

FEDERAL AID IN SPORT FISH RESTORATION
Volume 2, Number 6
Homer Area Sport Fisheries Enhancement
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F-27-R-1

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September 1987

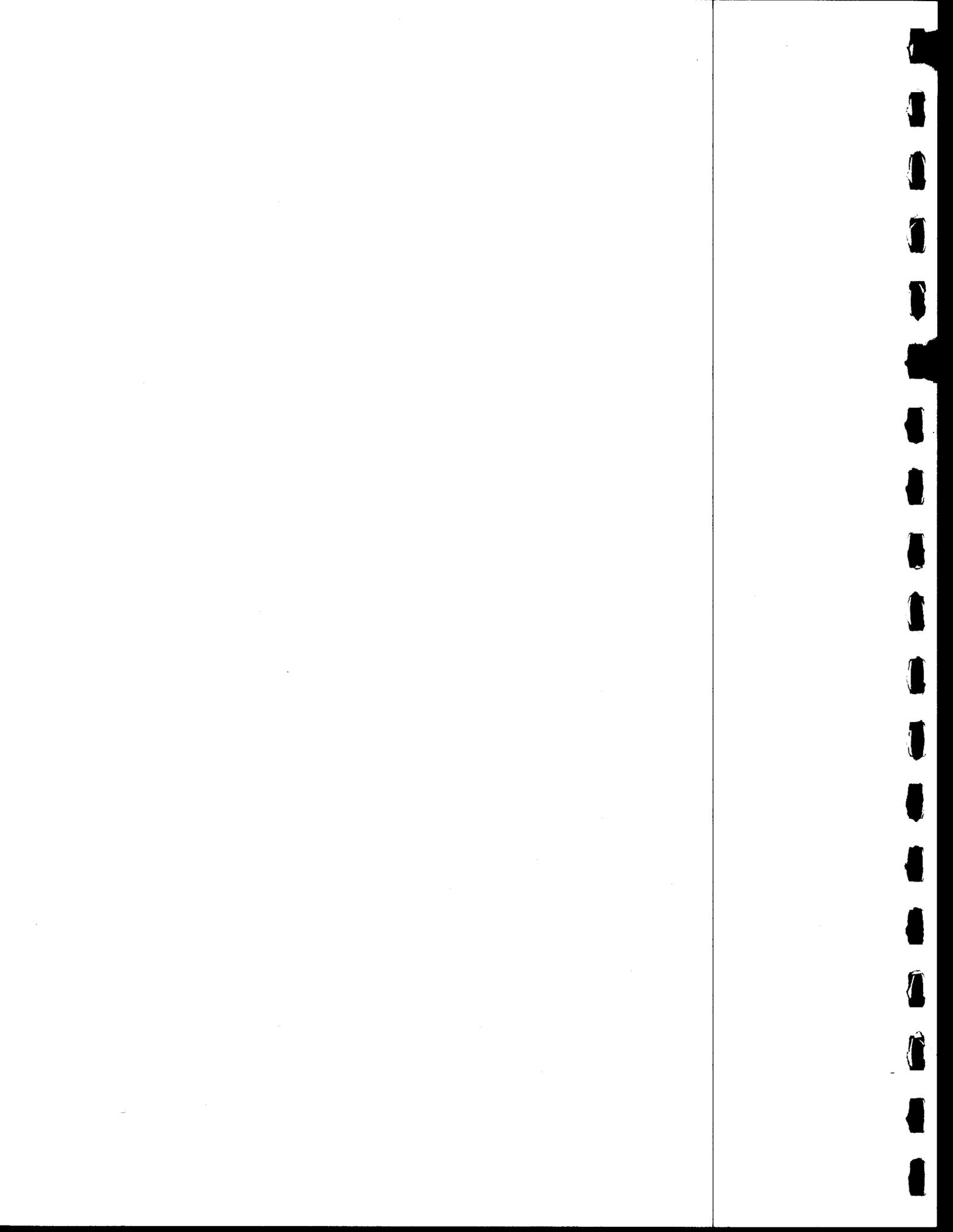


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RESEARCH PROJECT SEGMENT

State: Alaska

Name: Southcentral Sport
Fisheries Enhancement

Project: F-27-R-1

Study: F-1a, 1b, 2a,
2b, 3, and 4

Study Title: Homer Area Sport
Fisheries Enhancement

Cooperators: N. Dudiak, L. Boyle, M. Dickson,
B. Hauser, and A. Quimby

Period Covered: 1 October 1986 to 30 June 1987

ABSTRACT

Increasing numbers of anglers utilizing lower Kenai Peninsula salmon fisheries have created the need for additional salmon returns to satisfy the increased pressure. Supplemental production of chinook salmon, *Oncorhynchus tshawytscha*, coho salmon, *O. kisutch*, sockeye salmon, *O. nerka*, and pink salmon, *O. gorbuscha*, by the Fisheries Rehabilitation, Enhancement, and Development (FRED) Division in the Homer area is being undertaken to provide additional angling opportunities. Salmon smolts, fingerlings, and fry are released in areas that have no natural salmon runs. Returns from these releases provide additional sport fishing to satisfy the provision in the Cook Inlet Regional Salmon Enhancement Plan to meet 10,000 angler-days of fishing effort. Fishing effort on these enhanced salmon returns also displaces pressure on the natural salmon returns in the area, which have become restrictively managed to insure adequate spawner escapement. The Homer Area Sport Fisheries Enhancement Project currently provides over 90% of the salmon sport fishing opportunities in the Kachemak Bay area.

During 1987 approximately 280,000 chinook salmon smolts, 200,000 coho salmon fingerlings, 12,000 rainbow trout, *Salmo gairdneri*, fingerlings, 2 million sockeye salmon fry, and 21 million pink salmon fry were released to enhance local sport fisheries. Nearly 8,000 adult salmon were harvested, including chinook, coho, sockeye, and pink salmon.

KEY WORDS: salmon, enhancement, sport fishing, chinook salmon, *Oncorhynchus tshawytscha*, coho salmon, *O. kisutch*, sockeye salmon, *O. nerka*, pink salmon, *O. gorbuscha*, Homer, Kenai Peninsula, Cook Inlet, imprinting, homing, survival rates, smolts.

INTRODUCTION

The sport fisheries restoration and enhancement program in the lower Cook Inlet area includes a comprehensive approach that involves five species of anadromous salmonids that return throughout the summer to several locations. Fishermen with different capabilities and interests have the opportunity to harvest fish that would otherwise not be available. The complexity of the program is reflected in the variety of separate projects that make up the total. This report therefore includes several sections that categorize the various projects. Because this is the first Federal Aid annual report written for the lower Cook Inlet area, several extra sections have been included to provide background information for the reader.

The Project Leader is Nick Dudiak; however, other ADF&G FRED Division employees have made significant contributions to these projects during the phases of planning, implementation, data collection and interpretation, and reporting before or during FY 1987. These include Bill Bechtol, Larry Boyle, and Mark Dickson. In addition, many other people within ADF&G and in the City of Homer, have made substantial direct and indirect contributions, including

Lower Cook Inlet Seiners Association, South Peninsula Sportsman's Association, Tom Schroeder, Bill Hauser, and others.

The purpose of this report, therefore, is to summarize recent contributions of sport fisheries enhancement projects in Lower Cook Inlet. The major objectives of the program include the following:

- 1) Enhance salmon stocks annually for sport fishermen.
- 2) Increase sport fishing opportunities in Kachemak Bay in the proximity of the Homer area to meet projected demands.
- 3) Obtain experimental data on salmon imprinting and marine-survival rates for future applications to stocking programs.

A total of five species of salmonids are involved with sport fisheries enhancement projects in lower Cook Inlet. The most important of these are chinook salmon, *Oncorhynchus tshawytscha*, and coho salmon, *O. kisutch*. Sockeye salmon, *O. nerka*, and pink salmon, *O. gorbuscha*, sport fisheries have been incidental to commercial fisheries, but in 1987 pink salmon were stocked specifically for the benefit of sport fishermen. Steelhead, *Salmo gairdneri*, brood stock are collected in lower Cook Inlet for enhancement projects outside of this area. Individual projects are strategically located in the area so that returning adult salmon are vulnerable to anglers fishing from shore or small boats (Figure 1).

HALIBUT COVE LAGOON CHINOOK SALMON ENHANCEMENT PROJECT¹

Background

Halibut Cove Lagoon is located on the south shore of Kachemak Bay approximately 19 km southeast of Homer Spit (see Figure 1). A

¹ Dudiak, N., L. Boyle, M. Dickson, and W. Hauser.

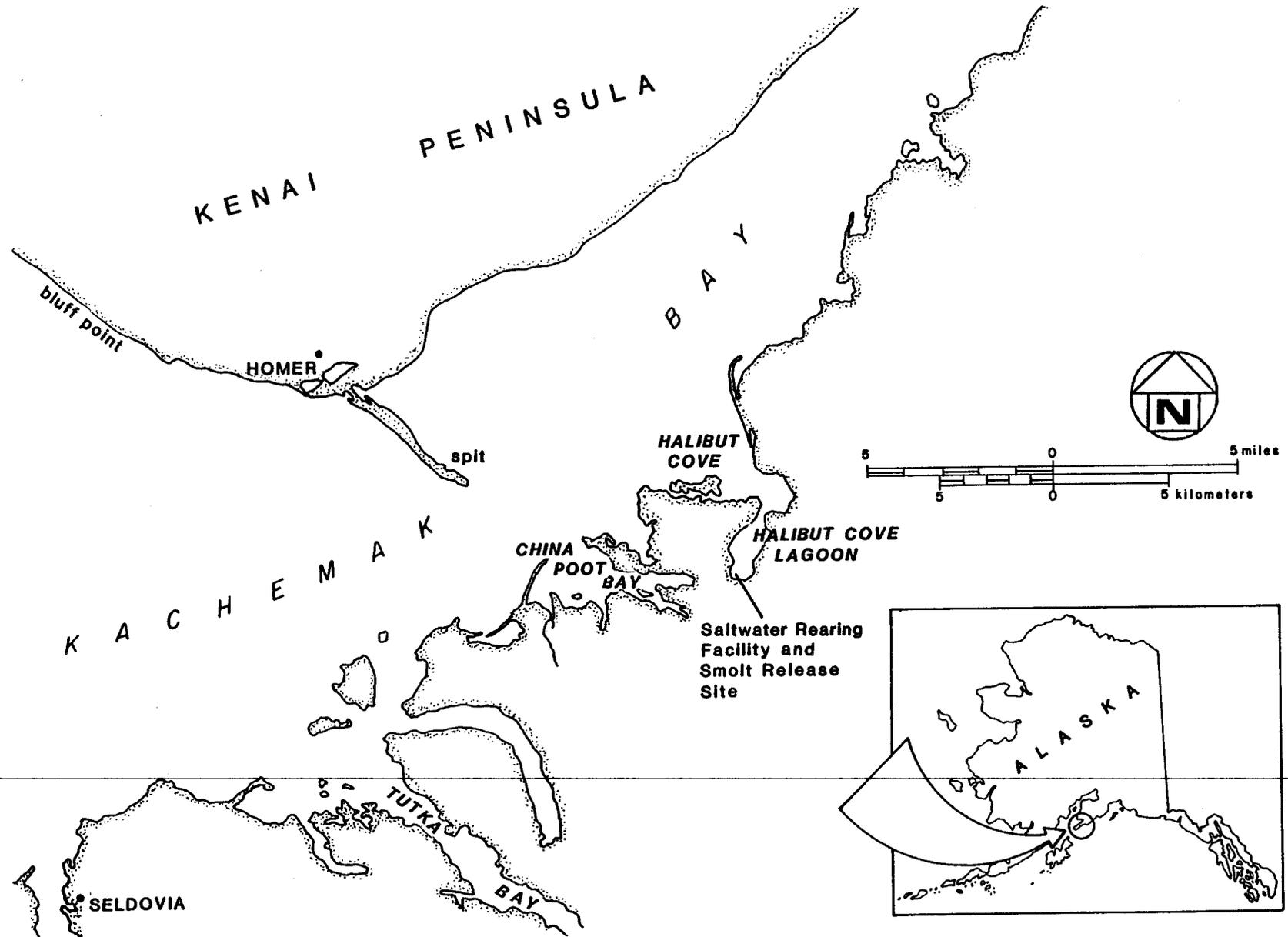


Figure 1. Location of Homer area sport fisheries enhancement sites.

saltwater facility was established in 1973, and chinook salmon smolts have been released in Halibut Cove Lagoon from 1979 to the present to maintain a sport fishery (Figure 2). The methods, results, and contributions from these releases have been summarized through 1984 (Dudiak et al. in press). Since that time, there has been no substantive change in the methods used in the Halibut Cove Lagoon chinook salmon enhancement project.

1981 Smolt Release Experiment: Reared vs. Direct

On 5 June 1985 and 7 June 1986, 98,000 and 101,000 healthy chinook salmon smolts were released, respectively, (without rearing) in Halibut Cove Lagoon. Those released in 1985 averaged 17.9 g; those in 1986, 13.4 g.

The smolts released in 1981 were part of an experiment designed to evaluate if there was a survival advantage for smolts held and reared in net pens for 14 days, compared to those released directly into the estuary (Table 1).

The fish in the "direct-release" lot were released into the estuary where a natural freshwater imprinting lens was available from the creek run-off of the headwater lake. Several hundred mortalities were observed during the direct estuarine release; however, it appeared that nearly all of the mortalities came from a single transport tank. The direct-release smolts showed typical reactions of erratic swimming and jumping when they encountered the brackish water of the estuary.

The lot of "pen-held" smolts were put into five floating net pens anchored to the main float dock area adjacent to the stream mouth. The net pens provided a rearing volume of 59 m³/pen. Approximately 10,200 smolts were stocked in each pen. No mechanical freshwater-injection system was used, and the only fresh water in the pen area was the lens from the creek outflow.

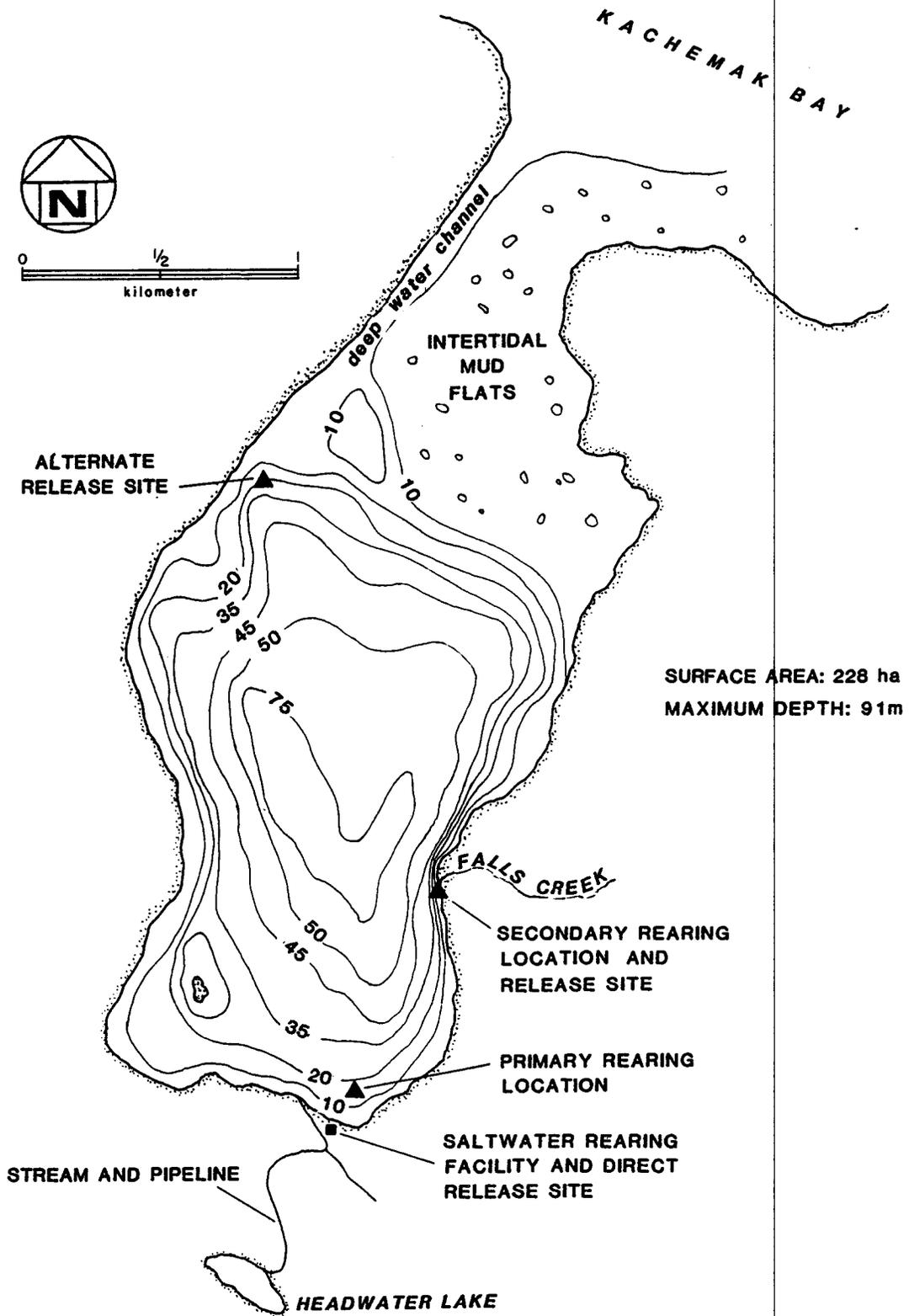


Figure 2. Halibut Cove Lagoon chinook salmon enhancement site.

Table 1. Chinook salmon smolts planted into Halibut Cove Lagoon on 1 June 1981.

Treatment group	Number of smolts released			Average size (g)
	Marked ^{a/}	Unmarked	Total	
Direct release	25,389	24,569	49,958	17.2
14-day rear	22,803	24,980	47,793 ^{b/}	17.3

^{a/} Adipose fin clip plus coded-wire tag.

^{b/} After total transport and holding mortality of 3,622 smolts.

Fish were fed 3.5-mm-size Oregon Moist Pellet (OMP) throughout the 14-day rearing period. When mortalities were enumerated daily, each smolt was checked for an adipose finclip to accurately account for the number of marked and unmarked smolts at time of release. A total of 3,622 mortalities were recorded over the 14-day rearing period; of these, most occurred within the first week and were attributed to shock and stress from the transport and saltwater exposure.

Average chinook salmon survival rates from smolt to adult for 11 complete hatchery brood years was 2.5%. Average survival rate for smolts directly released into the estuary was 2.3%, compared to 2.6% for those reared. However, these results involved different brood and release years, minimizing comparability. The experiment conducted in 1981 compared survival rates of smolts from the same brood year released directly in the estuary to those subjected to 14-day rearing in saltwater net pens. Smolt size was similar at 17.2 g for the direct release and 17.3 g for the reared fish. Ocean survival rate was higher at 6.1% for the reared group, compared to 4.4% for the direct release. Age-class distribution was similar and proportional for both groups. No significant difference in size of adults among the four age classes was observed.

Project Performance: 1974-1986

The estimated survival rates of chinook salmon smolts released into Halibut Cove Lagoon have ranged from 0.3% to 6.1% (Table 2). From these, an estimated 13,090 chinook salmon have returned to Halibut Cove Lagoon between 1974 and 1986. Of these, an estimated 9,530 were harvested by over 14,700 sport fishermen. The annual catch rate has averaged 0.5 fish per angler (Table 3). Most anglers fish about 2.5 to 5 h/day; i.e., one tidal cycle, since access to Halibut Cove Lagoon is restricted to high-tide

Table 2. Estimated survival rates and 95% confidence intervals of chinook salmon smolts released into Halibut Cove Lagoon, 1974-1981.

Release year	Treatment	Estimated survival rate (%)	Confidence interval
1974	reared	1.2 ^{a/}	0.8 - 1.6
1975	reared	1.6 ^{b/}	1.4 - 1.9
1976	reared	4.6	4.3 - 4.9
	reared	5.7	5.3 - 6.2
1977	reared	0.6	0.6 - 0.7
1978	"small" sized	0.6	0.5 - 0.7
	"large" sized	0.3	0.3 - 0.4
1979	direct release	2.1	1.9 - 2.3
1980	direct release	0.4	0.3 - 0.5
1981	reared	6.1	5.6 - 6.6
	direct release	4.4	4.0 - 4.8
Average		2.5	

^{a/} Includes ages 0.3 and 0.4

^{b/} Includes ages 0.2, 0.3, and 0.4

Table 3. Halibut Cove Lagoon chinook salmon creel-census data, 1979-1986.

Year	Estimated number of fish harvested	Number of boats	Number of anglers	Fish harvested per angler-day
1977	ND ^{a/}	ND	ND	ND
1978	100	ND	ND	NA
1979	500	452	1,331	0.38
1980	125	230	625	0.20
1981	689	399	1,086	0.63
1982	2,200	680	2,210	0.92
1983	2,171	1,070	3,018	0.72
1984	2,640	1,410	3,730	0.71
1985	705	575	1,632	0.43
1986	400	393	1,100	0.36
TOTAL (1979-86)	9,530	5,179	14,722	0.54

^{a/} Unmeasured but small harvest.

periods. Consequently, the average annual harvest rate is 0.14 to 0.28 fish/angler-hour, or 3.6 to 7.1 h/fish.

The chinook salmon sport fishery in Halibut Cove Lagoon has provided a unique recreational opportunity for anglers in Kachemak Bay since 1979. Until recently, no similar fishery has been available in the area, and there is no self-sustaining run in Kachemak Bay, but because of the stocking program nearly 4,000 angler-days² of effort have been expended to harvest nearly 3,000 chinook salmon each year.

The reason for the high variability of the survival rates of smolts released into Halibut Cove Lagoon is unclear; however, of all the lots of chinook salmon smolts released there, those with a history of disease or evidence of unusual stress have had the lowest survival rates. The average survival rate of lots of apparently healthy smolts was 3.7%. With all age-classes of fish returned, the "reared" treatment lot from the 1981 experimental release survived 39% better than the direct-release treatment lot. Unfortunately, as a result of budget constraints, this technique has not been routinely employed. Recently, however, with the aid of volunteer labor and some shifting of other efforts, some smolts are again being held in pens for short periods before their release.

² In this report, an angler-day refers to a day during which an angler fished, irrespective of the number of hours fished in that day.

HALIBUT COVE LAGOON CHINOOK SALMON ENHANCEMENT,
1987 SMOLT RELEASE AND ADULT RETURN³

Introduction

Sport fishing in the lower Cook Inlet area has been on the increase (Mills 1985), and this increased fishing pressure has severely restricted the opportunities to catch chinook salmon in the rivers of the lower Kenai Peninsula. In the lower Kenai Peninsula, Anchor River, Deep Creek, and Ninilchik River are open to chinook salmon fishing for only four to six weekends per year. However, fishing in Halibut Cove Lagoon is open throughout the entire chinook salmon return. The chinook salmon enhancement project has been providing increased numbers of fish for harvest by anglers, and the season has been lengthened. There has been some shift of angler pressure on local chinook salmon rivers as well.

The major objectives of this project are to enhance chinook salmon stocks annually for sport fishermen in the Kachemak Bay area. Specifically, the goal statement in the Cook Inlet Regional Salmon Enhancement Plan provided for an additional harvest of 2,000 chinook salmon to satisfy 10,000 angler-days of fishing effort (CIRPT 1981). The other major objective is to obtain experimental data on imprinting and marine survival of those chinook salmon smolts reared in marine pens for several days (short-term group), compared to those liberated in marine waters with no pen rearing (direct-release group).

The production goals for FY 87-88 include holding approximately 50,000 chinook salmon smolts in pens in Halibut Cove Lagoon for 5 days and to directly release another 50,000 chinook salmon smolts into the estuary near the pens.

³ L. Boyle and N. Dudiak

Materials and Methods

Smolt Release:

Smolts released at Halibut Cove Lagoon were provided by the Alaska Department of Fish and Game (ADF&G) Elmendorf Hatchery in Anchorage. The brood stock is from Crooked Creek, a tributary of the Kasilof River, approximately 96 km north of Homer. The eggs were taken at the Crooked Creek Hatchery and transported to Elmendorf Hatchery in Anchorage for incubation and rearing. Heated water from a nearby electric-power generating plant was used to accelerate the development rate so that the chinook salmon smolts could be released in about 11 months.

Smolts were transported at a density of approximately 0.1 kg/liter of water. The truck and transport trailer were loaded onto a landing craft for the trip across Kachemak Bay to Halibut Cove Lagoon. Four 3.6- x 3.6- x 3.6-m nets were suspended in floating pen collars attached to the dock. Smolts were discharged into the pens and fed for 5 days before their release; this reinforces the imprinting of the smolts, allows them to regain the swimming ability often partially lost when placed in salt water, and increases their ocean-survival rate (Wedemeyer et al. 1980; Reisenbichler 1982; Dudiak et al. 1987). The smolts were fed the OMP frozen-fish food formula. Water temperatures, salinity, and mortalities were monitored daily. The remaining smolts were released directly into the estuary where the stream has created a freshwater lens.

Adult Return:

The evaluation of the 1987 adult return was conducted by personnel stationed at the site during the chinook salmon return. Fishermen were requested to bring their catch for inspection. All chinook salmon with excised adipose fins had their heads removed and passed through a detector to determine if a coded-wire tag (CWT)

was present. Tags were removed and fastened to the field-data sheet with transparent tape. They were later cleaned and decoded with the aid of a binocular microscope. A portion of the age-0.1 and 0.4 adults were the only CWT groups in the 1987 return. The scale samples were collected, pressed, and read later in the Homer office to determine the ages of returning adult salmon.

The numbers of boats, anglers, and chinook salmon caught were recorded for each day that personnel were at the site. Because the fishery was not monitored 24 h/day, this figure was expanded to estimate the total harvest.

Boat surveys were made four or more times weekly during the return to determine the number of chinook salmon present. Aerial surveys were also made approximately twice a month. Sport fishermen were well informed of the timing and strength of the run.

Results

Smolt Release:

On 11 June 1987, 94,144 chinook salmon smolts averaging 18.5 g were released into Halibut Cove Lagoon. Of these, 70,873 smolts were held in net pens for 5 days before release. Only a small number of smolts died from transport stress (<150 smolts). There was some minimal gull predation on the direct-release fish. None of the smolts released was coded-wire tagged. The fish were in excellent condition.

Adult Return:

Fishermen began sporadic trips to Halibut Cove Lagoon in early May looking for chinook salmon; however, adult chinook salmon were not observed in the lagoon until 15 May. The first catches of chinook salmon began on 24 May. In spite of additional chinook salmon fishing opportunities on the Homer Spit where a boat is not needed, fishing effort was as heavy as in previous years.

The observed catch was over 700 salmon (Table 4), while the estimated total return was 1,250 to 1,750 fish (Table 5). The year-class composition for the 1987 return consisted of 14% age-0.1, 12% age-0.2, 34% age-0.3, and 40% age-0.4 fish. The predominate age at return for this brood stock has been 0.3, while no age-0.5 fish have returned (Waite 1983; Dudiak et al. 1987).

Mean weights for age-0.1, 0.2, 0.3, and 0.4 fish were 0.9 kg, 3.9 kg, 7.2 kg, and 9.8 kg, respectively. The mean lengths of the four age classes were 376.2 mm, 606.4 mm, 761.6 mm, and 850.1 mm, respectively (Table 6).

Only one marked age-0.4 chinook salmon was observed in 1987. This fish was from the 1983 "direct-release" lot. Five marked age-0.1 chinook salmon of the 36 examined were found; all were from the 1986 release. The popularity of Halibut Cove Lagoon as a sport fishery was evident again in 1987 when over 500 boats carrying more than 1,664 fishermen were observed. The total estimated effort expended in the fishery was 630 boats and 1,930 anglers (Table 7). An estimated 550 chinook salmon of Halibut Cove Lagoon origin were harvested by commercial fishermen in 1987; including 346 taken by set nets and 206 by purse seiners.

Discussion

The 1987 chinook salmon return to Halibut Cove Lagoon was the fourth largest on record. More fishermen utilized the fishery than in 1985 or 1986. This is significant because of the additional chinook salmon angling opportunities provided on the Homer Spit that do not require a boat, showing that given a choice of boat or beach angling, some boaters will use their craft for sport fishing on Kachemak Bay and that overall fishing pressure has increased on the lower Kenai Peninsula.

Table 4. Angler, boat, and chinook salmon harvest counts in Halibut Cove Lagoon, 1987.

Date	Anglers	Boats	Chinook harvest	Remarks
May 11	7	2	0	
12	3	1	0	
13	2	1	0	
14	0	0	0	
15	12	5	0	
16	2	2	0	
17	5	2	0	
18	6	2	0	
19	4	1	0	
20	13	4	0	
21	7	3	0	
22	7	3	0	
23	-	-	-	Working in town
24	69	23	7	
25	9	5	0	
26	27	10	2	
27	24	11	2	
28	21	10	2	
29	27	12	0	
30	98	23	17	
31	35	12	6	
June 1	6	3	0	
2	33	10	5	
3	22	7	4	
4	18	10	1	
5	35	11	3	
6	114	35	57	
7	59	18	4	Left at 11:30 a.m.
8	-	-	-	Working in town on
9	-	-	-	Spit project.
10	-	-	21	Smolt released @HCL
11	124	34	71	
12	131	41	31	
13	143	48	49	
14	108	36	18	
15	170	54	20	
16	113	18	115	Catch from 00:01 a.m.
17	90	15	100	to 10:00 a.m.
18	100	20	120	
19	-	-	-	Working in town
20	44	15	5	
21	52	18	21	Left at 11:50 a.m.
22	-	10	-	
23	-	15	-	

-Continued-

Table 4. Continued. Angler, boat and chinook salmon harvest counts in Halibut Cove Lagoon, 1987.

Date	Anglers	Boats	Chinook Harvest	Remarks
June 24	...	6	...	Boat counts provided by State Parks personnel.
25		4		
26		22		
27		24		
28		14		
29		6		
30		12		
July 1		16		
2		12		
3		11		
4		12		
5		7		
6		6		
7		10		
8	No Data			
9		4		
10	No Data			
11		4		

Table 5. Estimated number of chinook salmon returning to Halibut Cove Lagoon 1974-1987.

Release year	Tag code	Number released	Estimated adult bu return year											Totals	Estimated Survival (%)
			1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987		
1974	4-01-12	3,872	32	15										47	1.2
1975	4-02-03	3,679	6	36	18									60	1.6
1976	4-04-06	10,074	172	88	196	6								462	4.6
1976	4-04-07	6,109	163	52	131	6								351	5.7
1977	4-17-02	48,906		88	84	77	49							297	0.61
1978	4-18-03	26,464			40	27	62	41						170	0.64
1978	4-16-08	99,842			95	40	148	40						323	0.32
1979	4-18-61	225,000				67	668	2,145	1,923					4,803	2.1
1980	4-20-13	155,754					29	116	495	30				669	0.43
1981	4-20-32	49,958						77	373	1,320	406			2,176	4.36
1981	4-20-33	47,843						85	563	1,680	571			2,899	6.06
1982	-	0													
1983	31-16-14	200,983								10	360	450	700	1,520	0.76
1984	NA	84,000									0	225	595	820	(Prelim)
1985	NA	98,000										75	210	285	(Prelim)
1986	31-17-26 NA	20,400 80,800											250	250	(Prelim)
TOTALS		1,161,684	373	279	562	221	956	2,504	3,354	3,030	1,337	750	1,755	15,132	2.4
	Run size		366	567	580	250	800	2,500	3,080	3,000	1,200	750	1,755	15,132	
	Est. hatchery contrib. (%)		102	49	97	88	120	100	109	100	100	100	100	100	

Table 6. Average lengths and weights of chinook salmon returning to Halibut Cove Lagoon, 1987.

Age	Length (mm)	Weight (kg)
0.4	850 sd=47.83 n=41	9.8 sd=1.53 n=40
0.3	762 sd=42.13 n=37	7.2 sd=0.50 n=13
0.2	606 sd=38.92 n=13	3.9 sd=0.83 n=13
0.1	376 sd=54.41 n=14	0.9 sd=0.14 n=14

Table 7. Halibut Cove Lagoon chinook salmon creel-census data, 1979-1987.

Year	Estimated number of fish harvested	Number of boats	Number of anglers	Fish harvested per angler/day
1977	<u>a/</u>	ND	ND	ND
1978	100	ND	ND	ND
1979	500	452	1,331	0.38
1980	125	230	625	0.20
1981	689	399	1,086	0.63
1982	2,200	680	2,210	0.92
1983	2,171	1,070	3,018	0.72
1984	2,640	1,410	3,730	0.71
1985	750	575	1,632	0.43
1986	400	393	1,100	0.36
1987	1,200	630	1,930	0.62
TOTAL	10,730	5,839	16,662	0.55 ^{b/}

a/ Small but uncounted harvest

b/ Mean for 1979-87

Many anglers interviewed at Halibut Cove Lagoon have indicated that they prefer to fish there because angler activity in lower Kenai Peninsula rivers is very intense. This preference has helped displace fishing pressure from the natural systems, and it is considered a major benefit that is provided by enhanced chinook salmon fishery projects such as that at Halibut Cove Lagoon.

Anglers included local and nonlocal Alaska residents and nonresidents from many states and foreign countries. Several charter-boat operators regularly fished the lagoon. The number of clients per boat ranged from two to 18. Chinook salmon were most effectively taken on a variety of lures and bait early in the return. Many anglers enjoyed seeing the schools of chinook salmon as they move around the lagoon. They were often able to watch fish follow their lure or bait and strike.

Regulations enacted in 1986 closed snagging in lower Cook Inlet from 1 January through 15 June. This change was proposed by anglers who worked more time to catch fish with lures or bait, and it affected the fishing in Halibut Cove Lagoon as well as all other saltwater fisheries in southcentral Alaska. Many anglers have expressed a desire to extend the closed snagging period past 15 June and will likely submit proposals to that effect to the Alaska Board of Fisheries. However, since the fish become less vulnerable to lures and bait late in the return, snagging becomes an effective and practical method of harvesting the remaining fish.

The 1987 adult returns to Halibut Cove Lagoon included the age-0.4 chinook salmon that were released in 1983. The ocean-survival rate for this release group was only 0.8%, the fifth lowest recorded. This is poor, compared to the 2.4% average survival rate for all release groups at Halibut Cove Lagoon (Table 8).

A major reason for the poor survival was attributed to the small average size of the smolts (9.9-11.2 g) at release. Many of the smolts exhibited "parr" rather than "smolt" characteristics, and 44% of the smolts died in 5 days during saltwater bioassay tests

Table 8. Estimated survival rates and 95% confidence intervals of chinook salmon smolts released into Halibut Cove Lagoon, 1974-83.

Release year	Treatment	Estimated survival rate (%)	95% Confidence interval
1974	reared	1.2 ^{a/}	0.8 - 1.6
1975	reared	1.6 ^{b/}	1.4 - 1.9
1976	reared	4.6	4.3 - 4.9
	reared	5.7	5.3 - 6.2
1977	reared	0.6	0.5 - 0.7
1978	"small" sized	0.6	0.5 - 0.7
	"large" sized	0.3	0.2 - 0.4
1979	direct release	2.1	1.9 - 2.3
1980	direct release	0.4	0.3 - 0.5
1981	reared	6.1	5.6 - 6.6
	direct release	4.4	4.0 - 4.8
1982	no smolt released		
1983	direct release	0.8	0.7 - 0.9
Mean survival rate		2.4	

^{a/} Only includes age 0.3 and 0.4 returns

^{b/} Only includes age 0.2, 0.3, 0.4 returns

(*in situ*) conducted at the time of the 1983 smolt release. The small size of the smolts was caused by a limited availability of heated water at Elmendorf Hatchery during the 1982-83 incubation period. Since then, the smolts have been substantially larger; e.g., up to 18.5 g in 1987. The survival rates of smolts released since 1983 are expected to be good, considering their sizes and excellent condition; also, in 1987 most were held and fed for 5 days.

The number of age-0.4 chinook salmon in the 1987 return exceeded the return of age-0.3 fish, which are usually abundant. This resulted because a much larger number of smolts were released in 1983 (201,000) than in 1984 (84,000). Chinook salmon released in 1984 have a survival rate to date of 0.98%; another year of returns is expected in 1988. With two or more return years still to come, the survival rate of the fish released in 1985 is 0.29%; while the age-0.1 chinook salmon have a survival rate of 0.25% and three return years remaining.

Conclusions

The Halibut Cove Lagoon project continues to provide increased chinook salmon sport fishing opportunities in the lower Cook Inlet area with the following considerations:

- 1) Over 1.2 million chinook salmon smolts have been released at Halibut Cove Lagoon since 1974.
- 2) The 1987 chinook salmon return of over 1,700 fish represents the fourth largest return to Halibut Cove Lagoon.
- 3) Between 1977 and 1987 more than 16,650 anglers harvested 400 to 2,600 chinook salmon annually, for an estimated total of 10,730 chinook salmon.

- 4) This project has provided fishing opportunities for as many as 3,700 anglers per season.
- 5) The Halibut Cove Lagoon chinook salmon project and other local enhancement projects (Homer Spit chinook, Tutka Bay Lagoon pink and China Poot Bay sockeye salmon) provide over 90% of the salmon sport fishing opportunities in the Kachemak Bay area.

Recommendations

- 1) Continue to release 100,000-150,000 chinook salmon smolts annually in Halibut Cove Lagoon.
- 2) Attempt to hold and feed a portion of each year's release for 5-10 days to increase their survival and reinforce the imprinting to the release stream.
- 3) Chinook salmon smolts stocked into Halibut Cove Lagoon should be healthy and have a minimum size of 17 g.
- 4) Continue to provide on-site evaluation of the adult returns to the project.

HOMER SPIT CHINOOK SALMON ENHANCEMENT PROJECT, HISTORICAL PERSPECTIVE⁴

Introduction

Angling opportunities for salmon in Alaskan waters were abundant and widespread. Unfortunately, many of these opportunities were in remote locations and not accessible to many anglers, while readily accessible opportunities became overcrowded. New angling

⁴ Dudiak, N., W. Hauser, and A. Quimby

opportunities needed to be created by developing new access to existing fish populations or by creating new fish populations for existing access. Because large numbers of anglers were concentrated along the limited highway system on the Kenai Peninsula, the ADF&G, FRED Division has attempted to create new angling opportunities for them. The chinook salmon sport fishery in Halibut Cove Lagoon became highly successful, but opportunity was limited to anglers equipped with the substantial boats that are required to traverse the 12.5-km-wide Kachemak Bay. In an attempt to improve angling opportunities for shore-based anglers and those with small boats, FRED Division recently released artificially imprinted chinook salmon smolts so that returning adults could be attracted to Homer Spit, which is a more accessible location (Figure 3).

The Homer Spit is an excellent site for a sport fisheries development project, because it is highly accessible and large numbers of tourists and residents are attracted to the area. Unfortunately, it has no freshwater discharge for salmon imprinting or spawning. The goal of this project is to create a return of adult chinook salmon adjacent to Homer Spit. This project was originally designed to use the organic chemical morpholine[®] as an imprinting agent during the smolt stage and a homing stimulus for returning adults.

If successful, this would also provide the option of decoying adults to an alternate site. The imprinting technique has been tested on salmonids in Lake Michigan (Cooper et al. 1976; Cooper and Scholz 1976; Scholz et al. 1978) and summarized by Hasler and Scholz (1983). Additional work has been done with chinook and coho salmon in California (Hassler and Kucas 1982). These studies have shown success in imprinting salmonids with morpholine in freshwater systems. To our knowledge, however, the Homer Spit experiment is the first reported attempt to use this chemical as

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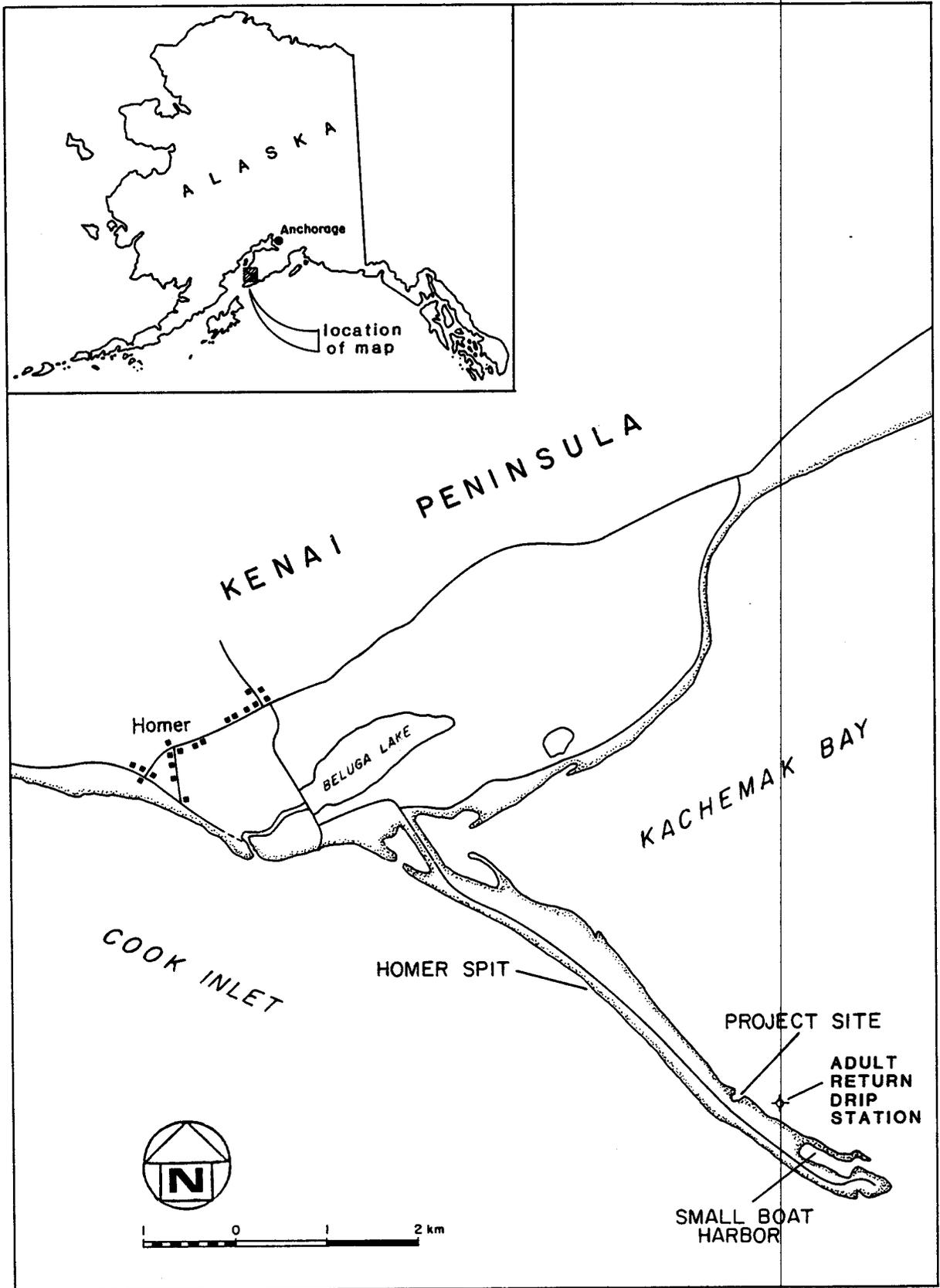


Figure 3. Homer Spit chinook salmon enhancement site.

an artificial imprinting agent in salt water for chinook salmon and the first to attempt to decoy returning fish to a more favorable harvest location.

The objectives of this project include the following:

- 1) Increase chinook salmon sport fishing opportunities in Kachemak Bay in proximity to Homer Spit to meet increasing demands; the goal statement in the Cook Inlet Regional Salmon Enhancement Plan includes the provision of an additional harvest of 2,000 chinook salmon to satisfy 10,000 angler-days of effort.
- 2) Supplement the larger boat-access-type enhanced chinook salmon fishery available at Halibut Cove Lagoon with a small boat- and shore-based-type fishery along the Homer Spit.
- 3) Through adult return monitoring, determine if a viable sport fishery can be developed by releases of chinook salmon smolts from a small inlet on the Homer Spit.
- 4) Initiate a pilot program to obtain experimental data on chinook salmon imprinting and marine-survival rates for future applications in marine-stocking programs.

Materials and Methods

The brood stock was of Crooked Creek origin, which is located approximately 96 km north of Homer. The spawning operation was conducted at the Crooked Creek Hatchery, and the eggs were transported to the Elmendorf Hatchery in Anchorage where heated water is available to accelerate development and produce smolts in less than 1 year. The smolts in one raceway were exposed to morpholine for 30-38 days each year from 1984 to 1986. The morpholine was dripped into the head of the raceway from a low-flow piston-drive pump (model Rp-B625 from Fluid Metering, Inc.[®]) powered by a 12-volt battery. The exposure concentration in the raceways was

adjusted to 5×10^{-5} mg/liter of morpholine following the calculation of Scholz et al. (1975).

Upon completion of imprinting, smolts were transported to the Homer Spit and released into a small saltwater intertidal inlet located approximately 5.8 km out on the Spit (see Figure 3). This inlet is approximately 100 by 60 m, with a maximal depth of approximately 3 m at mean-low tide (Figure 4). There is no freshwater discharge into this inlet, except for surface runoff during rains. This inlet has the same salinity as adjacent Kachemak Bay water (Table 9), and most of the volume is drained during each tidal cycle with an approximate 6.0-m change in seawater elevation.

Floating 3.7- x 3.7- x 3.7-m net pens were anchored in the inlet to hold a portion of the smolts released in 1985 and 1986. The penned smolts were held and fed for 5 days. During this period in 1985, the morpholine-drip apparatus was installed on the net-pen complex, and the artificial imprinting was continued.

Because the closest chinook salmon run is on the opposite side of Kachemak Bay and adult chinook salmon have been caught only rarely from the Homer Spit, we assumed that all fish observed in the area were of hatchery origin. The numbers of fish in the inlet were estimated by an aerial survey when water conditions allowed. On several occasions an instantaneous population estimate was made by seining, marking, and recapturing fish in the inlet. The estimated harvest was calculated periodically by multiplying the numbers of anglers by the average catch per angler.

Results

Approximately 80,000 chinook salmon smolts were released into the small inlet in 1984 (Table 10). A total of 152,200 smolts was released in 1985; of these, 72,500 smolts were held in saltwater pens. In 1986 nearly 104,000 chinook smolts were released; approximately 50% were directly released, and 50% were held in pens for 5 days (Table 10).

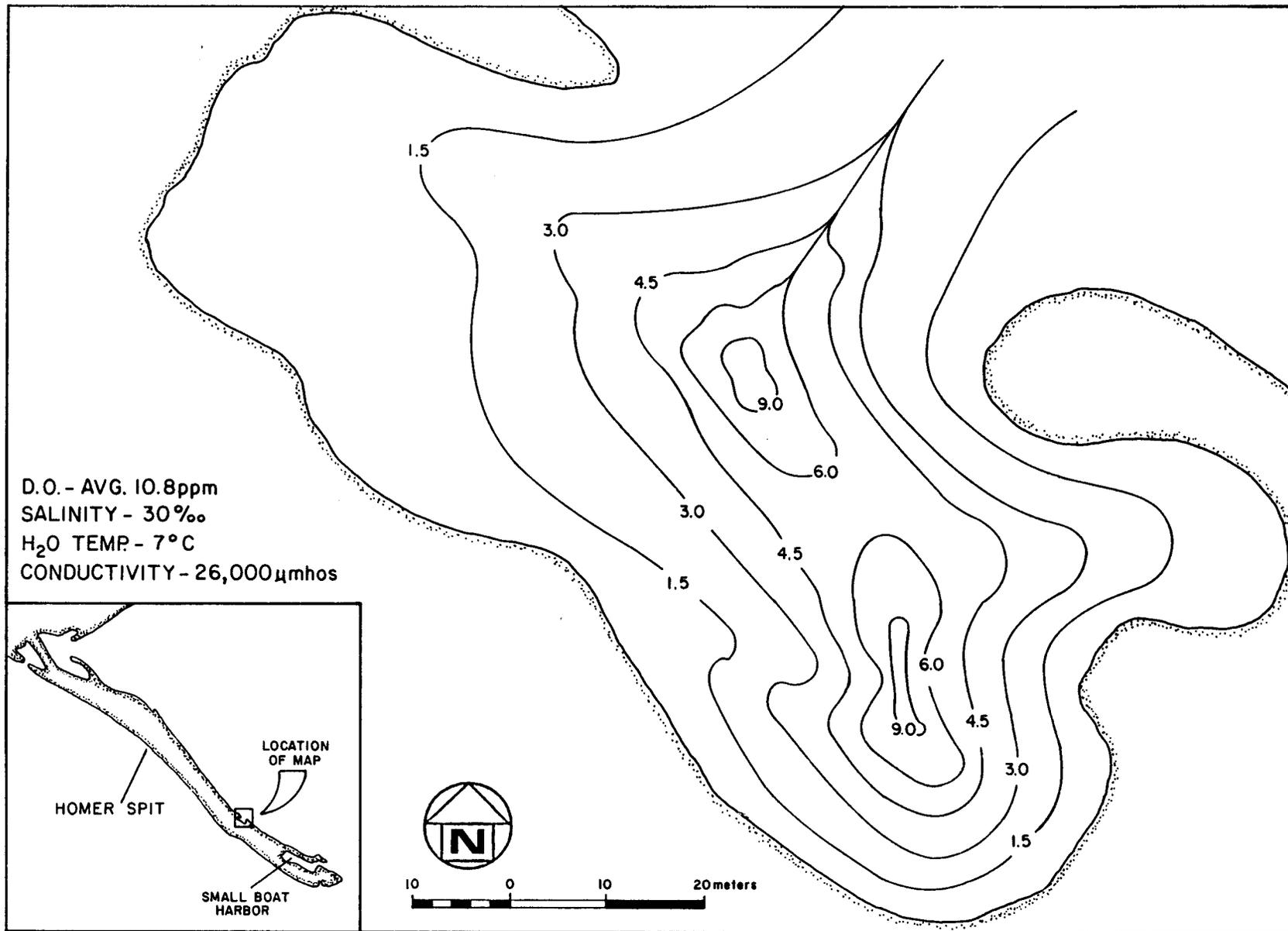


Figure 4. Bathymetric map (at high-slack tide) of the intertidal inlet used for Homer Spit chinook salmon enhancement project (depth contours in meters).

Table 9. Water-quality parameter profiles in the Homer Spit inlet, June 1985.

Date	Time (hr)	Tidal stage	Depth (m)	Temperature (°C)	Salinity (ppt)	Dissolved oxygen (ppm)
10 Jun	2100	Flood	0.0	8.9	29.0	8.4
10 Jun	2100	Flood	0.5	8.5	28.8	8.2
10 Jun	2100	Flood	1.0	8.5	28.5	8.1
10 Jun	2100	Flood	1.5	8.5	28.5	8.1
10 Jun	2100	Flood	2.0	8.4	28.5	8.1
10 Jun	2100	Flood	3.0	8.2	28.5	8.0
11 Jun	1500	Low	0.0	10.0	29.0	8.1
11 Jun	1500	Low	3.0	9.0	28.5	7.6
11 Jun	2200	High	0.0	9.5	30.0	8.1
12 Jun	1545	Low	0.0	11.5	33.0	7.0
12 Jun	1545	Low	0.5	11.0	34.0	7.0
12 Jun	1545	Low	1.0	10.0	34.5	6.9
12 Jun	1545	Low	1.5	9.5	34.5	6.8
12 Jun	1545	Low	2.4	9.5	34.5	6.8
13 Jun	1500		0.0	11.0	32.0	7.0
13 Jun	1500		0.5	11.0	33.0	7.0
13 Jun	1500		1.0	10.0	34.0	6.9
13 Jun	1500		1.5	10.0	34.5	6.8
14 Jun	0900	High	0.0	9.5	32.5	-
14 Jun	0900	High	0.5	9.2	32.0	-
14 Jun	0900	High	1.0	9.0	32.0	-
14 Jun	0900	High	1.5	8.8	32.0	-
14 Jun	0900	High	2.0	8.5	32.0	-

Table 10. Chinook salmon smolts released and adult returns,
Homer Spit, 1984-1986.

Year	Date	Smolts released			Adults returned		
		Number	Size (g)	Pen rearing	Year	Age	Number
1984	12 Jun	80,000 ^{a/}	17.8	No	1985	0.1	400
1985	11 Jun	79,700	18.8	No	1986	0.2	300
1985	15 Jun	72,500	18.8	Yes	1986	0.1	1,000
1986	10 Jun	52,300 ^{b/}	13.8	No			
1986	15 Jun	51,600 ^{b/}	13.8	Yes			

^{a/} Estimated number released after transport mortality due to mechanical failure.

^{b/} Approximately 10,700 smolts in this group were marked Ad + CWT (31-17-25). No differential mark between the direct released and pen-reared groups.

In 1985 an estimated 400 age-0.1 chinook salmon "jacks" (35-50 cm long, 1.4 kg) returned to the small inlet from the 1984 release of 80,000 smolts. In 1986 an estimated 1,000 "jacks" as well as 300 age-0.2 chinook salmon (60-70 cm, 6.0 kg) returned from the 1985 release.

The first 3 years of returns have created an extremely popular family oriented, shore-based fishery with an estimated harvest of over 1,300 chinook salmon. Over 120 anglers have been observed fishing at one time. Total season effort was an estimated 4,000 angler-days in 1986. Successful angling techniques include light tackle with small artificial lures, flies, salmon-egg clusters, or shrimp.

Discussion

The highly visible, roadside fishery created by this experimental smolt release has generated intensive fishing effort, successful results, and very positive public response. Local residents as well as tourists from other parts of Alaska, other states, and many foreign countries have participated in this fishery. The City of Homer Harbormaster Office and Homer Port and Harbor Commission have been very cooperative and supportive of this project.

Surprisingly, however, most of the returning fish in both 1985 and 1986 returned to the inlet along the Spit before the morpholine could be dripped into the water to supply that homing odor. Because there is no fresh water available for imprinting, the fish are orienting to the unique chemical characteristics of the inlet's highly saline waters. This illustrates the sequential nature of the imprinting and homing mechanism. In this case, however, the freshwater portion of the sequence has been eliminated, and only the "lower estuary" portion is present.

It is still unclear, however, whether the chinook salmon are imprinted to the morpholine. During both 1985 and 1986, most fish entered the inlet prior to the operation of the drip stations

along Homer Spit, so they are homing to whatever unique characteristics may be associated with the intertidal inlet (e.g., metal scraps on the bottom, leaching of chemical preservatives from the wood of an old barge or of pilings, characteristics of the sand and gravel, etc.). After the drip stations began operation, however, the fish did appear to become more concentrated nearby.

Another aspect of the imprinting and homing mechanism that we have been particularly impressed with is the apparently brief imprinting period required. All of the fish released in 1984 and more than half of those released in 1985 were released directly into the inlet. Some were observed migrating out of the inlet within several hours. None of the treatment lots was marked, however, so there is no estimate of differential survival.

Considering these preliminary return rates, as many as 2,600 adult chinook salmon are expected to return in each of future years. The first age-0.4 fish, some weighing over 18 kg, should return in 1988.

These results suggest that management biologists may have many more options available to create new chinook salmon fisheries in locations previously believed unworkable because of the lack of fresh water for imprinting. If these fish imprinted to morpholine as we had planned, we would be able to decoy them to another harvest location or alter their behavior pattern to create a unique new troll fishery in the vicinity of Homer Spit.

Introduction

The Homer Spit chinook salmon enhancement project has been highly successful, and it has created a substantial sport fishery. Many anglers with limited ability have been able to participate in this unique chinook salmon fishery where few alternate opportunities are available. By 1987 this project has become an important project in the sport fisheries enhancement program in Lower Cook Inlet.

The objectives of this project include the following:

- 1) Increase chinook salmon sport fishing opportunities in Kachemak Bay in proximity to Homer Spit to meet increasing angler pressure. Specifically, the goal statement in the Cook Inlet Regional Salmon Enhancement Plan to provide an additional harvest of 2,000 chinook salmon to satisfy 10,000 angler/days of effort (CIRPT 1981).
- 2) Supplement the enhanced chinook salmon fishery available at Halibut Cove Lagoon with a fishery on the road system accessible to those anglers without a boat or those with small boats.
- 3) Determine if a viable sport fishery can be developed by releases of artificially imprinted chinook salmon smolts directly into a saltwater inlet with no source of fresh water.
- 4) Obtain experimental data (pilot program) on chinook salmon imprinting and marine-survival rates for future application in estuarine-stocking programs.

⁵ Dudiak, N. and L. Boyle

Materials and Methods

The chinook salmon smolts in one raceway at Elmendorf Hatchery were exposed to morpholine for 33 days from 5 May to 7 June 1987 at a concentration of 5×10^{-5} mg/liter of morpholine, following the calculation of Scholz et al. (1975). Four floating 3.7- x 3.7- x 3.7-m net pens were anchored in the inlet (*see* Figure 3) to hold approximately 53,900 smolts. The penned smolts were held and fed OMP fish food for 5 days until their release on 13 June (Table 11).

The floating morpholine-drip station was anchored just offshore of the Spit and slightly southeast of the small inlet on 16 May in an attempt to attract returning adult chinook salmon (*see* Figure 3). The station was positioned to allow for at least 1-m depth at the lowest tide levels. The initial concentration released was similar to that in the hatchery raceway (5×10^{-5} mg/liter of morpholine); however, considering the extreme tidal-exchange rate and massive water flows, this concentration was increased during the season. The final concentration applied by 27 June was estimated at 2×10^{-4} mg/liter of morpholine. The pump system ran from 16 May to 8 July, except for periods when the weather was too rough to reach the float and refill the morpholine supply or during extremely low tides.

The numbers of fish in the inlet were estimated by an aerial survey when water conditions allowed or by an instantaneous population estimate made by seining, marking, and recapturing fish in the inlet. The estimated harvest was calculated periodically by making random counts of anglers and catch rates and extrapolating for the total catch. Sampled adult chinook salmon were measured to the nearest mm and weighed to the nearest 0.1 kg; a scale sample was also taken.

An interpretive sign was constructed in the parking area adjacent to the small inlet to increase public awareness of this new project. This was cooperatively carried out by an Eagle Scout,

Table 11. Chinook salmon smolt releases and adult returns, Homer Spit, 1984-1987.

Release year	Date	Treatment	Number released	Size (g)	Estimated adult return by year			
					1985	1986	1987	Total
1984	12 June	D.R.	80,000 ^{a/}	17.8	400	300	600	1,300
1985	11 June	D.R.	79,700	18.8		1,000	790	1,790
	15 June	S.T.	72,500	18.8				
1986	10 June	D.R.	52,300 ^{b/}	13.8			630	630
	15 June	S.T.	51,600 ^{b/}	13.8				
1987	8 June	D.R.	49,900	17.0				N/A
	13 June	S.T.	53,900	17.0				
TOTALS			439,900		400	1,300	2,020	3,720

^{a/} Estimated number of live smolts released after deducting transport mortalities.

^{b/} Approximately 10,700 smolts in the 1986 release were marked with an adipose fin clip and implanted with a coded-wire tag (31-17-25). The same mark was used for the direct release and pen reared groups.

D.R. - Direct release into inlet.

S.T. - Short-term pen reared.

the City of Homer, and ADF&G. The covered, two-sided, 1.2- x 1.8-m sign has large pictures arranged with captions under plexiglass windows.

Results

Smolt Release:

Approximately 103,800 chinook salmon smolts were transported and released into the small saltwater inlet on Homer Spit on 8 June 1987. Of these, 53,900 were held in saltwater net pens, while 49,900 were released directly into the inlet (*see* Table 11). The average smolt size was 17 g, and all appeared to be in excellent condition. This marks the fourth consecutive chinook salmon smolt release on the Homer Spit.

Adult Return:

The 1987 adult return of chinook salmon was estimated at over 2,000 fish and was composed of three age classes (*see* Table 11). Approximately 630 fish were age-0.1 precocious males ("jacks"), having an average length of 360 mm. An estimated 790 were age-0.2 chinook salmon. These fish ranged in length and weight from 536 to 615 mm and 2.5 to 3.6 kg, respectively. Approximately 600 age-0.3 chinook salmon were harvested in 1987; these fish originated from the initial Homer Spit release of 80,000 smolts in 1984. Average length and weight for the age-3.0 fish were 765 mm and 6.1 kg, respectively.

The 1987 chinook salmon return generated a very popular and intense sport fishery. Sport fishermen expended approximately 6,000 angler/days of effort to catch 2,000 chinook salmon, resulting in a 0.33 fish per angler/day average. Sport fishing activity was observed from 15 May through 15 July. Angler interviews through the season indicated that fishermen spent an average of 2.5 hours fishing/day.

Successful angling techniques included light tackle with small artificial lures, flies, salmon egg clusters, herring, and shrimp. Snagging became a legal harvest method after 15 June, and this was effective in harvesting chinook salmon after they quit biting later in the run.

Although the morpholine drip station was in position and operating during the 1987 return, there is only meager evidence that the chinook salmon were orienting to that station. Only twice during the entire run were small schools of fish observed down current from the drip station.

Discussion

This recently developed chinook salmon fishery on the Homer Spit has shown encouraging preliminary results; i.e., a sport harvest of over 3,700 chinook salmon during the initial 3 years. An estimated 10,000 anglers/days of effort have been expended in this fishery since the first return in 1985.

The 1987 chinook salmon return of over 2,000 fish generated very intensive fishing effort, successful results, and very positive public response. Many local residents and tourists from other parts of Alaska as well as those from other states and countries participated in the fishery on the Homer Spit. The City of Homer Harbormaster Office and the Homer Port and Harbor Commission have been very cooperative and supportive of this project. Many local merchants have described a significant increase in seasonal business directly related to this and the other enhanced fisheries.

A unique aspect of this newly created chinook salmon fishery on the Homer Spit is the opportunity for anglers of all ages and abilities to participate. The relatively simple angling techniques and excellent road-side access allow young children as well as the elderly and handicapped to enjoy this fishery.

Returning adult chinook salmon again "homed" back to the small inlet where they were originally released, rather than to the morpholine drip station anchored off the Spit. The majority of the fish were harvested either in the small inlet or the intertidal channel and respective shoreline on the flooding tides. Very few chinook salmon were taken by trolling in the area of the drip station. The major reason for attempting to imprint these salmon to the "decoy" drip station was to spread the fishery over a larger area.

Since there is no fresh water available in the small inlet for imprinting, the fish have been returning to the release site, in spite of the chemical imprinting at the hatchery prior to their release. It is not known if the fish were not imprinted as smolts or if the adults did not home to the morpholine because the concentration rate was not strong enough. The massive water volume movements from tidal exchanges (+6.6 to -1.5 m) may dilute the concentration to the extent that it cannot be detected by the salmon. Also, it is possible that unique chemical characteristics associated with the intertidal inlet (e.g., metal scraps on the bottom; leaching of chemical preservatives from the wood of an old barge or pilings; the sand and gravel; etc.) impart a stronger influence on imprinting at release than the previous exposure to morpholine. Further work with adjustment of the morpholine-drip concentrations will be required. In any case, it is important to note that a chinook salmon sport fishery can be created either by directly releasing or very short-term holding of smolts in highly saline waters without the influence of a freshwater imprinting source.

The preliminary return rates of chinook salmon to the Homer Spit project are encouraging. The return of 600 age-0.3 fish in 1987 and the previous 2 year's returns from the 1984 smolt release equals a total estimate of 1,300 chinook salmon (see Table 11). Thus the preliminary survival rate is 1.6%; age-0.4 fish are expected to return in 1988.

Perhaps even more encouraging is the preliminary return of 1,790 chinook salmon from the 1985 release of 152,200 smolts (see Table 11). Although this return only includes age-0.1 and 0.2 fish, the survival rate is already 1.2%; most of the fish are expected to return in 1988 and 1989. These survivals compare favorably to the overall survival range of 2.4% experienced at Halibut Cove Lagoon.

Considering the good preliminary returns through 1987, as many as 2,000-2,500 chinook salmon could return to the Homer Spit in 1988. This would include, for the first time, all four age classes.

Results from this fishery have surpassed expectations. Substantial angling now occurs on Homer Spit where none was previously available; however, good angling is available for only about 4 weeks. To extend the length of the Homer Spit angling season, pink salmon fry were released in 1987. Other enhancement options include a late-run stock of chinook salmon or coho salmon.

Conclusions

- 1) The recently developed chinook salmon fishery on the Homer Spit continues to be extremely popular, attracting increased use by anglers of all ages and abilities.
- 2) This highly visible roadside fishery has generated successful results and a very positive public response. Local residents, tourists from other parts of Alaska, and nonresident anglers have participated in this fishery.
- 3) Many local merchants have described a significant increase in seasonal business directly related to this and other enhanced fisheries in the area.
- 4) In 1987 sport fishermen expended approximately 6,000 angler/days of effort to catch over 2,000 chinook salmon. This resulted in an average of 0.33 fish harvested per angler/day.

- 5) An estimated 10,000 angler/days of effort have been expended at this sport fishing site since 1985.
- 6) The 1987 adult chinook return was estimated at over 2,000 age-0.1, 0.2 and 0.3 fish.
- 7) As many as 2,000-2,500 chinook salmon could return to the Homer Spit project in 1988, based on the returns to date; this will include the first age-0.4 fish.
- 8) Returning adults in the 1987 run "homed" back to the small intertidal inlet where they were originally released, rather than to the chemical morpholine dripped from the off-shore float. Similar results were observed in 1985 and 1986.
- 9) It is still unclear whether the returning chinook salmon are unable to detect the morpholine because the concentration is too weak or the unique chemical characteristics associated with the small inlet have imparted an even stronger imprinting influence.

Recommendations

- 1) Continue to release 100,000 to 150,000 chinook salmon smolts annually from the Homer Spit.
- 2) Attempt to hold a portion of the chinook salmon smolts in saltwater pens for at least 5 days prior to release.
- 3) Continue to evaluate the contribution of this enhanced chinook salmon sport fishery to the Kachemak Bay area by monitoring the adult returns.
- 4) Continue to determine and evaluate the feasibility of using morpholine as an artificial imprinting chemical for saltwater application.

- 5) Develop later-returning chinook salmon brood stock to extend available sport fishing over a longer period of time. In the interim, continue to rear and release pink salmon in the same small inlet on the Homer Spit.

OTHER HOMER AREA SPORT FISHERY ENHANCEMENT PROJECTS, 1987⁶

Introduction

Increased fishing pressure in lower Kenai Peninsula drainages has created the need for restrictive management to maintain adequate spawner escapement in natural systems. FRED Division has undertaken numerous projects to satisfy this increased demand for additional sport fishing opportunities and to displace fishing pressure on natural systems. Some of these projects include enhancing existing salmon runs, others develop new salmon runs, and one is used for brood-stock collection to create a new run in another area.

This section is intended to give an overview to other Lower Cook Inlet FRED Division sport fisheries enhancement projects not already detailed in the 1987 southcentral Sport Fisheries Enhancement Federal Aid Report.

Objectives of these other projects include the following:

- 1) Increase sport fishing opportunities in the Kachemak Bay area of Homer by providing new salmon production.
- 2) Assess the contribution of the enhanced salmon sport fisheries.

⁶ Boyle, L., and N. Dudiak

Projects

Anchor River Steelhead Brood Stock:

The Anchor River steelhead trout, *Salmo gairdneri*, brood-stock collection project was initiated to enhance existing runs to meet the increasing demand for this species in southcentral Alaska. Cooperating with the Sport Fish Division, FRED Division has developed a program for collecting and transporting steelhead brood stock from the Anchor River to a hatchery where they are held and spawned. The smolts that develop may be released into different streams in southcentral Alaska.

Since the project began in 1981 (Table 12), a total of 136 steelhead have been collected from the Anchor River and held until ripe. The fish overwinter at Crooked Creek Hatchery, near Soldotna, or Trail Lakes Hatchery, near Moose Pass. When the fish are ripe in the spring, the eggs are taken. The eggs are then incubated at the Fort Richardson Hatchery where the juveniles are reared to smolt size.

For this reporting period, the brood-stock collection began on 25 September 1986 and extended through 20 October 1986. We planned to collect adults for several weeks throughout the run. Generally, 10 males and 10 females are required for brood stock; however, an additional three females were collected so that additional eggs would be available for potential restocking of Bridge Creek Reservoir in Homer.

Adult steelhead trout were collected with a small mesh (64 mm) drift gill net. The netted fish were carefully removed and carried in soft, fine-mesh dip nets to a transport tank. The tank, mounted in the back of a pick-up truck, was equipped with a continuous oxygen-delivery system using air stones, medical oxygen tank, and regulator. On three different dates, a total of 23 steelhead was transported 200 km to the Trail Lakes Hatchery (Table 12).

Table 12. Steelhead brood stock collected from the Anchor River, 1981-1986.

Year	Date	Number of fish collected	
		Trip	Total
1981	October 26-27	10	10
1982	September 8-9	11	43
	September 22-28	13	
	October 6	9	
	October 22	10	
1983	September 21	5	20
	September 27	10	
	October 5	5	
1984	October 2	7	20
	October 8	7	
	October 15	6	
1985	September 24	6	20
	October 15	7	
	October 23	7	
1986	September 25	7	23
	October 7	8	
	October 20	8	
TOTAL			136

When the fish arrived at the hatchery, they were dipped from the tank with soft nets and immersed in a malachite-green solution for 10 s before being placed in the raceway. The fish were given periodic antifungal treatments as a prophylactic measure during the holding period.

The steelhead brood stock was held in an inside 1m- x 1.2m- x 16-m raceway that was covered with a tent of dark plastic sheeting. Lights mounted under the tent were adjusted for a light intensity and duration that matched the natural photo period. Water flow was maintained at 277 liters/min; the temperature, at 3.3°C. No feeding was attempted.

Spawning operations took place in early June 1987 at the Trail Lakes Hatchery, and the eggs were then transported to the Fort Richardson Hatchery. The resulting steelhead smolts will be released into Campbell Creek (Anchorage) in 1989.

Seldovia Chinook Salmon Enhancement:

Chinook salmon smolts were released in Seldovia for the first time on 1 June 1987. This project is similar to the Halibut Cove Lagoon and Homer Spit chinook salmon enhancement projects. The goal of this project is to create a chinook salmon sport fishery in Seldovia.

Seldovia is located approximately 24 km southwest of the Homer Spit (*see* Figure 1). A small stream running into Seldovia Bay near the harbor provides a freshwater imprinting source, and a good freshwater lens is present in the Seldovia Harbor where four 3.6- x 3.6- x 3.6-m net pens were secured in float pens.

The chinook salmon smolts were transported from the Elmendorf Hatchery by a tanker that was loaded onto a landing craft for the 2-h trip to Seldovia. There were 80,420 sixteen-gram smolts released: approximately 60,000 into the four pens and the remainder directly into the harbor. Three volunteers fed the smolts

daily for 4 days. The harbormaster supervised the volunteers and kept ADF&G informed of the smolts condition until they were released on 5 June 1987. Adults from this release will return over the next 4 years. A chinook salmon yearly adult return of 1,000-2,000 fish is possible by 1991, if smolts are released annually.

Caribou and Seldovia Lakes Coho Salmon Stocking:

Hatchery-produced coho salmon fingerlings have been planted in Caribou and Seldovia Lakes (see Figure 1) to satisfy increased sport and personal-use fishing efforts. The release of fingerlings into these two lakes appears to be a cost-effective method of supplemental production, since the fish are not held to the smolt stage at the hatchery. By using the lakes as natural rearing systems, most fingerlings overwinter and emigrate the following spring (Whitmore et al. 1979).

Coho salmon fingerlings have been stocked in these lakes annually since 1984 (Table 13), though previous stockings took place in 1975-1977. Adult returns to these projects have increased the number of coho salmon available to sport fishermen in Kachemak Bay. Coho salmon returning to Seldovia Lake are available to boating anglers and fishermen along the Seldovia River. Adult coho salmon returning to Caribou Lake move near the shore at Homer Spit and along the northern shore in Kachemak Bay; they are accessible to both boat and shore fishermen.

Bridge Creek Reservoir:

The City of Homer water reservoir at Bridge Creek (see Figure 1) was stocked with 9,900 fifty-seven-gram steelhead smolts in 1985 from the Anchor River brood stock. This large release size provided a catchable landlocked stock of rainbow trout, *Salmo gairdneri*, accessible by road. This fishery proved very popular, especially for families with children. No catch estimate is available, but city employees commented on the large number of anglers utilizing the fishery.

Table 13. Coho salmon fingerling releases, Caribou and Seldovia Lakes, 1984-1987.

Project	Release year	Number released	Number marked	Size (g)	Stocking method	Adult return
Caribou Lake	1984	121,075	0	2.6	Floatplane	No Data
	1985	139,310	21,414	1.0	Floatplane	1,200 ^{a/}
	1986	138,000	22,189	1.4	Aerial	N/A
	1987	150,000	0	0.9	Aerial	N/A
Seldovia Lake	1984	59,840	0	2.6	Floatplane	No Data
	1985	82,924	0	1.0	Floatplane	1,000 ^{a/}
	1986	71,500	0	1.4	Aerial	N/A
	1987	45,000	0	0.9	Aerial	N/A

^{a/} - Estimated return, data not available at time of report preparation.

Because of the popularity of the project, 9,900 steelhead trout fingerlings (3.1 g) from Anchor River steelhead brood stock were planted in the reservoir on 16 June 1987. This was a cooperative project with the Sport Fish Division and the City of Homer. Sport Fish Division staff installed a fish-proof screen on the reservoir overflow system to prevent emigration of smolts into the Anchor River drainage.

Tutka Lagoon Hatchery Pink Salmon Sport Fishery:

The Tutka Lagoon Hatchery (*see* Figure 1) has a capacity of nearly 50 million pink salmon eggs. The primary goal of this public hatchery has been to enhance pink salmon for the Kachemak Bay area commercial fisheries. The facility receives no Federal Aid (Sportfish Restoration funds), but it is included in this report because of the enhanced sport fishery it provides. The facility, which is located in Kachemak Bay State Park, completed its 11th production year in 1987 with the release of 23 million pink salmon fingerlings. Returning adult pink salmon enter Tutka Lagoon several weeks before spawning. This staging period in the 14-ha lake-like lagoon offers excellent sport fishing; as many as 100,000 pink salmon may be concentrated in the lagoon during July. More than 150 anglers in 40 boats have been observed fishing in the lagoon during a single high tide.

Since 1984 the average annual harvest of pink salmon by sport fishermen in Tutka Lagoon has been 8,000 fish (Table 14). Over 50,000 pink salmon have been taken by sport anglers since 1978. The popularity of this sport fishery with campers, anglers, and sport fishing charter boat operators has increased annually.

The 1987 pink salmon return to the Tutka Hatchery was by far the lowest in its history. Although the reason for the poor return is not known at this time, all wild pink salmon runs in the Cook Inlet area were also very poor. Because of this, sport fishermen only harvested an estimated 500 pink salmon from Tutka Lagoon.

Table 14. Tutka Lagoon and Tutka Creek adult pink salmon harvest summary for 1978 to 1987.

Return year	Sport harvest	Commercial harvest	Escapement	Hatchery egg-take	Total return
1978	1,500	167,800	15,000	21,000	205,300
1979	2,000	421,820	10,000	21,000	454,820
1980	5,000	321,510	17,160	12,900	356,570
1981	6,000	1,025,220	18,000	22,000	1,071,220
1982	2,000	184,880	18,500	43,200	248,580
1983	5,000	615,430	53,800	12,900	687,130
1984	8,000	241,000	10,500	41,000	300,500
1985	8,000	487,880	14,000	43,200	553,080
1986	8,000	380,000	13,400	43,000	444,400
1987	500	50,000	4,000	22,000	76,500 ^{a/}
TOTALS	46,000	3,895,540	176,360	282,200	4,398,100

^{a/} Pink salmon returns to all streams in Lower Cook Inlet were substantially below average in 1987.

Mid-way through the pink return, Tutka Lagoon was closed to sport fishing to allow adequate numbers of fish for hatchery egg-takes.

China Poot Bay Sockeye Salmon Sport Fishery:

This project is involved with utilizing Leisure Lake (i.e., China Poot Lake; Figure 1) as a rearing system for hatchery-produced sockeye salmon fry. This experimental project was designed to determine the optimal sockeye salmon fry-stocking densities for developing maximal production and subsequent adult returns. Lake fertilization has been initiated to enhance the sockeye salmon production.

The adult sockeye salmon returning to Leisure Lake create a terminal fishery because of a barrier falls above the intertidal area of China Poot Creek. Access to the fishery is by boat; fishing is done in salt water and the terminal-harvest area, which provides excellent opportunities for anglers and dipnetters in approximately 180 m of China Poot Creek between the barrier falls and intertidal mud flats.

Current regulations allow year-round angling, and personal-use dipnetting is open during the month of July. A resident sport fishing license is required for dipnetting. Since 1979 an estimated 20,260 sockeye salmon have been harvested by anglers and dipnetters (Table 15). The highest catch to date by anglers and dipnetters occurred in 1983 when anglers caught 480 fish, while dipnetters harvested 5,190 fish.

In 1987 over 2,000 sockeye salmon were taken by anglers and dipnetters. The total sockeye salmon return to this project was only 23,700 in 1987. A low return has been forecasted because of the low numbers of smolts emigrating from the lake in 1985. These smolts were also well below the optimal size because so many (2.0 million) sockeye fry were planted prior to lake fertilization.

Table 15. Harvest of China Poot Bay (Leisure Lake) sockeye salmon returns by user group, 1979 to 1987.

Return year	Sport harvest	Personal Use harvest	Commercial harvest	Total return ^{a/}
1979	650	0	ND	650
1980	1,000	1,000	12,000	14,000
1981	1,500	0	10,000	11,500
1982	450	1,320	200	3,400
1983	480	5,910	84,020	90,420
1984	500	2,000	114,360	117,360
1985	500	3,000	61,500	65,920
1986	100	150	18,350	18,800
1987	200	2,000	21,500	23,700
TOTALS	5,380	15,380	321,930	345,750

^{a/} Total return counts include estimates for escapements (i.e. non-harvested fish).

ND = No Data

Table 16. Juvenile salmonids released to enhance sport fisheries in Lower Cook Inlet area in 1987.

Project/Site	Species	Hatchery	Number	Lifestage	Treatment
Tutka Bay	Pink	Tutka Lagoon	16,100,000	Fingerling	Short-term Reared
Tutka Bay	Pink	Tutka Lagoon	4,400,000	Fry	Direct Release
Homer Spit	Pink	Tutka Lagoon	295,000	Fingerling	Short-term Reared
Leisure Lake	Sockeye	Crooked Creek	2,000,000	Fry	Direct Release
Halibut Cove	Chinook	Elmendorf	94,000	Smolt	Direct Release
Homer Spit	Chinook	Elmendorf	104,000	Smolt	Chemical Imprint
Seldovia Bay	Chinook	Elmendorf	84,000	Smolt	Direct Release
Caribou Lake	Coho	Trail Lakes	150,000	Fingerling	Direct Release
Seldovia Lake	Coho	Trail Lakes	45,000	Fingerling	Direct Release
Susan Lake	Rainbow	Fort Richardson	1,600	Fingerling	Direct Release
Bridge Creek Reservoir	Steelhead	Trail Lakes	10,000	Fingerling	Direct Release

Table 17. Adult salmon returns from Homer area sport fishery enhancement projects, 1987.

Project	Species	Hatchery of origin	Total number returned	Sport and personal use harvest
Halibut Cove	Chinook	Elmendorf	1,750	1,250
Homer Spit	Chinook	Elmendorf	2,020	2,000
Caribou Lake	Coho	Trail Lakes	1,200 ^{a/}	1,000 ^{a/}
Seldovia Lake	Coho	Trail Lakes	1,000 ^{a/}	800 ^{a/}
Leisure Lake	Sockeye	Crooked Creek	20,000	2,000 ^{b/}
Tutka Lagoon	Pink	Tutka Lagoon	80,000	500 ^{b/}
TOTAL FOR ALL PROJECTS			105,970	7,550

^{a/} Estimated return and harvest. Final figures not available at report preparation time.

^{b/} This harvest rate was unusually low due to extremely low survival rates of hatchery and area natural pink salmon stocks. Sport harvest averages 8,000 pink salmon annually in Tutka Lagoon.

- 2) Attended the American Fisheries Society (AFS) Alaska chapter meeting in November in Anchorage to present a lecture on the Homer Spit Chinook Salmon Project at their poster session.
- 3) Participated in the Alaska Sportfishing Association's annual sportfishing fair in Anchorage by presenting an extensive slide series on sport fishing in Kachemak Bay.
- 4) Attended the Alaska Chinook Salmon Workshop held 13-15 April 1987 in Juneau and gave the following presentations:
(a) "Homer Spit Chinook Salmon Stocking Project;" (b) "Halibut Cove Lagoon Chinook Salmon Project;" and (c) "Recovery of Nonlocal Origin Marked Chinook Salmon in Kachemak Bay, Alaska."
- 5) Several field trips and slide shows were presented to local schools.
- 6) Provided updated sport fishing reports to the media, including KIMO television; KSRM, KGTL, KTEN, and KBBI radio; Homer, Soldotna and Anchorage newspapers; and the Fishing and Hunting News produced in Washington.
- 7) Prepared several brochures and handouts on sport fishing in the Homer area with special emphasis on the enhanced fisheries.
- 8) Maintained a local sport fishing telephone hotline (907-235-6930) with weekly updates as well as a sport fish report bulletin board in the Homer ADF&G office lobby.
- 9) Answered many daily phone calls and visitor questions in the office concerning area sport fishing.
- 10) Worked with volunteers from the South Peninsula Sportsman's Association and Boy Scouts of America on projects, e.g., feeding and rearing pink salmon fry on the Homer Spit for future sport fishing benefits and designing and constructing a visitor interpretive sign for the Homer Spit Chinook Salmon Enhancement Project.

ACKNOWLEDGMENTS

Mark Dickson, Fishery Technician, has played a significant part in the Halibut Cove Lagoon project for many years. Tom Schroeder, Area Biologist for the Commercial Fisheries Division, has flown many aerial surveys to assist in enumerating adult returns and has offered various ideas and suggestions. Alaska Department of Natural Resources, Division of State Parks personnel provided cooperation in logistical aspects of the project. Dr. Allen Scholz, Eastern Washington Univ., Cheney, WA, provided technical comments about the use of morpholine as an imprinting agent. Michael Vandersanden, local Eagle Scout, helped design and construct a visitor interpretive sign for the Homer Spit chinook salmon enhancement project. The City of Homer, the Homer Harbor-master Office, and the Homer Port and Harbor Commission have been very cooperative and supportive of this project. The Lower Cook Inlet Seiners Association has provided financial assistance for some of these projects and they and the South Peninsula Sportsmans Association have supplied volunteer labor to help with several projects. The authors wish to thank Darrell Keifer and his staff at the Elmendorf Hatchery complex for their assistance in administering the morpholine as well as producing and transporting salmon smolts; Peter Velsko, Tutka Lagoon Hatchery Manager, and his staff for the production of pink salmon for area sport fish enhancement; Bill Gaylor, Trail Lakes Hatchery Manager, and his crew who did an excellent job of holding steelhead overwinter, taking eggs, and production of coho salmon fingerlings; and the Crooked Creek Hatchery staff, managed by Bob Och, who provided excellent quality sockeye salmon fry for the China Poot Lake and Bay project. Bill Hauser, Regional FRED Biologist, provided input and editing of this report. Thanks also to Ken Leon for technical review and Sid Morgan for editorial assistance.

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