

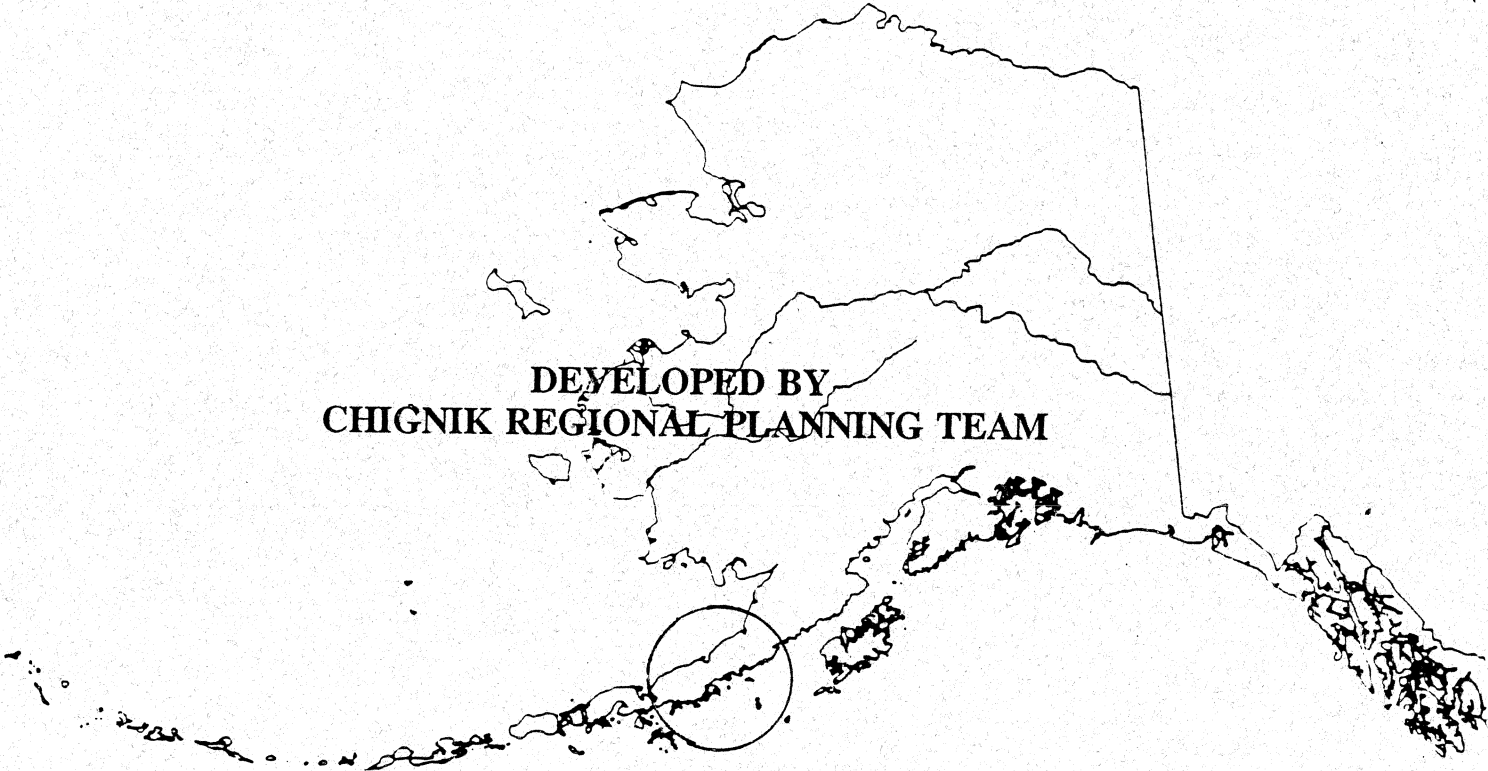
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PUBLIC REVIEW DRAFT

CHIGNIK REGIONAL COMPREHENSIVE SALMON PLAN

1992 - 1996



**DEVELOPED BY
CHIGNIK REGIONAL PLANNING TEAM**

**CARL ROSIER
COMMISSIONER
ALASKA DEPARTMENT OF FISH AND GAME**

JUNE 1992

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EXECUTIVE SUMMARY

Development of a comprehensive salmon plan for the Chignik region was initiated by the Alaska Department of Fish and Game (ADF&G) in the winter of 1990 in compliance with the the Commissioner's statutory mandate for salmon planning and in response to interest expressed by the Chignik Seiners Association.

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INTRODUCTION

Authority for Writing the Plan

The Commissioner of the Alaska Department of Fish and Game (ADF&G), in accordance with Alaska Statutes 16.10.375-470, has designated salmon production regions throughout the state. In each region, the Commissioner is responsible for the development and amendment of a comprehensive salmon production plan. The Commissioner has placed this responsibility with regional planning teams (RPT) that statutorily consist of representatives from ADF&G and the regional aquaculture associations. The mission of the RPTs is to plan for the long-term future of the salmon resource within their regions by initiating and continuing an orderly process that examines the full potential of a region's salmon production capacity.

On May 14, 1990, the Commissioner established Area L boundaries as a salmon production region for comprehensive salmon planning purposes. The Chignik region includes all waters of Alaska on the south side of the Alaska Peninsula enclosed by 156° 21' 13" West longitude (the longitude on the southern entrance to Imuya Bay near Kilokak Rocks) and a line extending southeast (135°) from the tip of Kupreanof Point. Figure 1 identifies the boundaries. The Chignik Regional Planning Team (CRPT) was established by the Commissioner in July 1990. Originally, the team was composed of three representatives from ADF&G (i.e., Commercial Fish, Sport Fish, and Fisheries Rehabilitation, Enhancement and Development Divisions) and three from the Chignik Regional Aquaculture Association (CRAA). At the first

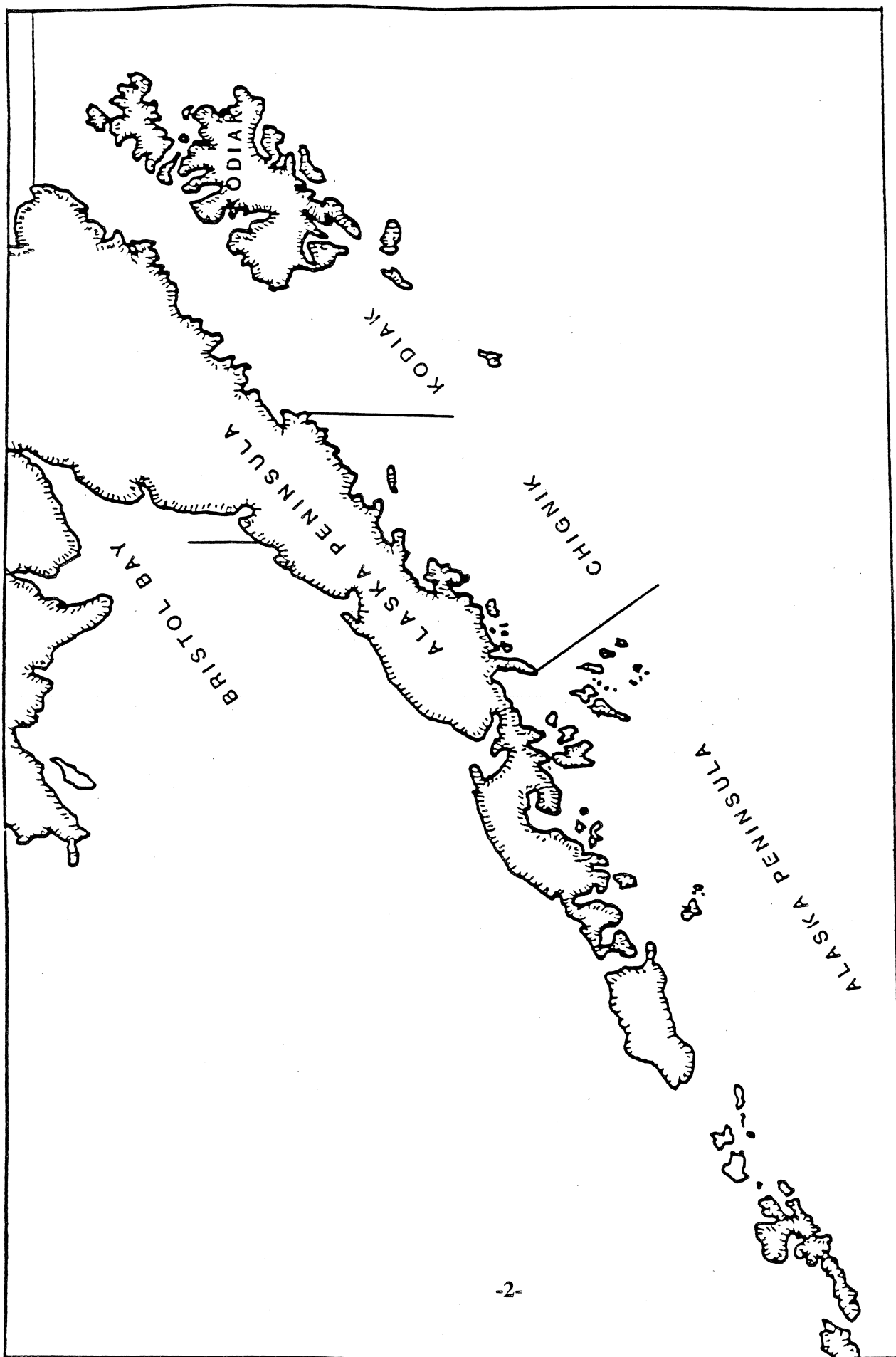


Figure 1. Map of the Alaska Peninsula illustrating the relative location of the Chignik Management Area.

meeting of the CRPT, it was decided that ex officio membership should be extended to the Lake and Peninsula Borough and to residents of Chignik Lake. The CRPT felt it was important for the borough, local native corporation (Chignik Lake River, Ltd.), and residents of Chignik Lake to be kept informed and to participate in the development of a comprehensive salmon plan for the region.

The RPT is the only legislatively mandated planning group with ADF&G and private-sector participation. Alaska statutes define certain duties of the RPT as follows: (1) plan development and amendment; (2) review of private nonprofit (PNP) hatchery permit applications and recommendations to the Commissioner; and (3) review and comment on proposed permit suspensions or revocations by the Commissioner. A regular exchange of information, discussion of objectives, and active cooperation between the association, regional planning team, and various divisions of ADF&G are possible with this planning effort (Appendix).

Comprehensive salmon planning in Alaska progresses in stages. The actual plans that have been developed and approved consist of two phases: Phase I sets the goals, objectives, and strategies for the area and Phase II identifies potential projects and establishes criteria for evaluating the enhancement and rehabilitation potentials of the salmon resource. However, the intent of the CRPT is to generate a regional comprehensive salmon plan that considers both the long-term goals and objectives and the short-term strategies and projects in one document.

Creation of the Chignik Regional Aquaculture Association

The Chignik Regional Aquaculture Association was officially approved by the Commissioner on May 14, 1990. One of the desires of the CRAA was to participate with ADF&G in planning for the long-term health of the salmon resource within the region. This determination of association status by the Commissioner was transmitted to the Department of Commerce and Economic Development in order to assist them in applying for any loans or grants available to qualified regional associations in accordance with the Fisheries Enhancement Loan Program detailed in AS 16.10.500-620.

Planning Assumptions

An important component of the planning process is the adoption of key assumptions. During development of the comprehensive salmon plan for the Chignik region these assumptions are essential to the accurate understanding and implementation of goals:

1. It is the primary consideration to protect wild stock species of salmon and maintain their historic levels of productivity; protection of wild stocks is inseparable from their use in commercial, subsistence, and recreational fisheries as well as the carrying capacity of their habitat;

2. It is biologically feasible to bring about a sustained increase in the harvest rates of salmon beyond the past 10-year (1981-1990) average, if appropriate technological and managerial practices are used;
3. The goals and objectives of the plan will be reviewed and revised as needs, knowledge, and resources require;
4. Research programs will be implemented to obtain information for optimizing salmon production and to determine whether management, habitat protection, enhancement, or rehabilitation measures will be needed;
5. Political support will continue, and sufficient funding will be provided to achieve the goals in a timely manner; and
6. Close cooperation between those involved in the planning and implementing processes (i.e., state agencies and representatives of commercial fishing and processing interests) will continue so that the maximal sustainable harvests of salmon can be achieved.
7. The intent of this plan is to provide fish for all common property users (subsistence, commercial and sport) in the area, but not to produce fish that further complicate allocative decisions.

Planning Period

The Chignik Regional Planning Team selected the 5-year period 1992-1996 as the focal point for the comprehensive plan because this period would enable them to acquire the necessary baseline database for implementation of larger enhancement or rehabilitation projects (e.g.,

stabilization of Black Lake, water control diversions, hatchery facility) as well as implement smaller projects (e.g., stream clearance, lake fertilization, etc.). It was further agreed that at the end of the 5-year period, they might have a better indication on the status of the market place, so they could more constructively prepare their long-range strategies

REGIONAL PROFILE

Physical Environment

The Chignik region encompasses all coastal waters and inland drainages of the northwest Gulf of Alaska between Kilokak Rocks and Kupreanof Point (Figure 2). The area includes the Chignik River system and approximately 100 other salmon producing streams. The Aleutian Range, which runs the length of the Alaska Peninsula, is a dominant influence on the region, providing a natural barrier to weather systems and creating two distinct climatic zones. On the Pacific side of the peninsula, the Aleutian Range meets the water abruptly at the sea in rugged cliffs and a number of offshore rocks and islands. Several large bays protected coves are found along the Pacific coastline. Within the Chignik area the lowlands are extremely narrow and limited, with mountains rising directly from the ocean in many places; however, on the Bering Sea side of the Alaska Peninsula, the Aleutian Range gradually slopes toward the Bristol Bay coastal plain.

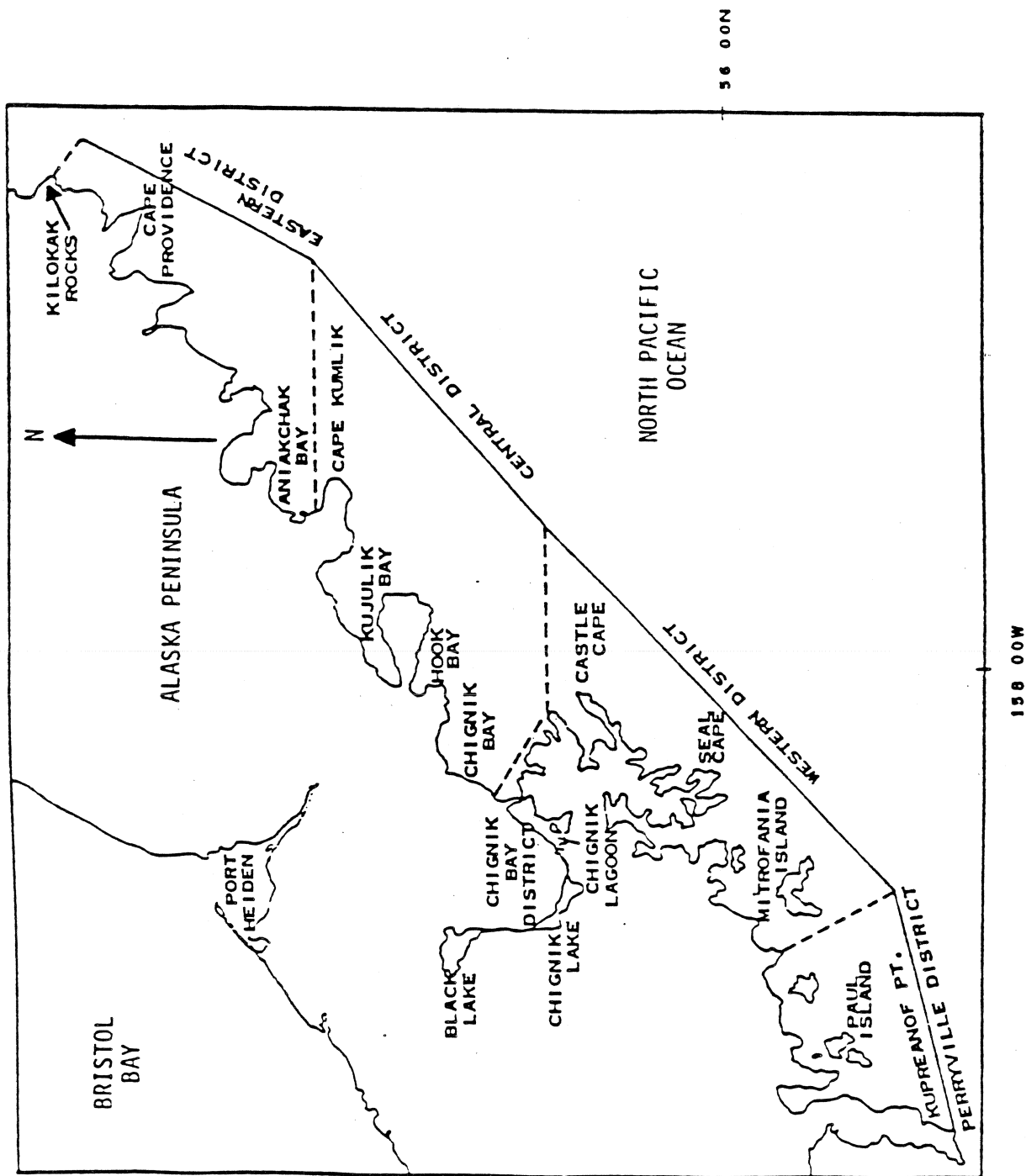


Figure 2. Map of the Chignik Management Area illustrating district boundaries.

The entire Alaska Peninsula is an area of considerable volcanic and tectonic activity because the Pacific Plate subducts beneath the North American Plate along the Aleutian Trench, making it part of the "ring of fire" surrounding the Pacific Basin. There are 11 active volcanos within 300 miles of Chignik, including Mount Veniaminof 40 miles to the west. Because smaller earthquakes (i.e., less than 5.0 on the Richter Scale) commonly occur, all structures (e.g., hatchery facility) must be designed to withstand them. Because the Chignik area is within the Shumagin Islands Seismic Gap, it must be considered a high-risk seismic zone, and it is possible that a great earthquake (i.e., greater than 7.0) will occur there.

Communities:

Chignik. The City of Chignik is surrounded by mountains and is accessible only by water or air. The area around the community is characterized by long mountain slopes containing many streams and supporting alpine tundra at higher elevations and alder-willow scrub below. Depressions in the rolling slopes may contain muskeg. Coastal flooding is estimated to occur once in 40 to 60 years. Located in Anchorage Bay, it is accessible by air and sea; however it has the most reliable and frequent marine services (barges and ferries) in the region. A road system provides access to the airfields and scattered residential areas.

Chignik Lake. On the banks of the lake bearing the same name, Chignik Lake is located approximately 20 miles west of Chignik, 265 miles southwest of Kodiak, or 565 air miles from

Anchorage via King Salmon. For travel outside the community, residents use skiffs and fixed-wing aircraft. Jet service is available at King Salmon; ferry service, in Chignik.

Chignik Lagoon. Hugging the southwest shore of a lagoon flowing into Chignik Bay, the community is approximately 5 miles west of Chignik and 13 miles downriver from Chignik Lake. The runway intersects the community, and commercial air traffic is primarily out of King Salmon and Port Heiden. Fishing boats and skiffs make year-round use of open-water conditions, and Kodiak is the most frequent port of call in the Alaska Peninsula area. There is approximately 2 miles of road in the community.

Ivanof Bay. This community is located on the northeast end of the Kupreanof Peninsula and is accessible by air and water. Commercial air taxis from King Salmon or Sand Point provide service to the other communities in the region. Three-wheelers and skiffs are used locally for transportation. There are no roads in Ivanof Bay, nor is there a deep-water harbor.

Perryville. This community is located on the south coast of the Alaska Peninsula about 39 air miles south of Chignik. The community has regularly scheduled air service to King Salmon twice a week. There is no harbor in Perryville, and all goods arriving by barge or fishing vessels are lightered to shore., Skiffs provided transportation to Ivanof Bay, 20 miles to the south.

Water Resources:

Water, in a variety of forms, is a major feature on the Alaska Peninsula. Several lakes and rivers, streams, ponds, wetlands, coastal bays, ports, tidal flats, and harbors are found throughout the region. The Chignik River, draining out of Black Lake, and Clarks and Kametolook Rivers draining the snowfields of Mount Veniaminof are the 3 major river systems for the Pacific side of the Alaska Peninsula.

Climate:

The Chignik region is partly protected from the most severe southerly Pacific storms by a ridge of mountains rising to 3,000 feet. Frequent cyclonic storms crossing the northern Pacific and the Bering Sea are the predominant weather factors. These storms account for the frequent high winds and the common occurrence of fog and low visibility. Fog occurs most often from mid-July to mid-September. The Chignik region has a maritime climate characterized by cool summers, relatively warm winters, and rainy weather. The mean daily temperature ranges from about 40° to 60° F in the summer and from approximately 20° to 40° F during the winter; the highest recorded temperature is 76° F, and the lowest is -12° F.

Thick cloud cover and heavy winds limit travel to and from Chignik and the surrounding region, especially in the winter, when the region experiences from 35 to 45 days of adverse weather and rough seas. In summer, approximately 15 to 20 days are affected by storms. Total precipitation

averages 130 inches annually; average snowfall is 60 inches. The average wind speed at Chignik is estimated at 10 miles per hour. Residents say winds generally blow from the northwest, but the direction often changes quickly. Sudden violent gusts of cold air called williwaws are common. Tides in the area range from a mean higher high water (MHHW) level of approximately +8.9 feet to an extreme low of -4.0 feet; the mean is 4.8 feet. High water levels caused by offshore storms occur each year.

Vegetation:

Vegetation along the ridge tops is relatively barren because of the harsh environment of broken rock and steep topography. At lower elevation, the vegetation is predominantly alder-willow scrub with a dense understory of bluejoint grass and a mixture of herbs. Along the shore line and in the lowlands there is beach fringe and wetland vegetation.

Wildlife:

Brown bears are common throughout the region and are often seen in and about Chignik, congregating in the summer and fall around salmon spawning streams. Although moose and caribou occur in the area, their numbers are not abundant. Other terrestrial mammals common to the area include wolverines, wolves, lynx, beavers, river otters, mink, weasels, foxes, porcupines, and arctic hares. Marine mammals found in the coastal waters include harbor seals, sea lions, gray and belukha whales, walruses, and sea otters. The peninsula also provides

abundant habitat for millions of birds, particularly pelagic birds, waterfowl, and shorebirds. Much of the waterfowl, such as dabbling ducks, diving ducks, and geese the region as a staging area to and from their nesting grounds farther north. Warm ocean currents and ice-free waters Encourage some waterfowl and shorebirds to winter along the coast.

Fish:

Salmon are the dominant fish species harvested in the area by all user groups. Virtually all of the Chignik Bay District (i.e., those waters southwest of a line extending from Jack Point on the south to Neketa Creek on the north) harvest is generated by the highly productive Chignik River system. Species include sockeye, coho, pink, chum, and chinook salmon (Table 1). Other important finfish species include halibut, walleye pollock, Pacific cod, sablefish, arrowtooth flounder, herring, and Dolly Varden char. Nursery areas for many of the bottom fish are located in the estuaries, bays, and near-shore waters; as these juvenile fish develop they move to progressively deeper areas of the continental shelf before finally merging with the adult populations. Important shellfish species include king, tanner, and dungeness crabs; shrimps; clams, and scallops.

Table 1. Life cycles of salmon species in the Chignik area drainages.

Lifestage	Activity	Chinook	Coho	Sockeye	Pink	Chum
Egg	Incubation location	clean gravel riffle	small streams; clean gravel	streams near lakes; springs	clean gravel, intertidal, lower stream	intertidal lower stream
Alevin	Hatching (remain in gravel)	midwinter	late winter	mid/late winter	midwinter	midwinter
Fry	Emergence (swim-up)	April-May	May-June	April-May	April-May to estuary	April-May to estuary
	Rearing location	stream, river edges	lakes, streams, ponds, sloughs	mostly lakes; some sloughs	nearshore, marine	nearshore, marine
	Time in fresh water	1 year	1-2 years	1-2 years	short-term	short-term
Smolt	Food	aquatic insects	aquatic insects	plankton	plankton	plankton
	Migration	May-June	June-July	May-June	May-June (as fry)	May-June (as fry)
	Size	3-4 inches	4 (+) inches	3 (+) inches	1.5 inches	1.5-2.0 inches
	Age	1 year	2 years	1 or 2 years	1-3 weeks	1-6 weeks
Ocean rearing & development	Food	fish/other	fish/other	large plankton	fish/other	fish/other
	Growth	rapid	rapid	rapid	rapid	rapid
	Time in ocean	1-5 years	1 year	3 years	1 year	2-4 years
Homing Migration	Timing	June-July	August-October	June-September	July-August	July-August
	Size	15-70+ lb	10-15+ lb	6-15 lb	4-6 lb	10-20 lb
Spawning	Timing	July-August	September-October	June-August	July-August	July August
	Location	streams, rivers	streams	streams, near lakes lake upwelling, sloughs	intertidal; lower stream	intertidal; lower streams, sloughs

Human Environment

History:

Six thousand years before the arrival of European explorers in 1741 (i.e., Vitus Bering and Aleksei Chirikof), the Pacific shore of the Alaska Peninsula was inhabited by Pacific (Kaniagmuit) Eskimos, who were maritime hunters that relied heavily on the marine mammals and fish for food, oil, and clothing needs. They were extremely adept at using ocean-going craft (e.g., bidarkies and unimaks), relying on raincoats made from the intestines of whales, seals, or sea lions to keep themselves warm and dry.

Between 1741 and 1784 Russian exploration in Alaska was sporadic; instead much of the exploring and mapping was conducted by non-Russians; e.g., James Cook, John Mears, and Nathaniel Portlock. In 1784 Gregorii Ivanavich Shelikov established a colony at Three Saints Bay on Kodiak Island, resulting in the establishment of a series of trading posts (related to the fur trade). In 1790 the first serious attempt to explore the Alaska Peninsula was undertaken by Dimitri Bocharov, who travelled up the Bering Sea coastline as far as the Kvichak River.

Although the United States purchased Alaska from Russia in 1867, a USGS survey of the southern coast of the Alaska Peninsula was not conducted until 1895 by George Becker and William Dall. When the American government assumed political control, commercial activities continued along the same lines as those established by the Russians (e.g., whaling, trapping).

The major factor changing the patterns of life in the region was the introduction of commercial fishing. Chignik was established as a fishing village in 1888 when the Fisherman's Packing Company of Astoria, Oregon packed 2,160 barrels of salted salmon. In 1889 this same company built a cannery in Chignik Lagoon, and two more had been built in the area by 1893. From that point onward, commercial fishing has been the dominant influence there. Many of the values and the regional economy have developed as a result of the dominance of the commercial fisheries.

In the early processing days the canneries owned the boats and gear and operated the traps. Increased opportunities for the involvement of local residents into commercial fishing and processing industries occurred during the 1940s (World War II); however, since that time the relationships between fishermen and processors have gradually evolved from one where the canneries provided and controlled just about all facets of the fishery to a more balanced one of cooperation and equality, with independent fishermen owning their own boats. Although many changes continued to occur and are occurring in the region, subsistence fishing, hunting, and gathering activities have remained an important component for residents there. Table 2 provides a brief outline of the historical events occurring on the Peninsula.

Population Characteristics:

Alaska Natives, who identify themselves as primarily Aleuts, compose the majority of the residents of each community in the region. In most instances the non-Alaska Native residents

Table 2. Significant historical events occurring on the Alaska Peninsula.

Date	Historical event
1741	Vitus Bering and Aleksei Chirikof land in Alaska
1804	Russian-American Company establishes trading posts at Katmai Village and Sutwik Island
1867	United States purchases Alaska from Russia
1888	Salmon saltery is established at Chignik Bay
1903	Oil drilling begins at Puale Bay
1912	Novarupta erupts, forcing residents of villages of Katmai and Douglas to relocate and establish new village at Perryville
1918	Katmai National Monument is established
1922	Oil drilling is resumed at Puale Bay, and Kanatak becomes a boom town
1923	Russian Orthodox church is built at Perryville using icons from Katmai and Douglas
1940- 1945	Scarcity of labor by 2nd World War results in opportunities for Alaska Native residents to participate in commercial fisheries
1949	School teachers establish Slavic Gospel Mission in Chignik
1950	Perryville organizes under IRA charter
1959	Alaska becomes 49th state, and fish traps are prohibited
1960	The community of Chignik Lake begins as residents remain year-round at the seasonal trading camp
1965	Families from Perryville establish new village at Ivanof Bay
1971	The Alaska Native Claims Settlement is passed

-Continued-

Table 2. Continued

Date	Historical Event
1975	Limited entry to commercial salmon fisheries in Alaska is established
1978	U.S. Secretary of Interior withdraws 110 million acres of land throughout Alaska, including 4.3 million acres for the Alaska Peninsula Wildlife Refuge, 1.2 million acres for Becharof Wildlife Refuge, 0.35 million acres for Aniakchak National Monument, and an additional 1.37 acres for expansion of Katmai National Monument
1980	Alaska National Interest Lands Conservation Act (ANILCA) is passed: Alaska Peninsula and Becharof Wildlife Refuges designated, Katmai National Monument redesignated as Katmai National Park and Preserve, and Aniakchak National Monument and Preserve increased by 0.16 million acres. Rural subsistence hunting and fishing established as the priority use of fish and wildlife resources on federal lands
1989	An 11 million gallon oil spill of the tanker <u>Exxon Valdez</u> in Prince William Sound causes cancellation or curtailment of most salmon fisheries in Chignik region; i.e., fishing confined to Chignik Lagoon
1990	Alaska's subsistence laws overturned by the Alaska Supreme Court. Federal government steeped in to assume management of all fish and game on federal lands (i.e., approximately 60% of state)

have settled into the area through marriage to residents of one of the communities. The greatest number of nonmarriage-related or non-Alaska Native residents are usually in those communities having active land-based processing operations; e.g., Chignik. Major social criteria of the communities are related to the importance of family and kinship, identification with Native issues, and participation in commercial fishing. Kinship commonly ties households and families within and between communities. The working groups for both commercial and subsistence activities are generally established along these family and kinship networks.

Economy:

Commercial salmon fishing is the single, most important cash-producing activity for Alaska Peninsula residents, although other fish species, such as halibut and crab, are also commercially sought. The lack of wage earning opportunities outside of commercial fishing and its related activities is prevalent in communities throughout the region. Average gross income from the salmon fishery between 1975 and 1983 for all the Chignik communities except Ivanof Bay are shown in Table 3 (Langdon 1985). By comparison, respondents to the Chignik Questionnaire for Comprehensive Salmon Planning indicated they needed an average annual gross income of \$300,000 to pay for their annual fishing and living expenses.

Employment other than those related to fishing is dominated by seasonal and part-time positions, many of these provided by local, state, and federal agencies (e.g., village and city councils, school district, Department of Transportation, U.S. Post Office, etc.). Much of the local

Table 3. Per capita annual gross earnings (in thousands of dollars) from the salmon fisheries of the communities of the Chignik region, 1975-1983.

Year	Chignik Bay	Chignik Lake	Chignik Lagoon	Perryville
1975	19.0	20.6	31.3	19.7
1976	54.9	62.4	75.7	62.4
1977	155.0	141.5	186.5	169.2
1978	106.8	145.6	169.0	197.8
1979	97.2	115.1	149.7	166.7
1980	56.9	51.4	78.1	73.9
1981	157.4	133.1	219.7	164.8
1982	106.4	99.1	195.9	131.9
1983	86.0	85.2	122.2	131.8

employment opportunities are limited to unskilled labor; for example, construction projects, janitorial services, etc. Although skilled laborers sporadically find work, opportunities generally depend on the amount of contract work associated with grants or schools. Self-employment opportunities are found in family retail stores, rental units, video (movie) rentals and video game machines, and other miscellaneous cottage crafts. In Chignik Bay, where a land-based processing plant is located, residents are less dependent on fishing for cash incomes because many of the residents are employed by the cannery. Table 4 shows the relative number of households in the various communities that participate in nonfishing wage employment (Morris 1987).

Table 4. Number and percentage of households (N^a) participating in nonfishing wage employment in the communities of the Chignik region, 1986.

Chignik Bay (<u>N</u> = 19)	Chignik Lake (<u>N</u> = 23)	Chignik Lagoon (<u>N</u> = 17)	Ivanof Bay (<u>N</u> = 6)	Perryville (<u>N</u> = 20)
13 (60%)	11 (48%)	9 (53%)	2 (33%)	10 (50%)

^a No. of households surveyed in each community.

Land Status and Use:

The Chignik region is flanked to the northeast by the Becharof National Wildlife Refuge, and with the exception of a scattering of private or selected (i.e., patent, state, or Native) lands, the majority of the land has been incorporated into either the Alaska Peninsula Wildlife Refuge or the Aniakchak National Monument and Preserve (Fig. 3). In 1984 a plan was cooperatively developed for the Bristol Bay area, including the Alaska Peninsula, to address land usage and development (DNR et al. 1984). The principal use of these lands were determined to be the harvest of fish and wildlife; i.e., commercial fishing, sport fishing and hunting, and subsistence activities. Two goals were established to protect the fish resources: (1) to maintain historic levels of fish productivity as well as the carrying capacities of their habitats and (2) to provide optimal use of fish resources through conservation and compatible management of land use.

To assure the maintenance of existing fish population levels in the region, navigable waters within Becharof and Alaska Peninsula wildlife refuges were closed to mineral entry. Surface

entry for oil and gas exploration development in the Black and Chignik Lakes and Chignik River and coal development within one mile of Black Lake and any active salmon spawning stream bed in the Chignik area were prohibited.

Except for public water supply and domestic use, the maintenance of fish stocks is the highest priority use of water in the region. To minimize negative impacts on water quality and public access, where possible the state will retain a strip of land or buffer adjacent to fish habitat; private owners are also encouraged to maintain such buffers. Development of lands adjacent to fish habitat will be limited to those that do not significantly alter the natural stream course or channel, and the extraction of sand, gravel, and minerals from fish habitat will be avoided.

REGIONAL FISHERIES

Subsistence Fisheries

Salmon has been and continues to be the most important subsistence resource on the Alaska Peninsula. Methods of harvesting salmon in historic times focused chiefly on fishing in streams, rather than in the bays; the methods of harvest were generally weirs, spears, and traps. The two main factors distinguishing current methods with those of the past is that most harvesting is done almost exclusively with nets in saltwater bays. Although many people in the region's communities fish for salmon on a small scale, a few devote substantial time and effort, and those who fish most intensively often work cooperatively with others. The primary expenditures for subsistence salmon fishing are a boat, motor, fuel, and nets; however, because of the expense

of nets (i.e., approximately \$1,000 or more for a new one) old commercial nets are most often cut down and used. While many local residents participate in the subsistence fisheries, virtually everyone in all the communities use them. The primary methods of preserving salmon include salting, drying, smoking, freezing, and canning.

Halibut and cod are the primary open sea fish resources for the region's residents, and their importance goes back to precontact times. They represent a single subsistence activity, because both fish are caught in the same places using the same methods. Fishing is done from skiffs with hand lines, fishing poles, or halibut skates. In addition to salmon, halibut, and cod, many other finfish species are utilized; foremost among these are Dolly Varden char, rainbow trout, herring, sea bass, pollack, and flounder. Marine invertebrates used include sear urchins, clams, chitons, mussels, crabs, and shrimp.

Generally, subsistence harvests in the region have been underreported, the RPT does not perceive any conflict during the initial 5-year period covered in the plan, the area is remote and nearly inaccessible from incursion by recreationists, and therefore no reasons exist for the demand for subsistence fishing to increase in the region.

Sport Fisheries

The Chignik River supports annual returns of all 5 species of salmon. Within the past several years, local residents have expressed concern about the status of the chinook salmon stocks returning to the river. The stocks are harvested incidentally in the primary commercial fishery that is directed at sockeye salmon as well as in the sport and subsistence fisheries. Beginning in late May and continuing until late August, escapements of chinook salmon are monitored at a weir on the Chignik River midway between Chignik Lagoon and Chignik Lake. The 10-year (1981-1990) average escapement of chinook salmon into the Chignik River is 3,369 (Table 5); the average commercial harvest for the same 10-year period is 4,608).

The sport fishing effort and harvest have been variable, and they are often based on the amount of commercial fishing time, because many of the sport fishermen are also associated with the commercial fishing industry. Programs designed to accurately estimate the harvest of chinook salmon have only been conducted in 1988 and 1989 (Murray 1988, Schwarz 1990). The sport harvests during those years were 233 and 181 chinook salmon, respectively. The respective commercial harvests for those 2 years were 7,296 and 3,542, and escapements were 6,091 and 3,888. Although a creel survey was not conducted in 1990, the commercial harvest of 9,901 and an escapement of 4,364 indicates that a sport fishing harvest in the neighborhood of 200 to 300 chinook salmon will not damage the stock. The return over the last 10 years (1980-89) has averaged 7,620. Of the various fisheries harvesting these stocks, the commercial fishery is the primary user. The sport fishing effort for chinook salmon (Table 6) occurs primarily in the

Table 5. Estimated Chignik River chinook salmon returns, 1963-1990.

Year	Escapement ^a	Harvest	Total Run ^b
1963	564	1,744	2,308
1964	914	1,099	2,013
1965	942	1,592	2,534
1966	822	636	1,458
1967	1,500	882	2,382
1968	1,000	674	1,674
1969	600	3,448	4,048
1970	2,500	1,225	3,725
1971	2,000	2,010	4,010
1972	1,500	464	1,964
1973	822	525	1,347
1974	672	255	927
1975	877	549	1,426
1976	700	763	1,463
1977	798	711	1,509
1978	1,197	1,603	2,800
1979	1,050	1,266	2,316
1980	876	2,325	3,201
1981	1,603	2,694	4,297
1982	2,412	5,236	7,648
1983	1,943	5,488	7,431
1984	5,806	4,318	10,124
1985	3,144	1,919	5,063
1986	3,612	3,037	6,649
1987	2,624	2,651	5,275
1988	4,868	7,296 ^c	12,164
1989	3,316	3,542 ^c	6,858
1990	4,364	9,901	14,265
1981-90 avg	3,369	4,608	7,977

^a no chinook escapement estimate after weir removal.

^b estimates are conservative because of difficulty in distinguishing small chinook from sockeyes at the weir.

^c excludes sport fish harvest estimates for 1988 and 1989 of 233 and 181 chinook salmon, respectively.

Table 6. Estimated number of anglers and hours spent (effort) for the chinook salmon sport fishery on the Chignik River, 1989.

	Period ^a			All Periods
	A	B	C	
No. Anglers	22	18	23	69
Effort (hr)	35	217	437	689

^a A = 0600-1159 hrs; B = 1200-1659 hrs; C = 1700-2300 hrs.

area of the river between the outlet of Chignik Lake and the weir, because this is where they hold up while they are becoming sexually mature. Although the sport fishery harvests make up only a small portion of the return (2% in 1988 and 1989), there is a general perception among local residents that these harvests have increased in recent years. A summary of demographic data collected in conjunction with the creels survey is provided in Table 7. These data indicate (1) a majority of sport anglers in the Chignik River chinook fishery were unguided adult residents of the state, (2) most anglers used spinners, and (3) the bulk of harvest occurred above the weir. Five-, four-, and three-year-old chinook salmon accounted for 44%, 43%, and 10% of the sport harvest in 1989, respectively. The proportion of males to females was nearly even at 47% and 53%, respectively. In the dominant age class (i.e., 5 years of age 1.4), the length of the males and females averaged about the same at 35 inches (905 and 889 mm, respectively).

Table 7. Summary of angler demographics and types of lures collected from sport anglers fishing for chinook salmon in Chignik River, 1989.

Angler demographics				Types of Lures	
Females	16%	Residents	79%	Bait	0%
Males	84%	Nonlocals	54%	Spinners	97%
Adults	95%	Nonresidents	21%	Flies	3%
Youths	5%	Unguided	100%		

Although there are a number of guiding operations out of King Salmon and Kodiak that bring sport fishermen into Chignik area to fish, their impact on the sport fisheries is minimal and has not yet been quantified. Regional staff of the Sport Fish Division are planning to investigate the status and impacts of this new sport fish industry in the near future, possibly during the summer of 1992. Sport fishing efforts have increased in the outlying districts, most notably Main River in Amber Bay and near the runway on Ocean Beach by Nakalilok Bay (Memo by Len Schwarz, December 4, 1990).

Sport fishing is generally perceived in the area as an internal effort, posing no threat to other user groups; however, although residents do not currently resent sport fishing activity, they are afraid that an expanded external sport fishery might negatively impact the other fisheries. For example, the residents of Chignik Lake do not want to experience a dramatic increase in tourism via sport fishing. Further the RPT recognizes that although conflicts between various user groups may occur, they are not irreconcilable.

Commercial Fisheries

The management area of the Chignik commercial salmon fishery is divided into five districts that are, from east to west, the Eastern, Central, Chignik Bay, Western, and Perryville Districts (see Fig. 2). It is the job of Commercial Fisheries (ADF&G) managers to achieve desired salmon escapements and allow for orderly harvests of the surplus. Purse seines are the only legal commercial gear type for the Chignik region; in 1990, 101 permit holders participated in the salmon fisheries (Table 8). The 1989 total harvest (1.26 million) was less than one-half the 1980-1989 average of 2.7 million fish (Table 9, Fig. 4). The sockeye and chinook harvests were within predicted ranges, while pink and chum catches were well below projected levels. This was attributable to the presence of oil contaminants (i.e., Exxon Valdez oil spill at Bligh Reef in northeastern Prince William Sound) in Chignik management area that precluded harvest of surplus local pink and chum stocks. Coho catches were also lower than projected.

Commercial fishing has been the region's most important cash-producing activity for much of the twentieth century. It has also been a factor for the harvesting of local resources for domestic uses. Access to commercial salmon fishing within state waters is limited to persons holding a permit issued by the Commercial Fisheries Entry Commission (CFEC). Beginning in 1975, CFEC has been issuing commercial purse seine permits to qualified persons. Eligibility was determined by a complex system based on points awarded by criteria such as residency and past participation in the fishery. Halibut fishing has been controlled by the International North

Table 8. Chignik area fishing effort in units of seine gear by resident status from 1966-1990.

Year	Units of Gear				Total
	Resident	Percent	Nonresident	Percent	
1966	65	89.0	8	11.0	73
1967	73	88.0	10	12.0	83
1968	59	88.1	8	11.9	67
1969	57	83.8	11	16.2	68
1970	57	82.6	12	17.4	69
1971	64	83.1	13	16.9	77
1972	62	78.5	17	21.5	79
1973	63	81.8	14	18.2	77
1974	79	84.0	15	16.0	94
1975	72	83.7	14	16.3	86
1976	66	85.7	11	14.3	77
1977	74	84.1	14	15.9	88
1978	82	86.3	13	13.7	95
1979	87	86.1	14	13.9	101
1980	87	86.1	14	13.9	101
1981	87	85.5	16	15.5	103
1982	89	84.8	16	15.2	105
1983	84	84.0	16	16.0	100
1984	84	83.2	17	16.8	101
1985	85	84.2	16	15.8	101
1986	87	87.0	13	13.0	100
1987	89	87.3	13	12.7	102
1988	88	86.3	14	13.7	102
1989	86	84.3	16	15.7	102
1990	85	84.2	16	15.8	101

Table 9. Historical salmon harvests in the Chignik Management Area, 1960-1990^{a/}.

Year	Catch by Species					Total
	Chinook	Sockeye	Coho	Pink	Chum	
1960	643	715,969	8,933	557,327	486,699	1,769,571
1961	409	322,890	3,088	443,510	178,760	948,657
1962	435	364,753	1,292	1,519,305	364,335	2,250,120
1963	1,744	408,606	9,933	1,662,363	112,697	2,195,343
1964	1,099	556,890	2,735	1,682,465	333,336	2,576,425
1965	1,592	599,553	9,602	1,118,158	120,589	1,849,494
1966	636	219,794	16,050	683,215	238,883	1,158,578
1967	882	462,000	13,150	108,981	75,543	660,556
1968	674	977,382	2,200	1,290,660	223,861	2,494,777
1969	3,448	394,135	18,103	1,779,736	67,721	2,263,143
1970	1,225	1,325,883	15,348	1,287,605	464,674	3,094,735
1971	2,010	1,016,136	14,557	612,290	353,952	1,998,945
1972	464	378,669	19,615	72,240	78,356	549,344
1973	525	870,352	22,322	25,445	8,701	927,345
1974	255	662,905	12,245	70,017	34,454	779,876
1975	549	399,593	53,283	66,165	25,161	544,751
1976	763	1,163,728	35,301	388,917	80,221	1,668,930
1977	711	1,972,207	17,429	604,824	110,452	2,705,623
1978	1,603	1,576,283	20,212	985,114	120,889	2,704,101
1979	1,266	1,049,497	93,146	2,056,999	188,169	3,389,077
1980	2,325	859,966	117,862	1,125,465	312,572	2,418,190
1981	2,694	1,839,469	78,805	1,162,613	580,332	3,663,913
1982	5,236	1,521,857	300,384	873,390	390,096	3,090,963
1983	5,488	1,824,175	61,915	321,160	159,362	2,372,100
1984	4,318	2,660,478	110,128	446,184	63,408	3,284,516
1985	1,919	922,151	206,624	174,966	26,146	1,331,806
1986	3,037	1,645,834	116,633	647,125	176,640	2,589,269
1987	2,651	1,898,838	150,414	246,775	127,261	2,425,939
1988	7,296	795,841	370,410	2,997,159	267,126	4,437,832
1989	3,542	1,159,287	68,233	27,712	1,624	1,260,398
1990	9,901	2,093,650	130,131	550,008	270,004	3,053,694
31-year avg.	2,237	1,053,180	67,745	825,413	194,904	2,143,478
10-yr avg. (1981-90)	4,608	1,636,158	159,368	744,709	206,200	2,751,043

^a Harvest numbers do not include Cape Igvak or Southeastern District mainland area.

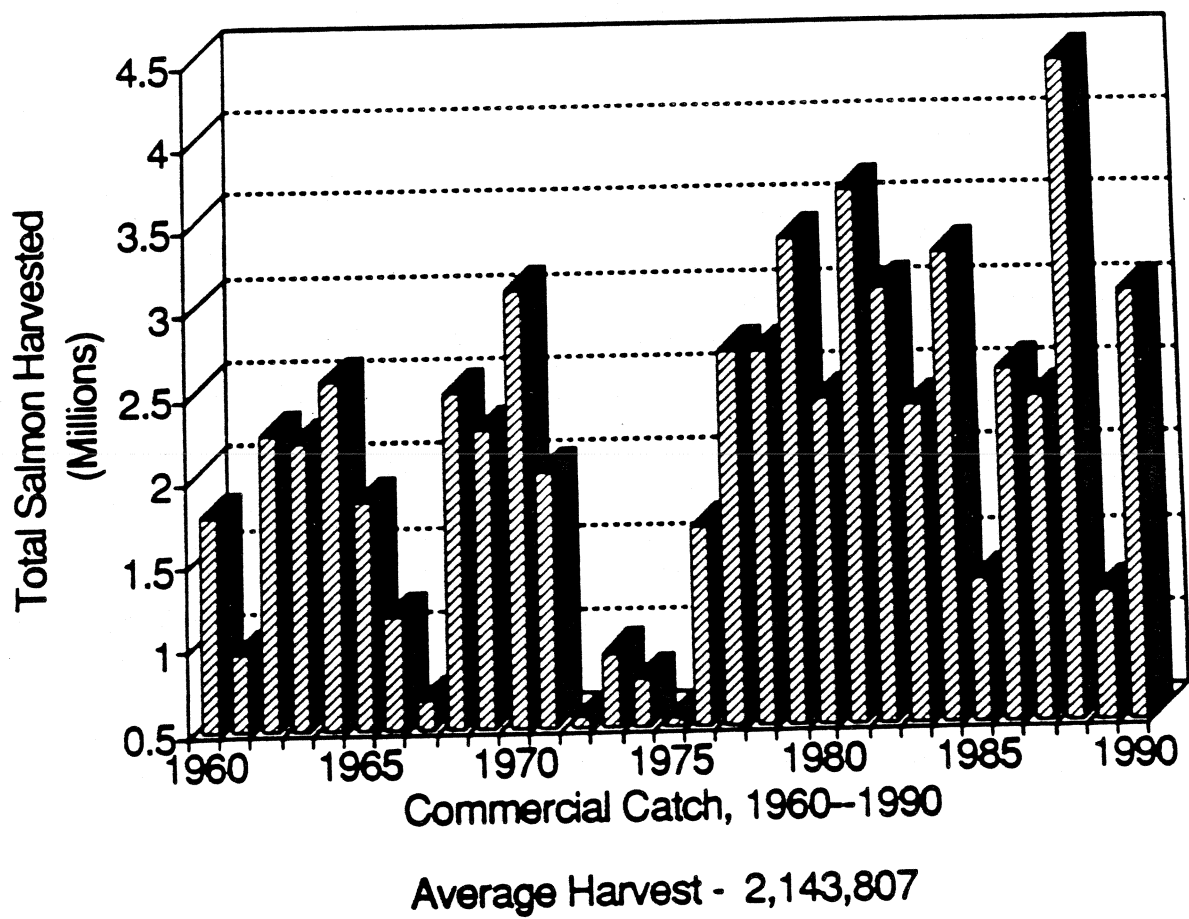


Figure 4. Chignik management area historical total salmon harvest.

Pacific Halibut Commission; in order to commercially fish for halibut, an annual license is required and all vessels over 5 tons must be licensed.

The sockeye salmon run into the Chignik River system is the most important fishery in the region, occurring in two separate periods. The early run (Black Lake stock) enters the system in early June, peaking towards the end of June just as the late run (Chignik Lake stock) begins. The second run peaks in the latter part of July and continues late into the fall. Four other Pacific salmon species are taken simultaneously with sockeyes: chinook, which generally run at the early part of the season, followed by pinks, chums, and cohos.

In 1990 salmon for commercial purposes could be harvested in the Chignik region (see Fig. 3) only by hand or purse seine. In all districts except Chignik Bay, seine gear could not be less than 100 nor more than 225 fathoms in length, while in Chignik Bay District the length of the seine was limited to 125 fathoms. In Chignik Bay the commercial salmon fishing season in 1990 opened in June and ran through September; weekly fishing periods were established by ADF&G emergency orders. All other districts were opened and closed to commercial fishing by emergency order. The types of commercial fisheries and degree of participation among residents of the region are illustrated in Table 10 (Morris 1987). The variety of fisheries in which local residents participated was influenced by the location of their communities. One hundred and one limited entry seine permits (i.e., 90 permanent and 11 interim entry) were issued for the Chignik region in 1990. Because of the small size of the fleet, Chignik fisherman tend to know each

Table 10. Commercial fisheries in which the surveyed households (N^a) in the communities of the Chignik region participated (%) in 1984.

Fishery	Chignik Bay (N = 19)	Chignik Lagoon (N = 17)	Chignik Lake (N = 23)	Ivanof Bay (N = 6)	Perryville (N = 20)
Salmon	84.2	82.4	82.6	50.0	80.0
Crab	15.8	11.8	0.0	0.0	0.0
Herring	15.8	41.2	17.4	0.0	0.0
Halibut	84.2	88.2	82.6	66.7	96.0

^a N = No. of households surveyed in each community.

other or are related by kinship; consequently the fleet is more self-regulating than other Alaska fisheries. Purse seine crews generally consist of a skipper, skiffman, and three deckhands. According to Langdon (1986) fishermen from the communities of Chignik and Chignik Lagoon not only have consistently reported the highest gross earnings from commercial fishing, but they have upgraded their boats to be more adaptable for fishing for nonsalmon species. In as much as there is only one commercial gear group represented in the region, the primary conflict is between the inside (Chignik Lagoon, 75%) and outside (25%) fleets, although the trend is for more fishermen to move outside.

Fishing is the mainstay of the cash economy in the villages. Beginning around the second week in June, residents fish for sockeye salmon and successional runs of pink, chum, and coho

salmon. Fish are taken by purse seiners and delivered to the local cannery or to floating processors anchored in Anchorage Bay. Boats, crews, and families from several area villages and elsewhere congregate in Chignik during the salmon season. Boats tie up to both cannery docks. There is not enough room for all the boats; therefore, boats tie up side by side or anchor in the bay. The economic well-being of the region depends on the success of salmon fishing.

SALMON PRODUCTION STATUS

Chinook Salmon Background

Chinook production in the region is limited to the Chignik River system. this is the largest chinook salmon producing system on the south side of the Alaska Peninsula. Chinook salmon return to Chignik River primarily during July and August. Commercial catches of chinook salmon are incidental to sockeye catches and generally peak during July; since 1960 the annual harvests have averaged 2,237 fish (Table 9). Commercial catches have increased in recent years, averaging 4,608 fish from 1980 to 1990 (Fig. 5); there has also been a corresponding increase in chinook escapement for the past 10 years. Escapement estimates are considered conservative because of the difficulty in distinguishing smaller chinook salmon from sockeye salmon as they pass through the weir. Total ex-vessel value of the 1990 chinook salmon harvest was \$185,256 (1990 AMR). Average earnings per permit holder was \$1,834 (Table 11).

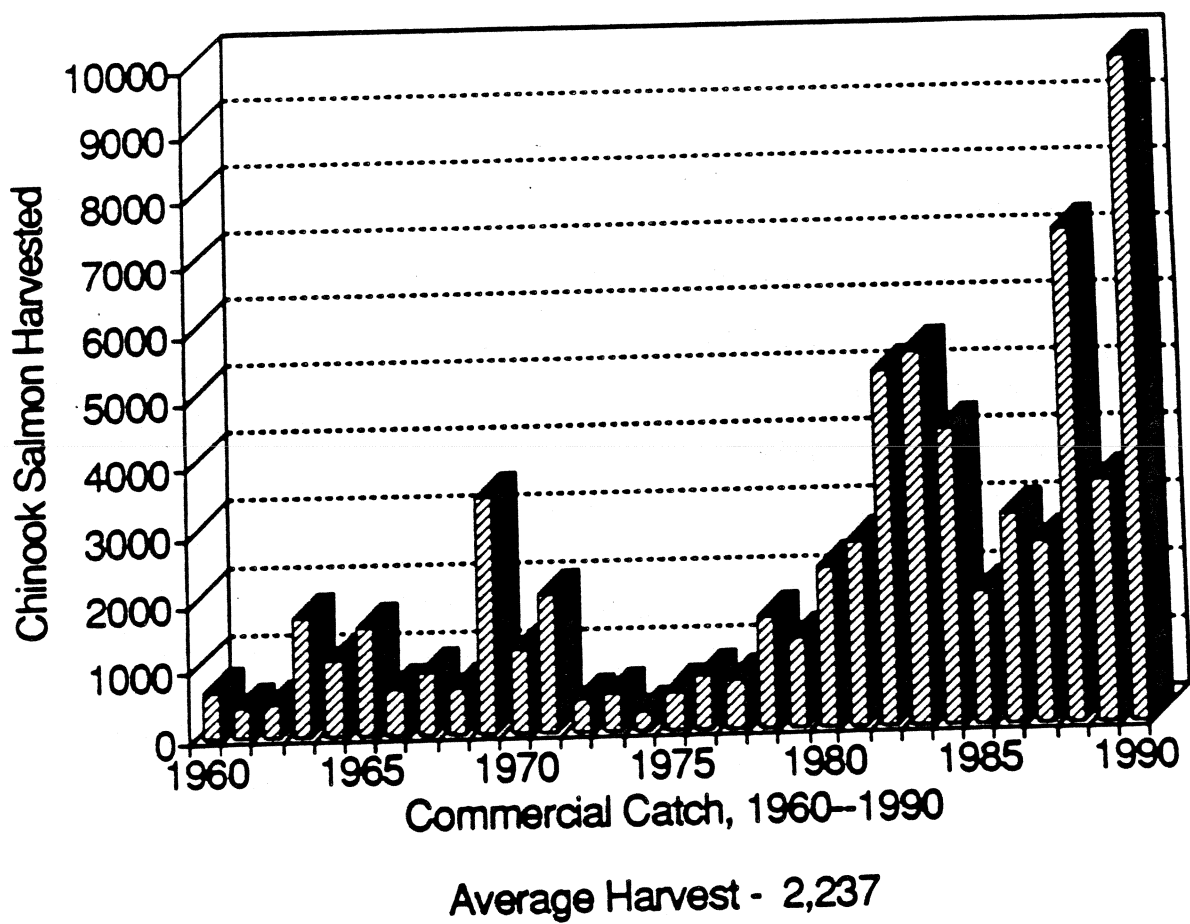


Figure 5. Chignik management area historical chinook salmon harvest

Table 11. Economic value (in dollars) of salmon to Chignik area fishermen, 1970-1990.

Year	Chinook		Sockeye		Coho		Pink		Chum		Total Value
	Total	Average	Total	Average	Total	Average	Total	Average	Total	Average	
1970	6,129	89	2,190,272	31,743	18,397	267	635,673	9,213	376,025	5,450	3,226,496
1971	6,472	84	2,034,279	26,419	23,240	302	366,693	4,762	326,760	4,244	2,757,444
1972	2,028	28	825,498	11,308	35,699	489	48,401	663	87,759	1,202	99,385
1973	5,255	72	3,030,057	41,508	73,663	1,009	20,610	282	10,180	139	3,139,765
1974	2,941	32	3,618,781	39,767	31,933	351	64,069	704	51,125	562	3,768,849
1975	6,561	76	1,384,271	16,240	213,539	2,581	104,115	12,211	61,704	717	1,770,190
1976	13,800	179	4,751,000	61,701	138,000	1,792	568,300	7,381	183,600	2,384	5,654,700
1977	18,828	212	14,553,720	163,525	104,819	1,178	920,881	10,347	368,066	4,136	15,966,314
1978	56,700	597	15,653,500	164,774	116,400	1,225	1,131,500	11,911	404,500	4,258	17,362,600
1979	32,050	317	11,345,503	112,332	710,192	7,031	2,622,269	25,963	126,866	1,256	14,836,880
1980	67,657	670	5,532,290	54,775	520,655	5,155	1,477,060	14,624	1,061,963	10,514	8,659,625
1981	75,231	730	17,262,119	167,593	439,900	4,271	1,881,334	18,265	2,431,421	23,606	22,090,005
1982	75,276	717	13,038,510	124,176	1,782,027	16,972	578,184	5,506	1,356,597	12,920	16,830,594
1983	96,159	962	10,728,088	107,281	219,650	2,197	240,171	2,402	421,713	4,217	11,705,781
1984	114,502	1,134	20,402,076	202,000	759,972	7,525	330,916	3,276	146,024	1,446	21,753,490
1985	67,088	664	7,997,834	79,186	1,471,418	14,568	140,076	1,387	59,475	589	8,735,891
1986	84,800	848	16,882,290	168,823	667,740	6,677	356,147	3,562	456,546	4,565	18,447,523
1987	72,739	706	24,783,033	240,612	1,035,129	10,050	269,868	2,620	339,819	3,299	26,500,588
1988	286,740	2,811	14,350,354	140,690	4,153,424	40,720	6,771,266	66,385	2,189,293	21,464	27,751,077
1989	78,999	790	13,047,378	130,474	436,892	4,369	32,994	3,299	4,745	47	13,601,008
1990	185,256	1,834	22,509,923	222,871	700,309	6,934	502,693	4,977	878,510	8,698	24,776,691

Sockeye Salmon Background

For the Chignik region, sockeye salmon are the most important commercially caught species from an economic viewpoint. The commercial fishery targets on the two runs of sockeye salmon entering the Chignik Lakes system. The Chignik Lake bound sockeye salmon are also intercepted outside the region in two historic fisheries, one to the east in the Kodiak Management Area (Cape Igvak) and one to the west in the Alaska Peninsula Management Area (Balboa-Stepovak).

Although most of the sockeye salmon production comes from the Chignik Lakes system some spawning activity does occur in the Eastern District. Sockeye salmon in the Eastern District spawn predominantly in Albert Johnson Creek and Surprise Lake, both tributaries to Aniakchak River. Relative to the Chignik Lake sockeye stocks, the other stocks are of minor commercial importance. Most sockeye harvested in the Eastern District are intercepted as they migrate to spawning areas outside the district. Lechner (1969) summarized several years of tagging data from the aniakchak and Cape Kumlik areas that showed sockeye salmon harvested in these waters are almost exclusively of Chignik Lake origin.

Sockeye returning to the Chignik Lakes system are composed of two stocks, one returning to Black Lake (early run) and the other to Chignik Lake (late run). The sockeye escapement goals for Black and Chignik Lake stocks are 400,000 and 250,000 fish, respectively. Commercial fishing time for sockeye salmon has been based on a threshold level of escapement for each run

by a specific date. To achieve these thresholds the escapements are monitored; however, these monitoring efforts have been complicated by an overlapping in early and late runs' time of entry (i.e., transition period). The transition period generally occurs from the last of June through mid-July. Two methods have been developed to estimate daily proportions of each run during the transition period. The first method is based on tagging studies from 1962-1966 (Dahlberg 1968). These studies enabled biologist to develop an average time of early entry curve (ATOE) to apportion the Chignik sockeye runs into early and late components. A form of this method is currently used for in-season management of the fishery. The second method, developed in the late 1970s and early 1980s, is based on differences in scale patterns between fry rearing in Black Lake and those in Chignik Lake (Marshall and Burgner 1975, Conrad 1983). Sockeye fry rearing in Black Lake (early run) emerge earlier and grow at a faster rate than fry rearing in Chignik Lake (late run) (Narver 1966). The faster growth rate experienced by Black Lake fry allow the majority to attain smolt length at age 1.0, while fry rearing in Chignik Lake experience a slower growth rate and generally smolt at age 2.0. Historically this has been recognized in the adult return. The returns to Black Lake have been characterized by the dominance of age 1.3 fish, while the Chignik Lake returns have been primarily age 2.3 fish. Because these differences in early life histories are reflected in the scale patterns, they supply the discriminating variables used in the scale pattern analysis program.

For the period of 1960-1989, the average commercial harvest of sockeye salmon has been 1,018,837 adults, and for the period of 1980-1989, the average commercial harvest has been 1,512,790 adults (see Table 11, Fig 6). In 1989, the presence of oil contaminated waters

(resulting from the Exxon Valdez oil spill) and beaches near Kilokak Rocks and the lack of associated monitoring in the Chignik Management Area dictated that waters of the Eastern District north of 56° 59' North latitude be closed to fishing. Oil was observed in varying quantities throughout the Eastern and Central Districts up to a point near the head of Chignik Bay at Unavikshak Island (Barrett and Monkiewicz 1989). Although oil was reported in Chignik Bay, the amount of contamination (sheen) within Chignik Lagoon did not appear to exceed a level associated with about 100 vessels operating there. Because of the presence of oil-contaminated or beaches in the immediate vicinity of Chignik Lagoon, a policy of fishing during daylight hours only was adopted. On August 4, 1989, oil from the Exxon Valdez oil spill, in the form of mousse, was located inside Chignik Lagoon and scheduled fishing periods on August 5-6 were canceled (Barrett and Monkiewicz 1989). In 1989 the ex-vessel value of the sockeye harvest in the Chignik Management Area was approximately \$13.1 million (AMR 1990); in 1990 the total economic value of the sockeye harvest was \$22.5 million. The average values/permit holder in 1989 and 1990 were \$130,500 and \$222,900, respectively (Table 12).

The Fisheries Research Institute (FRI), University of Washington, has maintained a salmon research facility at the outlet of Chignik Lake since 1955. The goal of their research, which has been funded by contracts or contributions from U.S. National Marine Fisheries Service, State of Alaska, salmon processors, and fishermen, has been to develop techniques for improved management of sockeye salmon.

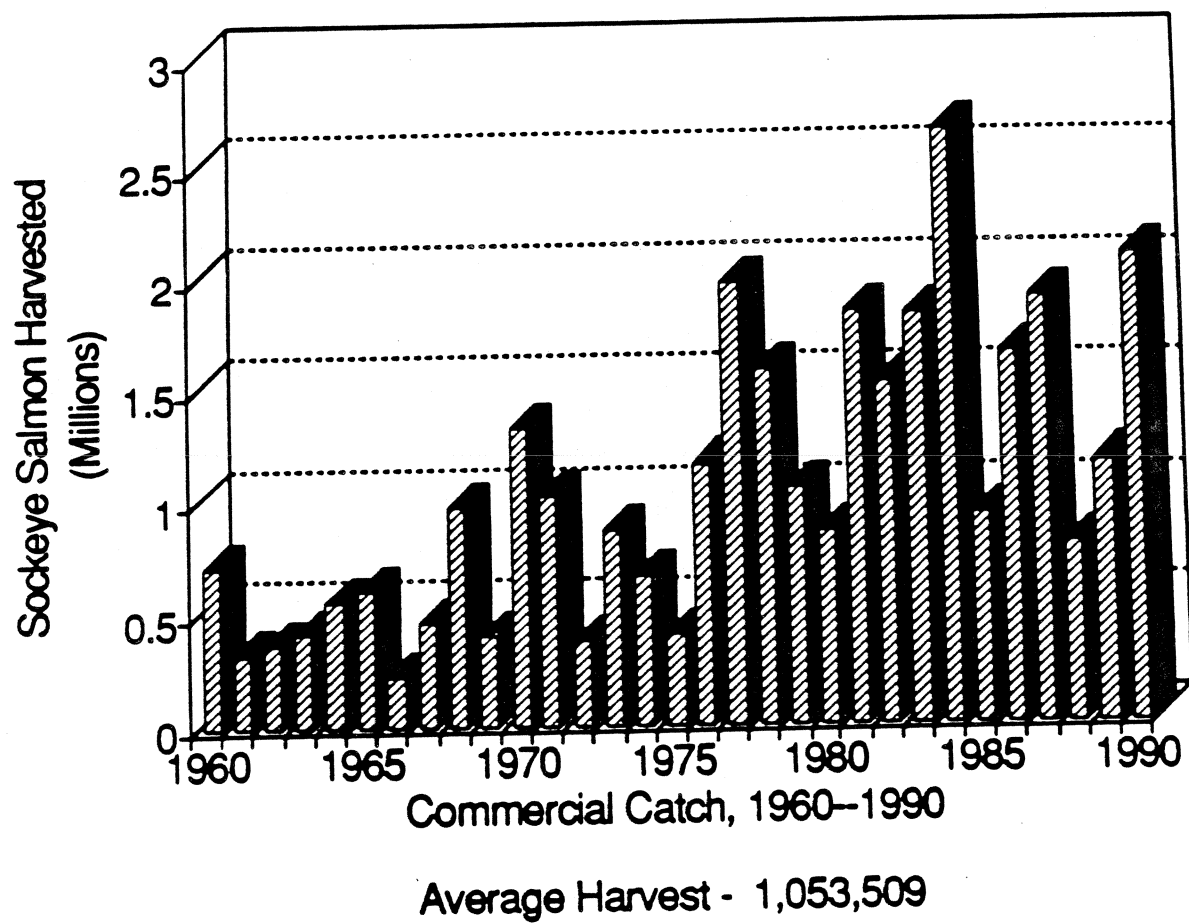


Figure 6. Chignik management area historical sockeye salmon harvest.

Pink and Chum Salmon Background

Pink and chum production in the Chignik region is sporadic from year to year; this erratic production is directly related to the morphology of the river and stream systems of the Chignik region that are characterized by loose substrate, steep gradients and short overall lengths. These systems are impacted by fall, winter, and spring floods that cause stream bed scouring, which may result in high egg and fry mortality. Management of the pink and chum fisheries in the Chignik region are based on in-season aerial assessment of escapement and catch per unit effort (CPUE) data collected during fishing periods. Currently, all salmon processed locally are for the fresh frozen market because there are no operational canning facilities in the area. Consequently, to provide the quality required for fresh frozen processing, the fisheries are managed to intercept migrating fish prior to or just as they reach terminal waters. For the periods 1960-1989 and 1980-1989, the average commercial harvests of pink salmon have been 834,593 and 802,255 adults, respectively (see Table 11, Fig. 7). For the periods 1960-1989 and 1980-1989, the average commercial harvests of chum salmon have been 192,401 and 210,457 adults, respectively (Fig. 8). The 1989 pink and chum fisheries were severely restricted because of the presence of oil contaminated waters or beaches (1989 Exxon Valdez oil spill) in the Eastern, Central, Western, and Perryville Districts of the Chignik region. Since most of the pink and chum production comes from these districts, there was no opportunity to harvest fish surplus to spawning requirements. Because of oil-related fishery closures, the ex-vessel value of pink (\$33,000) and chum (\$4,700) salmon were comparatively low (Table 11). In 1990 the ex-vessel values of pink and chum salmon were \$502,700 and \$878,500, respectively (Table 12).

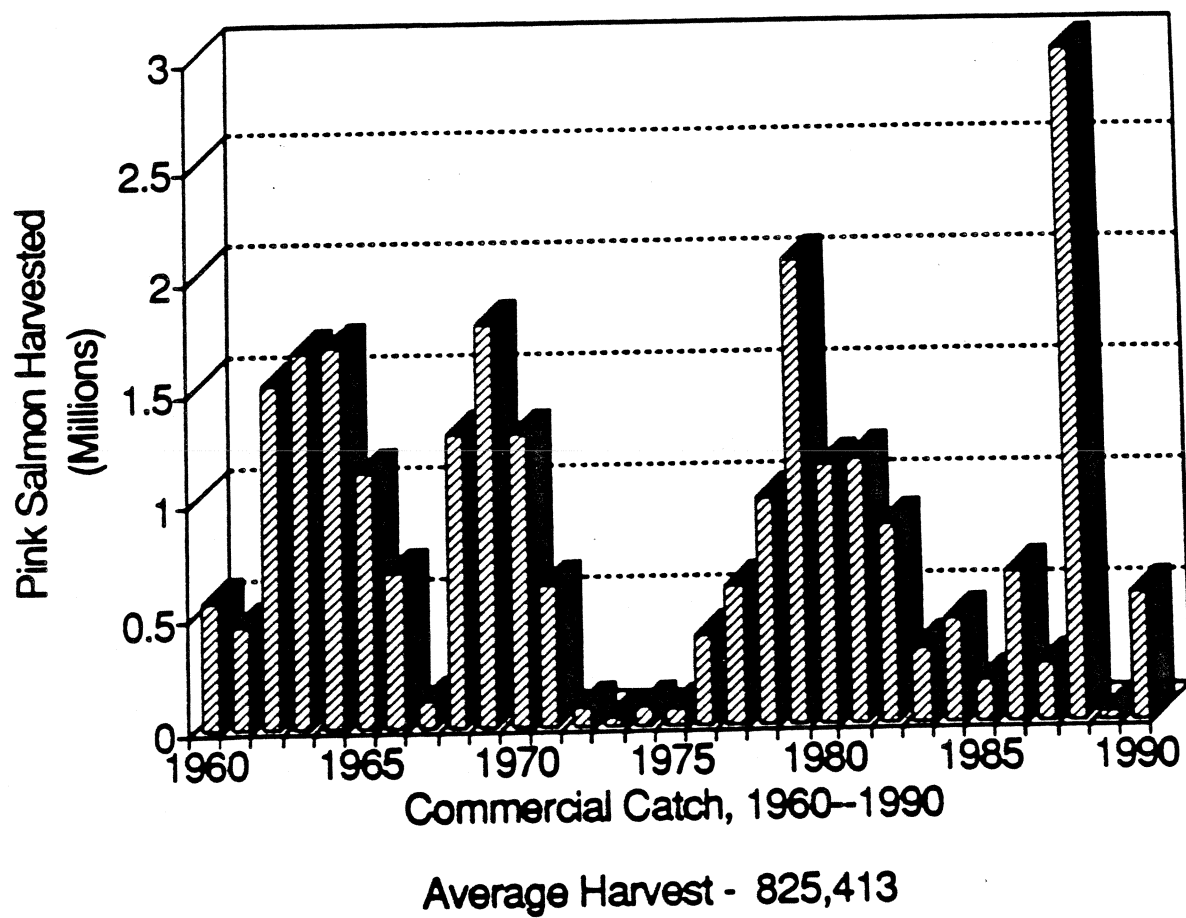


Figure 7. Chignik management area historical pink salmon harvest.

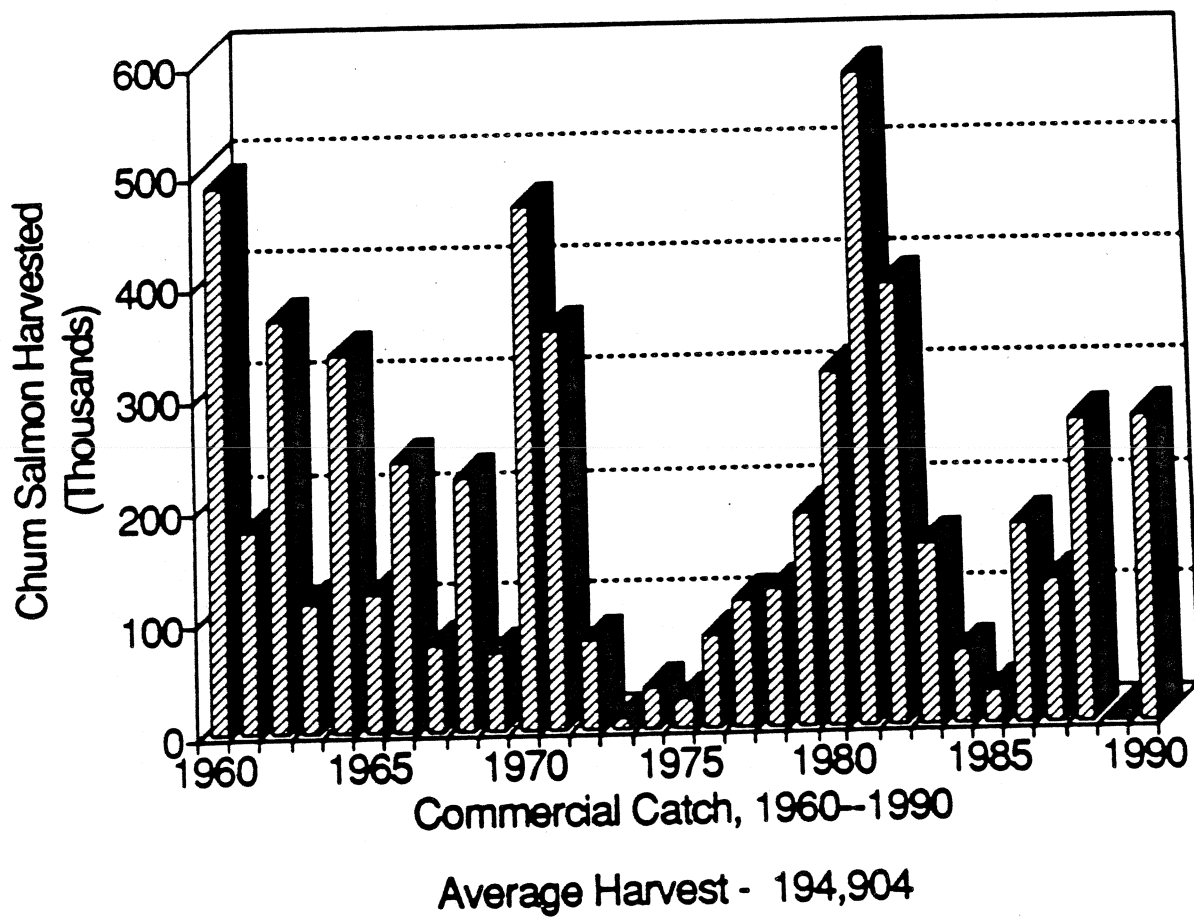


Figure 8. Chignik management area historical chum salmon harvest.

Coho Salmon Background

Coho salmon spawn throughout the Chignik region; however, most of the coho spawning occurs in the Chignik Lake system. Coho salmon first appear in the commercial fishery in about mid-July and are still present when the commercial fishery terminates in October. In comparison to other coho producing systems of the Westward region, the Chignik River system usually supports the largest coho harvests. Since 1976, commercial harvests have ranged from a low of 17,429 in 1977 to a high of 370,400 in 1988; the 1981-90 average harvest is 159,368 coho salmon (see Table 9, Fig. 9). Total coho production of the Chignik River system averaged 170,000 fish during 1979-1988, based on catch and effort relationships to estimate spawning escapement after weir removal (Ruggerone 1989).

In recent years, coho salmon catches in the Chignik region have shown a bimodal pattern with respect to time. Early coho salmon harvests start in late July during the targeted pink and chum salmon fishery, and late coho salmon catches extend from mid-August through the remainder of the season. Early coho salmon catches come from the Western and Perryville Districts. These fish usually have a smaller average weight than those caught during August and September. Based on timing information and average weights, an unknown portion of the early coho salmon catch are considered to be nonlocal stocks. From mid-August through the end of the season coho salmon are harvested primarily in the Chignik Bay District and are considered local stocks. Because of oil-related closures in the Eastern, Central, Western, and Perryville Districts, the entire 1989 harvest was in the Chignik Bay District. The ex-vessel value of the

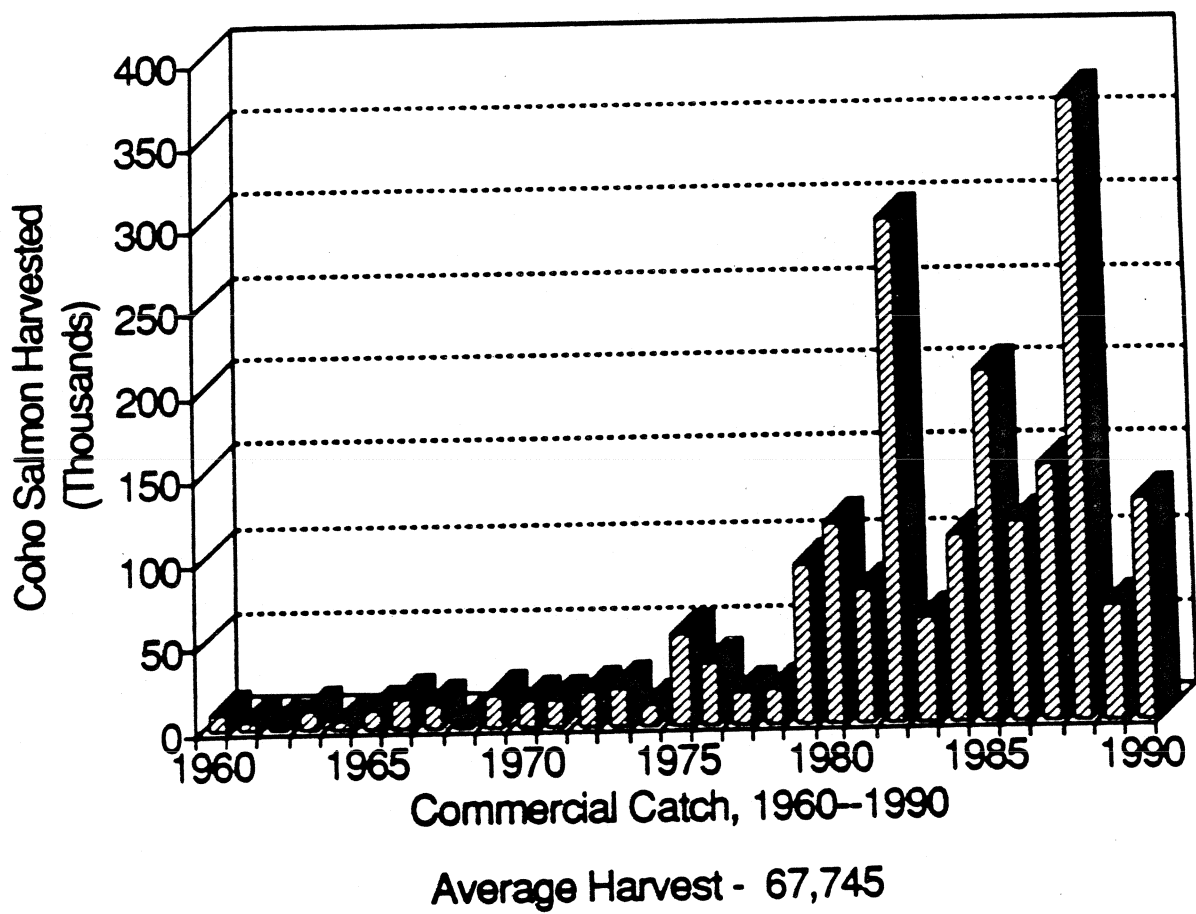


Figure 9. Chignik management area historical coho salmon harvest.

coho salmon catch to the Chignik fishermen was an estimated \$700,300 in 1990, and average earning per permit holder was \$6,900 (Table 11).

ANALYSIS OF REGIONAL STATUS

User Demand

The production of additional salmon in the Chignik region is a means of strengthening and preserving a resource base for subsistence, recreational, and commercial harvests. Historic patterns in the regional fisheries support the contention that when more fish are available to be caught, the resulting increased harvest is distributed throughout the user groups; therefore, the production of more fish in the region would be beneficial to these user groups.

The achievement of more productive and predictable salmon fisheries in the Chignik region will require identification of what the region's fishermen want from the resource and what the resource will be able to provide. Although the projects outlined in later chapters of this plan will provide for the orderly and systematic examination of the resource potential, the primary assumption here is that as the resource base increases, harvests will accordingly be allowed to increase in a biologically sound manner. A key element in the relationship of user groups to a potentially expanding resource base is the number of participants in the harvest; however, because (1) only one commercial gear group for salmon is represented (i.e., 101 CFEC seine permits), (2) subsistence harvests are generally considered adequate because of the remoteness

of the region and large seasonal population, and (3) sport fishing has not appreciably developed beyond a localized level, although Chignik Lake-River, Ltd. is investigating possibilities (mostly in Chignik River), the level of participation in the various fisheries are not anticipated to dramatically increase over the life of the plan. There is the possibility that sport fishing pressure from guided charter-boat operations at Amber Bay and Aniakchak are increasing; however, their impact on the area's sport fishery has not yet been quantified.

Chignik Questionnaire Summary

With the intentions of (1) determining major issues and concerns in the Chignik region and the best means of addressing them and (2) reaching as many of the region's fishermen as possible in the planning process, the Chignik Regional Planning Team drafted a 20-part questionnaire (Appendix) that was mailed to all permanent and interim commercial seine permit holders as well as all processors in the region. Approximately 30% of those receiving the questionnaires responded. The three most important problems associated with the commercial fisheries were ranked as follows: (1) price/markets, (2) lack of fish, (3) overcrowding. The highest ranked project possibilities were clearly (1) stabilization of water levels of Black Lake, (2) diversion of Alec River, and (3) implementation of studies to evaluate the production/carrying capacity of Chignik and Black Lakes. In response a question regarding the species of salmon they wanted to see increased, sockeyes ranked first, followed by cohos, chums, chinooks, and pinks.

In additional findings, only 3 fishermen indicated annual gross income percentages less than 80% derived from Chignik fisheries, while two said they relied on fisheries in other regions for the remainder of income; of 28 fishermen reporting the bulk of their income from salmon seining in the Chignik region, the average was 95.3%. Respondents indicated they needed an average annual gross income of \$300,000; the average investment for boat, permit, and gear amounted to \$745,400. Seventy-three percent said they took a portion of their commercial catches for personal use; sockeyes were decisively ranked first, followed by chinooks, cohos, pinks, and chums. All but two of the respondents indicated Chignik Bay as the principal area for increasing production of sockeye salmon, followed by Central, Westward, Eastern, and Perryville Districts.

When asked if their regional aquaculture association (CRAA) should consider sockeye hatcheries as a viable production means, provided a location could be found where reasonable segregation from natural stocks could be accomplished, 52% of the respondents said "possibly," 33% said "yes," and 15% said "no." Also an overwhelming majority indicated that harm to the natural stocks was their greatest concern when considering hatcheries. Based on these responses and supplemental comments by members of the CRPT, the introduction of hatcheries into the context of 5-year planning was not considered a practical option, although enough interest was generated to perhaps identify possible sites with sufficient quality and quantity of water to locate a hatchery facility.

GOALS, OBJECTIVES, STRATEGIES, AND PROJECTS

Introduction

In as much as all goals are definitive statements concerning a specific end we wish to achieve by a specific date, the overall goal of all participants in Chignik fisheries (i.e., commercial, sport, and commercial) is to protect the wild stocks, while increasing and stabilizing production and harvests--to improve the conditions in the region. What decides these improvements will be a series of discrete but related goals that may represent (1) a larger production/harvest of fish, (2) collection/evaluation of necessary data/research, and (3) revision of management policies/practices. Uniting these three types of goals are three basic assumptions: (1) the salmon resource needs to be maintained in the strongest possible condition (i.e., protection of wild stocks and habitat), (2) most effective management/rehabilitation/ enhancement strategies can only be realized through a complete data base, and (3) harvest of salmon resources to the greatest extent possible is beneficial to all participants, the region, and the state.

Production/Harvest Goals

Production/harvest goals are expressed in numbers of fish that will be available for harvest in Chignik's regional fisheries. Generally, these goals are expressed in conjunction with projects that have been identified by species and related production and harvest numbers.

Ten-Year Target:

The initial 5 years of the planning period will be devoted to habitat improvement projects and research; however, in addition to the various studies that have been and will be initiated, the CRPT decided to adopt a 5-year Action Plan for implementing projects such as the stabilization of the water level of Black Lake , Alec River diversion, stream passage improvement, stock status investigations, and beaver dam removal projects, in order to achieve the regional need for consistency and stability in the harvest. A good understanding of the hydrology of the Black Lake system and the dynamics of the biology of the fish that live there will be an important part of the development of projects there. Lake fertilization is another technique that can be implemented if Black and Chignik Lakes show signs of seasonal nutritional limitations. To these ends, the CRPT felt it was necessary to establish attainable 10-year harvest target numbers by species toward which the **Action** portion of the plan could be directed. Accordingly, a 20% increase in the annual harvest over that for the most recent 10-year average (1981-1990) for each salmon species was selected as the 10-year target (Table 12); however these increases will occur in the 10 years following the implementation of enhancement and rehabilitation projects designed to increase production. If no projects are undertaken to increase production, then there is no expectation to achieve the 20% target per species; for example, thus far there are no plans to increase coho production, but we reflect the 20% harvest increase in Table 12 as a reference. Our overall goal is to realize the 20% harvest increase; i.e., 20% over the 10-year annual average, representing the harvest expected without implementation of enhancement or rehabilitation projects.

Table 12. Chignik management area commercial salmon harvests, 10-year average (1981-1990) harvest, and 10-year/+20% (1992-2001) target.^a

Year	Harvest by Species					Total
	Chinook	Sockeye	Coho	Pink	Chum	
1981	2,694	1,839,469	78,805	1,162,613	580,332	3,663,913
1982	5,236	1,521,857	300,384	873,390	390,096	3,090,963
1983	5,488	1,824,175	61,915	321,160	159,362	2,372,100
1984	4,318	2,660,478	110,128	446,184	63,408	3,284,516
1985	1,919	922,151	206,624	174,966	26,146	1,331,806
1986	3,037	1,645,834	116,633	647,125	176,640	2,589,269
1987	2,651	1,898,838	150,414	246,775	127,261	2,425,939
1988	7,296	795,841	370,410	2,997,159	267,126	4,437,832
1989	3,542	1,159,287	68,233	27,712	1,624	1,260,398
1990	9,901	2,093,650	130,131	550,008	270,004	3,053,694
Avg	4,608	1,636,158	159,368	744,709	206,200	2,751,043
+20%	5,530	1,963,390	191,242	893,651	247,440	3,301,253

^a harvest data excludes Cape Igvak & Southeastern District (mainland area).

Many fisheries biologists believe that the salmon production in Alaska is heading into a cyclic downturn. If this occurs and if reliable, scientific data reflecting the impact of decreasing production in the Chignik area can be gathered, then this data could be factored into our assessment of our ability to achieve our 10-year targets; for example, if our sockeye harvests decrease by 20% after we had implemented our enhancement/rehabilitation projects and our annual harvests maintained the most recent 10-year average, then it would be justifiable to conclude that we had achieved our target for that species. On the other hand, if wild salmon harvests increase throughout the state, we may have justification for attributing some of the local increase to factors other than our own rehabilitation/enhancement projects.

Research/Data Collection and Evaluation Goals

There are a number of necessary and associated studies that will not directly be expressed in production/harvest numbers but may indirectly result in more fish. These studies will contribute to a stronger fisherman/manager/resource relationship that, in turn, will contribute to increased production and more efficient harvests. For example, hydroacoustical and limnological investigations will help clarify the (1) manner and extent to which salmon are utilizing the Chignik and Black Lake systems and (2) increase in production per unit area of the lakes that can realistically be expected. Also, increased escapement monitoring and smolt studies or stock separation studies (for example, age-structure, run timing, scale analysis, genetics, etc.) in other systems in the region will further increase understanding of the resources' potential.

Policy/Management Goals

One of the corollary goals is to support adequate funding of proposed research, data gathering, and production projects that assist Commercial Fisheries managers in the region. As a matter of policy the plan would be continuously reexamined in the context of that new information. All efforts supporting continuation and improvement of relationships and coordination between state, private nonprofit associations, and federal agencies involved in rehabilitation and enhancement activities will ultimately benefit the resource and those using it. It also must be recognized that, although the primary goal of the plan is for the rehabilitation and enhancement to the area's salmon stocks that will ultimately benefit the user groups in the Chignik region

(CFEC permitted commercial, subsistence, and sport fishermen), it is not the intent of this comprehensive plan to produce fish that further complicate allocative decisions in our region or in adjoining regions.

Policy for Evaluating Habitat Modification Projects:

Safety, security, and enhancement of the salmon resource have the highest priority. Adequate scientific research and peer review concerning potential negative impacts of all habitat modification proposals will be accomplished before any such project is implemented; the consensus among scientific investigators will be that no negative impacts to the salmon resource will occur as a result of implementation of such projects. Accordingly, there should be reasonable scientific grounds for believing that a given habitat modification enhancement project will result in improved salmon runs, which is a less rigorous scientific standard than one that guarantees the success of such a project and its subsequent benefit to the resource and its users alike. Where the risk is not damage to the habitat or salmon stocks but simply the potential failure of the project to enhance the salmon runs, the risk is primarily a financial one, which the CRPT may at its discretion choose to recommend implementation of a project.

Objectives

The establishing of objectives is a process whereby long-term goals are broken down into attainable short-term increments (for example, 5-year increments within a 20-year plan). From

this perspective, objectives are therefore benchmarks taken at a specified interval to measure a plan's progress and assess whether it is proceeding adequately toward meeting the goals; however, in Chignik the initial 5 years of planning will be devoted to habitat improvement projects and research. In addition to the various studies that have been and will be initiated, the CRPT has adopted an aggressive 5-year planning process for implementing projects such as the stabilization of the water level of Black Lake, stream passage improvement, stock status and limnology investigations, and beaver dam removal projects, in order to achieve the regional need for consistency and stability in the harvest. Moreover, the CRPT has selected a 20% overall increase in the harvest of each species of salmon by 2002 (10-year target); however, these increases per species will occur in the ten years following the initiation of rehabilitation and enhancement projects. To reach that single objective per species (see Table 12), the plan has set out strategies and projects in the **5-Year Action Plan** (see page 71).

Strategies and Projects

Those general statements of priorities to guide specific actions of agencies and associations working toward research, management, enhancement and rehabilitation goals and objectives for the salmon resource are strategies, and the specific tactics and actions employed to address them all are the projects. As such, they represent the heart of the 5-Year Action Plan--a means of resolving the production/harvest/management/research needs (in the short-term) of the regions users of the salmon resource. As each project is presented a complete description of the participants, the species involved, the work to be done, and the schedule for completion will be

identified. It is through the projects that a fuller understanding of the salmon species of the region is attained, and they may be use singly or in combination to address strategies and achieve objectives and goals. These projects may be used singly or in combination to address strategies and achieve results. The implementation of projects may indicate additional research is necessary, yield information applicable to other strategies, or contribute additional fish to the common property fisheries as well as new data to our understanding of the resource. In the context of the 5-Year Action Plan applicable strategies and projects will be provided for each of the goal categories (i.e., production/harvest, research/data collection/evaluation, and policy/management) for each species on a prioritized basis that are ranked as follows: (1) sockeye, (2) coho, (3) chum, (4) chinook, and (5) pink.

Production/Harvest Strategies:

These strategies are designed to replenish depressed stocks and increase the number of naturally occurring salmon beyond levels that they would reach without intervention (e.g., restoration and enhancement techniques). The following are strategies for Chignik that will be more thoroughly addressed in the following section (that is, Rehabilitation and Enhancement Techniques and Projects): water flow/water level structures, improved techniques for escapement management, stream clearance, spawning channels, fish passes, predator control, lake stocking, stream stocking, instream incubators, lake fertilization, and hatcheries.

Research/Data Collection and Evaluation Strategies:

These strategies provide effective tools for resource management. They are therefore indirect and supportive, compared with production/harvest strategies. By necessity they are employed in the long-term and demand a dedication of funding, staff, and consistency of approach in order to obtain the useful results. The following are general strategies that may be addressed during the course of the planning period: field surveys, computer modeling, data gathering, data analysis, qualitative sampling, fish enumeration, sockeye predator population studies, and stock separation studies.

Information concerning salmon biology and migration (i.e., stock separation) characteristics as well as the level of contribution to various fisheries can be obtained from well designed stock separation studies. Information from this type of work is very helpful in the fishery management decision making process to assure that wild stocks harvest levels and escapement can be maintained in balance and to allow for continued healthy perpetuation of the salmon runs. Additional information concerning movements and residence time of salmon in the coastal waters of the Alaska Peninsula would be very helpful.

Policy/Management Strategies:

Salmon populations in the Chignik region are managed on a sustained-yield basis. This requires the achievement of escapement goals to provide the seed for future production. When these

escapement goals are assured, the remaining fish are available to the area's common property fisheries (subsistence, commercial, sport). Allocation of fish among user groups is under the purview of the Alaska Board of Fisheries and is described by regulation. Alaska state law provides a subsistence priority over the other user groups. The focus for managers and fishermen alike in the Chignik area is to maintain and protect wild stocks by attaining the escapement goals for each species. Achievement of escapements into the major spawning systems is the priority. The following are general strategies that may be addressed during the course of the planning process: imposition of fishing periods, coordination of emergency closures and openings, escapement monitoring of all species to achieve reassessment of escapement goals for sockeye, test fishing, establishment of bag limits and licensing, limitation of entry into a commercial fishery (CFEC), imposition of gear specifications, and opening and closing fishing areas.

ENHANCEMENT, REHABILITATION, RESEARCH, AND MANAGEMENT TECHNIQUES

Definitions

The techniques used in the supplemental production of salmon will fall into one of two categories that are defined as follows: (1) **Enhancement**--the application to a stock already at natural capacity of procedures designed to increase the numbers of harvestable fish; this may be accomplished by using artificial or semiartificial production systems, increasing the natural productive habitat through physical or chemical modifications, or improving escapement

management and (2) **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.

Fish Habitat Restoration and Improvement Techniques

Water Flow Structures:

Techniques such as stabilizing stream banks or installing structures (e.g., boulders, woody debris) to maintain riffles and pools in a stream are used to provide fish habitat. Water level or water flow direction in some instances can be adjusted with various structures to improve fish production. It is also possible to connect ponds to existing salmon producing systems to expand available rearing areas and thereby increase production. As with the other techniques that will be addressed, habitat manipulation projects must be carefully evaluated by CRPT prior to installation.

Water Level of Black Lake. Black Lake (Fig. 10) in the Chignik Lake system is an unusual sockeye lake because (1) it is exceptionally shallow (<4 m) and (2) adult sockeye production (e.g., run size; return/spawner) there fluctuates more than that of other major sockeye systems (Ruggerone et al. 1992). Sockeye production in Black Lake may be enhanced by stabilizing the lake's water level near the high-water mark. Recently, Ruggerone et al. (1991) suggested that the large fluctuations of adult sockeye returning to the lake were influenced by the lake's

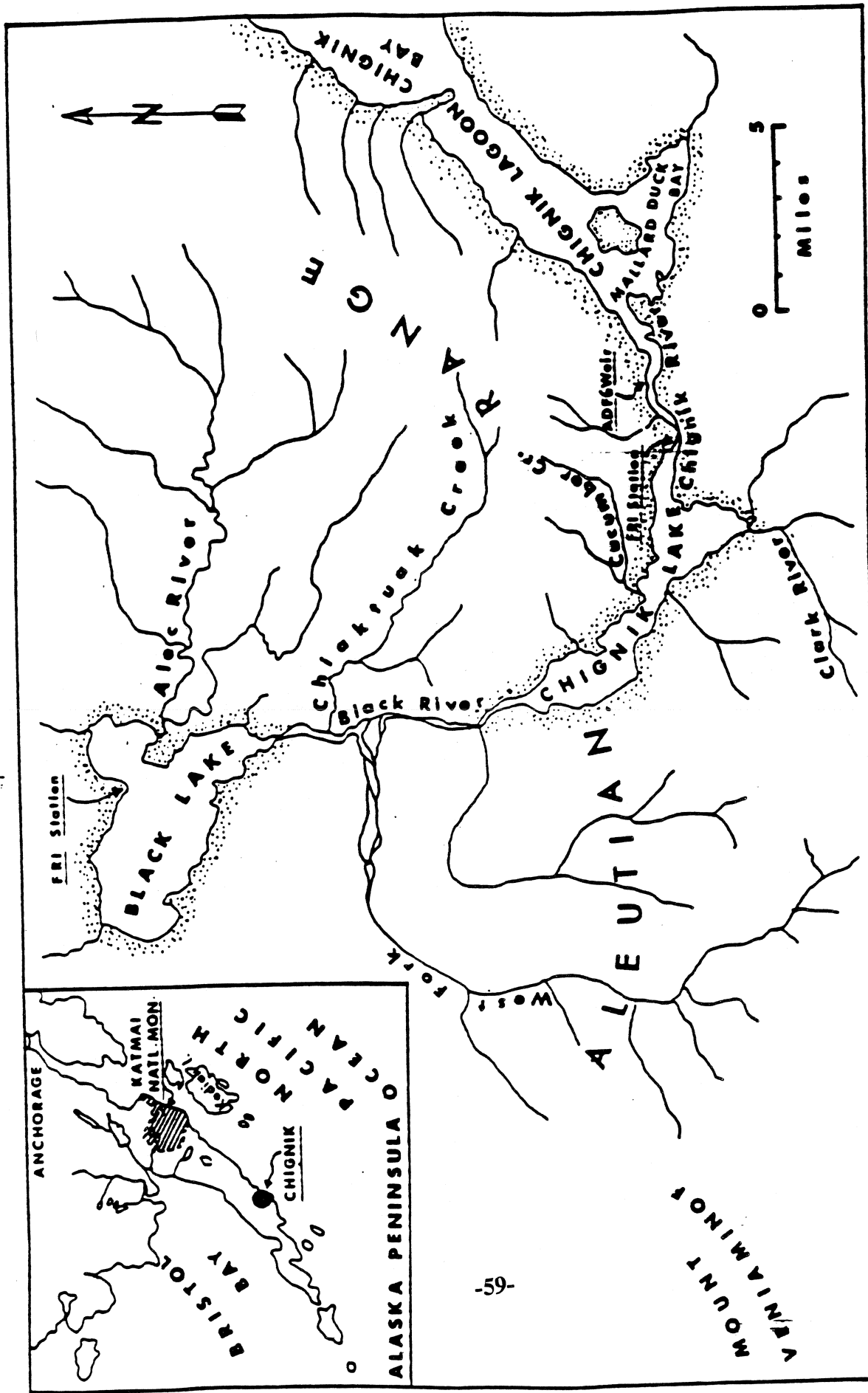


Figure 10. Chignik River drainage, showing locations of Chignik and Black Lakes (source: Kyle 1991).

inability to buffer short-term fluctuations in weather. Furthermore, lake depth measurements, aerial photographs, and observations by local residents and previous researchers indicated the lake has become more shallow since 1960.

Researchers are investigating (1) the amount of habitat lost during the winter because of low water levels as well as low dissolved oxygen levels, (2) avoidance of low dissolved oxygen levels by juvenile sockeye, (3) premature emigration of fry to Chignik Lake, and (4) effects of rapid water temperature increases on sockeye health. Furthermore, investigations are being initiated toward determining feasibility of stabilizing the level of Black Lake at about 1 meter above the low-water level and nearly double available sockeye habitat during the winter or early spring. Although the method for achieving lake stabilization has not been determined, the passage of upstream migrating adult and juvenile salmon as well as boats must be provided for. The presence of upstream migrating salmon fry has not been identified; however, it will be investigated.

Alec River Diversion. The Alec River (also known as the Scow River) drainage (Fig. 11) supports the great majority of spawning sockeye salmon returning to Black Lake. Observations indicate that the river is changing course approximately 2 km (1.2 mi) upriver from the lake. Flow measurements made during a low-water period in 1990 demonstrated that 60% of the water entered a side channel leading to Fan Creek and the outlet portion of Black Lake. Comparison of aerial photographs during the late 1950s with recent observations indicate the amount of water draining to the lake outlet has grown. The changing distribution of water flow appears to have

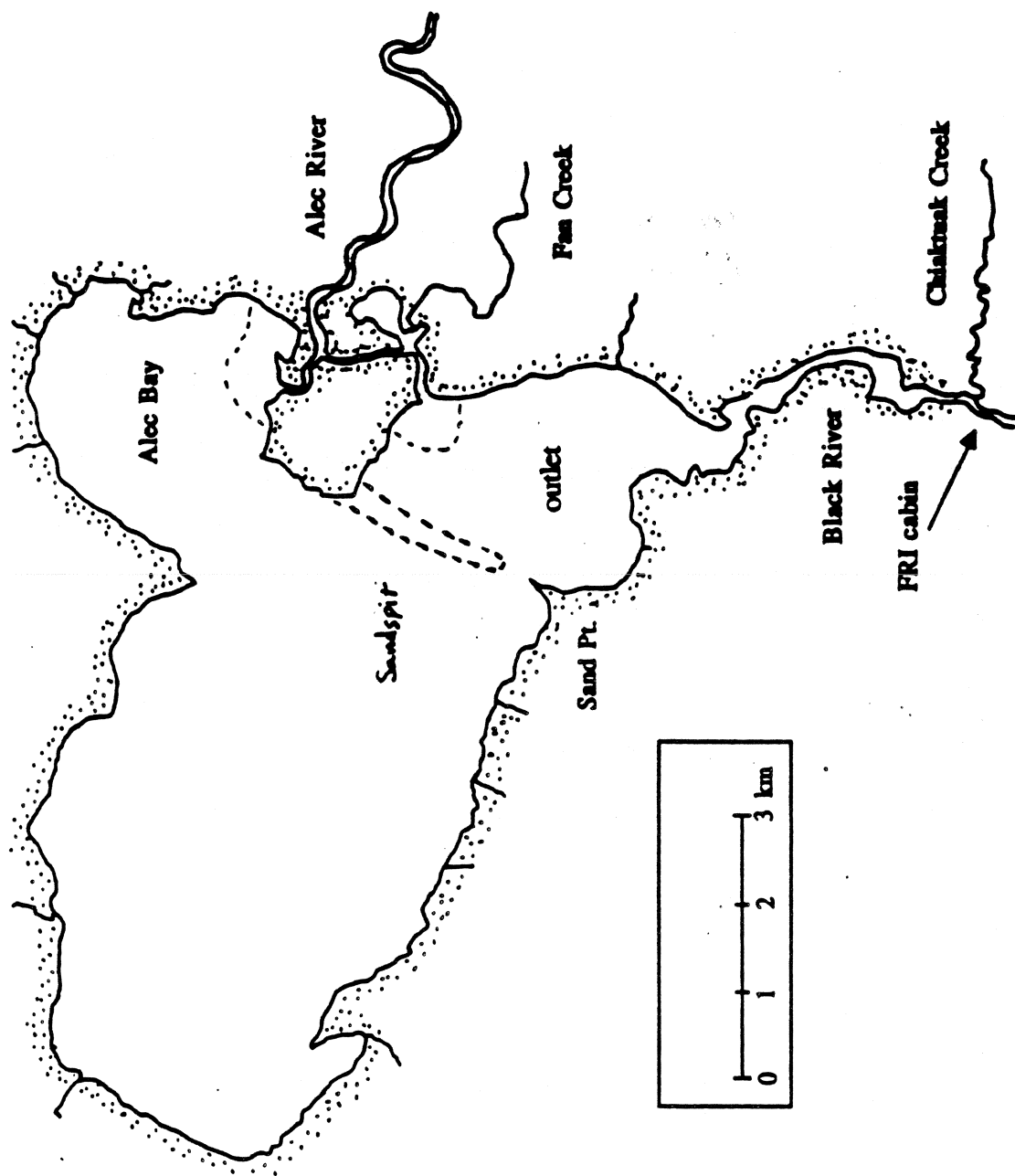


Figure 11. Black Lake in the Chignik Lake system. Note the channel connecting Alec River with the outlet area and the sand bar that separates the main lake from the outlet during low water (source: Ruggerone and Denman 1990).

enhanced the rapid growth of the sandspit that separates the lake outlet from the main lake (Ruggerone and Denman 1990). At low water this sandspit crosses 80% of the lake. Observations by FRI researchers, who have spent several weeks at Black Lake during each year in the early 1960s, indicate that the sandspit has grown considerably.

Left unchecked, Alec River will probably shift towards the outlet of Black Lake and the sandspit crossing the lake will grow (Ruggerone and Denman 1990). Emerging sockeye in the Alec River would be carried downstream to the shallow outlet area (< 1.5 m) and might migrate to Chignik Lake (as many do now), rather than find the entrance to the main lake area. To rectify this problem, researchers are investigating methods to divert water back to Alec Bay.

Stream Clearance:

Despite its simplicity and cost-effectiveness, this technique has some attendant risks. Complete removal of physical barriers (e.g., beaver dams, rocks; logs, driftwood, beach gravel deposits, or other debris) may, in turn, cause downstream scouring, elimination of pooling areas, or creation of velocity barriers; therefore, selective removal of a portion of a barrier sufficient to allow passage of fish upstream without substantially altering the flow of water or downstream conditions is required. When evaluating potential stream clearance projects, assessments should be made of the unutilized spawning or rearing habitat that will be made available, the portion of the barrier to be removed, the availability of sufficient spawning populations to make use of the new habitat, and the costs (time and equipment) involved.

Required applications vary from system to system; in some instances the rearranging of rocks or logs by hand to provide resting pools and shorten jumps over falls may be all that is needed. When beaver dams frequently block salmon streams or rearing habitat in the Chignik region, the temporary removal of portions of the dams also can be an effective means of modifying obstructions to provide access to spawning or rearing areas. Providing access to blocked side channels, lakes, or sloughs can also in some instances provide additional rearing area for coho.

Beaver Ponds, Water Levels, and Sockeye Production. According to local residents, the beaver population in the Chignik area has increased substantially during the past 20 or 30 years. Beaver ponds occur on numerous sockeye spawning streams that feed Black Lake as well as on the Clark River, which flows into Chignik Lake. These ponds may be responsible for decreases in sockeye production by reducing spawning habitat through stream blockages or siltation of spawning areas. Specifically, beaver ponds may reduce water flow to Black Lake, which is already shallow, if the water loss in the ponded areas through transpiration and/or evaporation is sufficiently high. The effects of beaver ponds on sockeye production in the Chignik area need to be addressed.

Spawning Channels:

Artificial spawning channels are designed to increase and enhance natural spawning habitat through control of such factors as water flow (cfs), substrate, sedimentation, and predation and thereby increase the egg-to-fry survival rates. While the average egg-to-fry survival rates in a

natural stream may be a little as from 10% to 15%, the introduction of spawning channels may increase those survival rates by as much as from 35% to 80%. Implementation of this technique requires a controllable water source, proper terrain, and sufficient brood stock to utilize the spawning channels. Because spawning habitat is not limited for sockeye salmon in the Chignik area, the application of this technique would be most promising for chum salmon.

Fishpassage Improvements:

The construction of a fishpass (fish ladder or steep pass) is a permanent form of habitat modification to enable fish to access spawning and rearing habitat beyond an impassable barrier such as the vertical face of a waterfall. This technique can be applied as either a constructed fish ladder (i.e., made of concrete, steel, or aluminum) to bypass a barrier or as an alteration of the barrier itself (e.g., through explosives to provide a series of ascending resting pools); however, their success will depend on an adequate preconstruction evaluation, including estimates of high- and low-water flows as well as the species and number of fish utilizing the system. Experience in these techniques over a broad range of conditions have allowed us to conclude that a well-placed fishpass can potentially yield a high benefit-cost ratio.

Predator/Competitor Control:

These techniques address modifications of the biological habitat, rather than the physical one. The techniques involve attempts to improve various conditions for salmon stocks at any one or

a number of different stages of their life cycle by taking direct action on species who prey on them or compete for their spawning habitat, food, or rearing area. Historically, projects have attempted to reduce populations of Dolly Varden char or sticklebacks from salmon streams. Resident fish in both Black and Chignik Lakes include threespine stickleback, ninespine stickleback, and pond smelt which are potential competitors for food. Historical information suggests that Black Lake supports a higher abundance of resident fish than Chignik lake, but interspecific competition for food may not be extreme because of divergence of food habits (Parr 1972). Ruggerone and Rogers (1992) identified predation by juvenile coho on sockeye salmon in Chignik Lake and identified an integrated harvest management strategy for coho and sockeye that would stabilize predation by juvenile coho on sockeye salmon fry. Present management of coho allow coho escapement to fluctuate depending on run size, whereas the sockeye escapement goal is fixed at 250,000 adults. Stabilization of the coho to sockeye spawning ratio could lead to enhanced runs of sockeye salmon, because from 1985 to 1987 coho were the major source of mortality for sockeye after they entered Chignik Lake (Ruggerone 1989, Ruggerone and Rogers 1992).

Limnological/Fisheries Investigations:

Limnological surveys were conducted four times on Black and Chignik Lakes during June and September 1991 by ADF&G staff. The collection of physical data included the measurement of lake temperature, dissolved oxygen, and light penetration. Water samples were analyzed for the following parameters as detailed by Koenings et al. (1987): conductivity, alkalinity levels, calcium, magnesium, turbidity, color, and total iron. Nutrients, phytoplankton, and zooplankton

calcium, magnesium, turbidity, color, and total iron. Nutrients, phytoplankton, and zooplankton levels were also determined, and a hydroacoustic survey was conducted in September 1991 to estimate the number and distribution of juvenile fish (sockeye salmon fry) rearing in Chignik Lake. The total population estimate of juvenile sockeye salmon there was 1,715,144, which represents a low population based on both euphotic volume and standing stock of macrozooplankton; that is, based on an euphotic volume (EV) of 158.9×10^6 , Chignik Lake would be forecasted to support a total of 5.2 million sockeye juveniles in the fall. In contrast, based on a standing stock of macrozooplankton, Chignik Lake would be projected to produce 14.5 million threshold-size smolts (2.2 g) or 6.4 optimum size (5.0 g) smolts. Hindcasting the population of all juveniles and assuming a 65% fry-to-smolt survival indicates that for the projected number of threshold size smolts, a total of 23 million juveniles would be rearing in the fall, and for optimum size smolts a total of 9.8 million fry would be rearing in the fall. Thus the fall population estimate of juvenile sockeye in September 1991 (based on hydroacoustic survey and townetting) was well below the projected rearing capacity of Chignik Lake based on euphotic Volume (Koenings et al. 1989) and standing stock of macrozooplankton.

Lake Fertilization:

Sockeye salmon production in the Chignik system is dependent on the rearing environments of Black and Chignik Lakes. Historically, Chignik stocks have formed the bulk of the total run into the Chignik system. Black Lake is a shallow, turbid system that produces fry that are thought to overwinter in Chignik Lake and large age-1 smolts. Chignik Lake is a large, clear

system that produces very small age-1 smolts. The existing pressure on the food base for resident Chignik fry, even without the added pressure from nonresident Black Lake fry is excessive. The geomorphological structure of Chignik Lake suggests a nutrient poor, unproductive environment for rearing fish relative to that for Black Lake. The poor growth of Chignik fry is apparent by the minimal size of the smolts and the mass starvation of fry witnessed to occur at the lake in the past.

The addition of nutrients to these lakes may increase the quantity of phytoplankton and, in turn, the quantity of zooplankton, which is the major source of food for rearing fish. Most importantly, these organisms resulting from lake fertilization must not disturb the community balance of existing plankton in the lake. Studies have shown an absolute correlation between the availability of food to juvenile salmon, their size at outmigration as smolts, and their survival in marine waters. Because of the inherent variability within and between lake systems, before a lake enrichment project is initiated, technical studies (e.g., limnological) will begin at least two years (in most cases) prior to actual fertilization and continue until at least two years after fertilization. Such evaluations of the physical, biological, and chemical status of the lake is mandatory in order to properly determine the success or failure of nutrient enrichment. Without an evaluation program, scientific and monetary benefits from lake enrichment projects may not be clearly identified, nor will benefits likely reach the maximum potential (Koenings 1979.) After studies indicate the rate and frequency of fertilization, the fertilizer is applied; thereafter, a postfertilization study is conducted to evaluate the effects of the application. This assessment

must be related to the overall physical/chemical condition of the lake, growth of juvenile salmon, and subsequent contributions to the regional fisheries.

Research/Management Techniques

Reevaluation of Sockeye Escapement Goals:

The existing escapement goals for sockeye salmon in Chignik and Black Lakes were developed in 1965 by FRI researchers who examined both the spawner/recruitment relationships during 1922-1964 and rearing capacity of the lakes (Narver 1966, Dahlberg 1968). These researchers recommended that the escapement goals be reexamined after a decade. Ruggerone (1989) published a brood table (a necessary tool for evaluating escapement goals) that incorporated scale pattern data for identifying stock specific run size. Small changes are needed to make the brood table more consistent over time. The goal of this reevaluation is to maximize the sustained harvest of sockeyes from the Chignik systems.

Management of Sockeye and Coho Salmon After Weir Removal:

Sockeye salmon enter the Chignik River from early June until early October, and coho salmon enter the river from early August until mid-October. A weir is used to enumerate sockeye salmon escapement from early June until approximately mid-August, when the weir is removed. Thus a significant portion (i.e., about 20%) of the total sockeye salmon escapement to Chignik

Lake and 100% of the coho salmon entering the Chignik River are not enumerated during the season. The escapement for these fish could be estimated during the season using a modified version of the catch-per-unit effort technique described by Ruggerone (1989). The data would be useful for their application toward management of the fishery; furthermore, these data would be a useful reference for stabilizing the sockeye:coho escapement ration, which is an important one because juvenile coho salmon are a major predator of juvenile sockeye salmon in Chignik Lake (Ruggerone 1989_a, 1989_b, 1989_c; Ruggerone and Rogers 1992).

Other Enhancement Techniques

In-Stream Incubation Units:

The application of this technique involves use of a large container in which fertilized eggs and selected gravel (substrate) are placed in alternating layers. A plumbing system forces water up through the gravel. Such units control the water flow, substrate type, sedimentation, and predation to provide green-egg-to-fry survival rates as high as 90%. In-stream incubators are a low-cost enhancement technique that are ideally suited for small operations at remote sites. After artificial spawning of the brood stock and placing of eggs in the unit, minimal care is required. When they are used for enhancement of indigenous stocks, these units can eliminate the genetic and pathology concerns associated with transport of eggs or fry. To effectively apply this technique, the following prerequisites are needed: (1) high-quality water source, (2) adequate head (i.e., height differential to provide sufficient flow) without installing excessive

length of piping, (3) suitable stream bottom, and (4) protected area for incubation units. These units can be used to bolster fry production independently or in combination with lake fertilization and fishpass projects.

Lake Stocking:

When a rearing area is a limiting factor in salmon production, lakes can be used as natural nursery areas. Some lakes (i.e., rearing habitat for chinook, coho, and sockeye salmon) are underutilized because there may be not enough fish returning to the system or access is blocked; however before this technique is applied, specific criteria need to be considered. (1) the lake must be located in an area that would facilitate harvesting the returning fish; (2) prestocking studies (e.g., limnological, predation, etc.) need to be initiated to determine suitability of lakes to ensure that planted fry would grow and survive until outmigrating to marine waters; and (3) stocking densities and timing need to be determined to optimize success.

Stream Stocking:

When streams have areas of underutilized habitat that can serve as natural rearing areas, a variety of stream stocking techniques may be helpful in rehabilitating declining populations of wild stocks. The various techniques follow: (1) after artificial spawning, green eggs are planted; (2) after artificial spawning and partial incubation, eyed eggs are planted; (3) after artificial spawning and incubation, unfed fry are released; (4) after artificial spawning,

incubation, and partial rearing, fed fry are released; and (5) after artificial spawning, incubation, and rearing smolts are released into the stream.

Hatcheries:

Hatchery facilities are generally eight times more efficient in converting eggs to juvenile fish than the natural environment. The efficiency of such production shortens the time involved in rehabilitating depleted stocks. Because of sizable initial capital investment, hatcheries may appear to be an expensive means of supplementing salmon production; also, the longer a hatchery holds fish, the more money it invests in each fish. This relationship is mitigated, however, by the improved survival of fish that have been more fully developed in the hatchery. Short-term rearing can double marine survivals and substantially increase hatchery feasibility. Because of the optimal productivity of the Chignik and Black Lake systems, this may not be perceived as a viable or necessary option for the region.

FIVE-YEAR ACTION PLAN

Sockeye Salmon Projects

The Chignik/Black Lake system's sockeye salmon resource is the most important species of salmon in the area. The resulting runs produced from these lakes not only support the Chignik area fisheries, they also significantly contribute to the salmon fisheries of the Kodiak and Alaska

Peninsula management areas. Continued success of these two sockeye runs will depend on a better understanding of the carrying capacities of Black and Chignik Lakes. The upgrade and review of pertinent data derived from limnological/biological studies of these lakes will provide that understanding. This data, when combined with a review of escapement goals and stock identification, fry/smolt, and other pertinent studies and then incorporated into management strategies, should result in the achieving of a consistent and healthy production of sockeye salmon.

Enhancement/Research Investigations:

Number-One Hydrology Project. Determine whether the water level in Black Lake can be stabilized above its current level in a manner that does not disrupt fish migrations. Researchers are investigating methods for stabilizing the water level of the lake and the sockeye production by placing structures near the lake's outlet or removing beaver dams from the tributary systems above the lake to bring the water level up 1 meter above low water and nearly double the rearing capacity of the lake. These structures must allow for the passage of upstream migrating adult and juvenile salmon as well as boat access to subsistence fishermen. Although the presence of upstream migrating salmon fry has not been identified, it will need to be investigated before any structures would be placed (for further discussion see **Effects of Beaver Dams on Sockeye Salmon Production**, page 74).

Number-Two Hydrology Project. In the Alec River during higher water flows, 70% of the volume of water is discharged to the lake outlet at Black River. This phenomenon raises the question of whether sockeye fry are moving prematurely down into Chignik Lake. Investigations need to be initiated to determine the biology and mechanics (hydrology) of this system. Moreover as more of a silt load is dumped into Black Lake, causing the water temperatures to fluctuate dramatically because of its shallowness and because its dark substrate absorbs heat, studies need to be conducted on the heat tolerance of sockeye fry. Diverting Alec River to maintain the rearing environment in Black Lake and thereby increase its production per unit area is one means of addressing the problem. Additional research/data will be needed on the type of structure necessary to divert the river; flood conditions; and historical tributary patterns through infrared photography.

Smolt Enumeration and Sampling. This project would provide data on smolts emigrating from both Chignik and Black Lakes necessary to compare actual juvenile production with existing models, determine the importance of each lake to total juvenile production of the Chignik system, and provide smolt age and size information which is critical to characterizing existing conditions of the rearing environment.

Chignik Lake Enhancement Study Team Aerial Photos. These studies of Black and Chignik Lakes will be useful in determining the extent of beaver dam incursion into this system and in achieving a fuller understanding of their detrimental and beneficial impacts; (1) **beneficial**--they provide extensive rearing areas for fry and prevent scouring during periods of flooding, and (2)

detrimental--they may obstruct adult salmon migration and affect water levels and temperatures downstream, in that more drainage surface area provided by beaver ponds also provide for greater evaporation rates and elevated temperatures.

Effects of Beaver Dams on Water Level and Production. Location of beaver ponds need to be mapped using aerial photos taken by the Chignik Lake Enhancement Study Team in the fall of 1991 (note: most of the Alec River drainage still needs to be photographed). Aerial surveys need to be conducted during the spawning periods (e.g., 10-20 August for the Alec River and September in the Clark River) to help catalogue ponds and determine whether sockeye salmon migrate beyond the dams. Foot surveys could also be conducted, but these could be difficult, especially if the dams are numerous and an airplane is necessary to provide access to the upper Alec River drainage. Aerial surveys should be conducted with high-wing aircraft (e.g., Super Cub, Cessna 180), and during these surveys photos should also be taken of each stream.

A literature survey needs to be conducted to determine water transpiration rates for vegetation in the Black Lake drainage. These rates as well as those for evaporation should be evaluated to determine whether significant quantities of water is lost prior to entering Black Lake. A worst-case scenario should be examined before a detailed water budget is developed.

Continuing Studies/Research:

Winter Study. These investigations include projects at principally Black Lake (but including Chignik Lake) to investigate (1) the reasons why there is so much fluctuation in the Black Lake run size from year to year and (2) the mechanics for the redistribution of water in Black Lake. Because aquatic plant growth may be reducing the amount of oxygen to rearing fish in Black Lake, a profile of oxygen concentrations throughout the lake is needed to determine its effect on rearing fry. In a corollary project the oxygen levels that sockeye and coho salmon fry could tolerate at various depths in Chignik Lake were investigated over a 24-hour period to determine mortalities per oxygen level. Based on the hypothesis that there should be a greater density of rearing sockeye fry in Black Lake than in Chignik Lake, fry traps were set out in both lakes.

Limnology. These investigations assess the physical, chemical, and biological parameters of the Chignik/Black Lake system. When completed (note: the initial year's investigations have been completed), these studies will provide an opportunity to assess the consistency of escapement goals (i.e., established in the 1960s) with the current biological productivity of the system. These study efforts are also directed toward ascertaining deficiencies in the food chain that can be made up through nutrient shifts using enrichment procedures. Limnological/ichthyological reconnaissance of Chignik/Black Lake system may be conducted for 2 years with the purpose of understanding the processes involved in production of food for juvenile sockeye salmon. If the investigation supports the hypothesis that the small size of Chignik Lake smolts is due to a growing season shortened by lack of sufficient nitrates early in the season, the study

would move into the next phase, which would be fertilization. One of the benefits of such an investigation would be the development of a better continuing studies program, providing the kind of annual measurements that would determine ongoing health of the system and provide managers with early clues as to how the system is doing.

Management/Research:

Reevaluation of Escapement Goals for Sockeyes. Sockeye salmon production in the Chignik system was studied extensively in the late 1960s and early 1970s. These data are now over 20 years old. This investigation would use either limnological or return-per-spawner data in Black and Chignik Lakes to evaluate and adjust escapement goals.

Existing Chignik River Weir. This weir is the most important tool that is utilized in the management of the Chignik/Black Lake system's returning sockeye salmon; it enables managers to accurately access the numbers of salmon escaping upriver to spawn. Commercial fishing is not allowed until interim escapement goals have been reached. The data derived from weir counts are essential in assisting in the determination of the spawners in each run; i.e., Chignik Lake and Black Lake returns. The possibility of maintaining the weir through the fall so that a more complete set of escapement data for both coho and sockeye salmon could be obtained should be investigated. The technique of counting fish 10 minutes/hour at the weir gate and on that basis estimating the count for the rest of the hour should be evaluated to determine if it is sufficiently accurate for estimating the total escapement of sockeye salmon into the system.

Sonar Counter on Chignik/Black River. The Chignik River weir is a very accurate tool for enumerating the salmon moving into the system; however, the construction and maintenance of the weir is time consuming and labor intensive. The weir is also susceptible to washing out during high-water conditions, when salmon escapement cannot be enumerated. This can be costly to the fishing industry because of lost fishing time and possible overescapement. Department (ADF&G) staff are also unable to leave the weir in place beyond August 10 because of limited funding as well as the high-water conditions encountered in the fall. After the weir has been removed, escapement estimates are based on fishing performance in Chignik Lagoon; unfortunately, these estimates potentially have a high degree of error. When a weir is not feasible, sonar technology could provide an accurate estimate of the total escapement, increase in-season management precision, and allow for testing of assumptions used by biologists to determine the final post-season run estimates. This technology would be ideally suited for implementation in the Black River, which drains Black Lake. A sonar counter at the Chignik River weir site could additionally provide a reliable back-up method in the event a portion of the weir is removed by flood conditions, similar to those occurring in 1986 and 1988. The success of this technology in other systems in Alaska warrants further investigation as to its feasibility in the Chignik/Black Lake system.

Stock Identification Studies. Sockeye returning to the Chignik Lakes system are composed of two stocks--one returning to Black Lake (early run) and the other to Chignik Lake (late run). Sockeye escapement goals for Black Lake and Chignik Lake stocks are 400,000 and 250,000 fish, respectively. Based on the premise that threshold escapement levels for each run can be

achieved by a specific date, commercial fishing time for sockeye salmon has been regulated. Monitoring escapement with respect to achieving these thresholds is complicated by an overlap of the timing for the early and late runs; i.e., the transition period, which generally occurs during the latter part of June through mid-July.

Two methods have been developed to estimate the daily proportions accountable to each run during the transition period. The first is based on tagging studies conducted from 1962 to 1966 (Dahlberg 1968), which allowed biologists to develop an average time of entry (ATOE) curve to apportion the Chignik sockeye salmon runs into the early and late components. A form of this method is currently used for in-season management of the fishery. The second method is based on differential growths of juvenile salmon rearing in Black Lake, compared with those rearing in Chignik Lake (Burgner and Marshall 1974, Conrad 1983). Sockeye fry rearing in Black Lake emerge earlier and grow at a faster rate than fry rearing in Chignik Lake (Narver 1966). The disparity in growth rates of fry rearing in Black Lake and Chignik Lake is reflected by their scale patterns--when they are measured (i.e., scale pattern analysis [SPA]), they provide the variables used to separate Black Lake and Chignik Lake stocks. Postseason SPA is preferably used instead of the ATOE curve for the final postseason allocations of fish to either the early or late runs. Continued research into refining methods of separating the two runs is essential for the continuing improvement of management and production of the systems sockeye salmon.

Stock Separation Studies. Further age structure, run timing, and scale pattern studies would help determine sockeye salmon origins in the Shumagin Islands and in the Westward/Perryville management districts.

Hatchery Site Investigations:

Investigate Ivanof, Perryville, Ocean Beach, Coal Creek, and Aniakchak Creek for adequate sources of disease-free (i.e., IHN-free) water for potential siting of a hatchery facility there.

Coho Salmon Projects

Although coho salmon are considered the second most important species of salmon in the region, limited data exists for this species. We need to gain a better understanding of the strength and potential of coho production.

Systems Investigations:

A 3-year study period to determine, catalogue, and inventory major coho systems in region through aerial-survey techniques, particularly Port Wrangell, Long Beach, Aniakchak River, Foot Bay, and Amber Bay.

Instream Incubation Boxes:

Introduction of this smaller-scale, lower-tech enhancement and rehabilitation project may be a practical and efficient means of increasing production in those systems having insufficient spawning areas.

Habitat Modification:

Clearing logs and boulders from streams or providing alternate means to access systems blocked by impassable barriers may be practical and efficient means of increasing production.

Recreational Opportunities:

Sport fishing opportunities need to be investigated in the Chignik system. The community of Chignik Lake might be interested in developing a sport fishery there.

Pink and Chum Salmon Projects

Regionally, in terms of effort that should be directed toward increasing production, chum and pink salmon have been ranked 3 and 5 (lowest priority) in the region. The lower priority for pinks has been based on the historical commercial harvests trends as well as the more recent 1991 decline in their marketability.

Habitat Modification:

Stream clearance of blockages in applicable systems should be investigated for both species, particularly because pink salmon are also utilized by subsistence fishermen. An investigation should be initiated to determine why Portage Creek has not been consistently producing chum salmon. One possibility is that there may be so many fish that they might be disrupting each others redds; however, the streambed may be rocky and during the winter the volume of water may be considerably reduced. Thus two things need to be determined: (1) the available spawning area and (2) whether or not blockages exist to prevent chum salmon from getting into the spawning area. Once the system has been assessed, strategies can be developed to remedy the problems.

Instream Incubation Boxes or Spawning Channels for Chums:

Because most chum salmon systems on the south side of the Alaska Peninsula are short and have limited spawning areas. These limitations can be countered by using spawning channels or incubation boxes to increase production. Thus these systems should be identified and follow-up investigations should determine which of the two techniques would be the most suitable and cost-effective.

Tagging/Marking/Recovery Program:

Fish marking and recovery is used to assess fish movements and estimate size or variance in size of fish populations. Mark/recovery investigations are applied by biologists to help answer these types of questions concerning fish in freshwater and saltwater environments. Mark and recovery studies will be conducted in the Black and Chignik Lake system in association with fish population and emigration studies. A tagging study to evaluate the movement, distribution, and harvest of Chignik-Black Lake sockeye salmon in fisheries outside the Chignik area also may be implemented. In other areas of Alaska mark/recovery studies are utilized to assess the contribution of enhanced fish to fisheries and to allow proper management of wild stocks in fisheries where wild and enhanced stocks are commingled.

CONTINUATION AND IMPLEMENTATION OF THE PLAN

The Regional Planning Team's Role

Alaska statutes specify three functions of the Regional Planning Team: (1) development of a comprehensive salmon plan, including provisions for both public and private nonprofit hatchery systems (AS 16.10.375); (2) review of private nonprofit hatchery permit applications (AS 16.10.400 [a]); and (3) review of the proposed suspension or revocation of a permit (AS 16.10.430). The remainder of this chapter provides a further elaboration on the responsibilities identified above and also a description of the annual updating process.

Ongoing Planning

Alaska Statute 16.10.375 provides the CRPT with the responsibility for development of a comprehensive salmon plan. Plan development is a constantly evolving process, as opposed to one that is fixed or static. This nature of the planning process gives CRPT a continuing role in salmon rehabilitation and enhancement planning. The CRPT is responsible for relating actual events to the plan and making the plan responsive to new knowledge, ideas, and changing conditions.

Opportunities have thus far been presented within a 5-year time-frame. Numerous unknowns surround many of these opportunities, and some will never become actual projects. As projects

in the five-year action plan become implemented or are determined to be infeasible or undesirable, they will be replaced with new projects for the upcoming five years.

The 5-year plan will be revised as necessary. A procedure for an annual update of the action plan will allow for revision of certain sections. At times, new information and events will require the reevaluation of goals, objectives, area and site-specific targets, or assumptions used for planning.

Annual Update

The comprehensive salmon plan is designed to be a working document that provides a framework for increasing salmon production for the Chignik area; therefore, it will be updated on an annual basis, and an annual report on regional comprehensive salmon planning in the Chignik region will be submitted to the Commissioner of ADF&G. For these annual updates, the CRPT will meet at least once a year to discuss (1) reports on current projects; (2) new projects under consideration; and (3) new opportunities that may be investigated as potential future projects.

Each year a statement of progress toward achievement of the goals and objectives in the plan and a project status report will be incorporated into the annual report. Over time, this annual report will reflect the achievement or nonachievement of the goals and objectives of the plan.

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LIST OF TERMS

ADF&G - Alaska Department of Fish and Game

alevins - Newly hatched fish on which the yolk-sac is still apparent.

allocation - To apportion, through regulation, salmon harvest to various user groups (i.e., subsistence, sport, or commercial fishermen).

anadromous - Fish such as salmon that are born in fresh water, migrate and feed at sea, and return to fresh water to spawn.

aquaculture - Culture of husbandry of salmon (or other aquatic fauna/flora).

benthic - bottom-dwelling fish such as halibut and rockfish.

biomass - The combined weight of a group of organisms; for example, a school of herring.

brood stock - Salmon contributing eggs and milt for supplemental culture purposes.

coded wire tag - Magnetically detectable pin-head sized tag implanted in the nose of a young fish for identification as an adult.

commissioner - Principal executive officer of the Alaska Department of Fish and Game.

commissioner approval - Formal acceptance of a salmon development plan or other RPT products by the Commissioner.

comprehensive salmon production plan - A statutory-mandated, strategic plan, spanning 20 years, for perpetuation and increase of salmon resources on a regional basis.

CRAA - Chignik Regional Aquaculture Association

criteria - Accepted measures or rules for evaluation of program and project proposals and operations.

CRPT - Chignik Regional Planning Team

CSA - Chignik Seiners Association

depressed stock - A stock which is currently producing at levels far below its historical levels.

enhancement - Strategy designed to supplement the harvest of naturally produced salmon species by using artificial or semi-artificial production systems or to increase the amount of productive natural habitat. Procedures applied to a salmon stock to supplement the numbers of harvestable fish to a level beyond what could be naturally produced. This can be accomplished by artificial or semi-artificial production systems. It can also be an increase of the amount of productive habitat in the natural environment through physical or chemical changes.

escapement - Salmon which pass through the fisheries to return upstream to a spawning ground or used as brood stock in a hatchery.

ex-vessel value - Price paid to the commercial fishermen for their catch.

eyed egg - The stage in which the eyes of the embryo become visible.

fecundity - The number of eggs per adult female salmon (or other fish).

fingerling - The stage of salmon life between fry and smolt.

fishery - The legally sanctioned harvesting of a particular species in a specific time and place; for example, the Chignik Lagoon sockeye salmon fishery.

fishpass - A fish ladder to enable salmon to get past a barrier to reach spawning grounds.

five-year action plan - The section of phase II planning that recommends projects for implementation within the next five years.

FRED - Division of Fisheries Rehabilitation, Enhancement and Development, Alaska Department of Fish and Game.

fry - The stage of salmon life from emergence from gravel until it doubles its emergence weight.

goals - Broad statements of what a planning team, with input from the user groups, hopes to see accomplished within a specified period of time.

green egg - The stage of salmon egg development from ovulation until the eye becomes visible, at which time it becomes an eyed egg.

hatchery - Facility in which people collect, fertilize, incubate, and rear fish.

incidental catch - Harvest of a salmon species other than the desired species from which the fishery is managed. Fish of another species and/or stock caught during harvest of specific species and/or stock.

instream incubator - A device, located adjacent to a stream, that collects water from the stream and is used to incubate and hatch salmon or trout eggs.

mixed stock fishery - Harvest of salmon at a location and time during which several stocks are intermingled. Harvest of more than one stock at a given location and/or period.

natural production - Salmon which spawn, hatch, and rear without human intervention (i.e., in a natural stream environment).

otolith - calcified ear bones of fish, otoliths offer future environmental marking promise. Manipulation of water temperature can produce distinctive otolith banding patterns in juvenile salmon, and these patterns can be used to identify specific groups of hatchery fish or differentiate between hatchery and wild fish stocks.

pelagic - Pertaining to the open ocean as opposed to waters close to shore.

pot - A box-like or conical trap covered with mesh for catching fish or shellfish.

plan development - Composing, drafting, revising, and finalizing a planning document.

PNP - Private nonprofit: level and/or operational status of a private sector organization without profit motives.

present condition - the average catch for the last five years.

private nonprofit hatchery permit application - A request presented by a private nonprofit corporation to the Department of Fish and Game for a permit to operate a private nonprofit hatchery.

private sector - That group active in salmon resource development which is not employed by government.

production - Perpetuation or increase of the salmon resource through maintenance, rehabilitation, or enhancement programs and techniques.

project - A unit of work having a beginning, middle, and end that functions according to defined performance criteria.

projected status - Continuation of the present condition without additional supplemental production.

public sector - That group active in salmon resource development that is employed by government.

recruitment - The upcoming or next generation of fish.

regional aquaculture association (RAA) - A statutory-based nonprofit corporation comprised of representatives of fisheries user groups organized for the purpose of producing salmon.

regional planning team (RPT) - A statutory-mandated planning group, composed of ADF&G staff and regional aquaculture association representatives, designated to develop a comprehensive salmon plan.

rehabilitation - Procedures applied to a depressed natural stock that increase it to historical abundance. A strategy directed towards restoring depressed natural stocks to previous levels of production.

restoration - Increasing the annual harvest of salmon to historic levels using management, habitat protection, enhancement, and rehabilitation strategies.

review and comment process - A collection of accepted procedures to solicit and generate examination and remarks.

revised plan - A document resulting from incorporation of commissioner-approved material into a plan.

roe - The eggs of a fish.

run - Returning salmon stock(s) bound for its spawning area which is often further described by its timing and numbers.

run strength - Total run of salmon, including escapement, plus harvest.

salmon:

chinook (king) - Oncorhynchus tshawytscha

Chum (dog) - Oncorhynchus keta

Coho (silver) - Oncorhynchus kisutch

Pink (humpy or humpback) - Oncorhynchus gorbuscha

Sockeye (red) - Oncorhynchus nerka

salmon stock - A population of salmon identified with a specific water system, or portion thereof. Salmon of a single species that are produced from a single geographic location and are of the same genetic origin.

seine (purse) - A long net that is drawn through the water encircling fish in its path; the bottom of the net is eventually closed and the captured fish brailed into the boat's fish hold.

smolt - A salmon, trout, or char which has passed through the physiological process of becoming ready to migrate to salt water.

sonar - Technology that uses sound waves in water to detect submerged objects such as schools of fish.

supplemental production - Salmon produced by method other than natural spawning using enhancement and/or rehabilitation methods.

spawn - (verb) To produce or deposit eggs; (noun) A mass of spawned eggs.

stock - A group of fish that can be distinguished by their distinct location and time of spawning.

terminal fishery - An area where a terminal fishery harvest could be conducted.

total run (run strength) - Number of salmon returning in a year for a stock or area (escapement plus harvest number).

uniform procedures - Those practices that have been accepted by planning participants as appropriate for conducting or accomplishing a task.

user group - Identification by method and/or reason for the harvest of salmon (commercial, sport, or subsistence).

weir - A fence, dam, or other device by which the stream migrations of salmon (or other fish) may be stopped or funnelled through for enumeration or holding purposes.

wild stock - Any stock of salmon which spawns naturally in a natural environment and is not subjected to man-made practices pertaining to egg deposition, incubation, or rearing. Stocks which have not been rehabilitated or enhanced.

zooplankton - Free swimming, drifting, or floating organisms, mostly microscopic in size, which are found primarily in open water and are an important source of food for small fish.

APPENDIXES

Regional Planning Team Review Criteria for Proposed Projects

Standard Review Criteria Include in Other Comprehensive Plans

Criteria for RPT Review of PNP Hatchery Permit Applications

AS 16.10.400(a) provides that a hatchery application must be at least evaluated in the context of its compatibility with the comprehensive salmon plan by the RPT, as well as criteria established by current regulations and statutes. AS 16.10.400(g) identifies conditions that must be satisfied if permits are to be issued by the Commissioner before the regional comprehensive salmon plan is complete.

Part (f) of the same law requires that the commissioner shall classify a stream as suitable for enhancement purposes prior to a permit being issued. There are, however, more than 330 anadromous streams in the Kodiak area. The process of evaluating a stream to determine whether or not it would be suitable for enhancement is very complicated, time consuming, and expensive.

To accomplish a full inventory and classification of all the anadromous streams in the Kodiak area was, therefore, beyond the financial and temporal limits of the plan. Instead, the RPT decided to formally make recommendations to the Commissioner at the time the department initiates the RPT review of a project for rehabilitation or enhancement of the fisheries.

The following criteria are hereby set forth in the Phase II Plan and are consistent with the language and the charge provided in AS 16.10.400(a), (f), (g). In reviewing and making recommendations to the Commissioner on nonprofit hatchery permit applications, the RPT will consider the following criteria in their review. The criteria will also be used to the extent practicable, in their review of other projects.

1. Will it make a significant contribution to the common-property fisheries? (Authority: Section 1, Chapter 111, SLA 1974). The RPT will consider and make its recommendations on each species to be produced if there is a reasonable opportunity for common property harvest consistent with the average Western Region common property fishery exploitation rate for that species. For a site to be suitable for private nonprofit development, there must be capability to generate common property harvest and at the same time provide adequate cost recovery for the facility.

Considerations pertinent to determining the potential common property benefits include:

Does the application contain significant omissions or error in assumptions? If so, the use of more accurate assumptions might indicate increased hatchery needs and decreased benefits to common property fisheries. Pertinent assumptions might include those relating to 1) interception

(harvest) rates in common property fisheries, 2) harvest in the special harvest areas, and 3) survivals of green eggs to adults.

If returns cannot provide the "significant" common property benefit in the traditional fisheries, is there an adequate terminal area where new fisheries, is there an adequate terminal area where new fisheries could be created for the desired common property benefit without endangering the wild stock?

If the application provides insufficient information for adequate RPT evaluation, the team will request additional information. If they conclude that basic production and harvest assumptions are not realistic, they will recommend that changes in the proposed projects be incorporated by the applicant.

2. Does it allow for continued protection of wild stocks? (Authority: Section 1, chapter 111, SLA 1974) (AS 16.400(g) and AS 16.10.420/10). Any judgment as to the acceptability of impacts on natural stocks from an enhancement project should be made on only on the actual and potential size of the affected wild stocks, but also on the extent of benefits from enhancement and alternative enhancement opportunities in the area that may have less impact on natural stocks. Considerations include:

Can management or harvest strategies be developed to allow harvest of enhanced returns while protecting natural stocks?

Is there a segregated area for hatchery harvest that will provide adequate cost recovery without impacting wild stocks?

Does the affected stock actually or potentially support a commercial, sport, and/or subsistence fishery?

Does the affected stock have unique characteristics or are there special circumstances (e.g., a unique early run of coho)?

What is the degree of risk and the probable degree of loss to the natural stock?

3. Is the proposed project compatible with the Comprehensive Plan? (Authority: Section 1, chapter 111, SLA 1974) (AS 16.10.375, AS 16.10.400(g)). The goals and objectives of the Comprehensive Plan, Phase I, are directed toward substantial public benefits. Phase II identifies ongoing and proposed projects that are compatible with management strategies for the wild stocks. Thus, the goals and objectives of Phase I and the recommendations in Phase II provide a basis for evaluating all projects.

The project should also be compatible with management concerns and guidelines set forth in the plan and with specific recommendations concerning strategies and projects.

The RPT, in its recommendation to the commissioner, will take all of those factors into consideration in determining the project's compatibility with the comprehensive plan.

4. Does it make the most appropriate use of the site's potential? (Authority: AS 16.10.400(g), AS 16.10.430(b)). A number of very good opportunities for further enhancement programs exist in the Kodiak management area. If the plan goals and objectives, as well as substantial public benefits, are to be achieved, enhancement sites must be developed to their fullest potential with appropriate species using the best available technology.

In most instances, investigation will show one strategy to be far more effective than the others. Within a given strategy, it will be extremely important that the proposed project will develop the site appropriately and to its full potential.

Given technical feasibility, the RPT's determination of the appropriate development of a site will be based on such factors as the magnitude of its water supply, harvest potentials, manageability, and potentials to address user needs.

The applicant, in his application and presentation to the RPT, should demonstrate adequate plans for the site and the capabilities to carry them out. If the applicant does not show adequate planning and documentation, the RPT cannot judge the proposed project's ability to satisfy any criteria or determine in general whether the proposed hatchery would result in substantial public benefit as required under AS 16.10.400(g), AS 16.10.430(b), and the Mission Statement of the plan (Phase I).

An applicant should document to the RPT an ability to develop the site properly and to its full potential. This documentation should include:

Plans for implementation and full development of long- and short-term production goals and objectives; and an adequate description of facility plans for incubation and rearing.

The RPT will formulate a recommendation based on its review of the application and forward it to the commissioner within 14 days of the date when the application is considered. The RPT's recommendation should not be construed as denoting the decision to be made by the Commissioner. The ADF&G staff as well as concerned members of the public also provide reviews and recommendations to the Commissioner. The Commissioner may uphold or reject the recommendations of the RPT after reviewing all the merits and potential problems associated with the proposal.

Since the RPT need adequate review time prior to considering an application, it will generally require that applications and attendant materials be received by the RPT members at least two weeks before the meeting at which the application is to be considered. It may also request additional information during the initial review if the information in the application is inadequate. A representative from the corporation making the application will be expected to make a presentation of the proposal at the RPT meeting.

Alaska statutes specifically grant the RPT an opportunity to review a permit suspension or revocation. However, revocation by the Commissioner would occur only as a very last, unavoidable course of action. It is far more desirable to identify problems early and attempt to remedy them. Existing procedures provide for an annual evaluation of operating hatcheries. The annual report supplies information on the hatchery's past performance, while the annual management plan provides a mechanism for monitoring and modifying hatchery operations on a year-to-year basis. These documents are subject to standard departmental review. RPT review of annual reports and annual management plans is a part of ongoing planning and is also the logical extension of review of hatchery applications. Actual hatchery performance will show whether it contributes to the fishery as planned. This departmental and RPT review allows for monitoring or ongoing performance.

If the department has determined that a hatchery's performance is inadequate and that a permit suspension or revocation is being considered, the Commissioner will notify the RPT, and the RPT will be provided with an opportunity to make a recommendation on the proposed action. In evaluating any PNP operation that is referred to the RPT by the Commissioner, the RPT will use the specific performance criteria in their review, evaluation, and recommendation to the Commissioner. The criteria are established in 5 AAC 40.860 of the 1986 edition of the "Alaska Statutes and Regulations for Private Nonprofit Hatcheries." The RPT, in this evaluation, will also consider any mitigating circumstances that were beyond the control of the hatchery operator.

The reader is referred to the next section (i.e., Project Review Criteria and New Project Solicitation Form) for a detailed listing of criteria used during an initial review by the RPT of rehabilitation and enhancement projects.

In addition to the fish culture information provided in the annual report for each PNP hatchery, one additional tool is needed for evaluation of performance. The RPT recommends mandatory tagging of hatchery-released salmon of all species for at least several cycles in order to measure contributions to the fishery as well as to provide valuable information for management. This tagging must, of course, be accompanied by an adequate program for tag recovery.

Contribution to the fishery will be the ultimate measure of hatchery performance. However, it is not easy to define this criterion in measurable terms or to delineate what actions should be taken if the criterion is not met. Furthermore, the build-up of production at any facility may be slow, so that the ultimate success or failure cannot be determined for many years. As experience with hatchery operations is gained, the performance criteria should be reviewed and refined as needed. There is additional project review criteria for consideration in addition to those listed above.

Project Review Criteria and New Project Solicitation Form

PROJECT REVIEW CRITERIA
PHASE II PLANNING - KODIAK

FRED PROJECT REVIEW CRITERIA

FISHERY CONCERNS:

1. Is supplemental salmon production needed and desirable?
 - a. What is the socioeconomic impact on local residents and fishermen?
 - b. Do the public and user groups want a hatchery in that location?
 - c. Will the hatchery fulfill a substantial portion of the region's 20-year salmon goals?

SITE LOCATIONS:

1. Can the hatchery be constructed?
 - a. Is the land available for reasonable purchase or lease, and will the landowners consent to construction?
 - b. What is the likelihood of site and construction permit applications being approved or disapproved.
 - c. Is the site area suitable and of sufficient size for hatchery construction?
 - d. Will the site require special biological and/or engineering studies and surveys (i.e., land, soil, water, and organisms)?
 - e. Will the hatchery be compatible with existing and future development in the area (i.e., potential habitat conflicts)?
2. Can the hatchery be operated and maintained?
 - a. How accessible and logistically difficult will the hatchery be to operate (i.e., access by road, air, or sea and distance from supply point)?
 - b. Protected and deep water bay for vessel docking and supply?

- c. Winter access and supply problems (i.e., bay ice conditions)?
 - d. Is the beach suitable for amphibious aircraft and landing craft (i.e., surf and wind protection, tidal changes, beach slope, and stability)?
 - e. Can electrical and fueling requirements be met?
 - f. Can personnel (including families) and support service be provided?
 - g. Is the site capable of the type of hatchery (incubation and rearing systems) that would be needed?
3. Is the water supply adequate and suitable?
- a. Adequate flow year around for intended operations?
 - b. Are water quality and seasonal temperature regimes suitable for intended operation?
 - c. Are exclusive water rights available, and can water quality be maintained to hatchery standards?
 - d. Are prime and secondary back-up water sources available?
 - e. Is gravity surface flow available, or will well field development and pumping be required?
 - f. What is the anticipated pipeline size, length, head, and route?
 - g. Anticipated hazards to the pipeline and intake?
 - h. Will future land/habitat uses conflict with quality or quantity of the water supply?
 - i. What is the probability of disease transmission in the water supply (i.e., virus shed by salmonids)?
4. Can brood fish be obtained and held?
- a. Are local brood fish stocks available and in sufficient number at the right time?
 - b. Is brood fish disease history known, and are disease problems anticipated?

- c. Are brood fish stocks genetically and biologically suitable and matched to hatchery water conditions (incubation and rearing schedules?)
 - d. Can brood fish be protected from the fishery and held in estuary or other holding area for ripening?
- 5. Can hatchery fry production be reared?
 - a. Is the estuary suitable for saltwater rearing pens (i.e., protected from seas, sufficient depth, salinities, temperature, fouling organisms, etc.)?
 - b. Can rearing be accomplished with land-based facilities (water and facility requirements)?
- 6. What is the capacity of the estuary and bay for additional salmon rearing?
 - a. Are food organisms abundant and available at time of release?
 - b. Will abundance of predatory and competitor species severely limit survival of hatchery fish?
 - c. Are estuarine and bay conditions suitable for good fry survival?
 - d. Will hatchery fish displace or decrease wild salmon fry (compete and prey upon wild fry)?
- 7. Can adult returns of hatchery fish be readily evaluated?
 - a. Will returning fish be mixed with other hatchery stocks and/or wild stocks?
 - b. What type and quantity of evaluation effort will be required to assess hatchery operation and goal achievement?

FEASIBILITY CONCERNS:

Is the hatchery feasible?

- 1. Are cost/benefit ratios and Net Present Value (NPV) acceptable and justifiable?
- 2. Are there specific or special economic impacts, benefits, and costs involved?

3. If constructed, will the hatchery distract from other worthwhile or perhaps more feasible projects and facilities for the region?

CRITERIA FOR FISHPASSES

FISHERY CONCERNS:

Same as for hatcheries with the frequent addition of increased need for regulation enforcement in remote areas as a salmon run is increased and additional escapement is required.

SITE CONCERNS:

1. Can the fish pass be constructed?

Same as for hatcheries with additional engineering requirements on high and low water flows and velocity, rock competence and fracture zones (geomorphology), fishpass location (protection) and salmon entrance, and passage capability. Each site requires specialized studies to determine the best engineering design for a specific location and target species.

2. Can the fish pass be operated and maintained?

Many of the same criteria as for hatcheries, especially during the construction stage, but less restrictive and demanding once built.

Fish passes require only seasonal operation and maintenance before, during, and after salmon migration. Larger fishpasses with salmon diversion weirs and manual water control structures require manned operation. Smaller installations require only opening, maintenance, spot-checking operation, and end-of-season closure.

Manned facilities require construction, operation, and maintenance of field living quarters, equipment, and seasonal logistical support of personnel.

3. Is the water supply adequate and suitable?

Many of the same water quantity and quality concerns for hatcheries are also important for fishpasses. Fishpasses require adequate flow for efficient salmon attraction and passage. Salmon are attracted to the area of greatest flow. Falls close to a fishpass entrance will tend to attract salmon to the falls rather than the fishpass unless diversion weirs are operated.

High water flows are of more concern for fishpasses than most hatcheries. Fishpasses can be flooded-out by high flows or permanently damaged by debris and ice during floods. Weirs and other associated fishpass structures have a high risk of wash-out and damage by debris at a falls.

Low water flows require either self-controlling or manual water control diversion to the fishpass.

4. Will wild salmon naturally use the fishpass and establish upstream spawning?

Some systems and stocks will require a hatchery and fry or egg transplants to establish new spawning area. Brood-stocks, therefore, become a consideration for fishpasses, as well as for hatcheries.

Natural stock below the falls may be sufficient to extend spawning range and use the fishpass without assistance. Stocks that are genetically programmed to spawn downstream or in site-specific areas (i.e., intertidal pink salmon, chum salmon that spawn in spring areas, etc.) may be slow to use a fishpass or may not extend spawning range.

Increased escapements are usually necessary to increase salmon density below the fishpass and, in turn, increase range extension upstream and salmon passage. Salmon passage through a fishpass is to some extent density related.

5. Is the upstream spawning and rearing area adequate?

The quality and quantity of spawning and rearing area above the falls area needs to be assessed to determine potential production capability. Biological evaluation of egg-to-fry survival may be required as part of this assessment.

6. Will emigrant fry or smolts survive to reach salt water?

Fry and/or smolt survival at falls requires assessment. Substantial mortality might occur at high vertical drop-offs on underlying rock. A series of falls may have greater mortality risk than a single fall.

7. What is the capacity of the estuary and bay for additional salmon rearing?

Same considerations as for hatchery fish releases.

8. Can adult returns of fish produced by a fish pass project be readily evaluated?

Both escapement and catch assessment is required. Counts at the fishpass and on spawning areas, in addition to commercial catch information, are a minimum evaluation effort. Frequently, mark and recovery projects are needed. Evaluation concerns for fishpasses are the same as for hatcheries. Additional evaluation to improve fishpass effectiveness and salmon passage is often required.

FEASIBILITY CONCERNS:

1. Is the fishpass feasible?

Same as for hatcheries. Normally, benefits are high for dollars spent on fishpasses, but the return on investment is usually more limited than for a hatchery and may also take longer to realize.

SPORT FISH PROJECT REVIEW CRITERIA

1. Fishery Status

- Is it a depressed fishery?
- Has the fish population been decimated or eliminated?

2. Habitat Assessment

- Lakes should be five acres in size or large, at least eight feet deep.
- Predator/competitor concerns must be identified.
- Available spawning area should be identified/estimated.
- Water quality characteristics.
 - D.O., Temp., Alkalinity, Conductivity
 - Morphodaphic Index-richer lakes are stocked prior to poorer lakes.

3. Access

- Will it create new fisheries (has to have the potential)?
- Accessible to the fishing public, anything you can hike to from the Kodiak road system within two hours would be a priority over fly-in.

4. Effect on Management

- New sport fish projects should not complicate commercial fisheries management plans.

5. Lake Stocking Guidelines
 - ADF&G guidelines should be adhered to with any new projects.
6. Genetics Consideration
 - Donor stocks would have to be taken from as close to the area as possible.

COMMERCIAL FISHERIES PROJECT REVIEW CRITERIA

Regarding supplemental production (enhancement):

1. What are the potential effects on management plans with the placement of a hatchery?
2. What effects will the proposed production, by species, have on present management schemes?
3. What effects will the hatchery stocks (and their harvest) have on natural stocks in the area?
4. Can returns be harvested to provide "significant" common property benefits in traditional fisheries?
5. Is there an adequate terminal area where new fisheries could be created to affect the desired common property benefit?
6. Does the hatchery as proposed allow for the continued protection of natural stocks?
 - a. Can management or harvest strategies be developed to allow harvest or enhanced returns while protecting natural stocks?
 - b. Is there a segregated area for hatchery harvest that will provide adequate cost recovery without impacting wild stocks?
 - c. Does the affected wild stock actually or potentially support a commercial, sport, and/or subsistence fishery?
 - d. Does the affected stock have unique characteristics or are there special circumstances (e.g., an unique early run of coho)?
 - e. What is the degree of risk and the probable degree of loss to the natural stocks?
7. Does the hatchery proposal make the most appropriate use of the site's potential?

Ref./File#: _____
Date: _____

CHIGNIKK REGIONAL PLANNING TEAM
FISHERIES REHABILITATION AND/OR ENHANCEMENT
NEW PROJECT SOLICITATION FORM

This form is to be used by Fish and Game and other government agency personnel and the public to identify opportunities that may be worthy to pursue to help rehabilitate and/or enhance the fisheries.

PROJECT DESCRIPTION:

1. WHAT: (Give a brief description of the project):

2. WHERE (be specific as to project location):

3. BENEFITS TO USER GROUPS:

4. COST ESTIMATE OF PROJECT (IF KNOWN):

5. SUBMITTED BY:

Name: _____ Date: _____
Address: _____ Phone: _____
Occupation: _____

6. ADF&G COMMENTS:

7. COMMERCIAL FISH MANAGEMENT COMMENTS:

8. SPORT FISH MANAGEMENT COMMENTS:

9. HABITAT PROTECTION COMMENTS:

10. FRED MANAGEMENT COMMENTS:

11. REMARKS:

Ref./File #: _____
Date: _____

POTENTIAL PROJECT VERIFICATION FORM

NAME: _____ Date: _____

LATITUDE: _____ SURVEYED BY: _____

LONGITUDE: _____

GEODETIC MAP NO: _____

LOCATION: _____

AERIAL SURVEY

NOTES: _____

TRAILS: _____

PROJECT WILL PRIMARILY BENEFIT: _____

AVAILABLE ESCAPEMENT DATA:

Year	Pink	Chum	Coho	Sockeye	King	Steelhead
1990	100	100	100	100	100	100
1991	100	100	100	100	100	100
1992	100	100	100	100	100	100
1993	100	100	100	100	100	100
1994	100	100	100	100	100	100
1995	100	100	100	100	100	100
1996	100	100	100	100	100	100
1997	100	100	100	100	100	100
1998	100	100	100	100	100	100
1999	100	100	100	100	100	100
2000	100	100	100	100	100	100
2001	100	100	100	100	100	100
2002	100	100	100	100	100	100
2003	100	100	100	100	100	100
2004	100	100	100	100	100	100
2005	100	100	100	100	100	100
2006	100	100	100	100	100	100
2007	100	100	100	100	100	100
2008	100	100	100	100	100	100
2009	100	100	100	100	100	100
2010	100	100	100	100	100	100
2011	100	100	100	100	100	100
2012	100	100	100	100	100	100
2013	100	100	100	100	100	100
2014	100	100	100	100	100	100
2015	100	100	100	100	100	100
2016	100	100	100	100	100	100
2017	100	100	100	100	100	100
2018	100	100	100	100	100	100
2019	100	100	100	100	100	100
2020	100	100	100	100	100	100
2021	100	100	100	100	100	100
2022	100	100	100	100	100	100
2023	100	100	100	100	100	100
2024	100	100	100	100	100	100
2025	100	100	100	100	100	100
2026	100	100	100	100	100	100
2027	100	100	100	100	100	100
2028	100	100	100	100	100	100
2029	100	100	100	100	100	100
2030	100	100	100	100	100	100
2031	100	100	100	100	100	100
2032	100	100	100	100	100	100
2033	100	100	100	100	100	100
2034	100	100	100	100	100	100
2035	100	100	100	100	100	100
2036	100	100	100	100	100	100
2037	100	100	100	100	100	100
2038	100	100	100	100	100	100
2039	100	100	100	100	100	100
2040	100	100	100	100	100	100
2041	100	100	100	100	100	100
2042	100	100	100	100	100	100
2043	100	100	100	100	100	100
2044	100	100	100	100	100	100
2045	100	100	100	100	100	100
2046	100	100	100	100		

Other Species Present: _____

Elements of the Benefit/Cost Analysis

Steps for undertaking the projects identified in this plan will incorporate variables such as the facilities and equipment, cost of operations, and the financing.

Feasibility of a Project

In determining the feasibility of a project, the team may consider the four following questions:

1. Are benefit/cost ratios and Net Present Value acceptable?
2. What special economic impacts, benefits, and costs are involved?
3. If a hatchery or other facility is constructed, will it detract from other more worthwhile projects in the region?
4. Will the cost for an annual hatchery or other facility operation and maintenance decrease funding available for other projects in the region?

Costing a Project

The cost of a project can generally be segregated into three major categories, depending upon the nature and the scope of the task. These are as follows:

Facility and Equipment:

- Site selection, including studies of alternative areas.
- Site acquisition.
- Construction costs, including planning fees.
- Equipment acquisition.

Operations:

- Cost of labor, utilities, fish feed, personnel, and maintenance costs.
- Administrative.
- Project evaluation costs.

Financing:

- Available funding sources.
- Current interest rates.

Economic benefits to most groups directly affected by specific projects are easier to identify. However, the benefits of an enhanced fishery to sport and personal use fishermen are, again, very subjective and therefore difficult to assign a dollar value. The dollar impact to this group may not vary significantly from project to project and, when compared to the total economic benefit/cost ratio, will not have a significant effect on the overall analysis.

Economic Benefits to Commercial Fishermen and Processors

The economic benefits to these two groups can be expressed in dollar terms throughout the analysis of two major components; the anticipated increase product available for catch and the dollar value of the catch increase. Regardless of the nature of the project, however, the amount of product available depends on the annual adult salmon rate of return and the annual catch rate, expressed in terms of pounds of product.

Variables to Consider in Determining the Product Value

The value of the caught product includes a scrutiny of the following variables:

1. Type of product;
2. Anticipated market price, including the effect of world supply and demand on the market price; and
3. Cost of catching and processing the product.

In order to prepare a benefit/cost analysis for hatchery stock development, a form is available from ADF&G which provides in detail the variables required to determine the quantity of catchable product, value of the catch, impact multipliers, and cost information relating the development of fish hatcheries. For further information, contact ADF&G, FRED Division in Kodiak.