29,197	10,309	415,369	0	459,899
1909	1,872	8,917	10,728	356,621	0	378,138
1910	93,840	3,002	7,156	206,220	0	310,218
1911	89,688	3,416	8,967	245,795	0	347,866
1912	11,149	2,419	0	341,059	0	354,627
1913	5,830	0	13,704	265,184	0	284,718
1914	9,662	1,064	14,531	541,690	0	566,947
1915	129,130	1,591	18,212	444,146	0	593,079
1916	259,013	7,500	49,196	1,173,914	0	1,489,623
1917	45,997	5,726	879	303,620	0	356,222
1918	94,036	6,663	6,588	638,537	0	745,824
1919	25,251	2,627	6,095	170,501	0	204,474
1920	188,469	5,503	31,765	208,601	0	434,338
1921	102,157	8,634	8,777	235,763	0	355,331
1922	57,367	27,659	4,888	426,001	0	515,915
1923	17,319	7,169	8,253	152,161	0	184,902
1924	113,731	6,042	13,455	152,235	0	285,463
1925	110,396	9,321	15,825	96,266	0	231,808
1926	130,644	1,017	19,062	175,295	0	326,018
1927	44,489	5,413	8,376	137,525	0	195,803
1928	109,060	12,294	15,070	260,157	0	396,581
1929	170,927	19,268	23,619	407,740	0	621,554
1930	95,991	16,339	18,835	95,765	0	226,930
1931	315,956	20,343	9,536	289,891	0	635,726
1932	337,062	11,810	11,811	547,839	0	908,522
1933	53,235	4,903	11,824	185,696	0	255,658
1934	149,676	9,723	16,089	156,581	0	332,069
1935	30,549	360	0	41,140	0	72,049
1936	83,069	10,630	5,346	159,919	0	258,964
1937	133,002	17,829	10,939	140,461	0	302,231
1938	319,420	52,390	38,460	135,110	0	545,380
1939	386,789	41,616	52,491	453,786	0	934,682
1940	145,101	18,594	0	129,455	0	293,150
1941	213,906	25,166	524	284,684	0	524,280
1942	22,240	0	14,363	132,360	0	168,963

Table 11. Commercial catch of Bristol Bay chum salmon in numbers of fish, by district, 1893-1986 1/.

Year	Naknek-Kvichak	Egegik	Ugashik	Nushagak	Togiak	Total
1943	136,743	0	9,320	230,740	0	376,803
1944	113,800	26,260	10,489	164,920	0	315,469
1945	198,348	0	33,400	403,545	0	635,293
1946	86,629	26,560	22,652	100,199	0	236,040
1947	110,009	31,175	17,307	57,224	0	215,715
1948	187,881	40,142	30,654	237,980	0	496,657
1949	60,748	16,422	36,400	155,568	0	269,138
1950	19,622	4,240	14,699	107,888	0	146,449
1951	38,844	15,439	16,843	85,624	0	156,750
1952	93,835	18,060	19,651	117,875	0	249,421
1953	212,112	26,724	21,027	127,483	0	387,346
1954	138,016	62,040	39,384	159,852	1,352	400,644
1955	39,405	23,238	51,280	97,521	735	212,179
1956	93,841	16,713	6,934	172,546	25,483	315,517
1957	45,620	12,849	13,226	143,461	44,186	259,342
1958	119,324	12,089	12,714	193,688	20,277	358,092
1959	200,458	29,407	20,185	186,891	44,575	481,516
1960	304,286	62,837	51,415	642,099	255,320	1,315,957
1961	182,398	57,429	30,928	267,176	190,001	727,932
1962	176,712	23,053	22,040	290,633	165,107	677,545
1963	100,408	14,807	10,554	167,161	77,167	370,097
1964	153,644	23,496	30,688	463,309	131,371	802,508
1965	45,430	11,188	14,971	177,434	111,521	360,544
1966	57,273	32,085	29,100	129,344	95,410	343,212
1967	49,606	11,039	14,104	338,286	63,322	476,357
1968	43,187	16,193	17,624	178,786	108,001	363,791
1969	42,535	7,835	1,995	214,235	66,389	332,989
1970	120,279	43,854	17,969	435,033	100,711	717,846
1971	151,465	27,073	14,506	360,015	123,847	676,906
1972	115,737	42,172	9,689	310,126	178,885	656,609
1973	123,610	23,034	6,092	336,331	195,431	684,498
1974	41,350	4,022	2,334	157,951	80,715	286,372
1975	79,740	4,094	1,634	152,890	87,058	325,416
1976	317,550	46,955	9,924	801,064	153,559	1,329,052
1977	340,228	83,121	4,465	899,701	270,649	1,598,164
1978	185,451	44,480	1,449	651,743	274,967	1,158,090
1979	177,918	33,306	17,583	479,217	222,224	930,248
1980	201,135	77,709	37,293	781,998	306,700	1,404,835
1981	355,943	87,581	36,275	795,143	229,886	1,504,828
1982	198,019	84,329	53,204	434,817	151,000	921,369
1983	325,884	123,860	108,374	586,166	322,670	1,466,954
1984	426,235	183,317	210,694	679,845	339,064	1,839,155
1985	175,598	109,788	118,652	252,748	206,370	863,156
1986	208,066	93,781	98,782	461,966	269,772	1,132,367

1. Sources: 1893-1973; Edfelt, 1973. 1974-1982; ADF&G Catch and Production Leaflets. 1983-1986 Preliminary data. 1983-1986 annual management reports.

and for the Togiak District are believed to be necessary to maintain the chum salmon stocks at a sustained production level in line with historical performance.

Chinook Salmon:

Compared to earlier years, current trends in chinook salmon adult production indicate a general improvement in status. Most recent harvest statistics for chinook salmon have been above the other long-term and ten-year (1977-1986) moving averages, reflecting generally improved regional chinook production. The recent ten-year moving average annual harvest of 163,000 fish and the consecutive yearly records of 237,000 and 254,000 (set in 1981 and 1982, respectively) are indicative of these long-term trends (Table 12). However, recent trends in the Nushagak River system suggest reduced levels of productivity.

The outlook is generally promising, although recent evidence from scale-pattern analysis demonstrates that Bristol Bay chinook salmon stocks, as well as numerous other Alaskan, Yukon, and British Columbian stocks, are still subject to directed foreign salmon fisheries (high-seas drift gill net interception) as well as incidental harvest in both foreign and domestic trawl fisheries within the fisheries conservation zone. The impacts of increased allowances in incidental salmon catch by domestic joint-venture trawlers in the Shelikof Straits, Unimak Pass, and Aleutian Islands groundfish fisheries may have a devastating effect on all chinook salmon stocks originating in Alaskan waters.

The majority of Bristol Bay chinook salmon originate in the Nushagak District, which accounted for 71% of the harvest during the 1960 to 1986 period. Another 17% originate in the Togiak District, and the remainder are rather evenly divided among the Ugashik, Egegik, and Naknek-Kvichak Districts.

Chinook salmon catches have been particularly good since 1960, even with the early 1970s decline suffered by all species. The 1962 to 1987 average annual harvest of 118,700 fish represents a 41% increase over the historical annual average of 84,100 fish. The 1981 and 1982 chinook salmon harvests of 237,000 and 254,000 eclipsed the previous record catch of 202,000 set in 1979. For a species that is the most long-lived of Pacific salmon and, consequently, exposed to mortality-inducing elements longer, the Bristol Bay chinook salmon stocks have exhibited a stable long-term productivity.

Other than minimal aerial survey coverage of the Branch and Naknek Rivers, the majority of escapement studies have centered in the Nushagak and Togiak Districts, where an extensive aerial survey data base has been developed. Aerial survey assessment of chinook salmon spawning populations began in the Nushagak area in 1966 and in the Togiak area in 1967. Presently, the aerial

Table 12. Commercial catch of Bristol Bay chinook salmon in numbers of fish, by district, 1893-1986 1/.

Year	Naknek-Kvichak	Egegik	Ugashik	Nushagak	Togiak	Total
1893	0	0	0	44,000	0	44,000
1894	0	0	0	10,500	0	10,500
1895	1,452	0	0	18,473	0	19,925
1896	2,524	0	0	14,777	0	17,301
1897	1,247	257	259	18,134	0	19,897
1898	1,845	537	142	16,736	0	19,260
1899	1,248	0	0	37,011	0	38,259
1900	2,342	41	778	55,146	0	58,307
1901	15,245	616	3,755	86,431	0	106,047
1902	6,755	0	4,118	98,216	0	109,089
1903	3,032	264	1,570	81,640	0	86,506
1904	11,406	0	760	85,787	0	97,953
1905	17,470	0	2,456	96,929	0	116,855
1906	33,574	400	4,162	105,058	0	143,194
1907	28,495	1,410	3,615	104,157	0	137,677
1908	17,565	1,213	2,056	69,175	0	90,009
1909	17,084	2,891	2,203	108,311	0	130,489
1910	13,629	801	892	86,433	0	101,755
1911	7,951	460	946	103,806	0	113,163
1912	9,570	202	467	87,489	0	97,728
1913	5,648	254	691	67,656	0	74,249
1914	10,657	405	1,209	88,693	0	100,964
1915	29,392	510	1,739	116,387	0	148,028
1916	20,934	365	1,904	81,921	0	105,124
1917	16,155	143	531	74,316	0	91,145
1918	39,540	427	695	46,386	0	87,048
1919	106,705	198	1,273	93,778	0	201,954
1920	27,791	441	1,181	97,937	0	127,350
1921	19,540	566	828	71,048	0	91,982
1922	11,272	940	626	61,182	0	74,020
1923	9,681	394	541	56,397	0	67,013
1924	17,715	126	290	53,532	0	71,663
1925	26,149	833	1,870	68,596	0	97,448
1926	18,933	331	484	54,856	0	74,604
1927	14,298	735	769	68,044	0	83,846
1928	13,876	462	661	51,076	0	66,075
1929	21,995	302	753	127,613	0	150,663
1930	16,131	316	949	88,032	0	105,428
1931	2,029	236	47	44,863	0	47,175
1932	10,091	271	203	57,721	0	68,286
1933	2,646	522	581	45,559	0	49,308
1934	8,130	364	576	36,875	0	45,945
1935	1,892	46	0	1,635	0	3,573
1936	7,699	362	217	13,425	0	21,703
1937	10,628	704	1,034	24,263	0	36,629
1938	13,120	1,731	1,352	29,731	0	45,934
1939	14,289	936	923	17,260	0	33,408
1940	7,596	772	0	6,899	0	15,267
1941	6,592	460	0	23,609	0	30,661
1942	3,736	0	695	14,575	0	19,006

Table 12. Commercial catch of Bristol Bay chinook salmon in numbers of fish, by district, 1893-1986 1/.

Year	Naknek-Kvichak	Egegik	Ugashik	Nushagak	Togiak	Total
1943	11,167	0	389	29,590	0	41,146
1944	7,925	20	258	8,170	0	16,373
1945	10,396	0	595	15,618	0	26,609
1946	7,889	699	693	18,120	0	27,401
1947	11,552	500	49	29,540	0	41,641
1948	8,408	303	188	40,217	0	49,116
1949	8,343	341	460	41,608	0	50,752
1950	6,472	333	10,768	27,688	0	45,261
1951	5,009	342	606	34,226	0	40,183
1952	11,404	972	632	39,848	0	52,856
1953	13,848	743	463	27,502	0	42,556
1954	7,101	9,777	1,093	38,045	0	56,016
1955	11,448	3,079	3,160	56,463	1,279	75,429
1956	6,006	1,448	616	57,441	866	66,377
1957	5,524	4,139	883	79,122	1,752	91,420
1958	8,391	3,155	2,368	87,245	2,048	103,207
1959	15,298	3,282	5,493	54,299	5,917	84,289
1960	17,778	2,991	2,209	81,416	7,309	111,703
1961	10,206	3,266	3,483	60,953	10,748	88,656
1962	8,816	2,070	2,929	61,283	8,949	84,047
1963	4,713	2,355	3,030	45,979	6,192	62,269
1964	12,902	3,618	3,694	108,606	10,716	139,536
1965	9,793	2,313	4,042	85,910	10,909	112,967
1966	5,456	1,949	1,916	58,184	9,967	77,472
1967	3,705	2,285	1,582	96,240	13,381	117,193
1968	6,398	3,472	2,153	78,201	13,499	103,723
1969	19,016	2,801	2,107	80,803	20,181	124,908
1970	19,037	3,765	1,498	87,547	28,664	140,511
1971	10,254	2,187	779	82,769	27,026	123,015
1972	2,262	1,097	166	46,045	19,976	69,546
1973	951	1,475	292	30,470	10,856	44,044
1974	480	1,133	1,200	32,051	10,797	45,662
1975	964	237	111	21,454	7,226	29,992
1976	4,064	1,138	338	60,684	29,744	95,968
1977	4,373	3,694	2,167	85,074	35,218	130,526
1978	6,930	3,126	5,935	118,548	57,000	191,539
1979	4,057	3,607	8,117	155,473	30,581	201,835
1980	7,907	5,329	5,809	64,324	12,339	95,708
1981	11,048	5,468	3,416	193,461	23,911	237,304
1982	12,425	4,834	7,170	195,287	33,786	253,502
1983	9,942	4,843	8,608	139,400	38,360	201,153
1984	9,198	4,707	4,782	61,124	21,920	101,731
1985	5,891	3,844	6,509	67,623	37,355	121,222
1986	3,552	1,895	2,977	63,859	19,895	92,178

1. Sources: 1893-1973; Edfelt, 1973. 1974-1980; ADF&G Catch and Production Leaflets. 1983-1986, preliminary data.

survey project forms the basis for escapement estimates in both districts.

Since 1966, escapements in Nushagak District have averaged 89,000 fish, with a range of 25,000 to 162,000 (see Appendix C); in recent years (1977-1986), the annual average has increased to 112,000. However, the 1986 escapement declined to 33,000.

Togiak District chinook salmon escapements have been slightly more stable, averaging 16,000, with a range of 8,000 to 40,000 from 1967 through 1986 (see Appendix C).

The Togiak District escapements represent data for some 12 streams throughout the district; the Togiak and Kulukak Rivers are the major producers. The Nushagak surveys involve 21 streams, and six of these are the key index streams or major producers.

Although escapement estimates are not available for the smaller chinook salmon producing districts, it is reasonable to project that in recent years total production throughout Bristol Bay has averaged about 300,000 chinook salmon.

Escapement goals have not been determined for chinook salmon, but minimal escapement levels have been set at 50,000 and 10,000 for the Nushagak and Togiak Districts, respectively. As commercial and recreational fishing pressure continues to build on the Nushagak chinook salmon stocks, the need to develop and refine real-time escapement enumeration techniques becomes more apparent.

Coho Salmon:

Beginning in 1979 and 1980, harvests of coho salmon in the Bristol Bay region rose dramatically to over 300,000 fish per year, peaking in 1982 at 620,000 fish, which broke all previous catch records. Harvests declined in 1983 to 116,000; however, the 1984 harvest increased again to 580,000 fish, the second highest coho salmon harvest recorded for the region (Table 13). Escapement enumerations of returning Bristol Bay coho stocks are too recent to assess fully the current and long-term biological status of the species in the Bristol Bay region. Past performance or harvest data are difficult to evaluate since coho salmon have not really been studied until quite recently.

Historically, the Nushagak District has contributed the largest number of coho salmon. Larger catches in other districts in recent years reflect increased interest in and effort for coho salmon and possibly the beginning of a new catch trend for this species. A significant fishery has developed since the start of the Togiak District coho fishery in 1954. During the past 20

Table 13. Commercial catch of Bristol Bay coho salmon in numbers of fish, by district, 1893-1986 1/.

Year	Naknek-Kvichak	Egegik	Ugashik	Nushagak	Togiak	Total
1893	0	0	0	74,000	0	74,000
1894	0	0	0	47,000	0	47,000
1895	0	0	0	28,050	0	28,050
1896	127,538	0	0	117,530	0	245,068
1897	0	0	0	150,000	0	150,000
1898	0	0	0	55,744	0	55,744
1899	0	0	0	100,396	0	100,396
1900	0	0	0	0	0	0
1901	1,286	0	0	2,893	0	4,179
1902	0	0	0	193,838	0	193,838
1903	0	0	0	60,073	0	60,073
1904	5,250	0	558	123,661	0	129,469
1905	7,000	0	5,733	65,568	0	78,301
1906	0	0	0	207,257	0	207,257
1907	0	0	0	129,065	0	129,065
1908	0	0	0	103,013	0	103,013
1909	0	0	0	80,513	0	80,513
1910	0	0	0	139,200	0	139,200
1911	0	0	0	129,971	0	129,971
1912	10	0	0	195,083	0	195,093
1913	2	165	0	66,640	0	66,807
1914	17,508	0	0	81,434	0	98,942
1915	13,271	0	0	117,172	0	130,443
1916	288	0	0	293,210	0	293,498
1917	3	0	0	62,260	0	62,263
1918	0	0	0	108,576	0	108,576
1919	0	0	0	46,687	0	46,687
1920	3,900	264	3,630	145,510	0	153,304
1921	0	0	0	84,564	0	84,564
1922	180	21	0	159,783	0	159,984
1923	0	0	0	9,274	0	9,274
1924	152	440	0	39,787	0	40,379
1925	5	0	0	16,591	0	16,596
1926	350	0	0	12,947	0	13,297
1927	8	1	0	137	0	146
1928	10	5	0	4,825	0	4,840
1929	117	59	0	58,444	0	58,620
1930	0	0	0	34,150	0	34,150
1931	0	0	0	920	0	920
1932	0	0	0	4,630	0	4,630
1933	0	0	0	15,800	0	15,800
1934	0	0	0	12,190	0	12,190
1935	0	0	0	2,230	0	2,230
1936	0	3,523	1,680	19,107	0	24,310
1937	320	0	0	1,380	0	1,700
1938	0	340	0	4,485	0	4,825
1939	0	297	0	26	0	323
1940	1,130	12,074	700	11,131	0	25,035
1941	2,273	241	1,168	30,958	0	34,640
1942	224	0	300	28,733	0	29,257

Table 13. Commercial catch of Bristol Bay coho salmon in numbers of fish, by district, 1893-1986 1/.

Year	Naknek-Kvichak	Egegik	Ugashik	Nushagak	Togiak	Total
1943	0	0	310	1,360	0	1,670
1944	0	240	620	23,660	0	24,520
1945	57	0	7,424	8,954	0	16,435
1946	0	5,758	14,124	31,126	0	51,008
1947	0	7,218	1,330	1,015	0	9,563
1948	481	9,061	7	2,269	0	11,818
1949	0	5,305	0	21,014	0	26,319
1950	3,720	2,644	585	21,788	0	28,737
1951	1,404	2,520	35,683	2,856	0	42,463
1952	11	0	2,936	2,067	0	5,014
1953	660	1,761	0	2,195	0	4,616
1954	111	2,932	70	20,423	0	23,536
1955	123	4,208	2,777	13,920	0	21,028
1956	887	8,573	0	53,999	0	63,459
1957	1,619	4,056	0	61,454	1,616	68,745
1958	3,624	4,370	746	127,088	0	135,828
1959	40	1,388	1,397	12,779	1,731	17,335
1960	197	2,421	0	13,457	65	16,140
1961	426	3,533	16	16,653	5	20,633
1962	2,474	3,828	4,553	28,418	11	39,284
1963	6,823	910	2,743	29,648	1,138	41,262
1964	3,133	775	380	26,416	5,859	36,563
1965	3,053	945	713	2,851	521	8,083
1966	4,096	1,932	533	11,517	15,864	33,942
1967	1,175	1,044	1,901	31,517	18,159	53,796
1968	7,357	6,507	5,771	48,867	24,872	93,374
1969	17	5,548	9,292	37,799	28,720	81,376
1970	53	7,027	1,695	3,688	2,027	14,490
1971	89	923	469	8,036	3,192	12,709
1972	402	1,249	0	3,654	8,652	13,957
1973	255	2,701	2,307	28,709	23,070	57,042
1974	916	1,156	4,055	12,569	25,049	43,745
1975	43	951	4,595	7,342	33,350	46,281
1976	1,195	2,321	3,561	6,778	12,791	26,646
1977	2,883	2,685	3,884	52,562	45,201	107,215
1978	913	2,256	2,024	44,740	44,338	94,271
1979	3,448	12,538	18,324	142,251	123,854	300,415
1980	7,748	19,783	9,341	149,719	148,059	334,650
1981	1,229	32,759	30,220	220,290	29,207	313,705
1982	10,586	74,989	50,803	349,669	133,765	619,812
1983	82	21,585	7,797	80,858	5,681	116,003
1984	2,805	66,179	68,788	271,570	170,948	580,290
1985	7,706	32,732	60,914	20,285	39,176	160,813
1986	3,078	34,500	25,562	72,896	48,440	184,476

1. 1983-1986: Preliminary data.

years (1966-1985), the Nushagak and Togiak Districts have accounted for 49% and 30% of the total catch, respectively. The Nushagak District watershed supports a far larger coho salmon population than Togiak, as the 1982 commercial catch of 350,000 shows (see Table 13).

As a species, coho salmon are rather notorious for unpredictable production. Their life history of extended juvenile stream life (in Bristol Bay, two or more years) makes them particularly susceptible to environmental mortalities during their freshwater phase. Their production pattern in Bristol Bay tends to be somewhat erratic, but factors other than basic production have contributed to this pattern. Generally speaking, coho salmon have not been of great interest to processors until recently. The relatively small size and the timing of the coho run after the sockeye season have discouraged the larger canneries from processing them. Fishing effort also tends to drop off significantly after July. The recent attention from the frozen fish market and the advent of freezer-processor vessels in Bristol Bay have stimulated more interest in coho salmon.

Very little information on coho salmon escapement is available for Nushagak and Togiak Districts where 80% of the Bristol Bay coho salmon catch has occurred since 1966. Because of the relatively low interest in this species until recently, no special effort has been directed toward developing escapement assessment techniques. However, the Nushagak River sonar-enumeration program (started in 1979) shows considerable promise for assessing coho salmon escapements. In 1980, in the first escapement estimate made for the Nushagak River, 102,000 coho salmon were counted through early August. The actual escapement was significantly higher than this since the sonar project was terminated ten days before the coho salmon commercial fishery peaked (see Appendix C). The project's objective was to count pink salmon, and the coho counting capability was not fully realized until after the fact. Coho salmon were not enumerated in 1981 because of inadequate funding, but in 1982 the sonar coho salmon escapement estimate was 234,000 fish. In 1983, 1984, 1985, and 1986, the estimates were 51,000, 171,000, 90,000 and 53,000 fish, respectively. Future plans entail expanding the project duration for complete assessment of the coho salmon escapement.

Togiak District coho salmon escapement studies were started in 1980 using aerial survey techniques, and this first-year effort indicated an escapement estimate of 96,000 coho salmon to the Togiak River, its tributaries, and the Kulukak River system. Aerial surveys were continued in 1981 and 1982; 61,000 and 81,000 coho salmon were estimated by this method, respectively. In 1983, aerial estimates were precluded by adverse weather and water conditions. In 1984, the escapement was estimated at 104,000 fish, in 1985 the estimate was 61,000 fish, and in 1986 the estimate was 30,000 fish. These escapement estimates represent the minimum number of fish in these systems.

Recent increases in both commercial and recreational fishing pressure on the bay's coho stocks dictate that more refined techniques be developed to measure current and long-term production trends. Basic biological information, such as age composition and sex ratios, is needed for Bristol Bay coho stocks.

Fisheries Enhancement

Supplemental Production:

As of 1988, there is no supplemental salmon production in Bristol Bay. However, prior to 1983, ADF&G conducted an experimental program to evaluate the potential of aquacultural techniques to supplement natural-stock salmon production in the region.

In 1975, the Alaska State Legislature appropriated $1.5 million of disaster funds to ADF&G to use toward the rehabilitation and enhancement of Bristol Bay's salmon runs. Initially, these funds were devoted to assessing the enhancement potentials of several of the region's lake systems. At that time, two particular systems were identified as having potential for rehabilitation and/or enhancement, the Egegik River/Becharof Lake system and the Snake River/Lake Nunavaugaluk system (Rowse and Kaill 1983). Clark (1980) determined that the main basin of Becharof Lake could provide extensive rearing habitat for juvenile sockeye salmon but was underutilized.

The Lake Nunavaugaluk/Snake River system was identified as the most feasible site for artificial propagation of sockeye salmon fry in the Bristol Bay area. From 1974 through 1978, a pilot program (using instream incubators) was conducted at East Creek on Lake Nunavaugaluk. In 1978, a permanent indoor hatchery facility was completed. The ultimate objective of the project was to produce 15 million sockeye salmon fry annually. Annual production only reached 5.6 million fry because of the lack of broodstock returning to the system and the shortage of funds for remote egg takes. Production at East Creek Hatchery ranged from 6,100 fry released in 1975 to 5.6 million fry released in 1982 (see Appendix C).

Recovery of marked, hatchery-produced fry was to be used as a means of evaluating enhancement results. A fry-marking program was planned for 1983 at East Creek Hatchery, but it was cancelled because of a concern for stress-related factors and the threat of infectious hematopoietic necrosis virus (IHNV) on emergent sockeye fry.

Development of the East Creek experimental facility proceeded until 1982. At that time, approximately $2.7 million had been invested in determining the feasibility of supplemental production of salmon in the Bristol Bay region. In 1983, the legislature expressed interest in transferring state-owned salmon

hatcheries to private ownership. The ADF&G investigated the possibility that the East Creek facility might be useful to another organization. Imarpik, the City of Dillingham, the University of Alaska, the Bristol Bay Native Association, Chogginung, Ltd. (the landowners of the hatchery site), the Southwest Regional School District, and the USFWS were all contacted during August 1982 regarding their interest in acquisition and continued operation of the salmon enhancement facility. A committee was formed to examine and pursue the options available for use of the facility and to make recommendations to the department. In mid January 1983, the committee replied that they had no solutions to the question of transferring the facility and had given up trying. Additional examination continued regarding the feasibility of use of the facility by the USFWS as a refuge headquarters.

In March 1983, ADF&G again reviewed the possibilities of transfer of the facility, presumably to a PNP hatchery corporation. The Alaska House of Representatives Journal of May 26, 1983 (page 1543) carried intent language that the hatchery should be transferred to Imarpik. Imarpik indicated, however, that it could not assume responsibility for the facility. The facility was finally closed in June 1983 and turned over to the Department of Administration for surplus state property disposal.

Lake Fertilization:

Artificial lake fertilization has also been investigated as a tool for enhancement and rehabilitation in Bristol Bay. Little Togiak Lake, in the Wood River Lake system, was used as an experimental site for lake fertilization studies conducted by the University of Washington, Fisheries Research Institute. A chemical fertilizer (diammonium phosphate) was added to the upper end of the lake in late August 1974 and again in 1975 and, subsequently, over most of the lake in mid July of 1976, 1977, and 1978. Rogers (1979) reported increases in chlorophyll, zooplankton, and emergent chironomid production late in the season (September). Growth of sockeye salmon fry did not increase significantly in early summer, but the size of migrating age-1.0 smolts the next spring showed a significant increase (Rogers 1979). In 1979, fertilizer was not added to Little Togiak Lake, but plankton growth was monitored. It was determined that zooplankton abundance and the standing crop of phytoplankton had returned to normal (i.e., levels of prefertilization).

Predator Management:

In the past, various studies of the potential for managing predators or competitors of Bristol Bay sockeye salmon have been conducted. Estimates based on a 1983 study suggest that belukhas

annually consume the equivalent of approximately 600,000 Bristol Bay adult salmon (Frost, pers. comm.).

In 1975 and 1976, ADF&G made several attempts at reducing belukha whale predation of smolts and adults with underwater broadcast of killer whale sounds (called "belukha spookers"). The intent of these broadcasts was to frighten and drive the whales away from concentrations of salmon. The technique appeared to be successful in keeping belukhas out of rivers, but there were extensive mechanical and logistical problems. This phase of the control technique was never evaluated.

In 1979, the FRED Division explored possible approaches to managing belukha whale predation on sockeye salmon. Goals were: (1) to develop acoustical repelling units for routine use; (2) to investigate abundance and distribution of belukha whales in the Nushagak Bay river systems; and (3) to design a field experiment for evaluation of repelling unit effectiveness. Because of budget constraints, only the abundance and distribution study in the Nushagak Bay river systems was completed during the 1979 field season.

In 1982 and 1983, ADF&G, Game Division resumed basic research on belukhas (Frost et al. 1985). Efforts were made to capture and radio-tag individual whales to monitor their movements, estimate abundance, and estimate daily rates of predation on salmon juveniles and adults.

Arctic char predation on sockeye juveniles has been a concern throughout the history of the commercial salmon fishery in Bristol Bay. Early predator management projects directed at Arctic char were carried out with enthusiasm but were never adequately evaluated. For instance, from 1928 to 1940, a bounty of 2.5 to 5 cents was paid for each char tail. This soon became an important aspect of the local economy, and bounty payments required hundreds of thousands of dollars. However, the program suffered from poor design and the absence of evaluation. Many fish tails brought in for payment were never identified and, unfortunately, other species, such as juvenile sockeye salmon, were included.

Assessments of Arctic char predation were begun in 1953 along the Wood River system. A 1977 estimate showed that 1.5 to 1.9 million sockeye salmon smolt were consumed by char each year at the mouth of the Agulowak River. This number represents an equivalent of 75,000 to 190,000 returning adult sockeye, based on typical marine survival rates. Because char populations appear to remain relatively stable compared to fluctuating sockeye salmon smolt populations, char predation is termed "depensatory mortality." The impacts of char predation on the sockeye salmon population were considered to be most pronounced during times of low sockeye abundance.

When Bristol Bay disaster funds were appropriated in 1974-1975, ADF&G directed efforts toward the Nushagak District char assessment and control investigation. A char impoundment was found to be most feasible from the standpoint of various user groups in the area. The program was initiated in 1975 at Little Togiak Lake and continued during 1980 at the Agulukpak and Agulowak Rivers.

Benefits of the impoundment program were reported in terms of "number of smolts saved" and "benefit-to-cost ratio." These estimates assume that confined char would have consumed the same number of smolts that unconfined char consumed. A benefit-to-cost ratio was obtained by multiplying the number of smolts saved by a 10% ocean survival rate to obtain the estimated number of returning adults available to the commercial fishery. The value of the commercial catch was then related to the cost of the impoundment project. Benefit-to-cost ratios at the Agulowak River in 1977 were 10:1, and in 1978 were 16:1. At the Agulukpak River, benefit-to-cost ratios were 2.2:1 in 1977 and 1:1 in 1978.

In 1979 and 1980, the Fisheries Rehabilitation, Enhancement and Development Division continued the char project at the Agulowak River mouth. Based on the previous success of the project, a commercial purse seine operated from a chartered vessel was used to capture char. Benefit-to-cost ratios on the char project in 1979 and 1980 at the Agulowak River were calculated to be 1.3:1 and 2.7:1, respectively. The ratio showed greater success in 1980 because of larger numbers of char that were impounded and increased consumption of smolts by unimpounded char.

In conclusion, a number of independent factors have caused a relatively unsuccessful supplemental production of salmon in Bristol Bay. This is in comparison to the natural rehabilitation of the region's wild stocks and to aquacultural advances in other regions of Alaska or in other parts of the world. The factors affecting Bristol Bay have included catastrophic outbreaks of IHNV at the ADF&G experimental hatchery at East Creek, funding limitations, and restrictions on supplemental production research, evaluation, and remote egg-take projects. The remarkable recovery of production of the natural salmon stocks since the early 1970s, in response to favorable climatic factors and improved fisheries management techniques, has minimized the need for supplemental production projects in Bristol Bay.

CHAPTER 4

SALMON PRODUCTION GOALS

Assumptions

The long-range production goals of this plan are based on the following assumptions:

1. The existing salmon habitat, on a region-wide basis, has not changed appreciably in the last 100 years and will not change over the long term. Although individual systems may naturally produce less than historically recorded numbers of fish, other systems are now becoming more productive. The sum of all the changes in the systems, when applied to present-day salmon habitat in the Bristol Bay region, should show that the current production potential remains equal to the historic potential of the entire area. However, this assumption is critically dependent on the continuation and improvement of the region's salmon habitat protection measures.

2. Within the range of historical productivity, ocean food supplies for salmon are not a limiting factor.

3. Marine and freshwater survival rates are variable from year to year, but they are predictable within limits over the long term.

4. Marine productivity is uncontrollable.

5. No major genetic changes have occurred to lessen the productive potential of Bristol Bay salmon stocks.

6. No debilitating diseases have affected the natural stocks.

7. No major increase in the interception rate in the salmon fisheries will occur, either within or outside the planning region. Ideally, high-seas interceptions will decrease in the future.

8. The record 30-year moving average harvest or 20-year average production for each species reflects the harvestable portion of the optimum production potential of the marine habitat for that species.

9. No major supplemental production (i.e., hatchery production) will occur. Goals will be reached primarily by using techniques to manage and maintain healthy wild stocks, rehabilitate wild stocks where necessary, and protect fisheries habitat.

Long-Range Production by Species

5 AAC 40.340 requires that each comprehensive salmon plan define regional production goals by species, area, and time. The Bristol Bay region has no supplemental salmon production projects, and none are currently anticipated. The production of salmon in Bristol Bay equates directly to harvest plus escapement. The goal for this plan is the attainment of a sustained salmon harvest equal to or greater than the record long-term average annual harvest. This number should approximate the sustainable yield from the natural environment, assuming that no detrimental habitat alterations occur and that continued improvements in fisheries management are implemented. In the following discussion, this goal is quantified for each species in the Bristol Bay region salmon fishery.

Harvest Goals

All Species:

The long-range aggregate species harvest goal is based on the record 30-year moving average annual harvest since the beginning of commercial harvest in the Bristol Bay region. The goals for the individual salmon species may vary from their record 30-year average annual harvest because of changing demand, known or presumed changes in the carrying capacity of the natural systems, the availability of appropriate enhancement technologies, and the cost efficiency of enhancement or rehabilitation for that species.

Table 14 is a listing of the record 30-year moving average harvests used by the RPT as the basis for production goals for the coming years.

Table 15 provides a historical listing of annual harvests in the Bristol Bay commercial fishery, by species and in aggregate, for the period 1884 to 1984, as well as the sequential 30-year moving averages and their accompanying standard deviations. Figures 4 through 9 provide a graphical comparison of the annual harvests and the centered 30-year moving average harvests. During 1987, harvests of sockeye and chum salmon exceeded their respective record 30-year average harvests. The previous record 30-year average harvests for all species except sockeye and chinook salmon have occurred during the most recent time period. Record harvests of recent years reflect the generally favorable trends of freshwater and marine production of recent years that were described in detail in Chapter 3.

Five-year average harvest goals through the year 2005 for all five of Bristol Bay's salmon species are summarized in Table 16. The all-species production goal was set at 119% of the record 30-year average. This number was arrived at as a composite of the individual species goals. Current levels of harvestable

Table 14. Record 30-year moving average annual harvests of Bristol Bay salmon.

	Species					
	Chinook	Sockeye	Coho	Pink	Chum	All species
Record 30-year average annual harvest	116,284	15,876,983	124,560	796,800	849,596	16,744,820
Standard deviation	55,028	6,126,724	161,152	1,241,548	459,216	6,223,689
Years of record	1957-1986	1909-1938	1958-1987	1958-1987	1958-1987	1909-1938
1987 harvest as percent of record	65%	101%	56%	49%[1]	178%	106%

[1] 1986 pink harvest. Odd year pink run is not present in Bristol Bay.

Table 15.
BRISTOL BAY COMMERCIAL SALMON CATCH, 30-YEAR AVERAGES, AND
STANDARD DEVIATIONS, BY SPECIES AND YEAR, 1884-1987.

Alaska Department of Fish and Game
Division of Commercial Fisheries
P.O. Box 3-2000; Juneau, AK 99802
Compiled 3-Oct-1988 (907)-465-4210

(Number of Fish)

Year	Chinook	30-year chinave	std dev chinave	Sockeye	30-year sockave	std dev sockave	Coho	30-year cohoave	std dev cohoave	Pink	30-year pinkave	std dev pinkave	Chum	30-year chumave	std dev chumave	All	30-year average	standard deviation
1884	0			0			0			0			0			4171		
1885	0			0			0			0			0			146000		
1886	0			0			0			0			0			509144		
1887	0			0			0			0			0			758157		
1888	0			0			0			0			0			937383		
1889	0			0			0			0			0			1209558		
1890	0			0			0			0			0			1234639		
1891	0			0			0			0			0			1391359		
1892	0			0			0			0			0			662204		
1893	44000			940000			74000			0			0			1058000		
1894	10500			1235400			47000			0			0			1292900		
1895	19925			1472137			28050			0			0			1520112		
1896	17301			2099740			245068			0			0			2362109		
1897	19897			3317523			150000			35348			0			3522768		
1898	19260			4927840			55744			59786			0			5062630	7608366	7087074
1899	38259			5112737			100396			16758			0			5268150	8325792	7374313
1900	58307			8547335			0			7803			0			8613445	8847393	7329059
1901	106047			10220577			4179			231188			0			10561991	9500219	7432248
1902	109089			12808518			193838			502265			0			13613710	10310289	7763565
1903	86506			16320092			60073			241504			0			16708175	11100757	7980551
1904	97953			11903352			129469			398146			37308			12566228	11314269	7790211
1905	116855			14833989			78301			291015			58984			15379144	11661726	7554016
1906	143194			10823431			207257			1901945			253541			13329368	12155777	7340821
1907	137677	88659	45195	10193403	12088500	6965413	129065	111843	68376	344148			508727			11313020	12956097	7353336
1908	90009	89426	44602	16233802	12663232	6720848	103013	109686	70596	399257			459899			17285980	13535602	7062634
1909	130489	91465	42204	15497883	12965454	6384690	80513	109465	70809	101279			378138			16188302	13852593	6698209
1910	101755	94049	39987	11593609	13180033	6086300	139200	109083	71292	652129			310218			12796911	14077102	6375710
1911	113163	95959	37485	8815114	13757178	5814210	129971	101358	68553	91764	404939	544224	347866			9497878	14668900	6067328
1912	97728	98091	34728	19696343	14015655	5497857	195093	96362	70324	1680652	403761	545089	354627			22024443	14929862	5730399
1913	74249	99651	32009	20581826	14508394	5314651	66807	94666	71933	425493	403324	545380	284718			21433093	15435246	5493858
1914	100964	103398	31141	20195107	14744258	5032837	98942	93273	72222	564998	402765	545798	566947			21526958	15693624	5172057
1915	148028	104969	29954	14787678	14601319	5270202	130443	94411	70959	134798	410796	541542	593079			15794026	15568990	5389054
1916	105124	103007	31756	17521921	14686987	5217158	293498	94303	71105	683771	403090	545814	1489623			20093937	15666072	5321555
1917	91145	101646	32354	24513532	14758022	5205194	62263	87996	70359	37082	392094	547068	356222			25060244	15748727	5307818
1918	87048	100407	33642	23090665	15004317	5450677	108576	86520	71421	619303	384049	551119	745824	417491	280381	24651416	15992784	5517636
1919	201954	98673	35082	7161375	15294222	5511012	46687	82611	72195	452	371887	554810	204476	427317	271627	7614942	16274710	5552484
1920	127350	94897	38941	8897915	14900521	5949467	153304	80075	73672	2045437	362187	558803	434336	427752	271026	11658344	15865432	6050924
1921	91982	90847	40047	15680076	15225970	5985681	84564	73977	70275	939	316250	478774	355331	427933	270908	16212892	16134977	6113837
1922	74020	87479	40222	23632077	15594783	6005741	159984	69731	70678	289795	304778	482194	515915	421050	271407	24671791	16477822	6122491
1923	67013	86010	40925	18181964	15876983	6231462	9274	66458	71354	3	291470	484998	184902	423899	272276	18443156	16744820	6330085
1924	71663	82774	41124	10302066	15804798	6248524	40379	63785	72305	103056	288095	486716	285463	442451	287581	10802627	16681904	6345169

Table 15.
BRISTOL BAY COMMERCIAL SALMON CATCH, 30-YEAR AVERAGES, AND
STANDARD DEVIATIONS, BY SPECIES AND YEAR, 1884-1987.

(Number of Fish)

Alaska Department of Fish and Game
Division of Commercial Fisheries
P.O. Box 3-2000; Juneau, AK 99802
Compiled 3-Oct-1988 (907)-465-4210

Year	Chinook	30-year chinave	std dev chinave	Sockeye	30-year sockave	std dev sockave	Coho	30-year cohoave	std dev cohoave	Pink	30-year pinkave	std dev pinkave	Chum	30-year chumave	std dev chumave	All	30-year average	standard deviation
1925	97448	79891	42747	7909508	15575901	6527650	16596	59980	71195	18	274969	481845	231808	441882	287868	8255378	16432623	6642974
1926	74604	77141	43184	19414094	15520521	6593700	13297	56802	70082	288041	271910	483337	326018	447762	287683	20116054	16374136	6713484
1927	83846	74517	44268	11071828	15075421	6750910	146	51274	65166	3	221619	403622	195803	441573	291724	11351626	15864405	6848850
1928	66075	73413	44686	19710000	14967034	6685238	4840	49103	65713	46665	207436	403686	396581	444643	290499	20224161	15741630	6778231
1929	150663	70594	45548	12188648	14678718	6638341	58620	46622	65169	0	190445	398815	621554	436260	290476	13019485	15422639	6721522
1930	105428	66546	43791	4259188	14429137	6773480	34150	42822	63413	248727	185952	400221	226930	437668	291363	4874423	15162125	6856728
1931	47175	63955	43729	12790614	14113446	6844690	920	34739	42298	0	164535	389716	635726	395881	215242	13474435	14772557	6898735
1932	68286	62305	43601	14939552	13917729	6617221	4630	32982	42210	172396	163313	390186	908522	391198	217650	16093386	14567528	6670056
1933	49308	61041	43409	23708950	13632853	6388719	15800	29757	39866	150	144444	380953	255658	382892	208199	24029866	14250988	6394648
1934	45945	56001	34307	20600510	13609118	6414860	12190	29078	39741	33303	144430	380958	332069	385048	206617	21024017	14223675	6425644
1935	3573	53265	31586	3022959	13551097	6466604	2230	24926	32084	0	77321	127633	72049	375451	210890	3100811	14082060	6530098
1936	21703	51538	30802	20586884	13172646	6666838	24310	23523	30254	523841	77291	127652	258964	368832	214627	21415702	13693830	6741833
1937	36629	50832	30511	21257814	12760448	6373688	1700	18357	16044	0	68102	121606	302231	359949	213843	21598374	13257688	6422834
1938	45934	50017	30390	24699788	12358099	6400572	4825	18202	16157	0	68103	121606	545380	366697	211308	25295927	12861117	6458809
1939	33408	49496	30139	13332345	12169784	6544636	323	17640	15644	48	68100	121605	934682	370536	210827	14300806	12675557	6598446
1940	15267	48762	29184	4726687	12057771	6648007	25035	17788	15655	258342	68100	121605	293150	369882	211302	5318481	12562302	6705224
1941	30661	48487	28970	7153704	11706683	6523061	34640	19460	17703	0	61564	114434	524280	369532	211386	7743285	12205727	6572799
1942	19006	48740	29320	6343363	11546806	6597510	29257	21747	19465	171913	61565	114434	168963	371650	209898	6732502	12050507	6648215
1943	41146	49978	30822	17330218	10989328	6590534	1670	26113	28251	0	97861	226932	376803	370367	209658	17749837	11533647	6593366
1944	16373	47765	25219	11545604	10736643	6687572	24520	24737	27611	55264	97871	226927	315469	369699	205593	11957230	11272716	6686770
1945	26609	47974	25734	7300247	11051504	6593792	16435	24136	27595	23	99648	228353	635293	402000	267168	7978607	11625263	6616238
1946	27401	49357	26783	8051206	11022281	6587759	51008	24794	27256	41250	99666	228345	236040	405874	270459	8406905	11601171	6610586
1947	41641	49882	27316	18642028	10681563	6642274	9563	25949	27105	421	124384	272379	215715	397374	258664	18909368	11279152	6619502
1948	49116	50314	27409	14544389	9986969	6314435	11818	26797	27175	53236	124394	272374	496657	401189	257342	15155216	10589664	6315884
1949	50752	53434	31860	6449321	9486823	6032723	26319	27610	27068	38	174936	375896	269138	416870	267132	6795568	10159674	6012850
1950	45261	57081	32214	7157275	10194566	6477324	28737	27805	26919	32171	174960	375884	146449	426487	259371	7409893	10880898	6420759
1951	40183	58940	31708	4326543	9818811	6173511	42463	28126	26933	34	240593	563825	156750	429295	257947	4565973	10575765	6112987
1952	52856	61625	33132	11266129	9254575	5857422	5014	29863	26850	14129	240631	563808	249421	435099	256946	11587549	10021792	5825943
1953	42556	63551	33861	6111500	8524343	5193413	4616	32814	28799	12	305158	640835	387346	429046	256397	6546030	9354910	5119471
1954	56016	66601	35148	4652625	8300655	5123228	23536	35516	29441	102982	305219	640805	400644	408990	238381	5235803	9116978	5047039
1955	75429	70776	36261	4549106	8833791	5552680	21028	35164	29633	9	311838	641330	212179	423146	243813	4857751	9674713	5515562
1956	66377	73855	36656	8881467	8914801	5545047	63459	34433	29915	91972	311845	641326	315517	428234	247560	9418792	9763164	5504787
1957	91420	75539	35180	6275502	8783896	5653146	68745	33923	30136	29	310349	641716	259342	444489	245953	6695038	9648193	5605367
1958	103207	75636	35086	2985666	8231600	5598506	135828	35769	29786	1135542	310362	641710	358092	454745	249424	4718335	9108108	5578349
1959	84289	76612	33763	4608119	7892162	5698459	17335	36410	29743	301	339852	649859	481516	453775	250040	5191560	8798809	5671395
1960	111703	76725	33595	13705002	7812114	5723870	16140	37405	29550	302032	339865	649852	1315957	443446	248680	15450834	8709553	5705716
1961	88656	79011	32436	11913926	7731051	5737572	20633	36593	29498	538	373042	659417	727932	479880	293309	12751685	8699572	5706525
1962	84047	81973	32961	4718016	7272246	5373782	39284	39848	31717	913934	373178	659338	677545	525962	352916	6432826	8293204	5379078
1963	62269	86721	37945	2871136	7118371	5222325	41262	42596	32759	461	543161	1090424	370097	548009	371209	3345225	8338854	5444733
1964	139536	92125	43747	5596120	7617681	5836165	36563	51532	56283	1549569	543288	1090359	802508	569264	372942	8124296	8873886	6043552
1965	112967	93800	42843	24255239	8171163	6536351	8083	62191	77930	700	627664	1145966	360544	607750	387109	24737533	9562565	6976166

Table 15.
BRISTOL BAY COMMERCIAL SALMON CATCH, 30-YEAR AVERAGES, AND STANDARD DEVIATIONS, BY SPECIES AND YEAR, 1884-1987.

Alaska Department of Fish and Game
Division of Commercial Fisheries
P.O. Box 3-2000; Juneau, AK 99802
Compiled 3-Oct-1988 (907)-465-4210

(Number of Fish)

Year	Chinook	30-year chinave	std dev chinave	Sockeye	30-year sockave	std dev sockave	Coho	30-year cohoave	std dev cohoave	Pink	30-year pinkave	std dev pinkave	Chum	30-year chumave	std dev chumave	All	30-year average	standard deviation
1966	77472	100371	49009	9314240	8880381	7223032	33942	73320	96615	2492851	627906	1145830	343212	652686	410488	12261717	10334660	7653044
1967	117193	107059	55555	4330730	9008323	7300328	53796	93813	137977	1114	677182	1150302	476357	675084	406034	4979190	10561458	7791027
1968	103723	112346	56738	2792849	10047174	8913184	93374	97526	136989	1935836	677195	1150294	363791	711071	426956	5289473	11645308	9324035
1969	124908	113870	55779	6621698	10714887	9239461	81376	116084	162042	1870	786714	1246155	332989	759022	469544	7162841	12490573	9857116
1970	140511	115396	55315	20720766	11345702	9447660	14490	120744	161222	456911	786730	1246145	717846	780721	458309	22050524	13149289	9988867
1971	123015	116284	54712	9583987	11579286	9471232	12709	124528	161163	212	796797	1241550	676906	807904	453928	10396829	13424796	9996407
1972	69546	115766	55028	2416233	11905030	9450555	13957	124560	161152	127023	796800	1241548	656609	849596	459216	3283368	13791748	9942759
1973	44044			761322			57042			387			684498			1547293		
1974	45662			1362479			43745			939978			286372			2678236		
1975	29992			4898815			46281			422			325416			5300926		
1976	95968			5619292			26646			1036543			1329052			8107501		
1977	130526			4877880			107215			4517			1598164			6718302		
1978	191539			9928139			94271			5152700			1158090			16524739		
1979	212873			21428616			294399			3849			906787			22846524		
1980	95528			23761746			348484			2563468			1301026			28070252		
1981	237304			25603081			376333			7280			1504828			27728826		
1982	253502			15104391			619812			1492416			921369			18391490		
1983	201153			37277029			116003			390			1466954			39061529		
1984	101731			24684013			580290			3388574			1839155			30593763		
1985	121222			23473556			160813			476			863156			24619223		
1986	93000			15889000			177000			394000			1131000			17684000		
1987	75900			16047800			69700			100			1510100			17703600		

* Individual species catches may not add up to the all-species total because of rounding.

** SOURCES: Edfelt, Larry, STATISTICAL HISTORY OF ALASKA SALMON CATCHES, 1973, ADF&G, Juneau (through 1971);
Middelton, Kenneth, BRISTOL BAY SALMON AND HERRING FISHERIES STATUS REPORT THROUGH 1982, Informational Leaflet No. 211, 1983, ADF&G, Juneau;
ADF&G Statistical Leaflets 25 through 31 (1972 - 1978);
ADF&G computer summaries (1979 - 1983); and ADF&G Annual Management Reports 1985-1986.
ADF&G Informational Leaflet No.259; Regional Information Report No.5J88-1

Figure 4. **Bristol Bay Salmon Harvest (all spec.)**

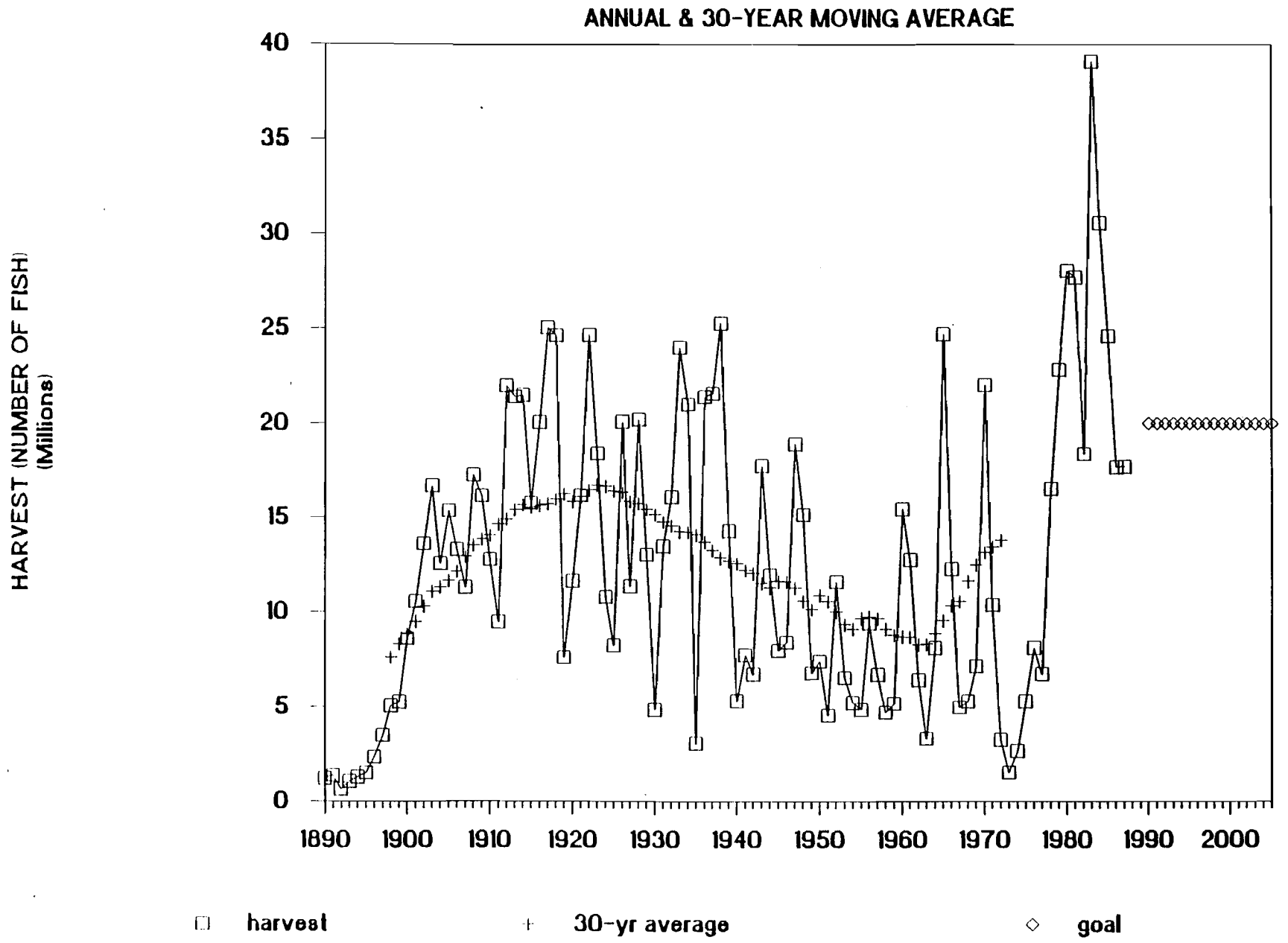


Figure 5. **Bristol Bay Chum Harvest**

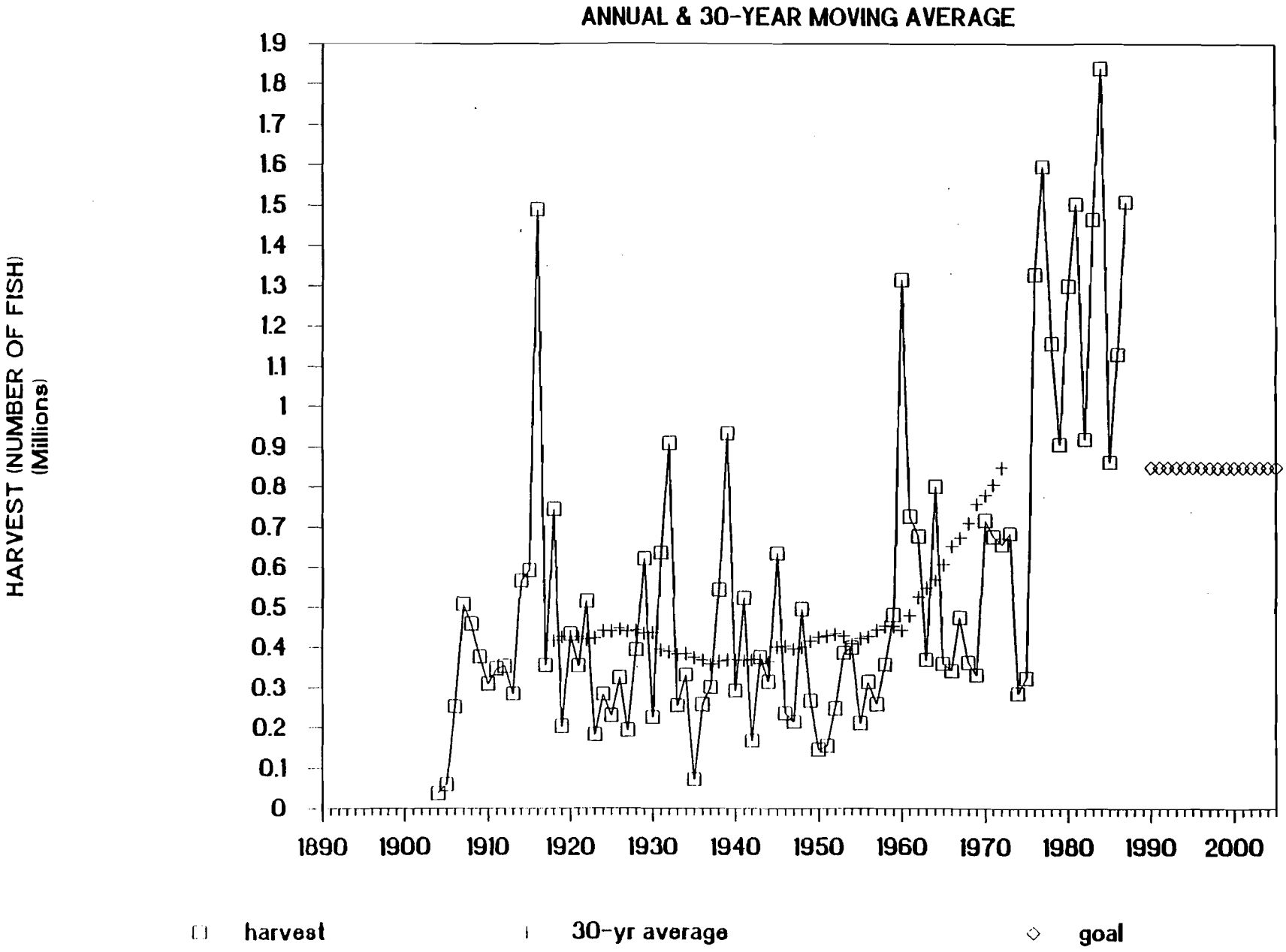


Figure 6. **Bristol Bay Chinook Harvest**

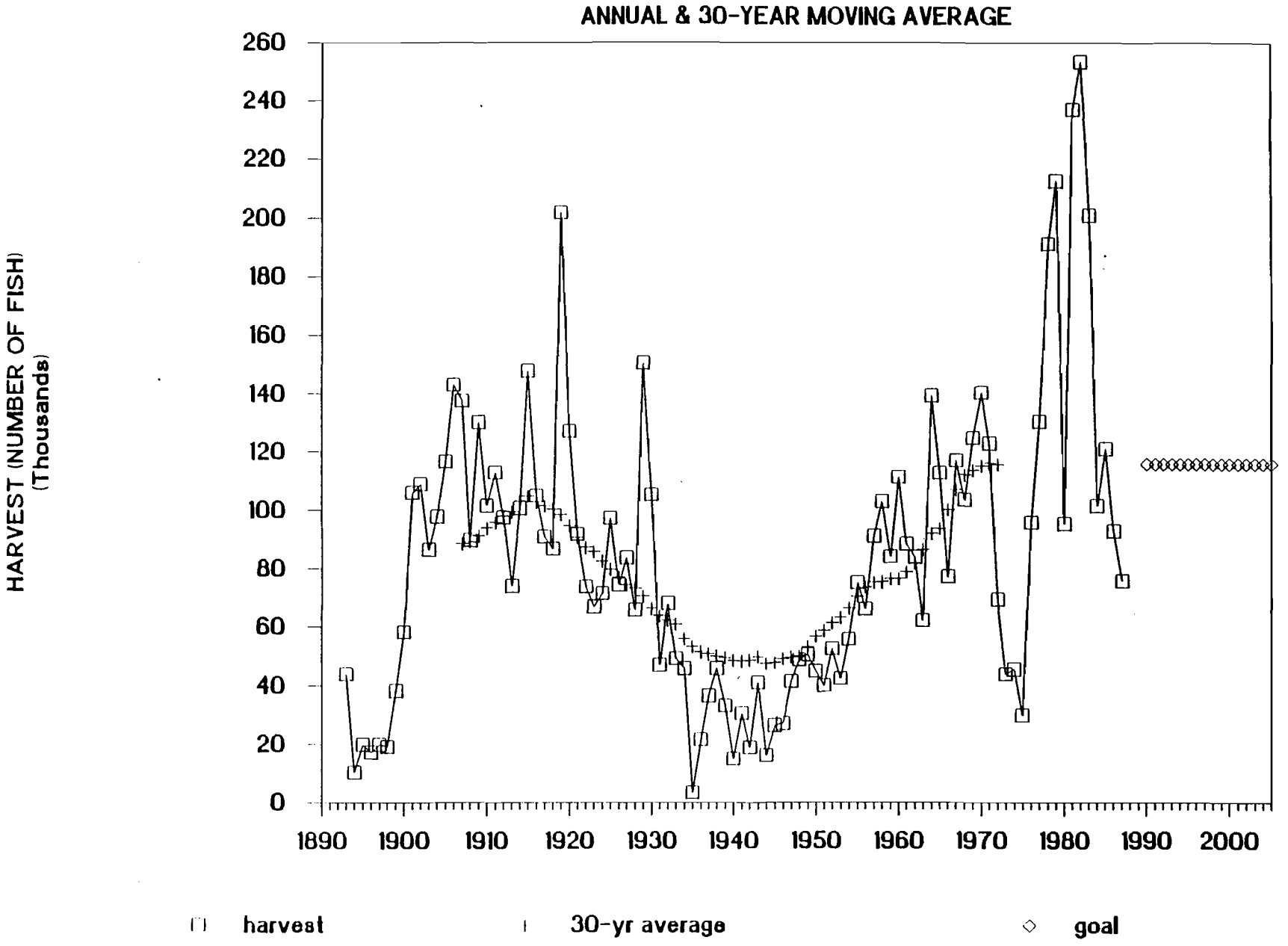


Figure 7. **Bristol Bay Coho Harvest**

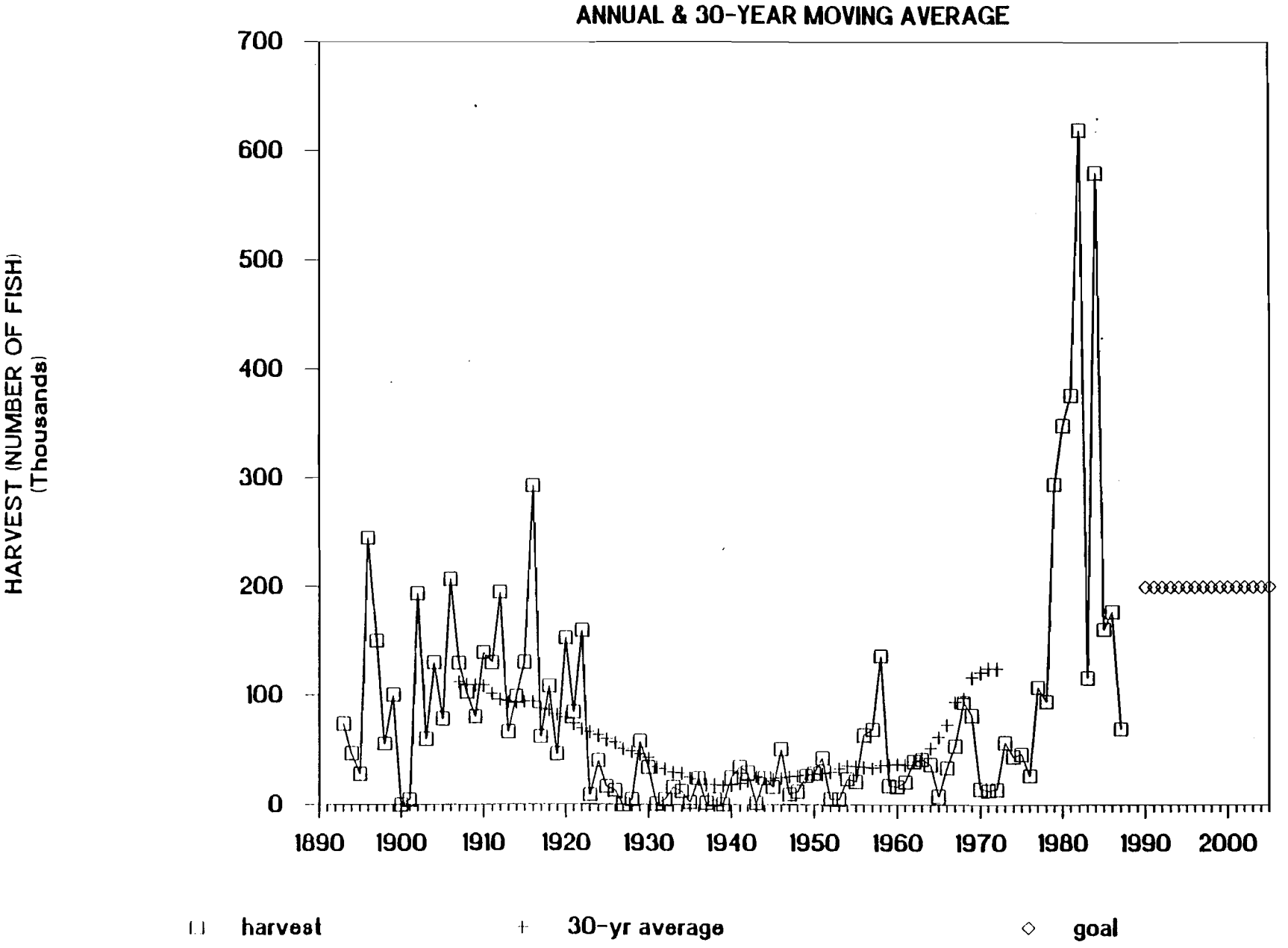


Figure 8. **Bristol Bay Sockeye Harvest**

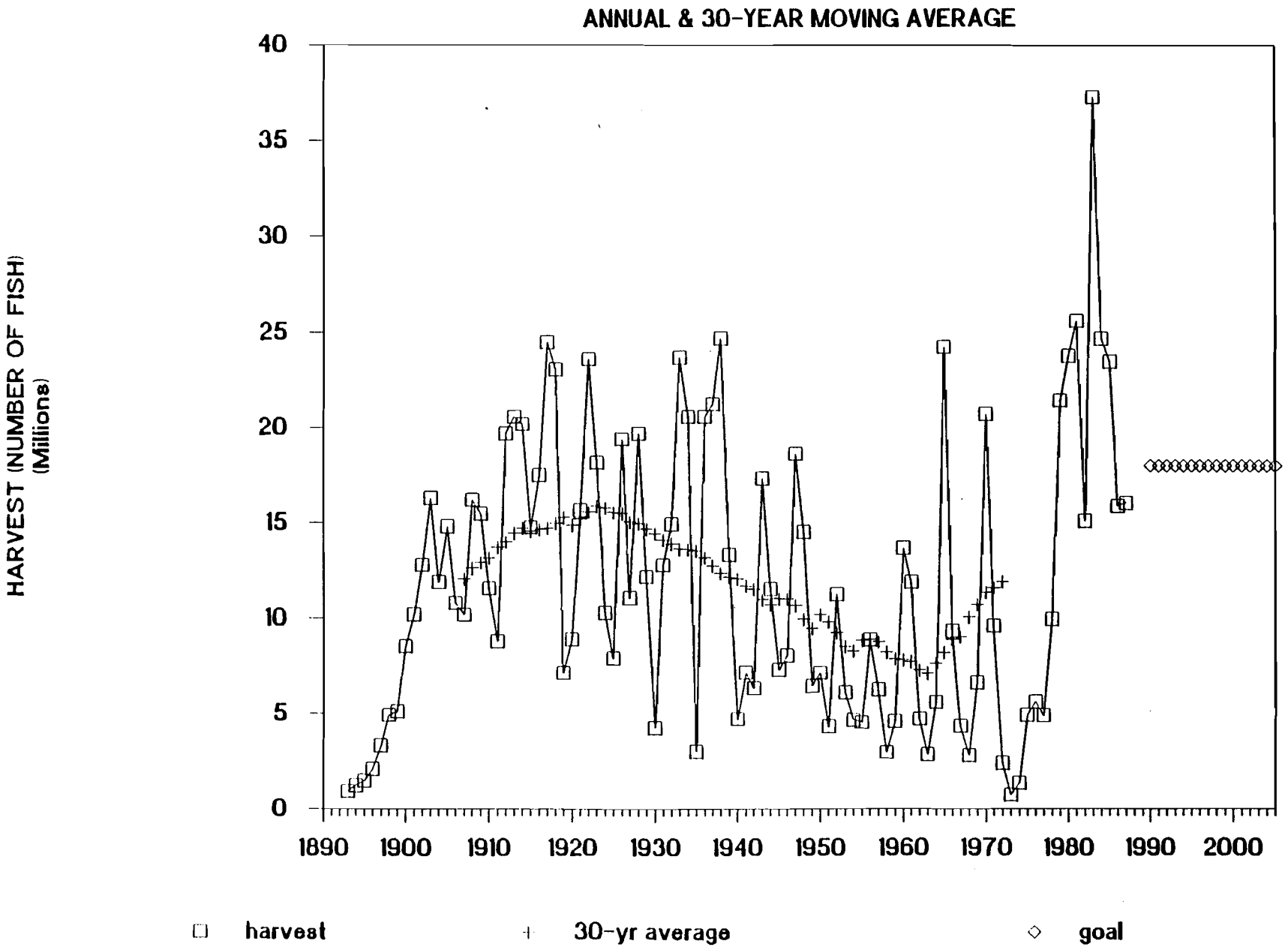


Figure 9. **Bristol Bay Pink Harvest**

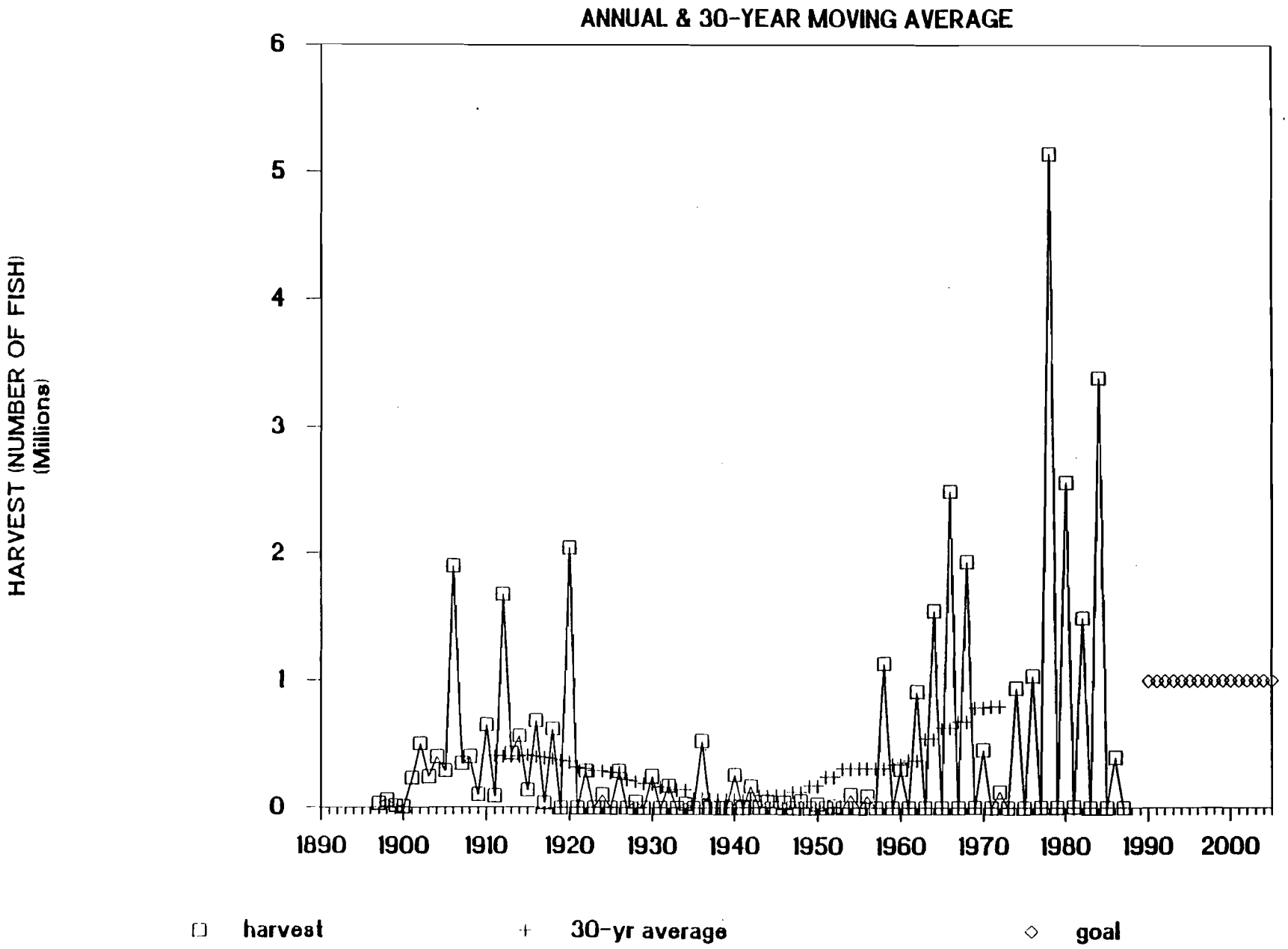


Table 16. Five-year average harvest goals through the year 2005 for the Bristol Bay salmon fisheries.

	Species					Total
	Chinook	Sockeye	Coho	Pink	Chum	
Long-range harvest goal	116,000	18,000,000	200,000	1,000,000	850,000	20,000,000
1983-1987 harvest as percentage of long-range goal	102%	130%	110%	76%	170%	130%

production are at 130% of this goal, indicating recent trends of above-normal production.

Sockeye Salmon:

After considering the most recent data on harvest and production, the RPT decided to formulate the long-range production goal for sockeye salmon from a slightly different data base than simply the record harvest averages. Because of the excellent production data base that exists for sockeye salmon (see Table 9), team members decided that smoothed production trends would better approximate the region's ultimate production potential and, in turn, provide more realistic long-range goals. Sockeye salmon production trends are plotted in Figure 10.

The revised long-range sockeye salmon harvest goal is based on the record ten-year moving average production for the region, minus the total regional escapement goal. As mentioned above, escapement goals for Bristol Bay sockeye salmon are currently being reevaluated. This plan will adopt a sustained, long-range average escapement goal of 15 million sockeye salmon for calculating harvest goals.

The record ten-year moving average production value for the Bristol Bay sockeye salmon fishery is 32,914,000 fish; this was calculated for the years from 1976 to 1985. The value recommended by the RPT for the long-range harvest goal for the sockeye salmon fishery is, thus, 18 million fish, approximately two million fish (or 13%) more than the long-range goal that would be derived using a 30-year average. Further, since the record 30-year average occurred from 1909 to 1938, the RPT thought that a harvest goal based on more recent experience would be consistent with both the improved data base and contemporary trends in salmon production. Generally, the RPT assumed that these favorable production trends would continue through the life of the comprehensive salmon plan and that long-range harvest goals for Bristol Bay sockeye salmon could, in turn, be biased toward higher levels of production.

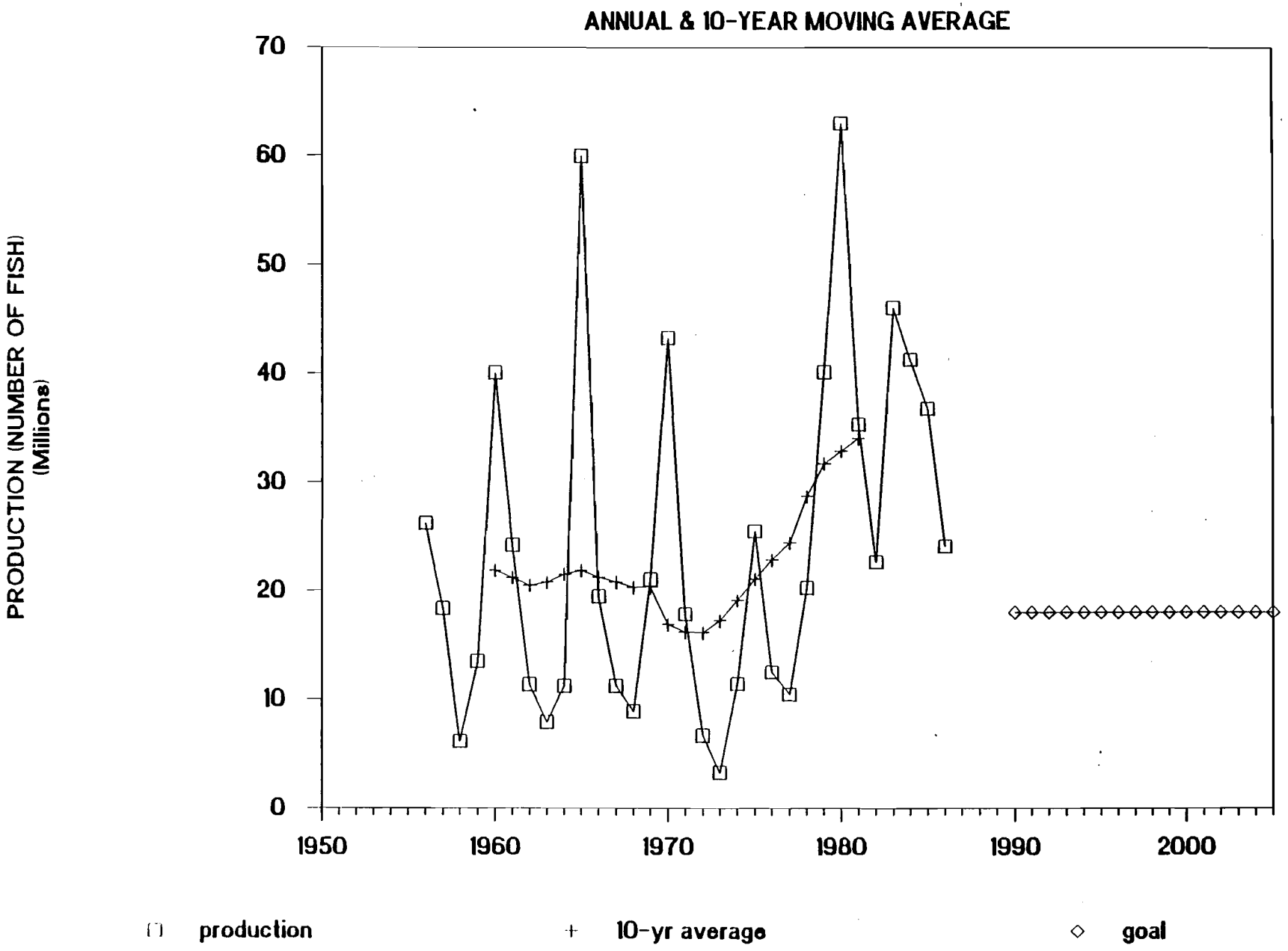
Chinook Salmon:

The goal for chinook salmon was set at the level of the record 30-year average harvest, or 116,000. The current (recent, five-year average) level of chinook salmon harvest is 102% of the goal.

Coho Salmon:

The goal for coho salmon was set at 200,000 fish, 165% of the record (and recent) 30-year average. Improved market demand for Bristol Bay coho salmon should support this level of production. Current harvest levels for coho salmon are 110% of the long-range goal. The goal for coho salmon may have to be reevaluated and

Figure 10. **Bristol Bay Sockeye Production**



revised upward if recent production trends continue. However, further investigation is required to determine optimum escapement levels of coho salmon. Before escapement goals are increased, expanded recreational and commercial harvest should be considered.

Pink Salmon:

The goal for pink salmon was set at 1 million, also higher than the record 30-year average, again because of the species' excellent potential for production. Harvestable production appears to be constrained at this time only by market factors. The goal for pink salmon is 125% of the record harvest. Current harvest levels for pink salmon are at 76% of the long-range goal. However, if only even-year harvests are considered, current harvests levels (1982-1986) are at 176% of the long-range goal.

Chum Salmon:

The goal for chum salmon was set at 850,000, the level of the record 30-year average harvest. The current level of harvestable production is at 170% of that goal. Chum salmon is another species for which production may be limited by the market. Actual biological production goals could be much greater than an optimum which may be derived from the 30-year average. If this is the case, then the goal for chum salmon should also be reevaluated. Also, chum salmon are primarily harvested in a mixed stock fishery, managed for sockeye salmon. Increased harvest of chum salmon could impact sockeye salmon management strategies.

CHAPTER 5
CONSTRAINTS AND STRATEGIES

This plan attempts to coordinate the state's fisheries programs in a rational manner while considering socioeconomic benefits. A foundation for the program would consist of a continuation of habitat protection and management activities concentrated on the biological resource. Enhancement of the social and economic environment would come from a well-coordinated program combining elements of seafood marketing, fisheries rehabilitation and enhancement, improved management, and control of entry into the fishery. Alaska is fortunate to have all of these elements in place, and continued coordination between the separate agencies would help the respective programs to complement each other.

Constraints

A variety of factors may limit and constrain the ability to reach the harvest goals identified in Chapter 4. Among them are habitat conditions, escapement needs, competition and predation from other fish and mammals, lack of information, interception of salmon runs, state and federal land management policies, questions regarding how to allocate costs of maintaining salmon production, the need to maintain an ecological balance, and economics. Each of these will be discussed below, followed by a discussion of strategies to overcome the limitations they impose.

Habitat:

The most important factor in continuing present production capability or increasing production is the maintenance and protection of existing fishery habitat. Any natural or man-made disruption of the habitat will cause declines in production. To avoid such declines, the chemical, biological, and physical characteristics of both freshwater and marine aquatic systems must be protected by means such as (1) enforcement of related laws and regulations, (2) maintenance of adequate instream flow allocations for salmon, (3) designation of new conservation areas for salmon, and (4) riparian development standards.

Habitat and, thus, production can be destroyed by such things as land-use changes, pollution, disease, natural disasters, migrational barriers, and streamside development. Oil exploration and placer mining activities occurring in the area will have to be carefully monitored and regulated to ensure that disruption of the existing fisheries habitat does not take place. Improper storage or transport of drilling materials can affect watersheds, and oil spills can impact aquatic life. Siltation effects and streambed alterations arising from improper activities can be highly detrimental to salmon and trout populations in fresh water. Road building and mineral extractions in close proximity to salmon habitat should only proceed when habitat impacts can be minimized.

Escapement:

Harvest management is an essential and cost-effective way to maintain current harvest averages based on natural production and to increase production where opportunities exist. Production and harvest levels are limited by escapement needs. Because the Bristol Bay systems have been relatively stable since the late 1970s, spawner-recruitment curves between parent-year escapement and present-year production have been developed statistically. Data on smolt production from known escapements have also been used to establish optimum escapement objectives. Based on these correlations, refined optimum escapement levels have been set; however, a series of reliable escapement and harvest statistics is necessary for effective management.

Predators and Competitors:

As discussed previously, other marine mammals and fish are natural predators of salmon, and their presence limits salmon production. Both legal and social restraints on management of certain predators limit efforts to achieve maximum production and harvest of salmon in the Bristol Bay region.

Since the 1950s, local fishermen as well as biologists have documented that belukha whales move into the various river systems in Bristol Bay during the spring and feed extensively on outmigrating sockeye salmon smolt. During certain phases of their lives, threespine and ninespine sticklebacks and juvenile sockeye salmon have been shown to have similar food habits and local migratory movements. As a result, there is interspecies competition for food and habitat. Arctic char are predators of juvenile salmon, and their effect on salmon production has been a primary concern throughout the history of the commercial sockeye salmon fishery. Additionally, brown bear, various species of trout, other marine mammals (e.g., northern fur seals, harbor seals, and sea lions), birds, and salmon sharks target on salmon during various stages of their life cycle.

Research and Information Needs:

Knowledge of the Bristol Bay area aquatic habitats and fish population dynamics is essential to maintaining optimum production. The lack of adequate research-based data is a constraint which limits management's ability to guide the fishery most effectively. Improving fishery management and, thus, production and harvest levels requires the collection of data to guide those who establish escapement levels.

Salmon Interception:

Interception of Bristol Bay salmon outside of the planning area is a serious issue because it is difficult to regulate harvest

and ensure adequate escapement of the many discrete stocks which comprise the Bristol Bay salmon run. Interceptions occur in the Japanese high-seas salmon fishery, in squid fisheries conducted by Japan, South Korea, and Taiwan, and in the domestic coastal fisheries.

The United States has been concerned for many years about the level of high-seas interception of the U.S.-origin salmon stocks, particularly by the Japanese mothership salmon fishery in the Bering Sea and the North Pacific Ocean. The International Convention for the High Seas Fisheries of the North Pacific Ocean is the formal name of the treaty between the U.S., Japan, and Canada, which was enacted to deal with international fisheries conflicts. The INPFC is the organization created to carry out much of the work mandated by the treaty. The INPFC is the only agency with authority to regulate the high-seas salmon fishery.

Recent negotiations have focused on increased protection from the Japanese interception fisheries for western Alaskan salmon stocks. However, salmon interceptions apparently will continue for the immediate future, both on the high seas and in Alaska's domestic fisheries and will remain a vital issue.

State and Federal Land Management:

The USFWS and the USNPS manage a significant part of the salmon spawning and rearing habitat in Bristol Bay. The planning team members believe that state and federal commitment to the principles embodied in the plan is important to the long-term management of salmon in Bristol Bay. Federal land management principles may preclude certain types of fisheries management techniques, including enhancement and supplemental techniques. In addition, improper protection of salmon habitat by state or federal land managers may reduce production.

The Bristol Bay Cooperative Management Plan (BBCMP) was prepared under the direction of the federal Assistant Secretary for Fish, Wildlife and Parks, the Alaska Regional Director of the USFWS, and the U.S. Department of the Interior. It provides, from a federal perspective, a comprehensive plan for the entire 31 million-acre Bristol Bay region, as defined by Section 1203 of ANILCA. However, it is unclear how this plan will influence salmon management activities on federal lands in the planning area.

Although the BBCMP began as a joint federal-state effort, in September 1984 the State of Alaska implemented its own Bristol Bay Area Plan. The Alaska plan addresses only state-owned lands within the Bristol Bay region. Both plans focus on the conservation of fish and wildlife and other significant natural and cultural resources within the region. At the same time, they

guide the orderly development of economic resources in an environmentally sound manner.

The Alaska Coastal Management Program (ACMP) will also guide land-use planning in the Bristol Bay planning area. The Alaska Coastal Management Act provided organized governments (e.g., the Bristol Bay Borough) and unorganized boroughs (e.g., the Bristol Bay Coastal Resource Service Area) the authority to develop local coastal management programs. Both the Bristol Bay Borough (BBB) and Bristol Bay Coastal Resource Service Area (BBCRSA) have developed local coastal management programs which stress the development of a salmon fishery and conservation of salmon-producing habitat. These programs have been approved by state and federal governments, and the policies of these programs now apply, along with the ACMP standards (6 AAC 80), to private, state, and federal land-use activities.

The ACMP, including the ACMP standards and the BBB and BBCRSA coastal management programs, are implemented by the state under the consistency review procedures described in 6 AAC 50. The state review of private, state, and federal activities is coordinated by state resource agencies (when only a single state permit is required) and the state Division of Governmental Coordination (when a federal and/or more than one state permit is required). All private and state activities are required to be consistent with the ACMP. Pursuant to Section 307 of the (federal) Coastal Zone Management Act of 1972 and its implementing regulations (15 CFR Part 930), all activities and authorizations of activities by federal agencies that directly affect the state's coastal zone are required to be consistent, "to the maximum extent practicable," with the ACMP. The state's coastal zone in the Bristol Bay region includes all lands within the 200 foot elevation contour, all documented anadromous fish waters and a one-mile zone from ordinary high water of each bank, and all surface waters draining into anadromous fish waters and a 200 foot zone from ordinary high water of each bank.

Present USNPS policy is to maintain most lands within Lake Clark Park and Preserve and Katmai National Park and Preserve in their natural and undeveloped state. This will provide long-term stability and protection to salmon habitat in these areas. However, USNPS policy precludes the use of existing or proposed salmon enhancement techniques on USNPS lands.

National Park lands within the Bristol Bay planning area will serve as benchmarks for evaluating the effects of human activities on salmon resources and aquatic habitats elsewhere. The direction for USNPS administration of Lake Clark and Katmai National Park and Preserve is defined in ANILCA and in General Management Plans for each unit. The General Management Plans emphasize the maintenance of ecosystem processes, the perpetuation of ecological systems, the regulation of consumptive uses, and the preservation of natural spawning and rearing conditions

for all fish species, including sockeye salmon. Senate Report 96-413 on ANILCA states: "It is contrary to the National Park Service concept to manipulate habitat or populations to achieve maximum utilization of natural resources." Both park units will have Resource Management Plans which address resource management issues, management strategies, and research or resource management projects necessary to achieve aquatic resource management goals.

The Bristol Bay region embraces four National Wildlife Refuges: Togiak, Becharof, Alaska Peninsula and Izembek. Each supports spawning and rearing habitat for Bristol Bay salmon. Section 304(e) of ANILCA permits the maintenance, rehabilitation, and enhancement of fish stocks on refuges subject to reasonable regulation in accord with sound management principles and acceptable scientific means. "Acceptable" means are those which are necessary, consistent, and compatible with the purposes of the refuge unit, and do not constitute a significant expansion of commercial fishing beyond the 1979 level. Comprehensive Conservation Plans (CCP), which emphasize habitat protection and the maintenance of wild, natural stocks, are prepared for each refuge. Fishery Management Plans (FMP) will be prepared as subsets of each CCP. Each FMP will identify state and federal strategies and projects necessary to achieve refuge fishery objectives. Refuge fishery objectives, in turn, will be linked to the strategies identified in this plan.

Allocation of Costs of Maintaining Salmon Production:

The planning team believes all user groups should assume a proportionate share of the cost of rebuilding and protecting salmon stocks.

Maintenance of Ecological Balance:

Maintaining an ecological balance within the planning area is important. Many species of wildlife, such as brown bear, eagles, other birds, foxes, wolves, marine mammals, and fishes, depend upon salmon (as eggs, juveniles, or adults) as an essential food source during certain seasons. Salmon carcasses also provide a large source of nutrients which are essential in maintaining the productivity of freshwater ecosystems. Inadequate production and escapement will reduce productivity and diversity of these wildlife populations and their associated ecosystems.

Economics:

In Chapter 1, this plan made crucial assumptions on funding of projects and research programs and support of an active salmon marketing program. Meeting these assumptions will assist the Bristol Bay fishery in continuing to be economically viable.

Strategies

Potential strategies to overcome the constraints to achieving production goals include management, habitat protection, mitigation, rehabilitation, and enhancement. Any or all of these strategies may be effective in maintaining and improving salmon production. Some strategies carry costs or responsibilities for user groups or others to achieve desired benefits.

This plan concentrates its strategic focus on salmon production activities that are consistent with its mission, as defined by the Bristol Bay RPT: "To promote, through sound biological and ecological practices, long-range activities to maintain and protect salmon-producing habitat and the salmon resource for the social and economic benefit of all the region's salmon user groups."

The definition of salmon production will only consider the biological processes that occur in freshwater and near-shore habitats. Allocative and economic guidelines for salmon production will not be specifically considered since they are the responsibility of the Board of Fisheries. The definition of production will consider primarily the needs of the harvesting sector; however, it is recognized the actions may have secondary benefits to other sectors.

Attainment of long-range goals for the Bristol Bay salmon fishery will only be accomplished by a combination of strategic techniques. The planning group recognizes that the choice and prioritization of strategies and technologies described in this plan will lead to long-term rather than short-term benefits to the Bristol Bay fishery. These benefits will not be apparent in actual harvests until at least one full life cycle of the species at issue has transpired. Conservative management of the fishery and protection of habitat, exclusive of all other strategies, are the foundation upon which fulfillment of the year 2005 goals will be based. To improve management and provide for the optimum harvest, extensive research will be primary. To reach or surpass the long-range goals, mitigation of future man-made disturbances, rehabilitation of some existing habitats, and enhancement of habitats may be necessary.

All options for planning strategic activities to maintain or increase salmon production must be examined to determine which will be most effective in meeting production goals. Several criteria are suggested for selecting, combining, and prioritizing strategies for each species:

1. Appropriateness to species and area;

2. Availability of proven technology; and

3. Risks and uncertainties--each technology has attendant risks that must be evaluated. Some risk is unavoidable, but if the risk is too great, it will preclude application of the technique.

Habitat:

Habitat protection is a fundamental technique for achieving the year 2005 goals with a minimum degree of risk. If habitat is destroyed and salmon production negatively affected, rehabilitation of habitat, compensation for loss, improvement of the habitat through various enhancement techniques, and supplemental production technologies may be necessary to restore production. Of prime concern, of course, is the enforcement of existing laws and regulations to avoid destruction of habitat. Failing that, every effort should be made to minimize the loss of habitat.

Realizing that some developmental activities will occur, the strategies for protecting habitat are in the following level of priority:

1. Disallow the activity as detrimental to habitat;

2. Provide for on-site mitigation (e.g., if a spawning area is destroyed, alternate spawning channels for the affected stocks of salmon will be provided);

3. Replace any loss of stock through off-site supplemental production technology (e.g., rebuild wild stocks, not trade wild stocks for maintained aquaculture replacement); and

4. Compensate monetarily for loss of salmon, with the understanding that some nonmarket values probably cannot be compensated for monetarily.

The goal of habitat protection in the strictest sense implies the zero-loss standard, meaning no loss of fish spawning or rearing habitat would be acceptable. Deviation from this standard will result either in unmitigated losses to a portion of the affected system or may require expensive rehabilitation or mitigation measures. Usually, the expenses involved in such measures are too great, and only partial compensation to the affected environment is achieved.

The "zero-loss" standard provides the goal for habitat protection projects. At times this standard must be reassessed to a "zero-net-loss" standard, which incorporates aspects of cost-benefit analysis. If a zero-net loss standard were applied, some unmitigated damages might still remain. If the monetary benefits from the disruptive action were large enough, the recipients could afford to donate an amount equal to the loss or cost to the common-property resource and still make a profit. The problem is

that it is usually more expensive to rebuild something or replace it than it is to destroy it. In some cases, technology does not exist to replace production. If a fishery is replaced, it is often not replaced at the same time or at the same location as it was originally lost. Such a situation may require reimbursement for the lost opportunity costs caused by missed fishing opportunities or relocation to new vocational opportunities. The distributional effects of temporary or permanent relocation or transfer of salmon production should definitely be considered as part of a comprehensive analysis of a project.

In the case of short-lived habitat destruction events, measures such as salmon fry planting, spawning gravel cleaning, or debris removal may alleviate long-term impacts. However, other destructive events may have long-term consequences that would entail costly restorative actions and compensations. Chemical or oil spills, seismic disturbances, stream diversions, or water-quality degradations caused by resource extractions may have pervasive effects on salmon habitat. These may require several life cycles of stream stocking, clean up, barrier removal, lake fertilization, predation management, reduced fishing seasons, cash compensations, and alternative employment before a balance in the ecosystem is again achieved.

Traditionally, and in other areas of Alaska, fish hatcheries have been constructed for mitigation purposes. However, there appears to be little opportunity in Bristol Bay for construction of hatcheries either to temporarily or permanently replace those stocks of salmon that might be lost to habitat destruction. In some locations, it might be possible to construct hatcheries without adverse management implications, but the design, construction, and operation at a scale necessary for replacement of lost natural production potential would be so costly that it might prove more cost-effective to simply pay cash compensations, buy back entry permits, or retrain and employ fishermen for other vocations.

However, these measures tend to overlook the nonmarket aspects of the resources: values associated with an established way of life and aesthetic values might be impacted and be impossible to compensate monetarily.

Escapement:

The plan's strategies for escapement are, first, to determine the optimum escapement level for each river and species and, second, to implement management objectives to achieve these levels with identified strategies. The major strategies are harvest management and related research. Refinements to management and research activities can significantly increase production and subsequent harvest of salmon.

Research projects implemented to improve the definition of appropriate escapement levels have considerable potential to increase salmon production. Since a basic management program is already in place and only a different level of escapement would be sought, precisely determining the number of spawners necessary for each unique river system could provide tremendous benefits with very nominal additional costs. Where existing escapement goals are set too high, fishermen benefit immediately as escapement goals are reduced and catches increase. If existing escapement goals are set too low, fishermen invest some of the fish that would have been caught to obtain much larger returns and catches in future years. However, future benefits are worth less in today's dollars than are immediate benefits so they may have to be discounted in calculating value to those participating in the fisheries.

Increased production can also be achieved by initiating projects that reduce management error and that more closely determine the necessary escapement level for each salmon stock. These include projects to improve forecast accuracy, in-season run strength assessment, earlier determination of actual escapements, and identification and separation of different salmon stocks.

Predators and Competitors:

The plan's strategy relative to predator management is determining economic feasibility of specific management activities. Studies concerning limiting or constraining predation on salmon in Bristol Bay have been going on since the 1950s. In the past, the cost-effectiveness of predator management has not been fully evaluated.

Research and Information Needs:

To meet the plan's strategy to generate information, the RPT noted the following specific research needs:

1. More refined evaluation of escapement goals to ensure system-specific production with routine maintenance of the sockeye salmon data base, and building adequate data bases for other salmon species;

2. Stock separation and identification studies to ensure minimization of interception and provide for terminal fishery harvests;

3. Understanding habitat productivity as it is affected by environmental conditions that influence primary production;

4. Improvements in the forecasting process that ensure accurate forecasts of future returns will require a long-term commitment to smolt-enumeration programs, escapement enumeration, catch allocation, and biological sampling.

5. In-season run strength assessment methods will require further refinement to ensure full use of harvestable surpluses, while still sustaining stock productivity.

6. Understanding the variability in return-per-spawner relationships between and within systems and years; and

7. More information on how the overall contribution of salmon production affects the ecology of the area.

Among the research projects identified were:

1. Continuation of sonar and tower monitoring to document escapement needs;

2. Expansion of air, float, and foot counts of indicator areas to monitor escapement in systems with no counting stations;

3. Feasibility studies of sonar counting applications for major area systems;

4. Consideration of coded-wire tagging of Bristol Bay area chinook and sockeye salmon, and a coast-wide recovery program to document any interceptions of mixed-stock salmon in the area; and

5. Evaluation of past high-seas tagging projects.

Another high-priority research need is for a complete catalogue and an inventory of Bristol Bay's salmon spawning and rearing habitats. An example of this type of catalogue is the Southwest Regional Guide. The guide is intended to address land and water development issues by mapping the distribution of fish and wildlife and documenting what is known about the species' biological life histories and their habitats, human use of the species, and the means available to assure compatible multiple-use development of habitats. As such, the guides are not specific land management plans and do not deal directly with the allocation or enhancement of fish and wildlife.

In addition to these other research needs, winter and summer habitat surveys of streams and lakes, coupled with enumeration of adult and juvenile use, and a catalogue of rehabilitation opportunities should be completed for all major and minor systems in the Bristol Bay region.

Salmon Interception:

To maintain current levels of production, the team recommends that:

1. The terminal fishery concept be enforced, i.e., stocks be harvested as close to their respective spawning grounds as possible;

2. Foreign offshore fishing be eliminated;

3. Optimum escapement goals for all segments of a return be achieved through harvest management; and

4. Management policies that will maintain genetic diversity and productivity of the individual stocks be followed.

State and Federal Land Management:

Many land-use regulations affecting salmon habitats have been promulgated by the USFWS, the USNPS, the BLM, and the Alaska Department of Natural Resources. The plan's strategies to address the constraints imposed by state and federal land management policies include the following:

1. State and federal land managers should manage land to maintain salmon production;

2. Where compatible with law and policy, salmon enhancement should be allowed on state and federal lands; and

3. A Memorandum of Understanding (MOU) implementing these recommendations should be prepared. The team seeks an amendment to the existing MOU between ADF&G, the USFWS, and USNPS to formalize their commitment. Differences in goals and management priorities will be resolved during the planning process or identified within the amendments to the MOU.

Allocation of Costs of Maintaining Salmon Production:

The RPT proposed the strategy of having the costs of managing and maintaining salmon production shared equitably between all user groups when possible.

Maintenance of Ecological Balance:

The strategy would be to maintain sufficient levels of salmon productivity to ensure the natural diversity of fish and wildlife populations and ecosystems.

Rehabilitation and Enhancement Technology

A variety of strategies may be used in rehabilitating and enhancing salmon stocks in the Bristol Bay area. These include:

1. Construction of spawning channels to rehabilitate and enhance the spawning environment. Successful channels depend on the control of factors such as waterflow rate, water table, substrate, sedimentation, and predation;

2. Development of artificial rearing ponds along road systems which may be connected to existing streams by ditches allowing passage of rearing salmon and trout to the newly created habitat;

3. In-stream or in-lake incubation boxes;

4. Lake and stream fertilization which is the application of nutrients to nursery areas for rearing salmon;

5. Stocking chinook and coho salmon juveniles in lakes and streams. Stream stocking may involve incubation boxes, as previously described, or the stocking of hatchery-reared fry above an inaccessible stretch of a stream to permit use of suitable upstream rearing habitat;

6. Research and development of new enhancement techniques, including design and development of new incubation or rearing devices, predator management, or others; and

7. Construction of fish ladders and ditches to provide access to presently inaccessible lakes and stream areas.

Hatcheries are the team's lowest-priority enhancement technique for the Bristol Bay region. The region does not contain many sites suitable for hatcheries, and current management practices in the area are an attempt to avoid mixed-stock fishery harvests.

CHAPTER 6
PREFERRED STRATEGIES

Based upon the existing constraints and potential strategies, the Bristol Bay RPT recommends that available opportunities for salmon production in the Bristol Bay region be implemented in the following order of priority:

A. Improved fisheries management techniques and habitat protection in the planning area.

Improvements in fisheries management, particularly in the area of determining optimum escapement goals for all species and management of the fishery to achieve escapement goals, could provide substantial benefits of fish production and harvest. Applied and basic research into the development of technology and techniques is needed to provide:

1. More accurate pre-season forecasts of potential run size by stream system;

2. An accurate in-season assessment of actual abundance within fishing districts; and

3. More accurate and timely in-season assessment of escapement by stream system.

Application of these technologies and techniques as part of a regional production strategy could stabilize escapements at their most productive level and increase allowable harvests for all segments of the fishery. Managers would be better able to meet escapement goals by system and to ensure that surplus salmon were available for harvest by fishermen.

The productivity of Bristol Bay salmon-producing regions is dependent upon a combination of factors, including water quality and quantity and stream substrate, which collectively comprise salmon habitat. The RPT recommends that the highest priority be assigned to habitat-protection activities to provide:

1. Maintenance of the present quantity and quality of salmon habitat in Bristol Bay as a prerequisite to maintaining salmon production and meeting harvest goals;

2. Enforcement of state and federal water-quality and anadromous-stream protection regulations; and

3. Development of land-use plans for public lands adjoining salmon waters which incorporate measures for maintenance of water quality, habitat, productivity, and avoidance of conflicting uses.

If the salmon production and harvest goals in this document are to be met, the standard for all land-use activities must be no net loss of salmon productivity. Compensatory investments in rehabilitation and mitigation technologies must be a part of each project that has the potential to reduce available salmon habitat or salmon productivity.

B. Enhancement of salmon production is a secondary priority in the Bristol Bay region.

Because of the natural productivity of the region, the high cost of salmon enhancement projects, and the current lack of adequate information to evaluate potential projects, the RPT feels that enhancement is not a high priority at this time. The RPT recommends that:

1. Research continue or be initiated in the areas of lake fertilization, identification of migrational barriers, stocking of systems which presently do not have salmon, predator and competitor interactions, stream improvement, flow control, and instream incubation;

2. All existing information on the results of previous studies, projects, and potential enhancement opportunities be compiled, evaluated, and summarized as an appendix to this plan; and

3. Projects such as beaver dam removal, lake fertilization, and construction of fishpasses around barriers, which may provide substantial increases in salmon production at relatively low cost, be implemented when the costs and benefits have been clearly identified and institutional and environmental constraints have been resolved.

C. Capital-intensive salmon stock enhancement, in the form of hatcheries and similar projects with relatively high start-up and operating costs, is the lowest priority for implementation.

Because of the natural productivity of the planning region, the RPT felt that public and private salmon hatcheries could not be recommended. However, the RPT does recommend that research into appropriate sites and facilities for such projects in the Bristol Bay region should continue as appropriate over the life of the plan. The goal is to have a number of viable projects at the pre-implementation stage with the ability to rebuild depleted stocks in the event of some catastrophic natural or man-caused reduction in regional salmon production. Selection of appropriate sites and technology should be based upon maintenance of genetic vigor and integrity of salmon stocks, management feasibility, disease prevention, cost effectiveness, and other best-available technology.

The RPT arrived at the recommendations contained in this chapter based upon the assumption that either public or private funds would be available to conduct the recommended projects. Projects may be conducted by state or federal agencies, by a private nonprofit aquaculture corporation, or cooperatively by one or more entities. Selection of production technologies should take into consideration the benefits to all user groups within the planning area, including commercial, subsistence, and recreational fishermen. The RPT also feels that a cost-benefit analysis should be performed for each project to ensure that potential increases in harvest or production exceed the anticipated cost of each project. Research necessary to meet production and harvest goals identified in this plan and to identify potential enhancement opportunities should continue at a steady rate and should avoid great fluctuations that result in increased cost and information losses.

Meanwhile, increased reconnaissance of salmon production opportunities specific to Bristol Bay will be necessary for continuation of planning efforts and eventual program implementation. Project scoping should include both projected impacts and potential outputs to the fishery from identified opportunities. As mentioned, there is at present no comprehensive, catalogued listing of either rehabilitation or enhancement opportunities for the Bristol Bay area.

A standardized "New Project Opportunity Form" (see Appendix D) will be available to field personnel of the ADF&G fisheries divisions and the USFWS, interested fishermen, and other users of the area's fisheries resource. The form will then serve as the basis for cataloguing program opportunities utilizing the strategy and technology options discussed in the previous chapters.

After potential project opportunities have been identified, the RPT will review them to verify their applicability to the plan. Depending on the detail of the review, this verification could help to quantify potential costs, impacts, and benefits. The verification will also serve as a record of comment by each of the agencies participating in the RPT.

The review of project opportunity forms could provide the basis for future salmon planning in the Bristol Bay region. Opportunities will be analyzed within the framework of this plan, and combinations of applicable techniques and technologies will be integrated with respect to their potential for contributing to achievement of individual species' goals. This process will result in fisheries program recommendations for strategy implementation. The prioritization of these programs and the refinement of the programs into fisheries plans of cooperating agencies will comprise a major portion of any future efforts toward comprehensive salmon planning for Bristol Bay.

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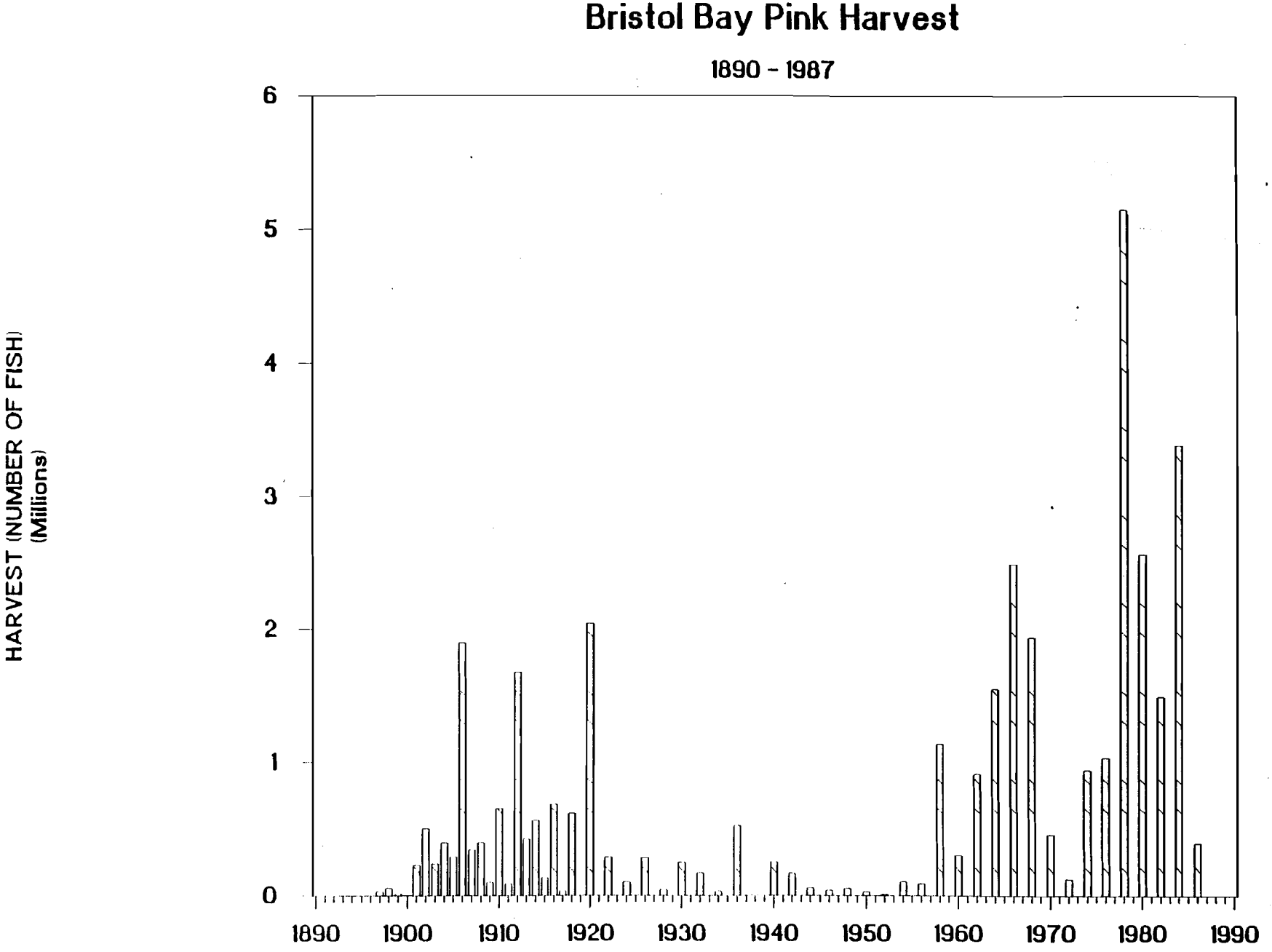
APPENDIX A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1890 - 1987
HARVEST (NUMBER OF FISH)
(Millions)
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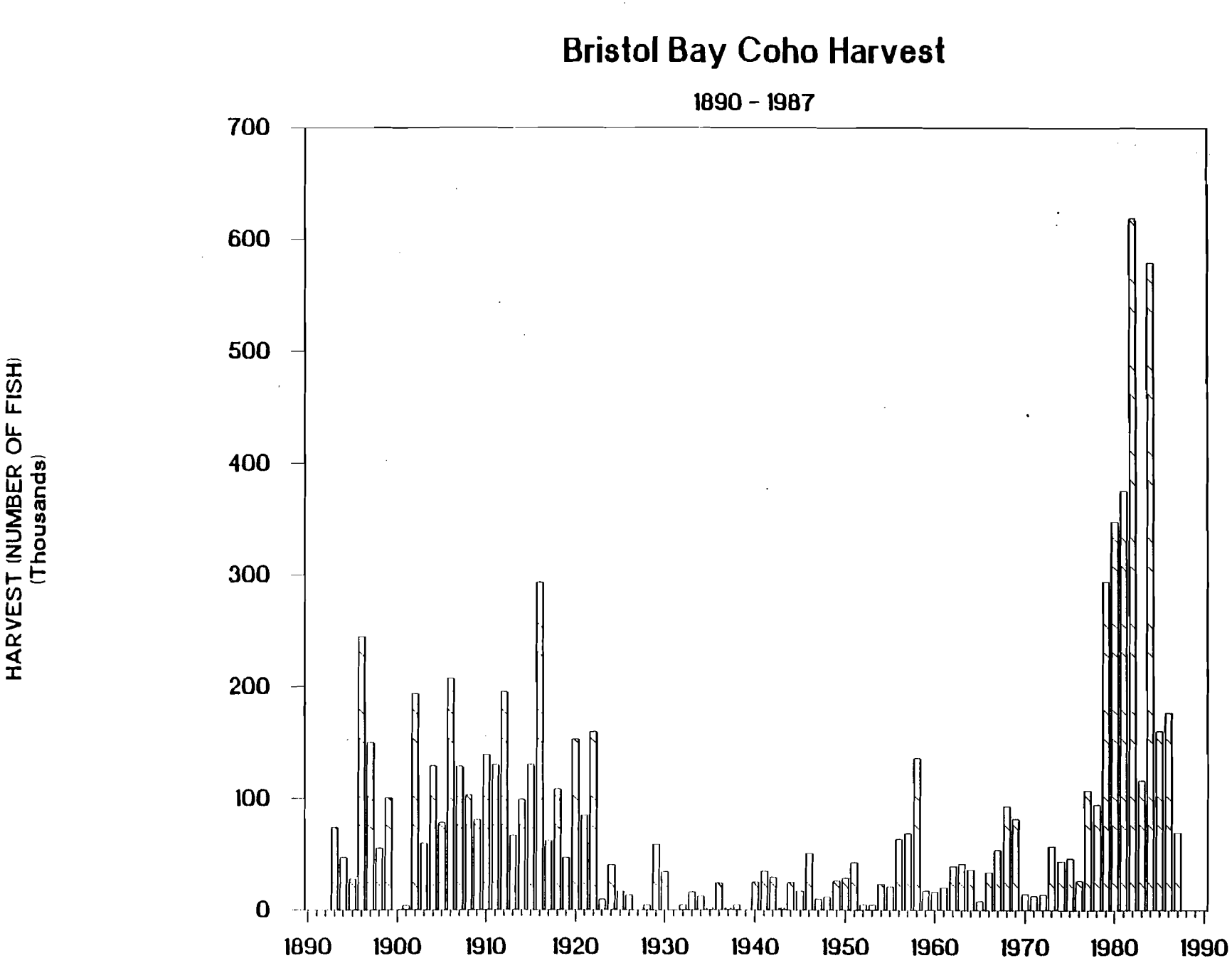
1
2
3
4
5
6
1890
1900
1910
1920
1930
1940
1950
1960
1970
1980
1990


Bristol Bay Coho Harvest
1890 - 1987
HARVEST (NUMBER OF FISH)
(Thousands)
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600
500
400
300
200
100
0
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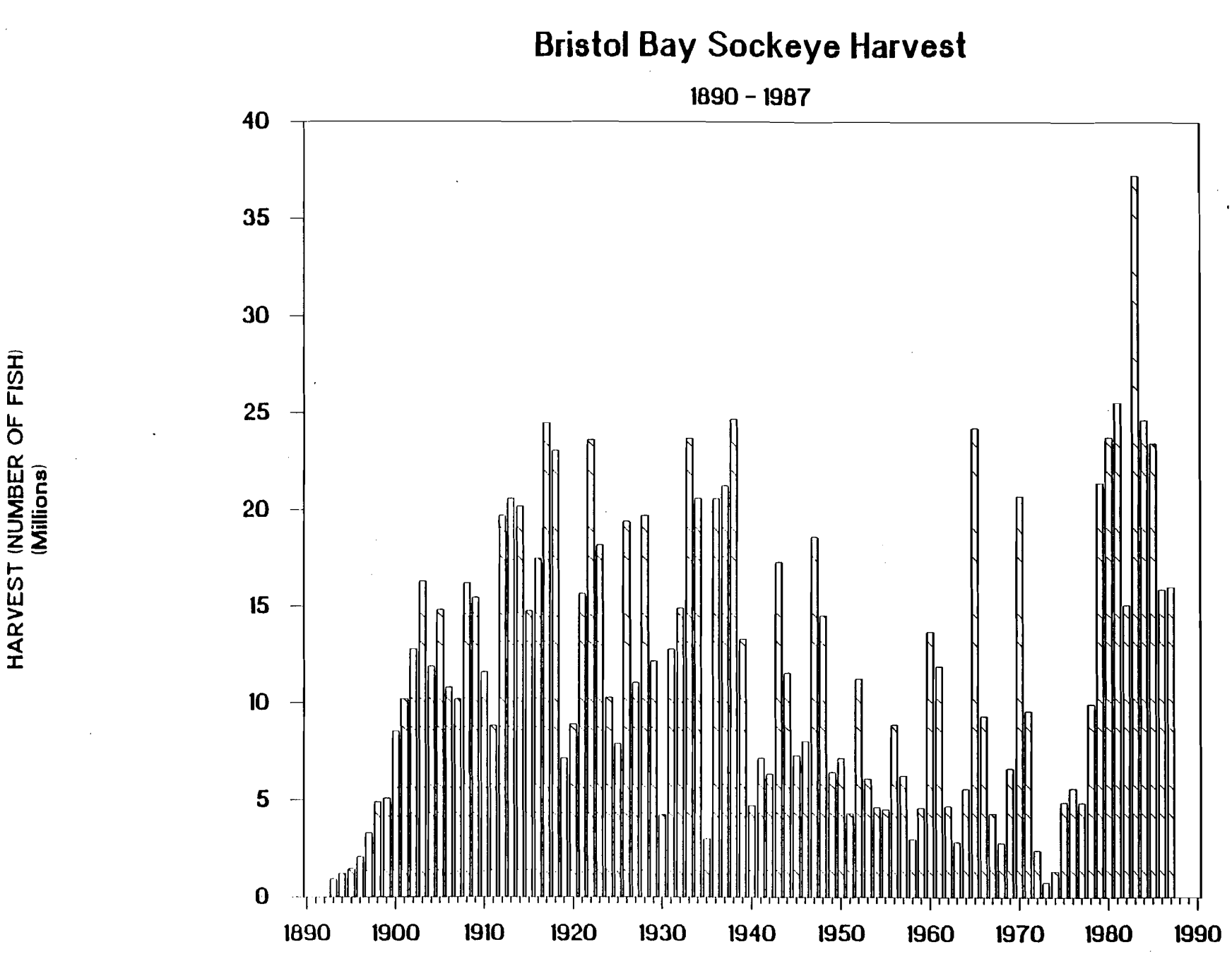
1900
1910
1920
1930
1940
1950
1960
1970
1980
1990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1890 - 1987
HARVEST (NUMBER OF FISH)
(Millions)
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10
5
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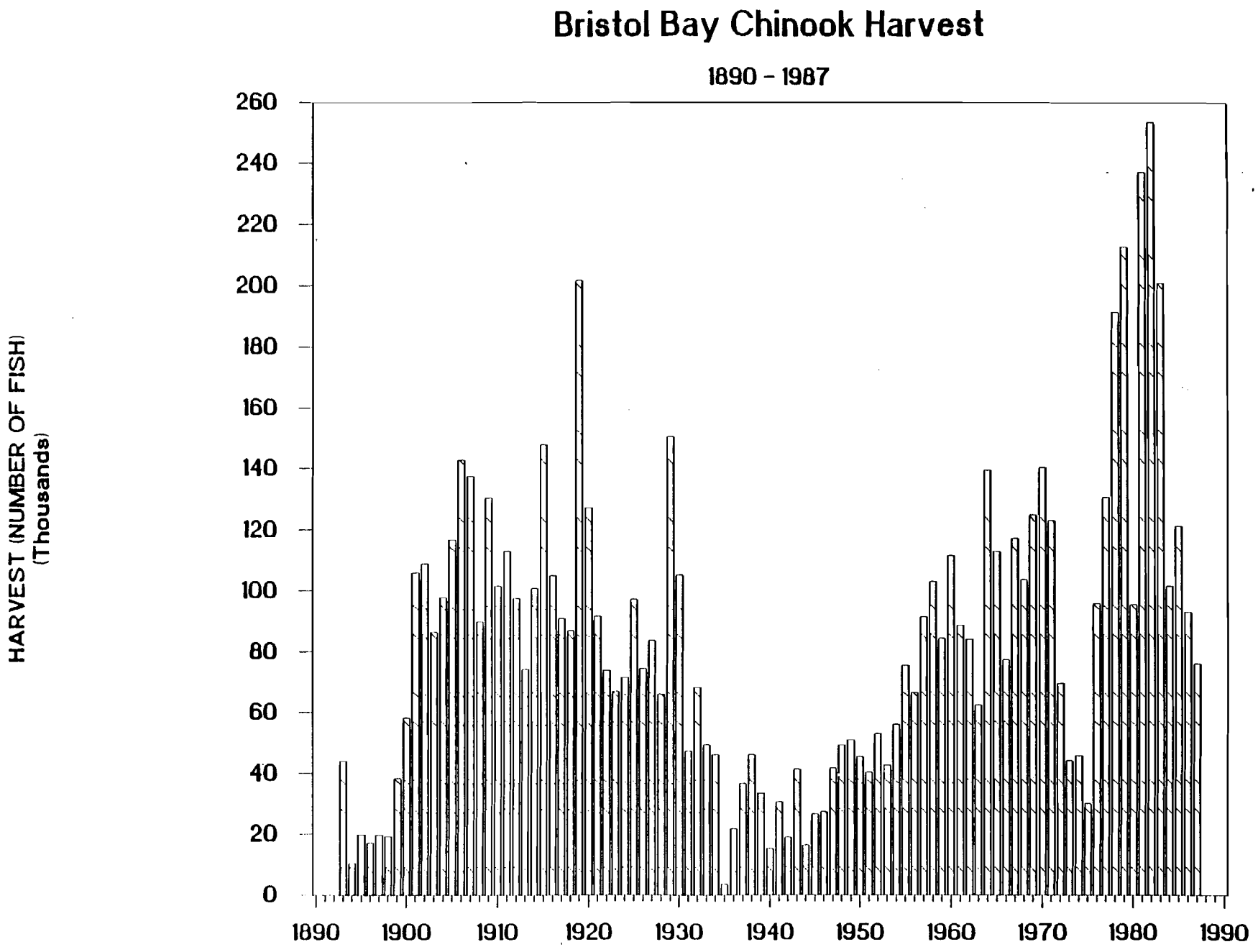
1900
1910
1920
1930
1940
1950
1960
1970
1980
1990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HARVEST (NUMBER OF FISH)
(Thousands)
260
240
220
200
180
160
140
120
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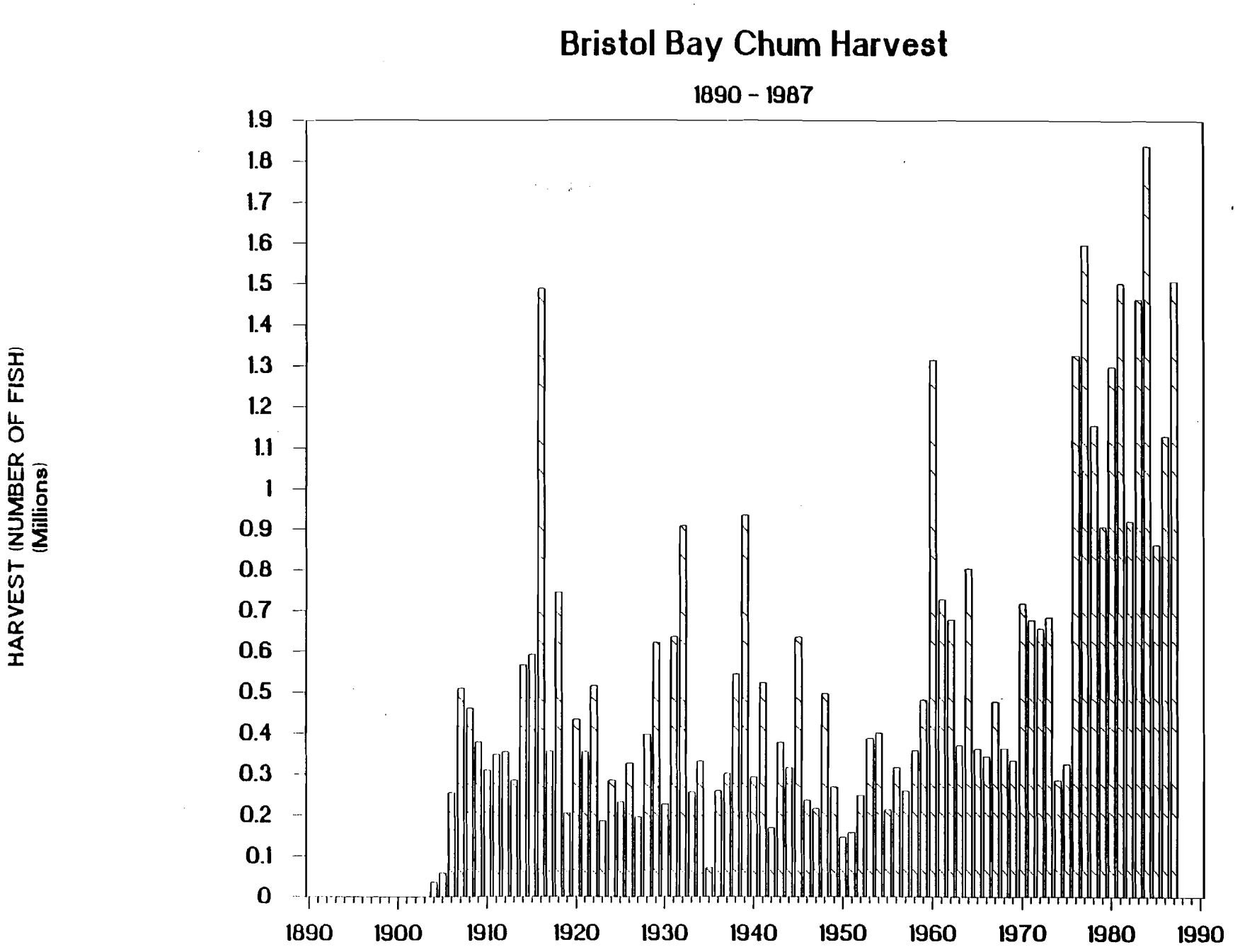
80
60
40
20
0
1890
1900
1910
1920
1930
1940
1950
1960
1970
1980
1990


Bristol Bay Chum Harvest
1890 - 1987
HARVEST (NUMBER OF FISH)
(Millions)
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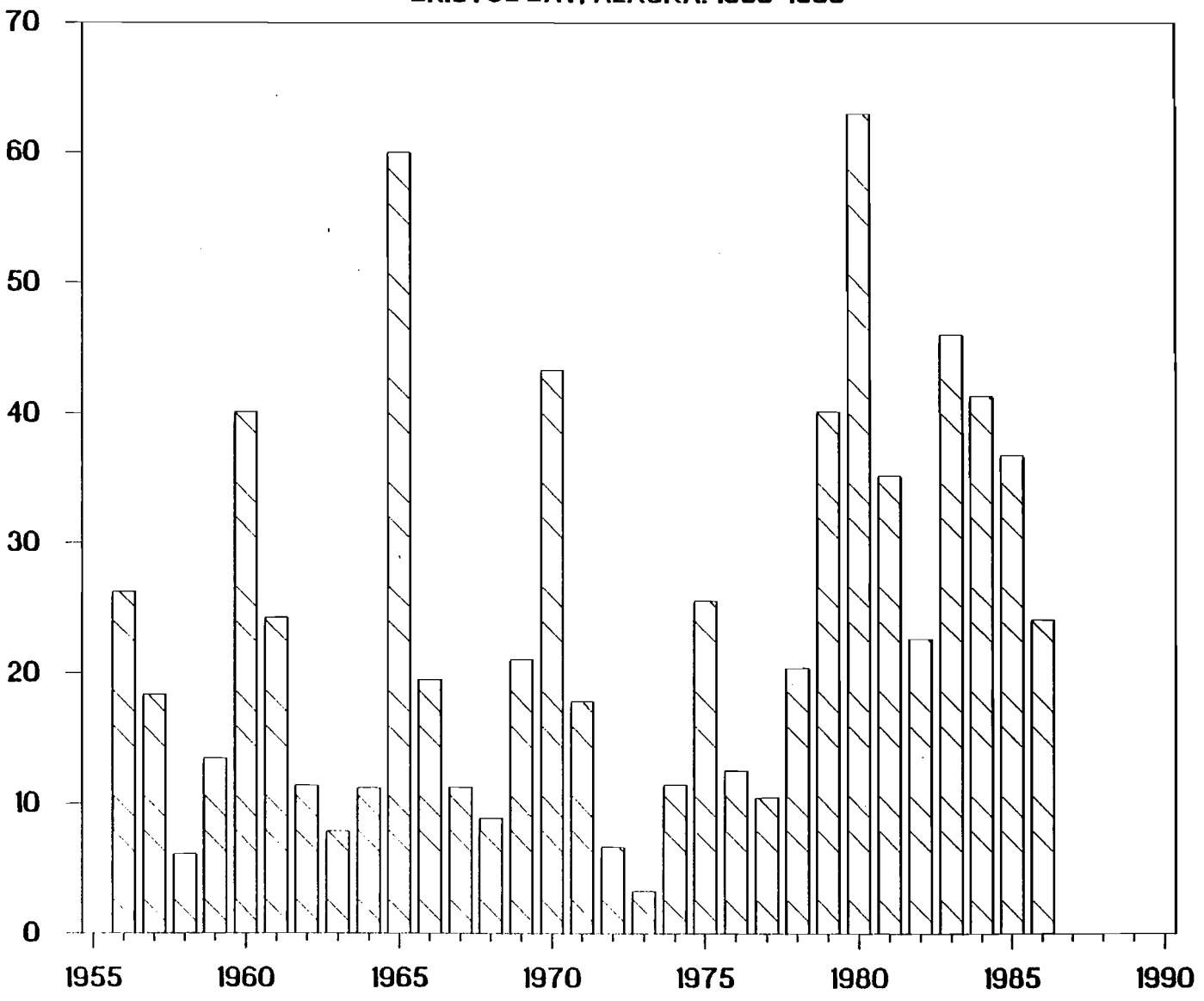
1.8
1.7
1.6
1.5
1.4
1.3
1.2
1.1
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
1890
1900
1910
1920
1930
1940
1950
1960
1970
1980
1990

APPENDIX B

Total Sockeye Production 1/

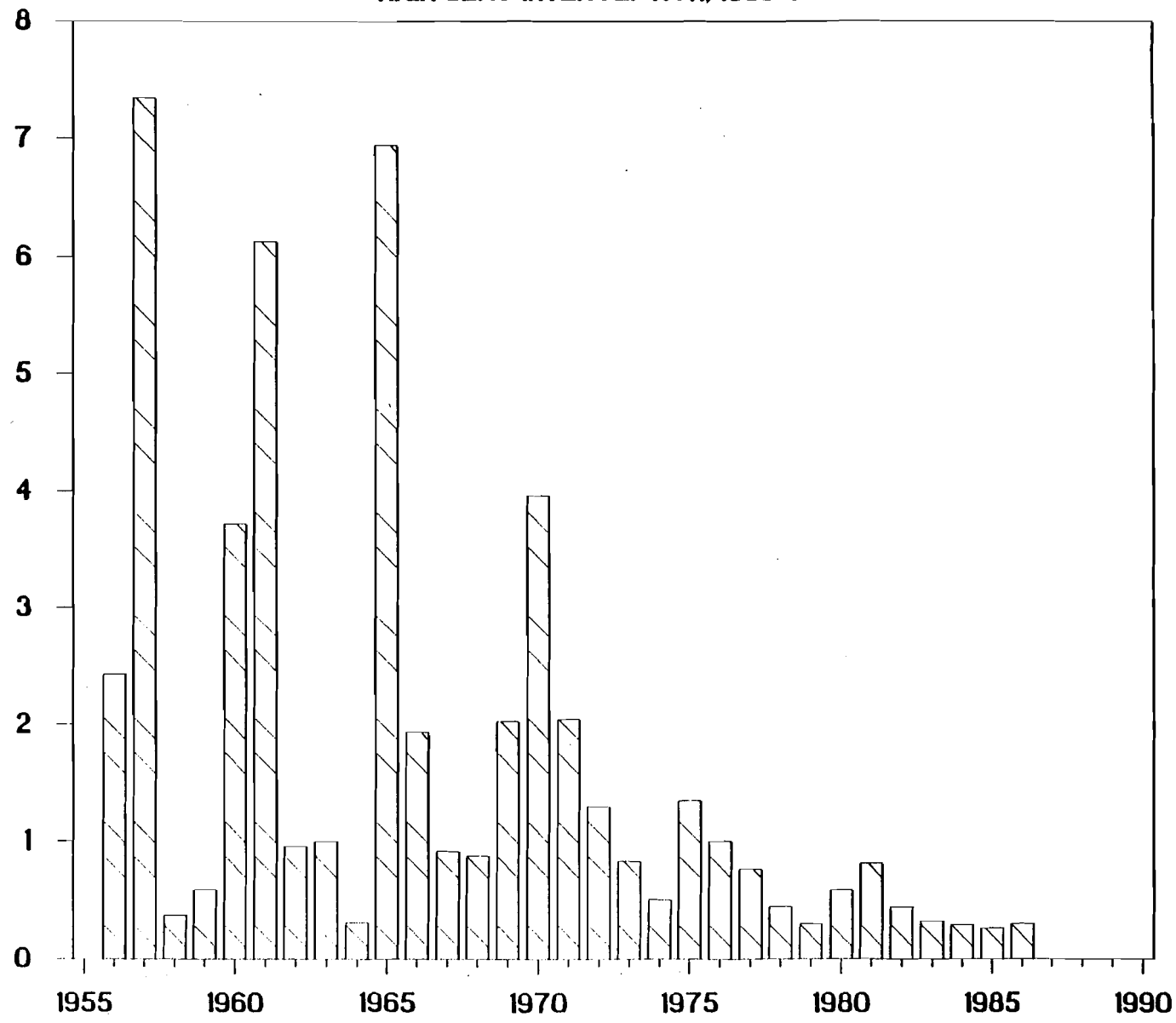
BRISTOL BAY, ALASKA. 1956-1986

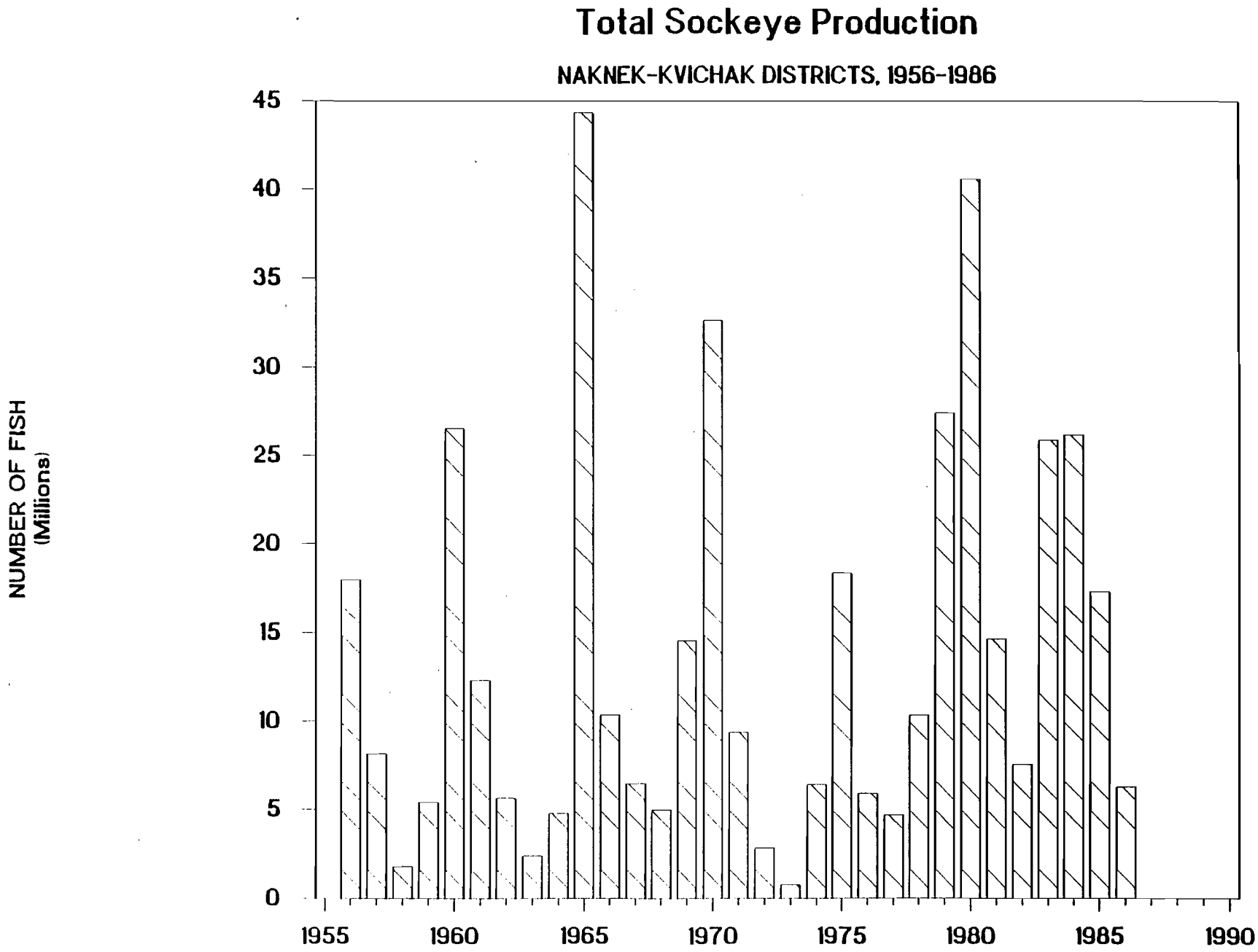


1. Including estimated high seas catch

Bristol Bay Sockeye Salmon

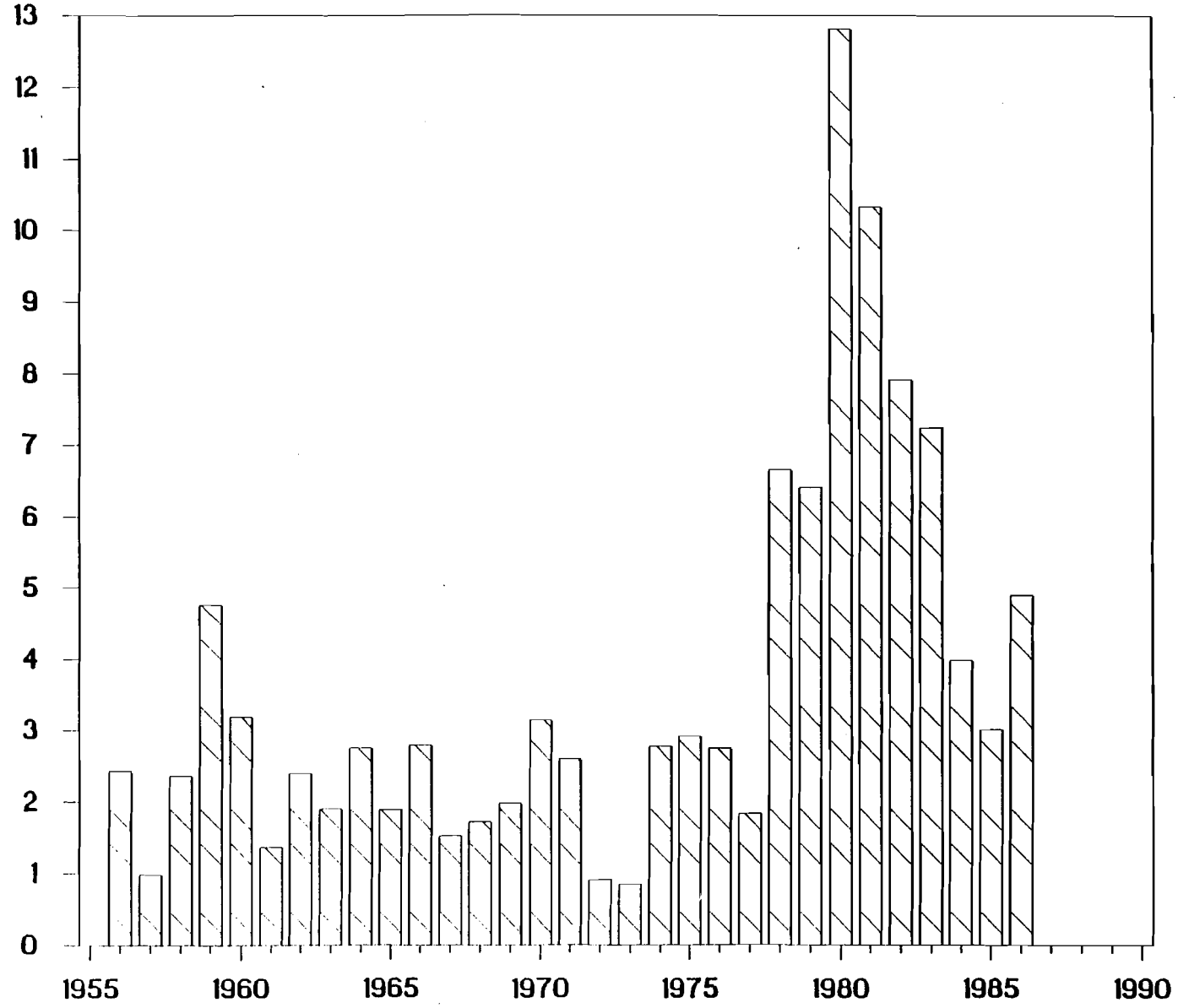
HIGH SEAS INTERCEPTION, 1956-1986




Total Sockeye Production
NAKNEK-KVICHAK DISTRICTS, 1956-1986
NUMBER OF FISH
(Millions)
45
40
35
30
25
20
15
10
5
0
1955
1960
1965
1970
1975
1980
1985
1990

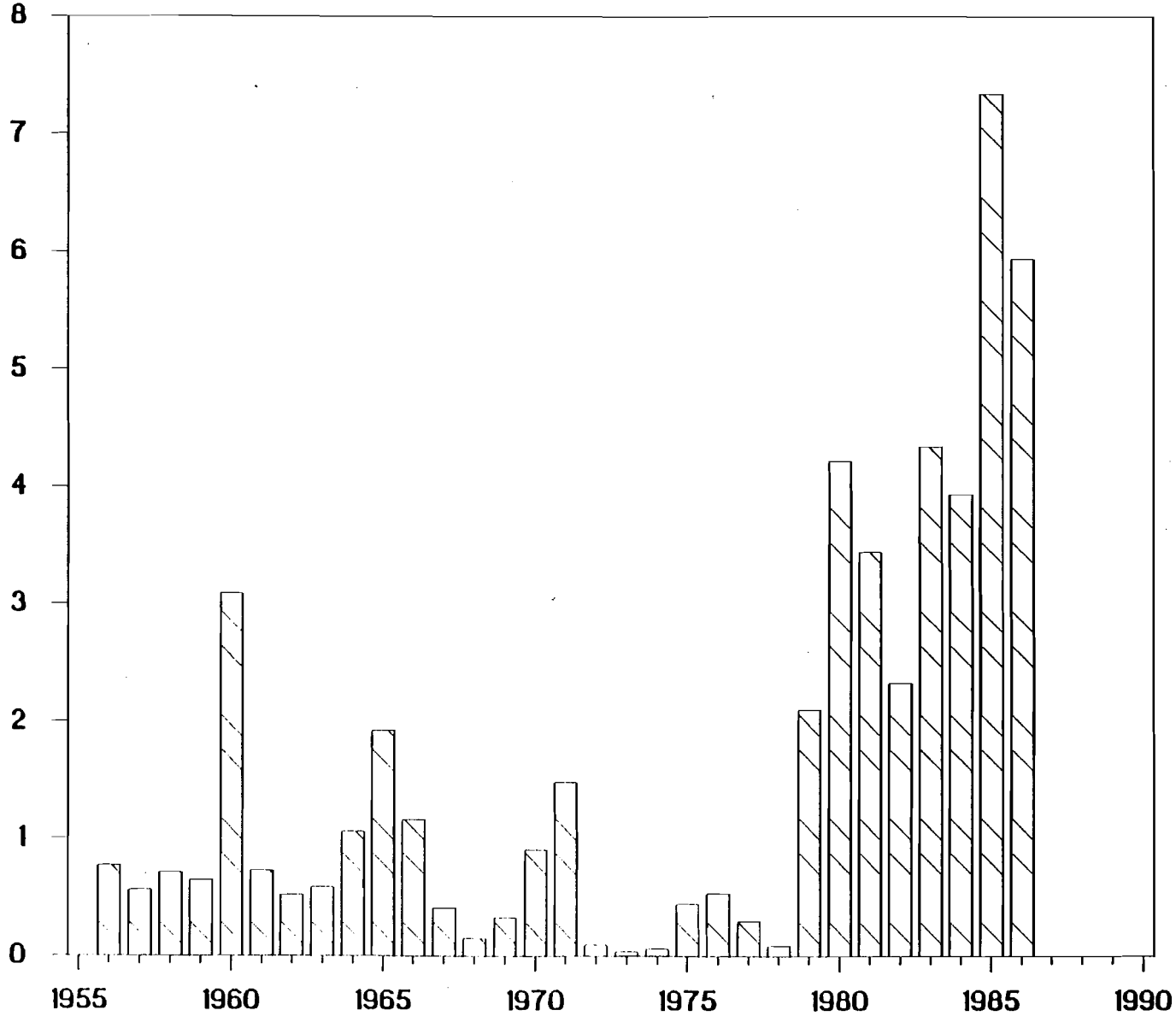
Total Sockeye Production

NUSHAGAK DISTRICT, 1956-1986



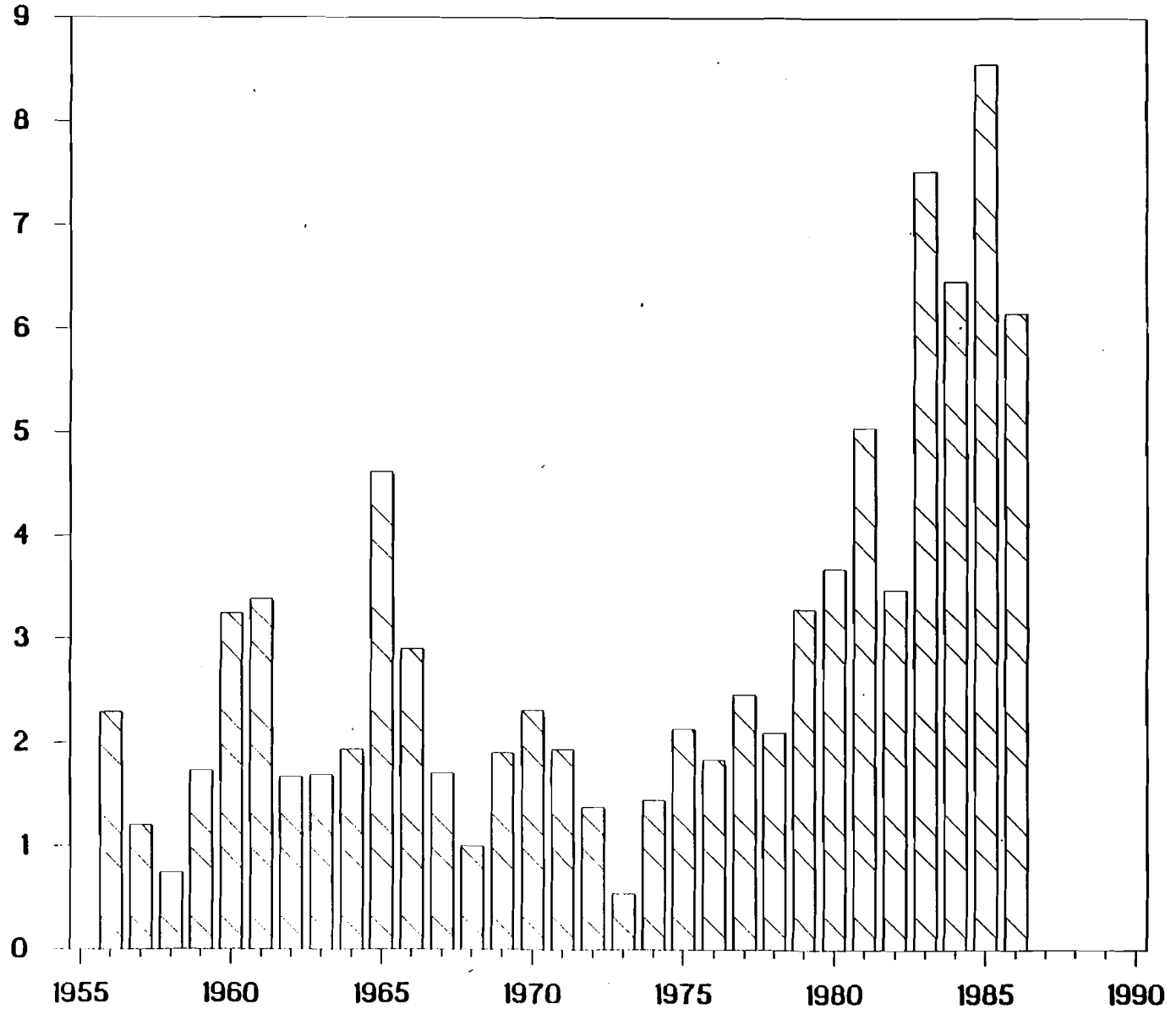
Total Sockeye Production

UGASHIK DISTRICT, 1956-1986



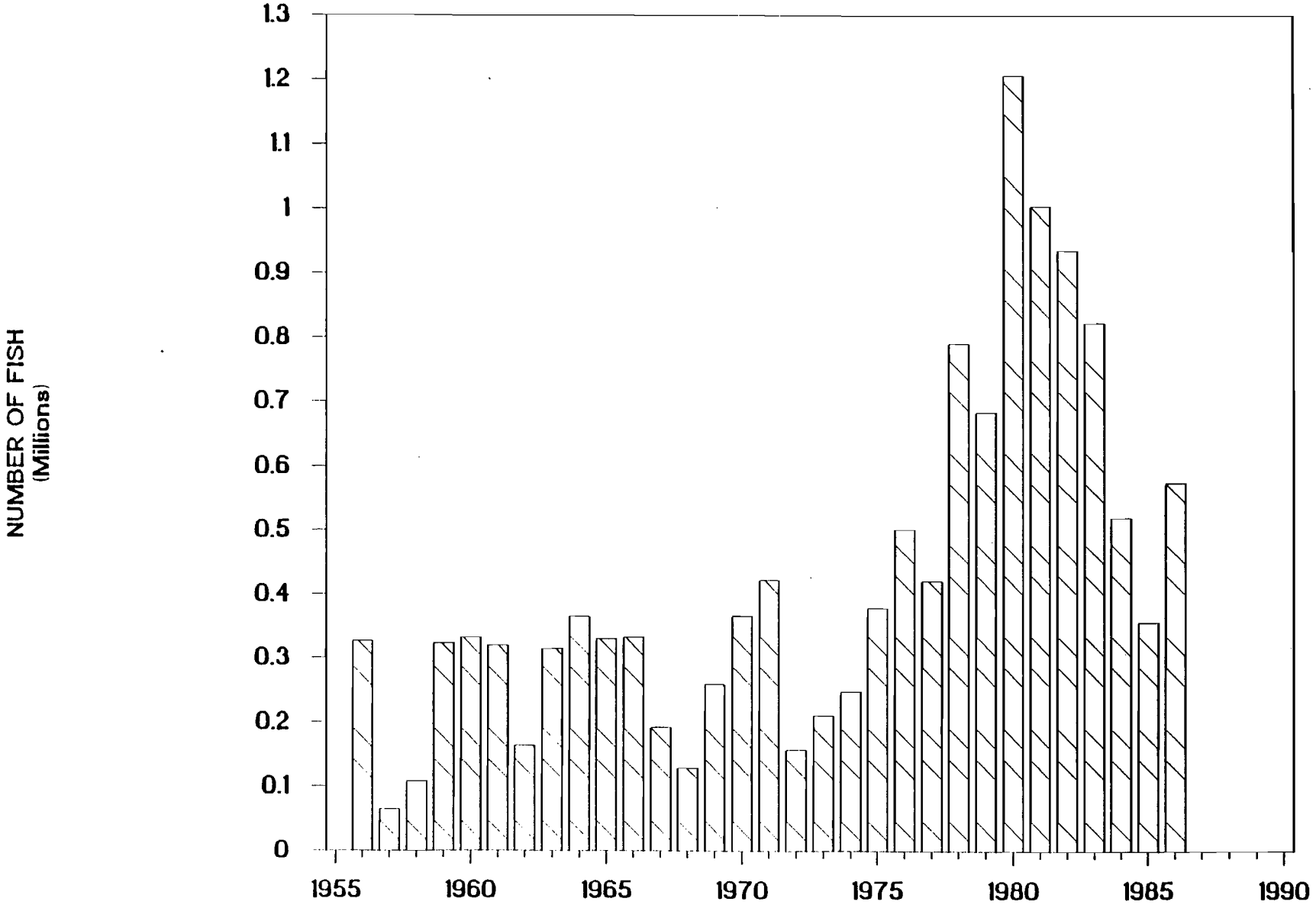
Total Sockeye Production

EGEGIK DISTRICT, 1956-1986



Total Sockeye Production

TOGIAK DISTRICT, 1956-1986



APPENDIX C

Appendix Table C-1. Commercial catch, escapement, and total run of chum salmon in the Nushagak and Togiak Districts, in thousands of fish, 1966-1986 1/.

	NUSHAGAK DISTRICT			TOGIAK DISTRICT		
Year	Catch	Escapement	Total	Catch	Escapement	Total
1966	129	80	209	95	0	95
1967	338	200	538	63	179	242
1968	179	100	279	108	348	456
1969	214	130	344	66	85	151
1970	435	273	708	101	241	342
1971	360	226	586	124	229	353
1972	310	195	505	179	170	349
1973	336	200	536	195	163	358
1974	158	100	258	81	161	242
1975	153	80	233	87	114	201
1976	801	500	1301	154	392	546
1977	900	609	1509	271	496	767
1978	652	293	945	275	396	671
1979	440	166	606	220	293	513
1980	682	969	1651	300	415	715
1981	795	177	972	230	331	561
1982	435	256	691	151	86	237
1983	586	164	750	323	165	488
1984	680	362	1042	339	204	543
1985	253	288	541	206	212	418
1986	462	200	662	270	330	600

1. 1966-1982 escapement estimates are from comprehensive aerial surveys. Zero escapements indicate lack of aerial surveys. Nushagak escapement estimate from aerial surveys and sonar counts, 1979, 1982; adjusted sonor estimate from Portage Creek, 1986. 1984-1986 data are preliminary.

Appendix Table C-2. Commercial catch, escapement, and total run of chinook salmon in the Nushagak and Togiak Districts, in thousands of fish, 1966-1986 1/.

	NUSHAGAK DISTRICT			TOGIAK DISTRICT		
Year	Catch	Escapement	Total	Catch	Escapement	Total
1966	58	40	98	10	0	10
1967	96	65	161	13	10	23
1968	78	70	148	13	16	29
1969	81	35	116	20	8	28
1970	88	50	138	29	15	44
1971	83	0	83	27	20	47
1972	46	25	71	20	14	34
1973	30	35	65	11	11	22
1974	32	70	102	11	15	26
1975	21	70	91	7	11	18
1976	61	100	161	30	14	44
1977	85	65	150	35	20	55
1978	119	130	249	57	40	97
1979	157	95	252	30	20	50
1980	65	141	206	13	12	25
1981	193	150	343	24	27	51
1982	195	147	342	34	17	51
1983	139	162	301	38	22	60
1984	61	81	142	22	26	48
1985	68	116	184	37	14	51
1986	64	33	97	20	8	28

1. 1966-1982 escapement estimates are from comprehensive aerial surveys. Zero escapements indicate lack of aerial surveys. 1984 - 1986 data are preliminary.

Appendix Table C-3. Commercial catch, escapement, and total run of coho salmon in the Nushagak and Togiak Districts, in thousands of fish, 1980-1986 1/.

	NUSHAGAK DISTRICT			TOGIAK DISTRICT		
Year	Catch	Escapement	Total	Catch	Escapement	Total
1980	148	232	380	151	96	247
1981	220	180	400	29	61	90
1982	350	234	584	134	81	215
1983	81	51	132	6	0	6
1984	272	171	443	171	104	275
1985	20	90	110	39	61	100
1986	73	53	126	48	30	78
Average	166	144	311	83	62	144

1. Escapement estimates are based on data collected from sonar enumeration and on comprehensive aerial surveys of spawning grounds. Zero escapements indicate lack of aerial surveys. 1983-1986: preliminary data

Appendix Table C-4. Historical production record, East Creek Hatchery[1].

Species	Brood year	Donor source	Number of eggs	Total number released	Date	Returns to hatchery	Year	Estimated harvest	Total returns by brood year
Sockeye	1974	East Creek	67,000						
		Killian Creek	73,000	6,000	1975				
	1975	East Creek	88,000			126	1980		
		Killian Creek	392,274		1976				819
		Outlet	141,660			313	1981		
		Beach	210,069	346,909					
	1976	East Creek	339,000			774	1980		
		Killian Creek	1,800,000		1977	250	1981	612	3,000[2]
		Beach	1,040,000	1,993,443					
	1977	East Creek	150,730						
		Killian Creek	379,919	1,663,417	1978	178	1981	436	614[2]
		Beach	1,549,919						
	1978	East Creek	240,000						
		Beach	2,400,000	2,687,511	1979				
	1979	East Creek	272,882						
		Francis Creek	6,327,338	1,000,000	1980[3]				
	1980	East Creek	2,978,724						
		Killian Creek	29,516	4,361,433	1981				
		Francis Creek	1,956,229						
	1981	East Creek	524,980						
		Francis Creek	6,165,272	5,564,002	1982				

[1] From ADF&G, 1982.

[2] Does not include possible returns in 1982 and 1983.

[3] IHNV outbreak at hatchery caused high mortality and resulted in destruction of those that survived, excluding the 1,000,000 that appeared healthy enough to be released.

APPENDIX D

BRISTOL BAY COMPREHENSIVE SALMON PLAN
NEW PROJECT OPPORTUNITY FORM

Reference or File No._____
Date_____

1. Principal Species:

2. Location:

3. Project Description:

4. Submitted By:

Name_____

Address_____

_____

_____

Telephone_____

Return to: Salmon Rehabilitation and Enhancement Coordinator
ADF&G, FRED Division
P.O. Box 3-2000
Juneau, Alaska 99802 (907) 465-4160

(If available please include additional estimates of potential costs and benefits associated with the project).

APPENDIX E

CHAPTER 40. PRIVATE NONPROFIT SALMON HATCHERIES

ARTICLE 5

REGIONAL COMPREHENSIVE PLANNING

Section
300. Regional planning teams in general
310. Regional planning team composition
320. Chairman of regional planning team
330. Quorum and voting
340. Regional planning team responsibility
350. Public notice
360. Public involvement
370. Plan approval

5 AAC 40.300. REGIONAL PLANNING TEAMS IN GENERAL. The commissioner will establish regions and regional planning teams for the primary purpose of developing comprehensive salmon plans for various regions of the state. The provisions of 5 AAC 40.300 - 5 AAC 40.370 govern the structure and functions of each regional planning team and the development of a comprehensive salmon plan for each region. (Eff. 3/31/85, Reg. 93)

Authority: AS 16.05.020
AS 16.05.092
AS 16.10.375

5 AAC 40.310. REGIONAL PLANNING TEAM COMPOSITION. (a) Each regional planning team consists of six members. Three are department personnel appointed by the commissioner, and three are appointed by the board of directors of the appropriate regional aquaculture association, qualified under AS 16.10.380.

(b) The commissioner will, in his or her discretion, request the involvement of representatives of federal and state agencies to assist a regional planning team if their contribution will aid in the development of the regional comprehensive plan. (Eff. 3/31/85, Reg. 93)

Authority: AS 16.05.020
AS 16.05.092
AS 16.10.375
AS 16.10.380

5 AAC 40.320. CHAIRMAN OF REGIONAL PLANNING TEAM. (a) Each regional planning team shall elect a chairman to serve at the pleasure of the team.

(b) The chairman or his delegate shall

(1) conduct regional planning team meetings, including recording of proceedings, and employing agreed-upon rules of order;

(2) set the agenda and meeting time and place for regional planning team meetings; and

(3) coordinate regional planning team staff in the accomplishment of tasks assigned to the chairman by the team, including

(A) providing the commissioner with team communications requiring commissioner review or approval;

(B) contacting members to determine who will be attending the next scheduled meeting; and

(C) preparing minutes of the previous meeting. (Eff. 3/31/85, Reg. 93)

Authority: AS 16.05.020
AS 16.05.092
AS 16.10.375

5 AAC 40.330. QUORUM AND VOTING. A regional planning team may not transact business without a simple majority of four members. Voting procedures may be established at the discretion of the membership. (Eff. 3/31/85, Reg. 93)

Authority: AS 16.05.020
AS 16.05.092
AS 16.10.375

5 AAC 40.340. REGIONAL PLANNING TEAM RESPONSIBILITY. Each regional planning team shall prepare a regional comprehensive salmon plan, for the appropriate region, to rehabilitate natural stocks and supplement natural production, with provisions for both public and private nonprofit hatcheries. Each regional planning team shall consider the needs of all user groups and ensure that the public has opportunity to participate in the development of the comprehensive salmon plan. Each regional comprehensive plan must define regional production goals by species, area, and time. (Eff. 3/31/85, Reg. 93)

Authority: AS 16.05.020
AS 16.05.092
AS 16.10.375

5 AAC 40.350. PUBLIC NOTICE. The chairman of the regional planning team, or his designee, shall give two weeks' notice, in a newspaper of general circulation in the appropriate region, of a planning team meeting. The chairman shall also give notice to

radio and television stations in the appropriate region, for broadcast as no-cost public service messages. (Eff. 3/31/85, Reg. 93)

Authority: AS 16.05.020
AS 16.05.092
AS 16.10.375

5 AAC 40.360. PUBLIC INVOLVEMENT. Each regional planning team shall encourage public participation during all stages of the development and review of regional comprehensive salmon plans. (Eff. 3/31/85, Reg. 93)

Authority: AS 16.05.020
AS 16.05.092
AS 16.10.375

5 AAC 40.370. PLAN APPROVAL. (a) A draft regional comprehensive salmon plan must be submitted to the PNP coordinator for department review and comment.

(b) The draft regional comprehensive salmon plan must be distributed for public review.

(c) The regional planning team shall respond to comments received as a result of these reviews, and may incorporate them in the final draft of the regional comprehensive salmon plan.

(d) The regional planning team shall submit a final draft of the regional comprehensive salmon plan to the commissioner for review and approval. (Eff. 3/31/85, Reg. 93)

Authority: AS 16.05.020
AS 16.05.092