STATE OF ALASKA

Bill Sheffield, Governor

Annual Performance Report for

COOK INLET CHINOOK AND COHO SALMON STUDIES

by

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RESEARCH PROJECT SEGMENT

State: Alaska

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Job: S-32-1 Job Title: Kenai River Creel Census

S-32-2 Kenai River Salmon Escapement

S-32-4 Kasilof River Creel Census

S-32-5 Deep Creek Marine Creel Census

Cooperators: Stephen Hammarstrom and Larry Larson

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ABSTRACT

The recreational fishery for chinook salmon, *Oncorhynchus tshawytscha* (Walbaum), in the marine waters of Cook Inlet south of Deep Creek was monitored by creel census for the fourteenth consecutive year. Estimated harvests from early and late runs were 5,087 and 1,731 fish, respectively. In addition, an estimated 22,706 Pacific halibut, *Hippoglossus stenolepis* Schmidt, were harvested from mid-May through July 31. Estimates were calculated on the basis of 3,383 angler interviews, 186 instantaneous boat counts, 485 creel-checked chinook salmon, and 2,119 creel-checked Pacific halibut. Historical data for this fishery are presented.

The age composition of the recreational harvest of chinook salmon from salt water displayed a slight difference between early and late runs; age class 1.3 fish (1980 brood year) comprised 24.5 and 11.5 percent of these runs, respectively; while the majority of the harvest, at 64.4 and 76.9 percent, respectively, was made up of age class 1.4 fish (1979 brood year). Classifications were based on 286 readable scales collected during the fishery.

The freshwater spring fishery for chinook salmon on three southern Kenai Peninsula streams (Anchor River, Deep Creek and Ninilchik River) resulted in an estimated harvest of 1,030 fish for 12,200 angler-days of effort. Individual stream-harvest estimates, as determined by onsite monitoring, are as follows: Anchor River, 330; Deep Creek, 100; Ninilchik River, 600. Effort was estimated by vehicle counts on

location. Minimal escapement counts for each stream were achieved by expanding results of a helicopter survey by a factor determined by a simultaneous limited-ground survey.

One of Alaska's most popular recreational fisheries, the Kenai River chinook salmon fishery, was monitored by creel census for the twelfth consecutive year in 1985. From May 18 through August 4 (the season was extended 4 days by emergency order), 18,275 anglers were interviewed, 444 instantaneous angler counts were made, 13 aerial surveys were flown, and 1,727 chinook salmon were creel-checked. These data were used to calculate an estimated harvest of 7,971 early run fish for 47,394 angler-days of effort and 8,055 late-run fish for 73,615 angler-days of effort. Historical data for this fishery are presented. One chinook salmon, harvested May 17, established a new world record for a sport-caught fish of this species: 97 lb, 4 oz (44.2 kg).

Based on 755 readable scales collected during the fishery, the age composition of both early and late runs, as represented by the recreational harvest, was predominantly age 1.4 fish.

To estimate the spawning population of both early and late runs entering the Kenai River, a total of 2,768 chinook salmon were tagged and released from May 20 through August 9. A creel census and campground survey were employed to examine 2,013 recreationally captured chinook salmon for marks. A total of 463 marked fish were recovered: 116 from formal monitoring programs, 216 from sport anglers, and 131 marked fish from all other sources. These data were used to generate an estimated spawning escapement of 8,001 early run and 21,708 late-run chinook salmon in the Kenai River drainage in 1985.

During creel-census activities on the Kenai River between August 1 and September 30, 256 instantaneous angler counts were made, 9,330 anglers were interviewed, and 4,493 coho salmon, *Oncorhynchus kisutch* (Walbaum), were creel-checked. Analysis of creel-census data resulted in estimates of the total coho salmon harvest of 40,096 for 54,953 angler-days of effort. Historical data regarding this fishery are presented.

During May and June 1985, an estimated 3,049 chinook salmon were harvested for 18,610 angler-days of effort in the Kasilof River fishery. The above estimates are based on data collected during 62 instantaneous angler counts and 2,409 completed-angler interviews. Totalling 2,205 fish, the chinook salmon escapement into Crooked Creek, primary producer of early run Kasilof River chinook salmon, was determined by a total count through a weir. An additional 477 fish were retained for egg-take purposes. Historical information regarding this fishery are presented. An expected fishery on late-run Kasilof River chinook salmon did not materialize sufficiently to warrant the expense of a creel census, and it was discontinued on July 10.

KEY WORDS

Chinook salmon, coho salmon, creel census, fish tagging, fish populations, spaghetti tags, radio telemetry, blood chemistry, hook-and-release, Kenai River, drift net.

BACKGROUND

Chinook salmon are the most popular game-fish species on the Kenai Peninsula. Historically, significant recreational fisheries occurred only on the southern Peninsula streams: Anchor River, Deep Creek, and Ninilchik River. Management on these streams has ranged from virtually no restrictions to total closure. From the mid-60s to the late 1970s, a punch card was used to enforce daily and/or seasonal bag limits. Since 1981, bag limits on chinook salmon have been enforced by requiring anglers to record the harvest of each fish over 20 inches on the back of their sport fishing license or on a special card.

The total chinook salmon harvest from each of these southern Peninsula streams is regulated by fishing time and area. Each stream (from salt water to approximately 2 miles upstream) is open to fishing during the last weekend of May (Saturday, Sunday, and Monday) and the first 3 weekends of June. The Ninilchik River, however, is closed after the second weekend of June. This management program has evolved through various quota schemes and restricted seasons. The current 12-day fishery has been in effect since 1978, and no emergency closures have occurred. However, in 1978 and 1979, two 4-day emergency openings were provided when surplus fish were available.

Pertinent historical data regarding the fishery on these three streams are presented by Dunn (1961), Logan (1962, 1963, 1964), Engel and Logan (1965, 1966), Engel (1967), Redick (1968), McHenry (1969), Watsjold (1970), Nelson (1971, 1972a, 1972b), Hammarstrom (1974-1981), Hammarstrom and Larson (1982, 1983, 1984), and Hammarstrom et al. (1985).

In 1972 anglers discovered chinook salmon could be harvested in the marine waters of Cook Inlet in the vicinity of Deep Creek. As these fish return to their natal streams, there appears to be a natural holding area near the village of Ninilchik. The reason is undetermined; however, in this area there is a definite demarcation between the turbid water of the upper Inlet and the relatively clear waters of the lower Inlet. Early run fish (early May through mid-June) are probably bound for many streams in Cook Inlet but are heavily influenced by runs returning to the Kenai and Kasilof Rivers. Late-run fish (late June through July) are bound almost exclusively for the Kenai River. The Sport Fish Division of the Alaska Department of Fish and Game (ADF&G) began monitoring this fishery in 1972, and it has done so each subsequent season with an onsite creel census. Because of the relatively poor boat-launching facilities (high tide only in the mouth of Deep Creek or through the surf), boat size has been limited. As a result, local weather conditions have more influence on the fishery than does run strength. In some years, available fishing time has been reduced

significantly by inclement weather. Historical data regarding this fishery are presented by Hammarstrom (1974-1981), Hammarstrom and Larson (1982, 1983, 1984), and Hammarstrom et al. (1985).

Most chinook salmon returning to the Kasilof River are considered early run fish. They enter the system in early May, are available to the angler through June, and are completed with spawning by early August. Most of these early fish spawn in Crooked Creek or return to the Kasilof Hatchery. There had been no recreational fishery for chinook salmon in this system prior to 1978 when the Board of Fisheries opened the river to chinook salmon fishing from January 1 through June 30. Most of the harvest occurs immediately downstream from the confluence of Crooked Creek with the Kasilof River. Crooked Creek is closed to chinook salmon fishing. In 1978 the Sport Fish Division conducted a creel census to monitor the recreational harvest; the total harvest was determined insufficient to warrant further funding of a creel census. However, from 1979-1983, the FRED (Fisheries Rehabilitation Enhancement and Development) Division of ADF&G monitored the fishery, in conjunction with smolt studies conducted in the immediate vicinity of the recreational fishery. The fishery had grown sufficiently for Sport Fish Division to initiate a census when FRED did not receive enough funding in 1984.

In 1985 the Board of Fisheries extended the chinook salmon season (Kasilof River, downstream from the Sterling Highway bridge) to July 31. The creel census used to monitor the early run was expanded to encompass the late run; however, lack of participation by the recreational public in this fishery did not warrant continuance beyond July 10. The relatively few anglers utilizing the stream after June 30 were primarily guided clients that could not fish the Kenai River because of the Sunday and Monday closures. The size of this run is unknown, and the success of a recreational fishery may be hindered by the extreme glacial turbidity of this river. Pertinent historical data regarding the chinook salmon fisheries on this stream are presented by Hammarstrom (1978), Hammarstrom and Larson (1984), and Hammarstrom et al. (1985).

Chinook salmon return to the Kenai River system in two segments: early and late runs. In accordance with the Upper Cook Inlet Salmon Management Plan that was adopted by the Alaska Board of Fisheries in 1981, early run fish (mid-May through late June) are allocated almost entirely to recreational anglers. This plan prevented commercial fishing along the eastern shore of Cook Inlet from Ninilchik to Boulder Point, the suspected route these fish travel, until June 25. Further restrictions in 1984 closed these areas until July 1. These restrictions were successfully challenged in court after the 1984 season. From 1973 through 1980, the commercial season was closed by regulation prior to June 25. As a result, only the very latter portion of the early run has been subject to a commercial harvest since 1973. Therefore, early run fish are harvested by recreational anglers in the Deep Creek marine fishery and in the very intense Kenai River fishery.

Late-run fish (early July through mid-August) are harvested by both commercial and recreational interests. The commercial harvest is incidental to the more abundant sockeye salmon and is dominated by set

gill nets along the eastern shore of Cook Inlet. The harvest of chinook salmon by the commercial drift gill net fleet in July, although relatively small, is considered to be primarily of Kenai River origin as there are no other known populations of significant strength in Cook Inlet with similar timing.

The Kenai River recreational fishery for chinook salmon became popular in 1973. In 1974 the Sport Fish Division initiated a creel census to monitor harvest and effort. That census was expanded in 1975 and has continued each summer. For the past 8 years, angling effort on the Kenai River has made this fishery the largest in Alaska. Effort levels have gradually continued to increase each year.

This late run of chinook salmon to the Kenai River has been the subject of much controversy between sport and commercial interests. The harvest of these prime game fish by gill nets has been considered "sacrilegious" by many sport fishermen, while management of a commercial fishery only to accommodate those individuals who are "just having fun" does not seem justified to commercial fishermen. The battle has resulted in much discussion at the annual Board of Fisheries meeting and some court action. The controversy promises to continue in the future. Those individuals who have been charged with resolving some of the various problems confronting the Kenai River, have made greater demands on ADF&G to provide more information regarding the total river system.

One of the most critical management needs on the Kenai River has been to define the spawning population of chinook salmon, especially the late run. Present state-of-the-art sonar has not proven successful. New equipment was tested in 1984 and 1985; however, results are currently undergoing analysis. The Sport Fish Division proposed a tag and recovery program in 1975. Various adult chinook capture devices have been evaluated since 1980, including electroshocking, drift gill nets (Hammarstrom 1980), fish traps and fish wheels (Hammarstrom and Larson, 1982, 1983, 1984). The drift gill net has been found to be the most effective method, and it has been employed during the past 2 years to capture the fish required for population estimates.

Another popular fishery on the Kenai River is the coho salmon fishery. This fishery differs from the chinook fishery in that it is essentially a stationary fishery. When fishing for chinook salmon, anglers fish primarily from drifting boats or by trolling from a boat held in the current by an outboard motor. In contrast, anglers fishing for cohos will motor to a favorite location, anchor, and either cast lures or still fish with salmon roe. The popularity of this fishery seems more aligned with return strength and river condition than does the chinook fishery. Years with poor catch rates or flood conditions are usually years when effort is relatively low.

Coho salmon also return to the Kenai River in two segments: early and late runs. Early run fish begin to appear in late July and are available through early September. Late-run fish show up in the river in late August and are available until freeze-up; however, the recreational fishery peaks in September. Early run fish are also taken in the commercial gill net fishery in Cook Inlet. The commercial

closing date of August 15 essentially prevents any harvest of late-run fish by commercial fishermen. A subsistence season, established by court order in 1985, resulted in the first significant gill-net harvest of late-run fish since the commercial fishery closed in 1978.

In 1982 Governor Jay Hammond appointed a task force to study the fisheries and habitat of the Kenai River. The findings of that committee and its accompanying public concern prompted current governor Bill Sheffield to appropriate additional monies for further studies. In addition, the Legislature created the Kenai River Special Management Area (KRSMA) during the 1984 session. In essence, this measure placed most of the Kenai River into the State Park system and gave control of the water and habitat to the Department of Natural Resources (DNR). A special advisory committee of local individuals and representatives of various agencies responsible for the river was formulated and charged with drafting a management plan over the next 2 years. Once that plan is adopted by DNR, it will become the direction for the management of the river for the foreseeable future.

Part of the legislation specifically addressed the question of commercial fishing guides operating on the Kenai River. Beginning in 1982, Kenai River guides were required only to register at ADF&G's Soldotna office. Subsequent to the 1984 legislation, however, they were additionally required to obtain a concessionaire's permit. Conditions of the permit were more restrictive than the ADF&G requirements, and a cooperative agreement with DNR was activated to cause the least amount of inconvenience to the operators.

Table 1 presents common and scientific names of species mentioned in this report.

RECOMMENDATIONS

1. The recreational fisheries on chinook and coho salmon continued to be monitored by creel census.

2. Escapement of early and late-run chinook salmon into the Kenai River should continue to be assessed and techniques further refined to ensure the accuracy of calculated estimates.

3. Spawning distribution and migrational behavior of both early and late-run Kenai River chinook salmon should be investigated through the use of radio telemetry.

OBJECTIVES

S-31-1 Lower Cook Inlet Creel Census and Escapement*

1. To determine the adult harvest and in-season run strength of chinook salmon in Anchor River, Deep Creek and Ninilchik River and to determine angler effort expended during this fishery.

Table 1. List of Common Names, Scientific Names and Abbreviations.

Common Name	Scientific Name and Author	Abbreviation
Chinook Salmon	*Oncorhynchus tshawytscha* (Walbaum)	KS
Sockeye Salmon	*Oncorhynchus nerka* (Walbaum)	RS
Coho Salmon	*Oncorhynchus kisutch* (Walbaum)	SS
Pacific halibut	*Hippoglossus stenolepis* Schmidt	H

2. To determine the age structure of the recreational chinook salmon harvest in Anchor River, Deep Creek and Ninilchik River.

* These objectives were included in this report so as to consolidate all chinook salmon work in one report. A separate S-31-1 report was written for other species.

S-32-1 Kenai River Creel Census

1. To accurately assess the recreational harvest of chinook and coho salmon from the Kenai River downstream from Skilak Lake.

2. To accurately assess the recreational effort in angler-days in the sport fishery for chinook and coho salmon in the Kenai River downstream from Skilak Lake.

S-32-2 Kenai River Salmon Escapement Studies

1. To estimate the spawning population of early run chinook salmon in the Kenai River.

2. To estimate the spawning population of late run chinook salmon in the Kenai River.

S-32-4 Kasilof River Creel Census

1. To measure the harvest of chinook salmon in the recreational fishery on the Kasilof River.

2. To measure the effort in angler-days in the recreational fishery on the Kasilof River.

S-32-5 Deep Creek Marine Creel Census

1. To measure the harvest, primarily of chinook salmon and pacific halibut, in the recreational fishery in the marine waters of Cook Inlet in the vicinity of the village of Ninilchik.

2. To measure the effort in the recreational fishery in the marine waters of Cook Inlet in the vicinity of the village of Ninilchik.

TECHNIQUES USED

Fisheries

The harvest of chinook salmon and angler effort on the three southern Kenai Peninsula streams (Anchor River, Deep Creek, and Ninilchik River) were determined by ADF&G personnel during each day of the fishery. The

methods used were the same as has been employed since 1977 (Hammarstrom 1978). The creel census used to determine the harvest and effort in the Deep Creek marine fishery followed Hammarstrom (1977).

The method used to determine the harvest and effort in the Kenai River recreational fishery was similar to that described by Hammarstrom (1977); however, a change in the regulations by the Board of Fisheries for the 1984 season altered the fishery. These regulatory changes adopted in 1984 (Hammarstrom et al. 1985) were further refined because the creel census is also a critical part of the escapement estimate. The 1985 fishery was conducted under the same regulations as the 1984 fishery (Hammarstrom et al. 1985).

Analysis of the 1984 escapement-estimate data revealed a need to increase the number of observations of sport-caught chinook salmon in the creel census in order to increase the number of observed marks. In 1985 one additional census taker was added to the downstream section of the Kenai River, bringing the total number of census takers to three. The two census taker schedules in the downstream section were adjusted to preclude any day from being missed. The stratification utilized in the past was also altered slightly, based on recommendations from the Division's Biometrics Section.

Every fishing day (0400-2400h) was comprised of five 4-hour cells (A thru E, A = 0400-0759h, B = 0800-1159h, etc.). Each cell was further divided into four 1-hour units. The fishing day was reduced to 16 hours in August (0600-2200h, 4 cells) and 12 hours in September (0800-2000h, 3 cells) because of reduced daylight hours.

From May 18 through September 30 in the upstream section, every weekend/holiday and 3 of 5 weekdays, selected randomly without replacement, were sampled each week. On weeks containing holidays, 2 of 4 weekdays were selected. On each sampled day, two cells were selected randomly without replacement. This dictated the time of day the census taker worked. Within each cell, one unit was selected randomly as the "count hour." For example, on June 4 the schedule called for B3 and D2. The census taker worked from 0800-1159h and again from 1600-1959h. At 1000 and 1700h, the census taker would initiate an instantaneous count. The remainder of the time worked would be spent interviewing anglers.

In the downstream section, from May 18 through August 4, an additional census taker was employed. This allowed daily sampling efforts, unless prevented by illness or equipment malfunction. On every weekend/holiday, four cells were selected by randomly eliminating the one cell that was not to be sampled. Again, one unit within each cell was selected as the "count hour." The first two cells selected comprised the "early shift"; the other two, the "late shift." This selection process was also prepared for every weekday; however, one day was randomly selected as the "joint day," when both census takers worked. On the other 4 days, either the early or late shift was selected randomly without replacement. This resulted in the sampling of three early shifts and three late shifts each 5-weekday period. The sampling design was further modified during July because of the regulation closing the stream to fishing from a boat each Monday in July after

July 5. Each census taker received Monday as a day off; this allowed 2 days to be selected randomly without replacement as "joint days," on which four cells could be sampled.

After the chinook season closed, only one census taker was employed in each of the downstream and upstream sections. The sampling design in the downstream section was the same as that previously described for the upstream section.

The conducting of the angler interview and count during the "count hour" was similar to that described by Hammarstrom (1978) but modified to result in six strata: upstream/downstream, weekend/weekday, guided/nonguided. Estimates for each stratum were totaled and expanded to achieve an estimate for the midstream section; estimates for all sections were totaled to arrive at estimates for the season.

During the season, aerial monitoring of the fishing effort was employed. Although a random schedule was established, availability of charter aircraft and the weather further randomized planned activities. During these flights, instantaneous counts of fishing boats by river section were obtained. The average proportion occurring in the midstream section was used as the expansion factor applied to the total harvest and effort determined in each sampled river section. Historically, this section has accounted for approximately 9% of the effort and 11% of the harvest.

The technique described by Hammarstrom and Larson (1982) to arrive at in-season estimates of harvest and effort was compared to the creel-census estimates. Although there were improvements with the addition of more data points, the technique needs additional data points to achieve the same degree of reliability as existed prior to the regulation changes that altered the fishery in 1984 (Hammarstrom et al. 1985).

Chinook Salmon Population Estimate

The methodology utilized in determining the spawning population of late-run chinook salmon entering the Kenai River was expanded to include the early run in 1985. The basic drift-netting technique has been described by Hammarstrom (1980); improvements were described by Hammarstrom and Larson (1984) and Hammarstrom et al. (1985).

To estimate the population of adult chinook salmon returning to the Kenai River, a capture/recapture technique is employed, utilizing a drift net as the capture mechanism and the sport angler as the recapture tool. Captured fish are tagged with successively numbered, 20-inch Floy FT-4 spaghetti tags for later identification in the recreational fishery. Only those tags observed in a statistically designed program (creel-census and campground survey) are useful in subsequent chinook salmon population-estimate calculations. Tags recovered by other means, although useful for movement analysis, are excluded from population calculations.

The 1984 field season incorporated a monetary-reward program to provide an incentive for anglers to return tags from harvested chinook salmon (Hammarstrom et al. 1985). This incentive program was eliminated in 1985. Justification for discontinuing the incentive program include:

1. Loss of population-estimate precision, resulting from an angler tendency to remove tags from nonretained fish.

2. Inability to use voluntary tag returns when calculating the population estimate.

3. Budget restraints.

Tag recoveries used to calculate the chinook salmon run strengths were collected through two independent creel-survey programs: a boat survey (Hammarstrom et al. 1985), incorporated during both the early and late runs (May 20-August 4, 1985) and a campground survey that was incorporated only during the late run (July 1-August 4, 1985).

The campground survey is a stratified, random survey based on a 20-hour fishing day (0400-2400h). The survey is conducted at several major Kenai River access points, the number and location of which varies from year to year as land use and ownership along the Kenai River is restructured. There were seven major boat access points during the 1985 field season: Soldotna bridge (river mile 21.5), Centennial Park (river mile 20.5), Poacher's Cove (river mile 17.5), King Run Resort (river mile 15.0), Big Eddy Jetty (river mile 14.0), Big Bend Campground (river mile 13.9), and Eagle Rock (river mile 11.5).

The campground creel-survey schedule included every weekend/holiday and 3 randomly selected weekdays from July 1 through August 4. The work day started on the hour and continued for the next 7.5 hours; each start hour was randomly selected from 0600 to 1600h; i.e., 0600-1330h, 0700-1430h, 0800-1530h, etc.

The Soldotna Bridge and Poacher's Cove were major launch sites for guided anglers and afforded an opportunity for survey staff to observe many retained chinook salmon. Guided anglers were most accessible at these sites during two 1.5-hour daily periods when they were returning from morning or afternoon guided shifts; the most accessible periods were 1130-1300 hours and 1730-1900 hours. One of these randomly selected sites was sampled on each work day during one of the accessible periods (except Sundays); three other sites were also selected randomly without replacement. These prime guided-angler sites were not sampled on Sundays in July because of the regulation prohibiting the use of guides. After July 5 sampling was not done on Mondays because fishing from a boat is prohibited on that day.

Three of the remaining five access points were randomly selected without replacement and surveyed for 1.75 hours each. This allowed survey personnel 45 minutes of travel time, by vehicle, between all four access sites surveyed daily.

Campground-survey personnel recorded information only from anglers who were returning to the access points during the scheduled interview period. Information recorded included:

1. The number of chinook salmon retained per angler.

2. The total number of hours spent fishing that day per angler.

3. Whether or not the retained chinook salmon was tagged.

4. The length (mid-eye to fork of tail to the nearest 5 mm), weight (to the nearest 0.1 kg), sex, and scale sample from each retained chinook salmon.

All chinook salmon recorded as retained had to be physically viewed by survey personnel to be included in the survey. If a tag was not present, a physical check for a tagging mark, either a hole located at the base of the dorsal fin (created from the insertion of the Floy FT-4 tag) or a fresh adipose clip, was conducted to ensure data accuracy. Chapman's modification of the Petersen estimate (Seber 1973) was used to estimate the total chinook salmon population entering the Kenai River during the period May 20 through July 31 and for the late-run period July 1 through July 31. The population estimate for the early run (May 20 through June 30) was obtained by simple subtraction of the late run from the total population. Chapman's modification of the Petersen estimate is:

$$N=[(n1+1)(n2+1)/(m2+1)]-1$$

where

N = the number of fish present at the time of tagging;

n1= the number of fish marked (tagged) and returned to the population;

n2= the number of fish sampled and examined for marks at a later time; and

m2= the number of fish marks in the later sample.

A 95% confidence interval was calculated for the fraction of the population marked [p=(m2/n2)] that, in turn, allowed a 95% confidence interval to be calculated for the population estimate (N) (Seber 1973). The formula for calculating a 95% confidence interval for p is:

$$p\pm 1.96\{SQRT[p(1-p)/(n2-1)]\}.$$

For N (Chapman's modification of the Petersen estimate) a 95% confidence interval is equal to:

$$N \text{ (lower bound)} = n1 * \{1/[p + 1.96(SQRT[p(1-p)/(n2-1)])]\}$$

and

$$N \text{ (upper bound)} = n1 * \{1/[p - 1.96(SQRT[p(1-p)/(n2-1)])]\}.$$

The creel census techniques employed for coho salmon on the Kenai River fishery were similar to those described by Hammarstrom (1977), including the refinements previously mentioned. However, only one census taker was used in each sampled river section, and the sampling design was an extension of that used for chinook salmon with a reduced fishing day as previously mentioned.

The method employed to determine the harvest and effort in the Kasilof River chinook salmon fishery was similar to that described by Hammarstrom et al. (1985). An extension of the season through July 31 by the Board of Fisheries caused the schedule to be extended also. However, the census was terminated after July 10 because of lack of participation by anglers.

FINDINGS

Southern Peninsula Fishery

The spring fishery for chinook salmon on Anchor River, Deep Creek, and Ninilchik River was conducted under the same regulations that have occurred since 1978, with the exception that catches must be recorded in ink on the back of an individual's sport fishing license or special card. Each stream opened May 25, 1985 for a 3-day period (Saturday, Sunday, and Monday) and remained open for the next 3 weekends, except Ninilchik River, which closed after the third weekend. Total harvest of chinook salmon over 20 inches was estimated at 1,030, and total effort for the entire fishery was estimated at 12,200 angler-days.

Anglers arriving on the southern Kenai Peninsula in late May were confronted with highly turbid conditions in each of the three streams open to chinook salmon fishing. In addition, fish appeared to be reluctant to enter the streams. Although fish were being harvested in the marine waters in the vicinity of these streams, very few fish were taken in the fresh waters. Many anglers left the fishery during the first weekend and did not return until fishing conditions and fish abundance improved. Conditions did not improve on each stream until the third weekend. Significantly more fish were in the streams, and fishing was relatively successful during the third and fourth weekends. A summary of daily harvest and effort is presented in Table 2.

Escapement surveys were conducted in late July by both helicopter and ground crews. Surveying conditions were not ideal in 1985; recent rains had caused some turbidity, but water levels were not excessive. The surveys were conducted under cloudy skies with occasional rain showers. However, the day following the escapement surveys, an 8-day period of rains began, causing turbidity and preventing counting for nearly 2 weeks. Escapements into Anchor River and Ninilchik River were less

Table 2. Summary of Angler Harvest and Effort* During the Chinook Salmon Fisheries on Three Southern Kenai Peninsula Streams, 1985.

Date	Anchor River		Deep Creek		Ninilchik River		Total	
	Harvest	Effort	Harvest	Effort	Harvest	Effort	Harvest	Effort
5/25	5	150	5	100	40	1,000	50	1,250
5/26	5	75	5	50	10	500	20	625
5/27	0	75	0	50	10	500	10	625
Subtotal	10	300	10	200	60	2,000	80	2,500
6/1	5	100	5	75	20	600	30	775
6/2	5	50	5	50	10	500	20	600
6/3	5	100	5	25	10	250	20	375
Subtotal	15	250	15	150	40	1,350	70	1,750
6/8	50	700	10	150	200	1,600	260	2,450
6/9	30	500	10	75	150	1,200	190	1,775
6/10	50	300	5	75	150	1,000	205	1,375
Subtotal	130	1,500	25	300	500	3,800	655	5,600
6/15	75	750	10	100	closed		85	850
6/16	50	700	15	150	closed		65	850
6/17	50	350	25	300	closed		75	650
Subtotal	175	1,800	50	550	0	0	225	2,350
Total	330	3,850	100	1,200	600	7,150	1,030	12,200

* Effort in Angler-Days
Numbers have been rounded to the nearest 5.

than the 1966-1984 mean. Deep Creek's escapement was estimated to be 45% greater than the 1966-1984 mean. Escapements were considered adequate because returns from similar sized escapements have produced excellent returns. Escapement into each stream was as follows: Anchor River, 1,330; Deep Creek, 1,110; and Ninilchik River, 650. Total harvest was 20% less than the historical mean. Overall exploitation rate was approximately equal to the 18-year mean of 28%. A summary of harvest and escapement data are presented in Table 3, while historical information on the fishery is presented in Table 4.

Deep Creek Marine Fishery

Creel-census activities in 1985 commenced May 18 on the Deep Creek marine-recreational fishery and was continuous through July 31. During that time a total of 186 instantaneous boat counts were made, 9,064 boats were counted, 3,383 anglers were interviewed, and 485 chinook salmon and 2,119 Pacific halibut were creel checked.

The season lasted 75 days, and creel-census activities were conducted on 54 days (72.0%). Of the 75-day season, early run fish were available for 41 days and late-run fish were available for 34 days, May 18-June 28 and June 29-July 31, respectively. Only 6 of 41 days (14.6%) during the early run and 1 of 34 days (2.9%) of the late run were recorded as weather days, when the water was too rough to allow significant effort. Total reduction in fishing time of 9.3% because of inclement weather is similar to the 6.6% in 1984 but in contrast to 41% in 1981 and 35% in 1980.

An estimated 5,087 early run chinook salmon were harvested for 22,118 angler-days of effort. Each angler-day of effort was 4.5 hours in length. The overall catch rate for chinook salmon during the early run was 0.058 fish per hour (17 angler-hours per fish). The 1985 catch rate was the highest since 1978 and higher than those recorded in 1983 and 1984: 0.011 and 0.040 fish per hour, respectively.

Harvest of chinook salmon during the late run was estimated at 1,731 fish for 13,422 angler-days of effort: a catch rate of 0.027 fish per hour (37 angler-hours per fish). The late-run harvest was approximately 80% greater than the 1972-1984 mean, while effort was approximately 104% greater than the 13-year mean.

An additional 12,135 Pacific halibut (catch rate of 0.143 fish per hour) were taken during the time early run chinook salmon were available, and 10,571 (catch rate of 0.156 fish per hour) were taken during the late run. The halibut harvest continues to increase each year, increasing angler opportunity. Most effort for chinook salmon centers around high tide, while effort for halibut occurs throughout the fishing day. Because of the increased chance of success and the possibility of catching relatively large fish (halibut in excess of 200 lbs have been taken in these waters), anglers are spending more time in pursuit of halibut than they have in the past. Historical data regarding the recreational-marine fishery for chinook salmon in the vicinity of Ninilchik are presented in Table 5.

Table 3. Historical Harvest* and Escapement for Three Southern Kenai Peninsula Chinook Salmon Streams (Anchor River, Deep Creek, Ninilchik River), 1966-1985.

Year	Anchor River			Deep Creek			Ninilchik River			Total		
	Harvest	Escapement	%Harvest	Harvest	Escapement	%Harvest	Harvest	Escapement	%Harvest	Harvest	Escapement	Run
1966	290	1,330	18	50	540	9	200	670	25	540	2,540	3,080
1967	240	1,200	17	180	270	40	120	360	25	540	1,830	2,370
1968	250	530	32	160	200	44	210	450	32	620	1,180	1,800
1969	80	1,800	4	40	200	4	130	760	15	250	2,760	3,010
1970	170	1,850	8	60	...	...	280	...	...	510	1,850+	2,360+
1971	60	1,220	5	40	...	...	140	...	...	240	1,220+	1,460+
1972	180	1,890	8	140	530	21	170	1,360	11	490	3,780	4,270
1973	330	1,660	17	140	220	39	300	640	32	770	2,520	3,290
1974	440	1,000	31	290	740	28	350	510	41	1,080	2,250	3,330
1975	210	1,290	14	100	610	14	540	830	39	850	2,730	3,580
1976	830	3,080	21	220	1,680	12	630	1,180	35	1,680	5,940	7,620
1977	1,020	4,170	16	240	990	21	910	1,400	40	2,170	6,560	8,730
1978	1,680	2,410	41	590	1,010	40	1,130	990	44	3,400	4,410	7,810
1979	1,030	2,000	34	370	1,750	17	700	1,390	34	2,100	5,140	7,240
1980 **	425	665	39	90	475	16	480	720	40	995	1,860	2,855
1981 **	1,040	1,230	48	580	920	39	1,300	830	61	2,920	2,980	5,900
1982	760	1,540	33	660	2,670	20	1,070	1,430	43	2,490	5,640	8,130
1983	930	1,490	33	1,100	1,010	52	1,160	710	62	3,190	3,210	6,400
1984	740	1,170	39	340	380	47	440	600	42	1,520	2,150	3,670
Mean ***	540	1,740	22	280	750	24	500	780	31	1,320	3,270	4,600
1985	330	1,330	20	100	1,110	8	600	650	48	1,030	3,090	4,120

Numbers rounded to nearest 10.
* Percent of total return harvested.
** Escapement counts considered minimal due to high turbid water during escapement surveys.
*** Excludes all 1980 and 1981 data.

Table 4. Historical Chinook Salmon Harvest and Effort* Data from Three Southern Kenai Peninsula Streams (Anchor River, Deep Creek and Ninilchik River), 1971-1985.

Year	Effort	Harvest	Length of Season (days)	Average Effort/Day	Average Harvest/Day	Angler-Days Per Fish
1971	15,900	240	6	2,650	40	66
1972	13,520	490	4	3,380	123	28
1973	24,100	770	6	4,017	128	31
1974	21,000	1,080	6	3,500	180	19
1975	19,600	850	6	3,267	142	23
1976	36,920	1,680	8	4,615	210	22
1977	24,520	2,170	8	3,065	271	11
1978	45,540	3,400	16 **	2,846	213	13
1979	36,640	2,100	16 **	2,290	131	17
1980	28,790	995	12	2,399	83	29
1981	32,330	3,020	12	2,694	252	11
1982	33,420	2,485	12	2,785	207	13
1983	27,370	3,185	12	2,281	265	9
1984	20,860	1,515	12	1,738	126	14
1985	12,200	1,030	12	1,017	86	12
Mean	26,181	1,667	10	2,836	164	21

* Effort measured in Angler-Days.
** Anchor River only was open for four additional days.

Table 5. Historical Summary of the Chinook Salmon Sport Fishery in Marine Waters off Deep Creek, 1972-1985.

Year	Early Run			Late Run			Total		
	Harvest	Effort*	C/H	Harvest	Effort*	C/H	Harvest	Effort*	C/H
1972	1,000	2,357	0.119	1,250	1,253	0.272	2,250	3,610	0.173
1973	519	5,245	0.028	491	2,795	0.050	1,010	8,040	0.034
1974	500	3,810	0.037	100	1,280	0.034	600	5,090	0.036
1975	540	3,370	0.061	345	4,680	0.031	885	8,050	0.044
1976	5,495	12,268	0.101	1,382	6,365	0.057	6,877	18,633	0.088
1977	4,617	18,803	0.069	366	6,938	0.017	4,983	25,741	0.056
1978	2,669	14,413	0.059	2,693	9,402	0.081	5,362	23,815	0.068
1979	3,088	13,352	0.053	1,164	8,728	0.034	4,252	22,080	0.046
1980	521	8,065	0.017	747	9,104	0.021	1,268	17,169	0.019
1981	2,363	11,601	0.051	170	3,325	0.018	2,533	14,926	0.042
1982	2,497	14,514	0.056	1,173	9,252	0.033	3,670	23,766	0.046
1983	1,000	21,707	0.011	1,707	10,640	0.045	2,707	32,347	0.021
1984	2,386	14,694	0.040	835	11,895	0.019	3,221	26,589	0.031
Mean	2,092	11,092	0.051	956	6,589	0.051	3,048	17,681	0.054
1985	5,087	22,118	0.058	1,731	13,422	0.027	6,818	35,540	0.045

* Angler-Days
C/H - Catch per Hour

A total of 286 readable scales were collected from chinook salmon harvested in the Deep Creek marine fishery in 1985; 208 scales from the early run and 78 scales from the late run. The predominate age class in both runs was 1.4 (1979 brood year); this age class represented 64.4% of the early run and 76.9% of the late-run harvest. There was a relatively large component (10.3%) of age class 1.5 fish (1978 brood year) during the late run; this has been the case the past 2 years. In 1979 age class 1.5 made up 17.5% of that year's recreational harvest of late-run chinook salmon in this marine fishery (Hammarstrom 1980). Mean lengths for all age classes were larger for late-run fish than early run fish. Summarized age-weight-length (AWL) information obtained from the samples collected from recreationally harvested chinook salmon during 1985 is presented in Table 6.

Kenai River Chinook Salmon Fishery

In 1985 formal creel census activities began on the Kenai River on May 18 and were continuous through September 30. In previous years, low water levels and lack of fish abundance have kept effort to insignificant levels prior to June 1. In 1984 anglers, especially those with the assistance of guides, began successfully fishing for chinook salmon in the river in mid-May. In 1985 some fish were taken in early May, and on May 17, the world record for sport-caught chinook salmon was broken by a 44.2 kg (97 lb, 4 oz) male harvested by a local resident. The capture of this prize and the publicity it received will ensure that significant effort will occur early in the season.

During the chinook salmon creel census (May 18-August 4), a total of 444 instantaneous counts were made, 17,783 boats were counted, and 54,383 boat anglers were enumerated. During the 18,275 angler interviews conducted, 45,618 angler-hours were reported and 1,727 chinook salmon over 51 cm (20 inches) were creel checked. During 13 aerial surveys, 1,793 boats were counted.

Analysis of the above data resulted in an estimated harvest of 16,026 chinook salmon: 7,971 fish during the early run and 8,055 fish during the late run. Effort during the fishery was estimated at 121,009 angler-days, 47,394 and 73,615 during the early and late runs, respectively.

Early run fish were considered available in the downstream section from May 18-June 30 (44 days), while late-run fish were available from July 1-August 4 (35 days). By regulation, the season closes July 31; in 1985 an emergency order extended the fishery through August 4, and circumstances surrounding this order will be discussed later in this report. In the upstream section (Naptown Rapids to Skilak Lake), early-run fish were available from June 1-July 7 (37 days), while late-run fish were present from July 8-August 4 (28 days). The midstream-section (Soldotna Bridge to Naptown Rapids) estimates were achieved by combining the downstream and upstream section totals and then expanding by a factor determined from the relative effort calculated from aerial-survey data.

Table 6. Summarized Data from Readable Scales Collected from Recreationally Harvested Chinook Salmon in the Deep Creek Marine Fishery, 1985.

Age Class Brood Year	1.2 1981	1.3 1980	1.4 1979	1.5 1978	Other	Total
			Early Run			
Number	13	51	134	7	3	208
Percent	6.3	24.5	64.4	3.4	1.4	100
Length (mm)*						
Range	540-670	680-1020	740-1175	880-1160	440-990	440-1160
Mean	607	803	928	970	773	876
S.D.	39.7	64.1	75.4	126.1	358.8	
Weight (kg)						
Range	3.0-7.0	5.5-19.0	6.8-26.5	10.0-23.0	1.0-16.5	3.0-34.7
Mean	4.3	8.9	13.4	15.0	9.6	11.7
S.D.	1.2	2.5	3.7	6.1	9.6	
			Late Run			
Number	1	9	60	8	0	78
Percent	1.3	11.5	76.9	10.3	0.0	100
Length (mm)*						
Range	635	750-1040	925-1260	920-1225		635-1260
Mean	635	870	1061	1086		1036
S.D.		102.4	73.5	98.8		
Weight (kg)						
Range	5.0	7.9-18.0	9.6-33.6	16.8-32.5		5.0-33.6
Mean	5.0	12.3	22.1	25.6		21.1
S.D.		3.5	5.6	6.6		

* Mid-eye to fork of tail.
S.D. - Standard Deviation

Total effort during the 1985 early run was 47,394 angler-days; each angler-day was equal to 3.9 angler-hours. The average catch per hour for the early run was 0.043 fish per hour (23 angler-hours per fish). The catch rate in 1985 was the highest recorded since the creel census began in 1974.

The separation date between the two runs is determined by examining daily catch rates and adjusting to the nearest weekly period. This determination was established because of various Board of Fisheries policies over the years that have required a distinction between the runs. There are no current policies requiring a differentiation; however, the method was retained to preserve compatibility of data. Daily catch rates for the downstream section are presented graphically in Figure 1.

Because of the entry pattern of late-run chinook salmon into the Kenai River, their migrational behavior, and the seasonal closure date of July 31, the majority of the harvest and effort occurs in the downstream section. During 1985 the total late-run harvest of chinook salmon over 51 cm (20 inches) was 8,055 fish for 73,615 angler-days of effort; of these, 71.8% of the effort and 88.1% of the harvest occurred in the downstream section. Overall catch per hour was 0.027 (48 angler-hours per fish). The catch rate in the downstream section was 0.034 fish per hour while only 0.007 fish per hour in the upstream section.

In addition to the 8,055 chinook salmon harvested in the Kenai River recreational fishery, another 16,985 chinook salmon of Kenai River origin were taken in the commercial set-net fishery along the eastern beaches of Cook Inlet; 1,731 chinook salmon, also believed to be bound for the Kenai River, were taken in the recreational-marine fishery off Deep Creek. Thus, the total harvest of late-run chinook salmon of Kenai River origin in 1985 was 26,771.

Effort during the early run was 8.4% less than in 1984 and late-run effort declined by 15.5%. Both early and late-run efforts in 1984 were record highs (Hammarstrom et al. 1985). Early run harvest was 25.3% greater than the previous record set in 1983. Late-run harvest, although not a record, was the second-largest catch recorded. A historical summary of the Kenai River chinook salmon fishery is presented in Table 7. Comparative data by river section appear in Tables 8 and 9.

Public concern over guides and guided anglers on the Kenai River caused the promulgation of a regulation in 1982 requiring commercial guides to register with ADF&G. Each year, public testimony concerning guide regulations has surfaced during Board of Fisheries deliberations over regulation changes; many of the requests, however, are beyond the scope of the Board's authority. With the creation of the Kenai River Special Management Area (KRSMA) by Legislative act, designating the Kenai River a state park, the Division of Parks and Outdoor Recreation (DPOR), Department of Natural Resources (DNR) was able to place controls on the conducting of business in areas under their jurisdiction. The legislation ensures that one of the first issues dealt with would be the guiding industry.

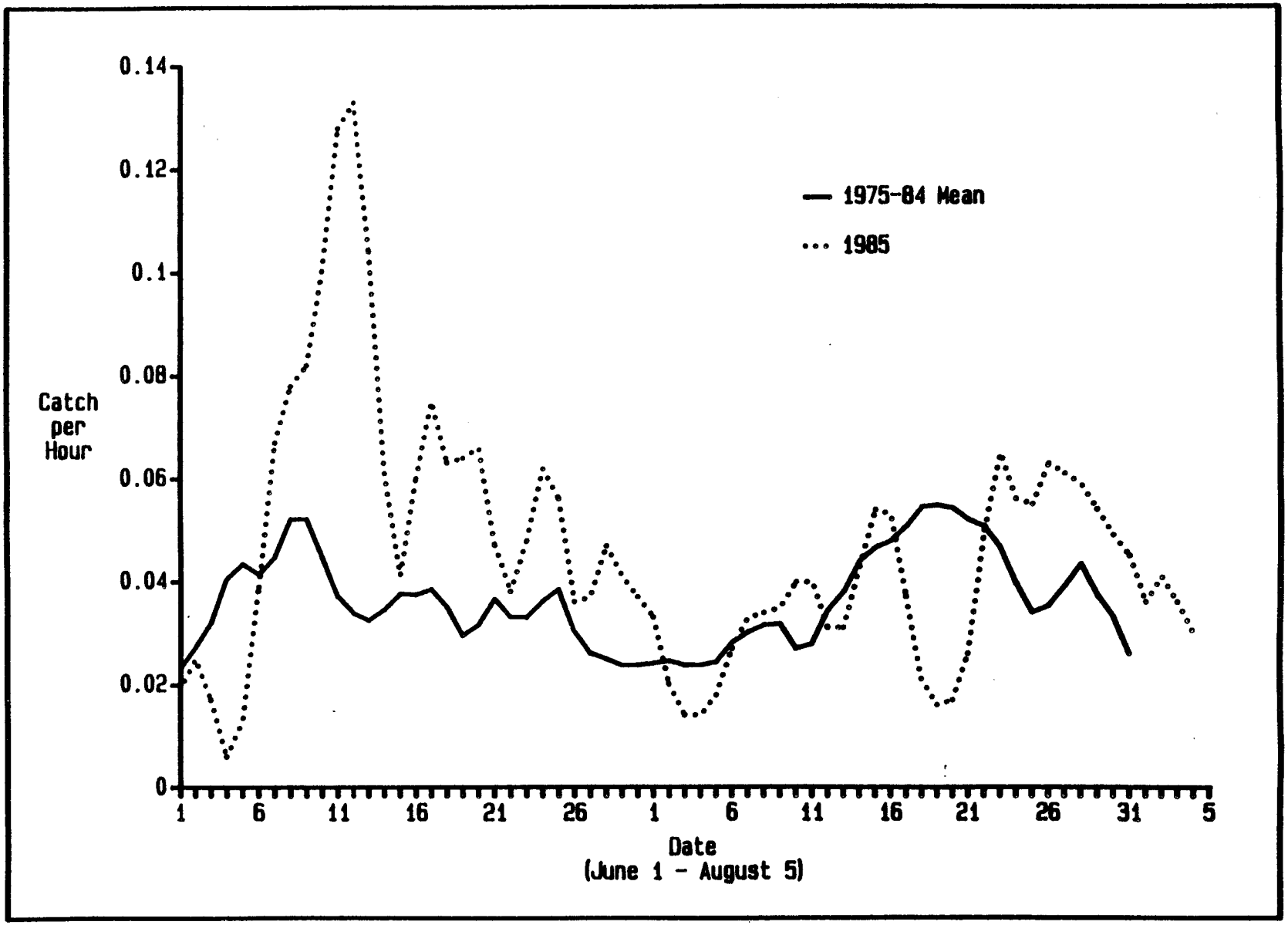

Figure 1. Catch per hour by date in the recreational fishery for chinook salmon in the Kenai River (downstream section), 1985 vs. 1975-1984 mean.

Table 7. Historical Summary of the Kenai River Recreational Fishery for Chinook Salmon, 1974-1985.

Year	Early Run			Late Run			Total		
	Harvest	Effort*	C/H	Harvest	Effort*	C/H	Harvest	Effort*	C/H
1974	1,685	11,275	0.041	3,225	12,335	0.037	4,910	23,610	0.038
1975	615	15,047	0.011	2,355	14,943	0.044	2,970	29,990	0.024
1976	1,554	16,430	0.024	4,477	28,030	0.039	6,031	44,460	0.033
1977	2,173	35,479	0.019	5,148	47,539	0.036	7,321	83,018	0.029
1978	1,542	19,569	0.018	5,578	60,636	0.026	7,120	80,205	0.024
1979	3,661	39,665	0.022	4,634	58,895	0.022	8,295	98,560	0.022
1980	1,946	32,365	0.016	3,608	38,260	0.018	5,554	70,625	0.017
1981	4,525	28,335	0.031	5,285	29,906	0.032	9,810	58,241	0.032
1982	5,466	45,723	0.033	4,810	43,366	0.024	10,276	89,089	0.030
1983	6,360	42,716	0.037	9,174	56,295	0.036	15,534	99,011	0.037
1984	4,956	50,455	0.025	7,376	77,462	0.021	12,332	127,917	0.022
Mean	3,135	30,642	0.025	5,061	42,515	0.030	8,196	73,157	0.028
1985	7,971	47,394	0.043	8,055	73,615	0.027	16,026	121,009	0.034

* Angler-Days
C/H - Catch per Hour

Table 8. Comparative Effort Data in Angler-Hours and Angler-Days for the Kenai River Recreational Fishery for Chinook Salmon, 1977-1985.

Year	Upstream Section Angler Hours	Upstream Section Angler Days	Upstream Section Hours/ Angler-Day	Midstream Section Angler Hours	Midstream Section Angler Days	Midstream Section Hours/ Angler-Day	Downstream Section Angler Hours	Downstream Section Angler Days	Downstream Section Hours/ Angler-Day	Shore Anglers Angler Hours	Shore Anglers Angler Days	Shore Anglers Hours/ Angler-Day	Total Angler Hours	Total Angler Days	Total Hours/ Angler-Day	CPUE
EARLY RUN																
1977	35,928	10,679	3.4	7,793	2,484	3.1	49,704	16,426	3.0	18,582	5,890	3.2	112,007	35,479	3.2	0.021
1978	35,698	7,761	4.6	5,885	1,199	4.9	38,800	7,321	5.3	16,241	3,288	4.9	96,624	19,569	4.9	0.017
1979	23,416	7,280	3.2	10,600	2,992	3.5	94,366	26,230	3.6	10,772	3,163	3.4	139,154	39,665	3.5	0.022
1980	30,108	6,663	4.5	18,110	4,620	3.9	61,356	17,530	3.5	13,445	3,552	3.8	123,019	32,365	3.8	0.016
1981	29,502	6,066	4.9	13,306	3,119	4.3	67,770	16,735	4.0	10,303	2,415	4.3	120,881	28,335	4.3	0.031
1982	25,562	6,228	4.1	22,444	6,224	3.6	99,128	28,348	3.5	19,200	4,923	3.9	166,334	45,723	3.6	0.033
1983	31,550	9,940	3.2	15,963	3,996	4.0	108,474	25,109	4.3	14,010	3,671	3.8	169,997	42,716	4.0	0.037
1984	43,269	10,725	4.0	18,258	4,514	4.0	130,159	32,152	4.0	10,135	3,064	3.3	201,821	50,455	4.0	0.025
1985	21,890	6,081	3.6	18,208	4,622	3.9	137,538	34,385	4.0	7,200	2,306	3.1	184,836	47,394	3.9	0.043
Mean	30,769	7,936	3.9	14,507	3,752	3.9	87,477	22,693	3.9	13,321	3,586	3.7	146,075	37,967	3.9	0.027
LATE RUN																
1977	14,962	5,087	2.9	9,398	3,328	2.8	88,312	31,233	2.8	22,410	7,891	2.8	135,082	47,539	2.8	0.038
1978	24,660	7,046	3.5	15,169	4,334	3.5	137,120	39,177	3.5	35,268	10,076	3.5	212,217	60,633	3.5	0.029
1979	26,478	7,565	3.5	15,276	4,413	3.5	143,256	40,930	3.5	20,877	5,987	3.5	205,887	58,895	3.5	0.022
1980	29,416	6,742	4.4	23,684	5,311	4.5	90,200	23,401	3.9	11,135	2,806	4.0	154,435	38,260	4.0	0.018
1981	22,284	4,965	4.5	17,842	3,574	5.0	96,660	18,861	5.1	12,510	2,506	5.0	149,296	29,906	5.0	0.032
1982	14,792	3,237	4.6	17,970	3,907	4.6	127,828	28,086	4.6	37,185	8,136	4.6	197,775	43,366	4.6	0.024
1983	29,376	8,640	3.4	11,270	2,429	4.6	164,928	33,236	5.0	42,945	11,990	3.6	248,519	56,295	4.4	0.036
1984	22,651	5,699	4.0	26,756	5,221	5.1	250,371	56,380	4.4	48,801	10,162	4.8	348,579	77,462	4.5	0.021
1985	38,016	9,748	3.9	22,838	5,765	4.0	211,507	51,587	4.1	22,092	6,515	3.4	294,453	73,615	4.0	0.027
Mean	24,737	6,525	3.8	17,800	4,254	4.2	145,576	35,877	4.1	28,136	7,341	3.9	216,249	53,997	4.0	0.027
BOTH RUNS																
1977	50,890	15,766	3.2	17,191	5,812	3.0	138,016	47,659	2.9	40,992	13,781	3.0	247,089	83,018	3.0	0.029
1978	60,358	14,807	4.1	21,054	5,533	3.8	175,920	46,498	3.8	51,509	13,364	3.9	308,841	80,202	3.9	0.024
1979	49,894	14,845	3.4	25,876	7,405	3.5	237,622	67,160	3.5	31,649	9,150	3.5	345,041	98,560	3.5	0.022
1980	59,524	13,405	4.4	41,794	9,931	4.2	151,556	40,931	3.7	24,580	6,358	3.9	277,454	70,625	3.9	0.017
1981	51,786	11,031	4.7	31,148	6,693	4.7	164,430	35,596	4.6	22,813	4,921	4.6	270,177	58,241	4.6	0.032
1982	40,354	9,465	4.3	40,414	10,131	4.0	226,956	56,434	4.0	56,385	13,059	4.3	364,109	89,089	4.1	0.030
1983	60,926	18,580	3.3	27,233	6,425	4.2	273,402	58,345	4.7	56,955	15,661	3.6	418,516	99,011	4.2	0.037
1984	65,920	16,424	4.0	45,014	9,735	4.6	380,530	88,532	4.3	58,936	13,226	4.5	550,400	127,917	4.3	0.022
1985	59,906	15,829	3.8	41,046	10,387	4.0	349,045	85,972	4.1	29,292	8,821	3.3	479,289	121,009	4.0	0.033
Mean	55,506	14,461	3.9	32,308	8,006	4.0	233,053	58,570	4.0	41,457	10,927	3.8	362,324	91,964	3.9	0.027

Table 9. Historical Harvest Comparison by River Section for the Kenai River Recreational Chinook Salmon Fishery, 1976-1985.

	Upstream Section		Midstream Section		Downstream Section		Shore Anglers		Total
	Harvest	Percent	Harvest	Percent	Harvest	Percent	Harvest	Percent	Harvest
					EARLY RUN				
1976	492	31.7	216	13.9	721	46.4	125	8.0	1,554
1977	737	33.9	166	7.6	1,083	49.9	187	8.6	2,173
1978	673	43.6	102	6.6	646	42.0	121	7.8	1,542
1979	103	3.9	290	10.9	2,156	81.0	112	4.2	2,661
1980	465	23.9	290	14.9	1,070	55.0	121	6.2	1,946
1981	346	7.6	528	11.7	3,464	76.6	187	4.1	4,525
1982	456	8.3	791	14.5	3,941	72.1	278	5.1	5,466
1983	400	6.3	645	10.1	5,255	82.7	60	0.9	6,360
1984	585	11.8	423	8.5	3,906	78.9	42	0.8	4,956
Mean	473	19.0	383	11.0	2,471	64.9	137	5.1	3,465
1985	261	3.3	885	11.1	6,765	84.8	60	0.8	7,971
					LATE RUN				
1976	89	2.0	616	13.8	3,370	75.2	402	9.0	4,477
1977	232	4.5	389	7.6	4,046	78.6	481	9.3	5,148
1978	278	5.0	439	7.9	4,429	79.4	432	7.7	5,578
1979	226	4.9	364	7.9	3,819	82.3	225	4.9	4,634
1980	242	6.7	515	14.3	2,483	68.8	368	10.2	3,608
1981	346	7.6	528	11.7	3,464	76.6	187	4.1	4,525
1982	456	8.3	791	14.5	3,941	72.1	278	5.1	5,466
1983	400	6.3	645	10.1	5,255	82.7	60	0.9	6,360
1984	585	11.8	423	8.5	3,906	78.9	42	0.8	4,956
Mean	473	19.0	383	11.0	2,471	64.9	137	5.1	3,465
1985	261	3.3	885	11.1	6,765	84.8	60	0.8	7,971

Table 9. (cont.) Historical Harvest Comparison by River Section for the Kenai River Recreational Chinook Salmon Fishery, 1976-1985.

	Upstream Section		Midstream Section		Downstream Section		Shore Anglers		Total
	Harvest	Percent	Harvest	Percent	Harvest	Percent	Harvest	Percent	Harvest
					LATE RUN				
1976	89	2.0	616	13.8	3,370	75.2	402	9.0	4,477
1977	232	4.5	389	7.6	4,046	78.6	481	9.3	5,148
1978	278	5.0	439	7.9	4,429	79.4	432	7.7	5,578
1979	226	4.9	364	7.9	3,819	82.3	225	4.9	4,634
1980	242	6.7	515	14.3	2,483	68.8	368	10.2	3,608
1981	255	4.8	660	12.5	4,150	78.5	220	4.2	5,285
1982	156	3.2	198	4.1	4,340	90.3	116	2.4	4,810
1983	133	1.4	490	5.3	8,324	90.8	227	2.5	9,174
1984	102	1.4	647	8.8	6,502	88.1	125	1.7	7,376
Mean	190	3.8	480	9.1	4,607	81.3	288	5.8	5,566
1985	267	3.3	633	7.9	7,100	88.1	55	0.7	8,055
					BOTH RUNS				
1976	581	9.6	832	13.8	4,091	67.9	527	8.7	6,031
1977	969	13.2	555	7.6	5,129	70.1	668	9.1	7,321
1978	951	13.4	541	7.6	5,075	71.2	553	7.8	7,120
1979	329	4.5	654	9.0	5,975	81.9	337	4.6	7,295
1980	707	12.7	805	14.5	3,553	64.0	489	8.8	5,554
1981	601	6.1	1,188	12.1	7,614	77.7	407	4.1	9,810
1982	612	6.0	989	9.6	8,281	80.6	394	3.8	10,276
1983	533	3.4	1,135	7.3	13,579	87.5	287	1.8	15,534
1984	687	5.6	1,070	8.7	10,408	84.3	167	1.4	12,332
Mean	663	8.3	863	10.0	7,078	76.1	425	5.6	9,029
1985	528	3.3	1,518	9.5	13,865	86.5	115	0.7	16,026

For the 1985 season, guides were required to provide proof of liability insurance, first-aid training, Coast Guard approved competency as well as pay a fee. To promote professionalism in the industry, both the public and the guides had previously asked the Board of Fisheries to implement these controls. The increased stipulations placed upon guides wishing to work the Kenai River reduced the number of individuals who registered. It is speculated that most of the guides who chose not to register in 1985 were those that had registered in 1984 but had guided rarely or not at all and had maintained the business for tax reasons. Table 10 summarizes the history of the registration program.

In 1983 guided anglers accounted for approximately 59% of the total harvest of chinook salmon and 24% of the effort (Hammarstrom and Larson 1984). In 1985 guided anglers accounted for 48.8% of the chinook salmon harvest and 21.9% of the effort. These percentages are similar to those observed in 1984 (Hammarstrom et al. 1985) and can be attributed, in part, to the regulation allowing anglers to utilize guides only from 0600 to 1800 hours.

In 1985 total harvest for guided anglers increased 42.6% over the 1984 harvest, from 5,488 to 7,825 fish; guided-angler effort also increased 22.7% from the 1984 estimates; from 22,258 to 26,483 angler-days. Nonguided effort went from 105,659 angler-days in 1984 to 94,526 angler-days in 1985, a decrease of 11,133 angler-days (10.5%). Catch rates for nonguided anglers increased by nearly 50%, from 0.015 fish per hour in 1984 to 0.022 fish per hour in 1985. Guided-angler catch rates rose by 30%, from 0.058 fish per hour in 1984 to 0.075 fish per hour in 1985. Data regarding guided vs. nonguided anglers are presented in Tables 11 and 12.

Since 1982 commercial-fishing guides on the Kenai River have had to maintain a daily logbook to record the number of each species retained and released by each client. For various reasons described by Hammarstrom et al. (1985), the estimates of harvest attributed to guided anglers generated through the creel-census program have differed significantly each year, except 1984, from the results of the logbook analysis. For the 1984 season, guided-angler harvest on the Kenai River became part of the Statewide Harvest Survey (SHS). The estimates from the SHS and the creel census were insignificant ($P<0.05$) in 1984. No estimate is available at this writing from the SHS for 1985; however, a preliminary evaluation of the logbooks for 1985 suggests once again a vast difference in estimated harvest. Numerous mistakes appeared in the manner in which the logbooks were completed by individual guides. For example, in the 1985 logbooks that were sampled, a total of 60 chinook salmon were entered as being harvested after the August 4 closure date.

As a result of the years of unusable logbook information, the program's administrative costs, and the ability of DPOR to control guides, the Board of Fisheries has stated that 1986 will be the last year ADF&G will require that logbooks be maintained.

During the 1984 fishery, a total of 755 recreationally harvested chinook salmon provided readable scale samples; 294 samples were from the early run and 461 from the late run. The predominant age class for both runs

Table 10. Historical Summary of Kenai River Guide Registration Program, 1982-1985.

	YEAR			
	1982	1983	1984	1985*
Businesses Registered	125	123	115	84
Guides Registered	207	198	214	166
Vessels Registered	179	185	199	178**
Logbooks Issued	222	236	283	274

* Data provided by Division of Parks and Outdoor Recreation
** 131 Powered Boats 47 Drift Boats

Table 11. Historical Comparison Between Guided and Non-Guided Chinook Salmon Anglers by River Section on the Kenai River, as Determined by Creel Census, 1981-1985.

	Early Run			Late Run			Both Runs		
	Percent Harvest	Percent Effort	CPUE	Percent Harvest	Percent Effort	CPUE	Percent Harvest	Percent Effort	CPUE
					1985				
Downstream Section									
Guided	61.8	36.6	0.083	38.1	19.1	0.067	49.6	26.0	0.076
Nonguided	38.3	63.4	0.030	61.9	80.9	0.026	50.4	74.0	0.027
Upstream Section									
Guided	39.8	7.1	0.067	57.1	4.1	0.064	38.4	6.5	0.066
Nonguided	60.2	92.9	0.008	62.9	95.9	0.005	61.6	93.5	0.006
Total River									
Guided	60.0	31.7	0.082	37.8	15.6	0.067	48.8	21.9	0.075
Nonguided	40.0	68.3	0.025	62.2	84.4	0.020	51.2	78.1	0.022
					1984				
Downstream Section									
Guided	56.6	31.2	0.055	40.2	16.8	0.062	46.4	21.7	0.058
Nonguided	43.4	68.8	0.019	59.8	83.2	0.019	53.6	78.3	0.019
Upstream Section									
Guided	23.6	5.5	0.060	51.0	3.4	0.067	27.7	4.7	0.061
Nonguided	76.4	94.6	0.011	49.0	96.6	0.002	72.3	95.3	0.008
Total River									
Guided	52.1	24.5	0.055	40.4	13.5	0.062	44.6	17.4	0.058
Nonguided	47.9	75.5	0.016	59.6	86.5	0.015	55.4	82.6	0.015
					1983				
Downstream Section									
Guided	67.1	40.4	0.076	59.1	33.2	0.087	62.2	36.3	0.083
Nonguided	32.9	59.6	0.025	40.9	66.8	0.030	37.8	73.7	0.029
Upstream Section									
Guided	47.0	10.5	0.057	11.3	1.8	0.031	38.1	6.5	0.053
Nonguided	53.0	89.5	0.008	88.7	98.2	0.004	61.9	93.5	0.006
Total River									
Guided	64.3	28.6	0.072	55.7	20.6	0.086	59.2	24.1	0.080
Nonguided	35.7	71.4	0.015	44.3	79.4	0.019	40.8	75.9	0.017

Table 11. (cont.) Historical Comparison Between Guided and Non-Guided Chinook Salmon Anglers by River Section on the Kenai River, as Determined by Creel Census, 1981-1985.

	Early Run			Late Run			Both Runs		
	Percent Harvest	Percent Effort	CPUE	Percent Harvest	Percent Effort	CPUE	Percent Harvest	Percent Effort	CPUE
					1982				
Downstream Section									
Guided	45.6	23.0	0.075	52.0	27.3	0.064	49.0	25.1	0.068
Nonguided	54.4	77.0	0.028	48.0	72.7	0.035	51.0	74.9	0.031
Upstream Section									
Guided	56.0	28.9	0.040	40.0	22.7	0.018	51.8	26.8	0.032
Nonguided	44.0	71.1	0.013	60.0	77.3	0.008	48.2	73.2	0.011
Total River									
Guided	44.9	21.7	0.061	50.1	21.6	0.056	47.3	21.7	0.058
Nonguided	55.1	78.3	0.023	49.9	78.4	0.027	52.7	78.3	0.025
					1981				
Downstream Section									
Guided	53.3	29.3	0.087	52.1	31.4	0.072	52.7	30.4	0.076
Nonguided	46.7	70.7	0.030	47.9	68.6	0.030	47.3	69.6	0.030
Upstream Section									
Guided	28.0	12.9	0.013	26.7	11.1	0.030	27.5	12.1	0.023
Nonguided	72.0	87.1	0.006	73.3	88.9	0.010	72.5	87.9	0.009
Total River									
Guided	49.0	22.6	0.072	48.5	24.9	0.066	48.7	23.9	0.070
Nonguided	51.0	77.4	0.021	51.5	75.1	0.022	51.3	76.1	0.022
					Mean				
Downstream Section									
Guided	56.9	32.1	0.075	48.3	25.6	0.070	52.0	27.9	0.072
Nonguided	43.1	67.9	0.026	51.7	74.4	0.028	48.0	74.1	0.027
Upstream Section									
Guided	38.9	13.0	0.047	37.2	8.6	0.042	36.7	11.3	0.047
Nonguided	61.1	87.0	0.009	66.8	91.4	0.006	63.3	88.7	0.008
Total River									
Guided	54.1	25.8	0.068	46.5	19.2	0.067	49.7	21.8	0.068
Nonguided	45.9	74.2	0.020	53.5	80.8	0.021	50.3	78.2	0.020

Table 12. Summary of Guided vs. Non-Guided Data From Kenai River Chinook Salmon Fishery, 1981-1985.

	1981			1982			1983			1984			1985			Mean		
	No.	%	CPUE	No.	%	CPUE	No.	%	CPUE	No.	%	CPUE	No.	%	CPUE	No.	%	CPUE
EARLY RUN																		
Guided Harvest	2,247	49.7	0.072	2,464	45.1	0.075	4,086	64.2	0.072	2,560	51.7	0.055	4,780	60.0	0.082	3,227	54.1	0.071
Non-Guided Harvest	2,278	50.3	0.021	3,002	54.9	0.023	2,274	35.8	0.015	2,396	48.3	0.016	3,191	40.0	0.025	2,628	45.9	0.020
Total Harvest	4,525	100	0.031	5,466	100	0.033	6,360	100	0.037	4,956	100	0.025	7,971	100	0.043	5,856	100	0.034
Guided Effort	6,569	23.2		8,170	17.9		12,241	28.7		12,081	23.9		15,012	31.7		10,815	25.1	
Non-Guided Effort	21,766	76.8		37,553	82.1		30,475	71.3		38,374	76.1		32,382	68.3		32,110	74.9	
Total Effort	28,335	100		45,723	100		42,716	100		50,455	100		47,394	100		42,925	100	
LATE RUN																		
Guided Harvest	2,530	47.9	0.066	2,397	49.8	0.047	5,110	55.7	0.086	2,928	39.7	0.062	3,045	37.8	0.067	3,202	46.2	0.066
Non-Guided Harvest	2,755	52.1	0.022	2,413	50.2	0.016	4,064	44.3	0.019	4,448	60.3	0.015	5,010	62.2	0.020	3,738	53.8	0.018
Total Harvest	5,285	100	0.032	4,810	100	0.024	9,174	100	0.036	7,376	100	0.021	8,055	100	0.027	6,940	100	0.028
Guided Effort	7,351	24.6		11,162	25.7		11,621	20.6		10,177	13.1		11,471	15.6		10,356	19.9	
Non-Guided Effort	22,555	75.4		32,204	74.3		44,674	79.4		67,285	86.9		62,144	84.4		45,772	80.1	
Total Effort	29,906	100		43,366	100		56,295	100		77,462	100		73,615	100		56,129	100	
BOTH RUNS																		
Guided Harvest	4,777	48.7	0.070	4,861	47.3	0.058	9,196	59.2	0.080	5,488	44.5	0.058	7,825	48.8	0.075	6,429	49.7	0.068
Non-Guided Harvest	5,033	51.3	0.022	5,415	52.7	0.025	6,338	40.8	0.017	6,844	55.5	0.015	8,201	51.2	0.022	6,366	50.3	0.020
Total Harvest	9,810	100	0.032	10,276	100	0.030	15,534	100	0.037	12,332	100	0.022	16,026	100	0.034	12,796	100	0.031
Guided Effort	13,920	23.9		19,332	21.7		23,862	24.1		22,258	17.4		26,483	21.9		21,171	21.8	
Non-Guided Effort	44,321	76.1		69,757	78.3		75,149	75.9		105,659	82.6		94,526	78.1		77,882	78.2	
Total Effort	58,241	100		89,089	100		99,011	100		127,917	100		121,009	100		99,053	100	

CPUE - Catch Per Unit Effort (Catch/Hour)

was 1.4 (1979 brood year), contributing approximately 75% to each run. The average weight for chinook salmon harvested from the early and late runs were 16.2 kg (35.6 lbs) and 19.4 kg (42.7 lbs), respectively; this difference was significant ($P<0.05$). Average fish from each age class, except age 1.5, were significantly larger ($P<0.05$) during the late run, compared with the early run. Summarized AWL information is presented in Table 13. Historical age-composition data are presented in Table 14.

Kenai River Chinook Salmon Population Estimate

A total of 2,656 adult Kenai River chinook salmon were tagged from May 20 through July 31, 1985. Of these, 1,263 were considered early run (May 20-June 30) and 1,393 were late-run (July 1-July 31) fish. An additional 112 late-run fish were tagged from August 1-9; however, none of these chinook salmon were recovered from the creel surveys; therefore they were eliminated from figures used in calculating the population estimates.

Figure 2 compares the tagging and creel CPUE curves that were used to select July 1 as the separation date between the early and late runs of chinook salmon entering the Kenai River.

A total of 463 tags were recovered from the following sources:

1)	Sport anglers (boat creel survey)	104
2)	Sport anglers (campground survey)	12
3)	Sport anglers (voluntary returns)	216
4)	Cook Inlet commercial fishermen	48
5)	In season carcasses	20
6)	Post season carcasses	21
7)	Russian River weir	3
8)	Juneau Creek	4
9)	Kasilof River drainage	13
10)	Susitna River drainage	1
11)	Other (personal-use fishery, found, no information, tag removed from released fish)	21
	TOTAL	463

Only those tags recovered by either the boat or campground creel surveys that had been harvested by the sport fishery were considered valid recaptures for the population estimates. Of the 2,013 chinook salmon that were examined during the season, 116 were tagged. The majority of

Table 13. Summarized Age/Weight/Length Data from Readable Scales Collected from Chinook Salmon Taken in the Recreational Fishery on the Kenai River, 1985.

Age Class Brood Year	1.2 1981	1.3 1980	1.4 1979	1.5 1978	Other	Total
			Early Run			
Number	18	39	225	12	0	294
Percent	6.1	13.3	76.5	4.1	0.0	100.0
Length (mm)*		660-990	790-1,190	950-1,210		
Range	435-700	715-970	670-1,170	840-1,340		435-1,340
Mean	619	851	981	1,093		946
S.D.	64.3	64.0	80.2	152.5		
Weight (kg)						
Range	2.7-7.3	6.2-16.5	14.7-30.0	12.7-35.8		2.7-35.8
Mean	4.9	11.7	17.5	23.1		16.2
S.D.	1.4	2.6	4.7	9.4		
			Late Run			
Number	18	59	339	37	8	1
Percent	3.9	12.8	73.5	8.0	1.7	100.0
Length (mm)*						
Range	530-770	680-1,050	830-1,260	850-1,320	380-1,230	380-1320
Mean	659	885	1040	1087	776	1004
S.D.	56.0	78.5	79.1	100.0	366.5	
Weight (kg)						
Range	2.3-8.2	7.0-19.1	7.8-34.1	11.8-36.4	0.8-26.8	0.8-36.4
Mean	5.6	13.3	20.7	24.4	15.1	19.4
S.D.	1.7	3.0	4.9	6.8	14.8	

* Lengths are mid-eye to fork of tail.
S.D. - Standard Deviation

Table 14. Historical Age Composition in Percent of the Recreational Harvest of Chinook Salmon from the Kenai River, 1974-1985.

Harvest Year	Age Class 1.2	1.3	1.4	1.5
Early Run				
1976	27.8	25.3	44.3	2.6
1977	14.4	30.8	53.7	1.5
1978	15.9	18.8	65.3	0.0
1979	5.8	30.8	51.9	11.5
1980	9.0	14.9	69.8	6.3
1981	14.7	32.1	51.4	1.8
1982	6.5	24.2	64.7	4.6
1983	8.2	16.4	70.5	4.9
1984	3.4	27.8	61.9	6.9
1985	6.1	13.3	76.5	4.1
Mean	11.2	23.4	61.0	4.4
Late Run				
1976	30.4	20.5	45.1	4.0
1977	11.6	41.6	45.0	1.7
1978	12.6	8.0	77.7	1.7
1979	15.1	17.8	54.8	12.3
1980	21.1	21.5	49.9	7.5
1981	12.8	22.2	62.4	2.6
1982	12.0	26.5	59.8	1.7
1983	4.4	26.3	68.7	0.6
1984	8.8	16.0	62.5	12.7
1985	4.0	13.0	74.8	8.2
Mean	13.3	21.3	60.1	5.3
Both Runs				
1974	5.9	4.7	83.5	5.9
1975	44.5	32.5	20.0	3.0
1976	29.3	22.5	44.8	3.4
1977	13.1	35.6	49.7	1.6
1978	13.5	11.1	74.2	1.2
1979	9.6	25.4	53.1	11.9
1980	15.7	18.6	58.7	7.0
1981	14.0	28.7	55.2	2.1
1982	8.9	25.2	62.6	3.3
1983	5.0	24.8	69.0	1.2
1984	6.8	20.4	62.2	10.5
1985	4.8	13.1	75.5	6.6
Mean	14.3	21.9	59.0	4.8

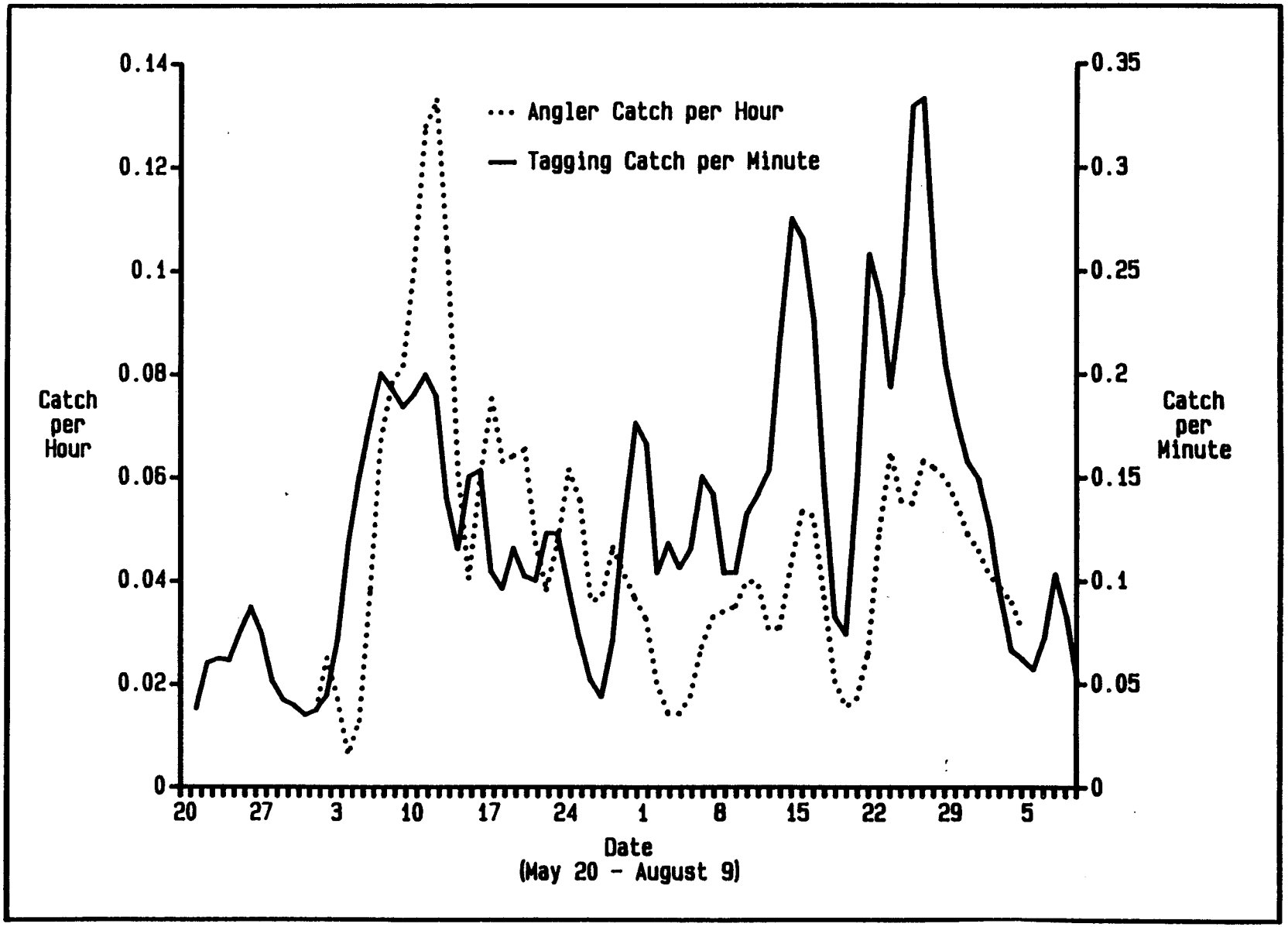

Figure 2. Graph comparing the catch rates in the recreational fishery for chinook salmon and in the drift-netting as part of the population estimate of chinook salmon in the Kenai River.

fish examined and tags recovered were in the downstream boat survey (1,629 examined, 103 tags reported). Only one tag was reported from the upstream boat creel surveys, and only 12 tags were reported from the campground creel surveys.

Two hypotheses concerning the tag-recovery data were tested with chi-squared analyses to see if the data from downstream boat surveys, upstream boat surveys, and campground surveys could be pooled. The hypothesis of equal tag-recovery rates for the downstream and upstream areas was not rejected (α=0.01), allowing the upstream and downstream boat survey results to be combined. The next hypothesis, concerning equal tag-recovery rates for the boat surveys (downstream and upstream combined) and campground surveys, was also not rejected (α=0.01). Therefore, the results of the campground creel survey were combined with the results of the boat creel surveys for the population estimates.

The population estimates for the number of chinook salmon entering the Kenai River during various periods prior to in-river recreational exploitation are as follows:

Period	Point Estimate	95% Confidence Interval Range
5/20-7/31	45,735	39,169 to 55,983
5/20-6/30	15,972	5,109 to 26,835
7/01-7/31	29,763	23,972 to 41,087

During the early run (May 20-June 30), a portion of the chinook salmon population that had entered the Kenai River and had been tagged was later recovered in other drainages; 13 chinook were recovered in the Kasilof River drainage, one chinook in the Deep Creek drainage, and one chinook from Willow Creek of the Susitna River drainage. All of these recoveries were tagged prior to June 26, 1985.

The majority of chinook salmon returning to the Kasilof River drainage were hatchery-reared fish that had been released in 1981, 1983 and 1984. Varying percentages of the hatchery-released fish had their adipose fins clipped prior to release. A total of 10 adipose-clipped fish were captured during tagging operations in the Kenai River.

Kasilof River Chinook Salmon Fishery

The Kasilof River recreational chinook salmon fishery has been a relatively recent development. Following 2 years of very strong natural returns, the stream was first opened to chinook salmon fishing in 1978. Concurrently, the Kasilof Hatchery, which had been recently constructed on Crooked Creek, had been releasing chinook salmon smolts that promised to keep the strength of the return healthy.

In 1978 the Sport Fish Division monitored the fishery with a creel census program. The total harvest was estimated at 250 fish for 1,750 man-days of effort (Hammarstrom 1979). The fishery was not large enough to warrant future funding for a monitoring program. In conjunction with ADF&G FRED Division's sockeye salmon smolt program, the fishery was

monitored through an informally structured census from 1979 to 1983 to evaluate the success of hatchery plants. The fishery grew from 2,000 angler-days to 24,000 angler-days. In 1984 funding cutbacks prevented FRED from monitoring the fishery, and the Sport Fish Division again monitored the stream with a formal creel census (Hammarstrom et al. 1985). In 1985 the fishing season on the Kasilof River (downstream from the Sterling Highway Bridge) was extended to July 31, allowing the harvest of late-run fish into the system.

The return of chinook salmon to the Kasilof River has similar timing to other early runs in Cook Inlet. Most of these fish are presumed to spawn in Crooked Creek. Early run fish are available from May 18 through July 10 (54 days). Some fish are taken earlier, however, the harvest is considered insignificant.

The harvest of early run fish takes place immediately downstream from the confluence with Crooked Creek. As these fish became less available because of maturation, the recreational effort in this area gradually declined. Early run fish are apparently not replaced by significant numbers of late-run fish in this area.

The fishery for late-run Kasilof River chinook salmon was conducted primarily from guided drift boats from the Sterling Highway bridge to the intertidal waters. Most activities were observed on days that guides could not fish on the Kenai River; i.e., Sundays and Mondays. During the period when late-run fish were available, few boats were observed during a day. Because of the lack of participation in the late-run fishery, the formal census was discontinued; however, the fishery was occasionally monitored.

During the early run fishery in 1985, creel-census activities were conducted on 34 of the 54 days. During that time, a total of 62 instantaneous angler counts were performed, totaling 4,097 fishermen; 2,409 completed anglers were interviewed, reporting a total of 394 chinook salmon over 51 cm (20 inches) long during 9,275 hours of fishing. Analysis of the aforementioned data resulted in a harvest estimate of 3,049 chinook salmon for 18,610 angler-days of effort: an overall catch per hour of 0.044 fish (23 man-hours per fish). The escapement into Crooked Creek, measured at the weir located on the hatchery grounds, was 2,205 fish. An additional 477 fish were used in the spawning operations at the facility (Waite, pers. comm.). Summarized historical data regarding the Kasilof River fishery are presented in Table 15.

Scale samples were collected from 370 chinook salmon harvested in the recreational fishery; 46 of these had clipped adipose fins, indicating they had been tagged with coded-wire tags (CWT) at time of release. When the scales of these fish were analyzed, the freshwater-growth zone appeared similar to natural fish. Most of the hatchery-reared fish would have been classified as one- or two-checked fish; however, as determined by CWT analysis, all hatchery fish (three rearing facilities were involved) were 0-check fish. It was decided to use only the marine-growth zone to distinguish different classifications. Results appear in Table 16; 4-ocean fish were predominant.

Table 15. Historical Data Regarding the Kasilof River Recreational Fishery for Chinook Salmon, 1978-1985.

Year	Kasilof River Harvest		Crooked Creek Egg Take*		Crooked Creek Escapement		Total Run		Angler Effort	Catch Per Hour
	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Angler-Days	
1978	251	4.7	444	8.3	4,630	87.0	5,325	100.0	1,750	0.038
1979	283	6.6	422	9.8	3,599	83.6	4,304	100.0	2,015	0.040
1980	320	11.0	240	8.2	2,355	80.8	2,915	100.0	4,830	0.019
1981	1,283	29.7	61	1.4	2,980	68.9	4,324	100.0	8,750	0.061
1982	2,787	37.7	249	3.4	4,356	58.9	7,392	100.0	14,580	0.088
1983	4,361	45.7	673	7.4	4,515	47.3	9,549	100.0	24,394	0.044
1984	5,047	51.8	648	6.6	4,057	41.6	9,752	100.0	22,415	0.062
Mean	2,047	26.7	391	6.5	3,785	66.9	6,223	100.0	11,248	0.048
1985	3,049	53.2	477	8.3	2,205	38.5	5,731	100.0	18,610	0.044

* Includes holding mortality.

Table 16. Summarized Age/Length Data from Readable Scales Collected from Chinook Salmon Taken in the Recreational Fishery on the Kasilof River, 1985.

Age Class*	1-ocean	2-ocean	3-ocean	4-ocean	5-ocean	Total
Number	6	86	59	215	4	370
Percent	1.6	23.2	15.9	58.1	1.1	100.0
Length (mm)**						
Range	380-425	480-840	630-875	710-1050	820-920	380-1050
Mean	402	635	784	862	868	789
S.D.	19.2	60.7	54.2	55.7	52.8	
Weight (kg)						
Range		2.2-6.3	4.0-12.2	6.3-15.6	11.5	2.2-15.6
Mean		4.5	8.2	10.2	11.5	8.4
S.D.		1.0	1.7	1.9		

* Contributions from three hatcheries made freshwater age undefinable.
** Lengths are mid-eye to fork of tail.

Kenai River Coho Salmon Fishery

During August and September 1985, creel-census personnel on the Kenai River conducted 256 instantaneous angler counts, counted 20,832 anglers, and interviewed 9,330 anglers who reported 25,946 hours of fishing necessary to retain 4,493 coho salmon. Analysis of these data resulted in an estimated harvest of 40,096 coho salmon for 54,953 angler-days of effort from August 5 through September 30.

Early run coho salmon first appeared July 22 in the downstream section; however, appreciable numbers did not appear in the creel until August 1. Prior to August 5, only 187 coho salmon were reported to census personnel. In the upstream section, early run coho salmon did not appear in the creel until July 29. Early run fish were considered present through September 2 in the downstream section and through September 8 in the upstream section. Harvest of the early run was estimated at 17,950 fish for 30,965 angler-days of effort; each angler-day was equal to 4.1 hours. The catch rate for early run coho salmon was 0.140 fish per hour (7.1 angler-hours per fish). In addition, 69,735 coho salmon, believed to be of Kenai River origin, were taken in the commercial east-side set-net fishery between July 1 and August 15.

Late-run coho salmon were considered available from the end of the early run through September 30. Some fishing occurs after September 30; however, it is quite dependent on environmental conditions and, when compared with the harvest prior to October 1, is considered insignificant. In 1985 an estimated 22,146 coho salmon were harvested for 23,988 angler-days of effort; each angler-day was equal to 3.9 hours. The catch rate was 0.239 fish per hour (4.2 angler-hours per fish), virtually identical to 1984. The late-run recreational harvest was the second largest recorded since 1976. In addition, 11,265 late-run coho salmon were taken in subsistence set nets along the eastern shores of Cook Inlet after August 15.

Graphs depicting run timing are presented for the downstream and upstream sections in Figures 3 and 4, respectively. Historical harvest and effort data for the Kenai River coho salmon fishery are presented in Table 17.

Discussion

Kenai River Salmon Fisheries:

During the 1985 late-run chinook salmon return, the recreational season was extended 4 days. On July 30 the decision to extend was made for the following reasons: (1) total harvest in the commercial east-side set gill-net fishery was well above the historical mean and predicted to be a near record; (2) gill netting near the mouth of the Kenai River, as part of the tag and recovery population estimate, had captured 30% more fish than had been taken through the same time period in 1984; (3) catch rates in the recreational fishery in the downstream section had been above average since July 22; and (4) as indicated through capture in the recreational fishery, the fish were well distributed throughout the

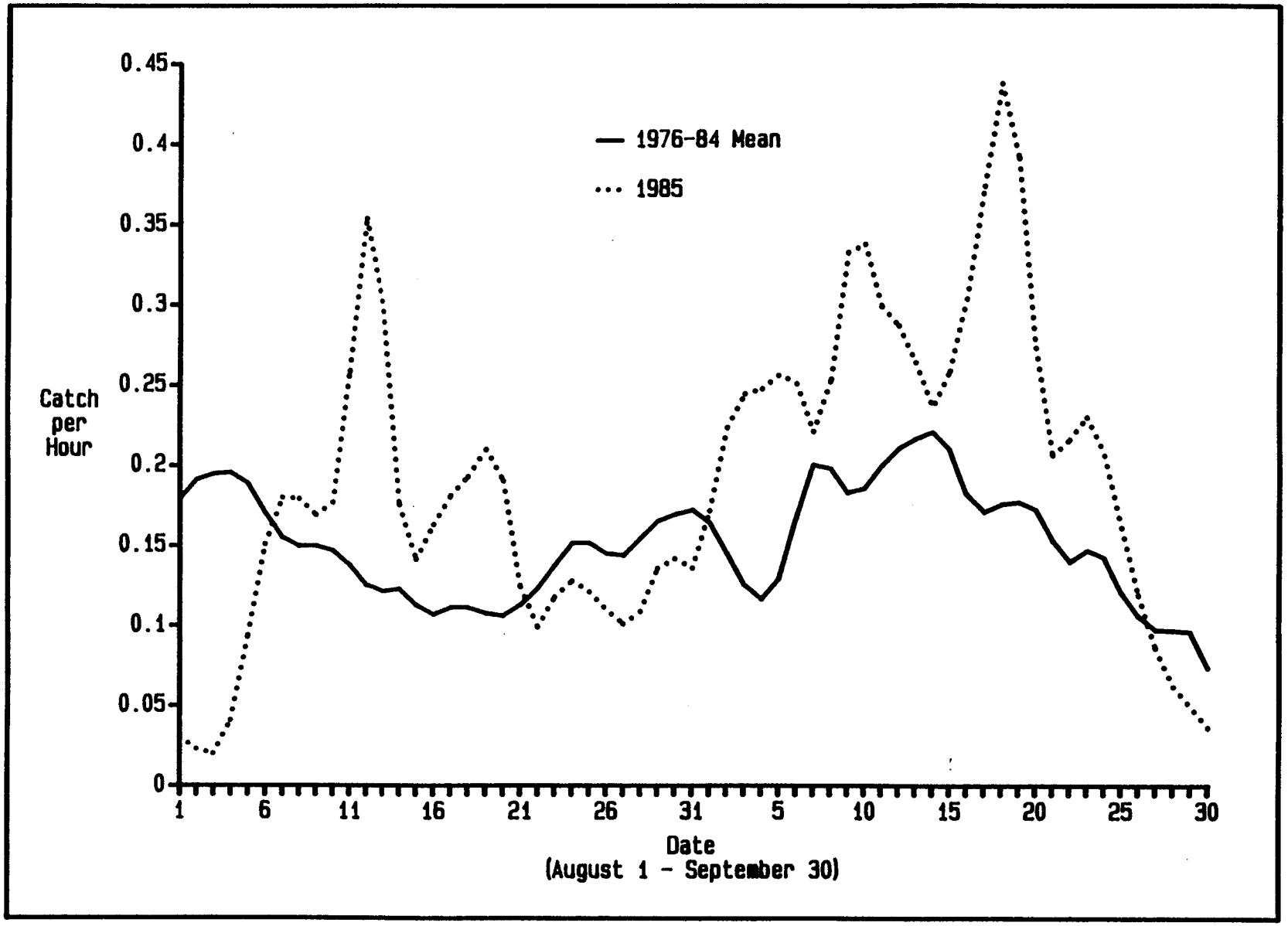

Figure 3. Catch per hour by date in the recreational fishery for coho salmon in the Kenai River (downstream section), 1985 vs. 1976-1984 mean.

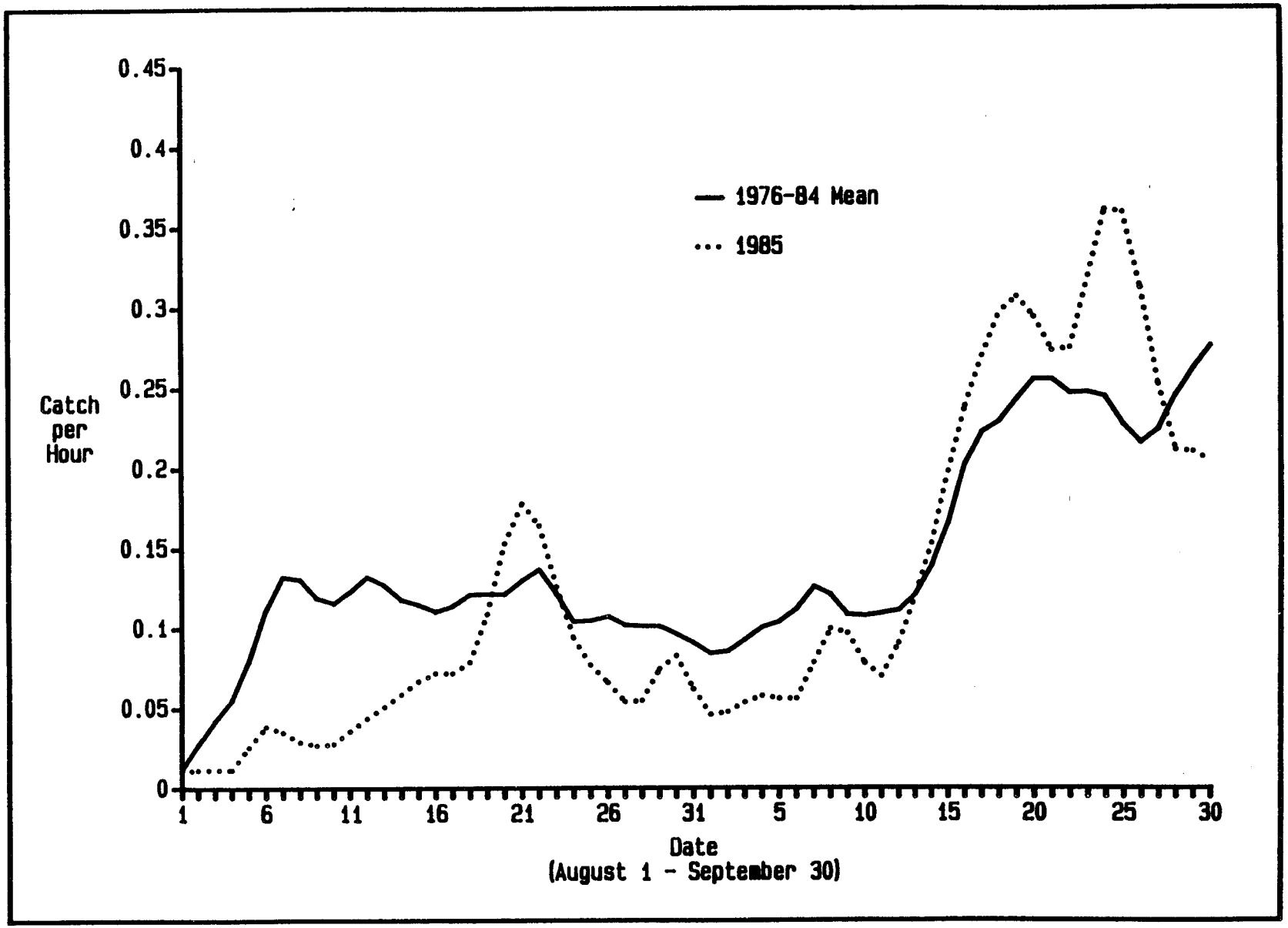

Figure 4. Catch per hour by date in the recreational fishery for coho salmon in the Kenai River (upstream section), 1985 vs. 1976-1984 mean.

Table 17. Historical Data from the Kenai River Recreational Fishery for Coho Salmon, 1976-1985.

Year	Early Run				Late Run			
	Harvest	Effort Hours**	Effort Days***	Catch Per Hour	Harvest	Effort Hours**	Effort Days***	Catch Per Hour
				Upstream				
1976	1,625	22,042	5,511	0.074	1,445	10,742	3,069	0.135
1977	3,349	24,046	5,465	0.139	898	6,020	1,281	0.149
1978	800	22,193	4,932	0.036	1,788	12,869	3,677	0.139
1979	1,831	23,562	4,284	0.078	2,003	16,427	4,323	0.122
1980	4,670	30,582	8,751	0.153	4,665	16,586	4,739	0.281
1981	4,719	36,392	8,768	0.130	2,900	20,628	5,157	0.141
1982	3,081	37,120	9,797	0.083	3,286	12,307	3,419	0.267
1983	1,993	34,141	8,503	0.058	1,543	11,176	2,483	0.138
1984	4,019	28,110	6,733	0.134*	3,390	23,144	5,950	0.146
Mean	2,899	28,688	6,972	0.098	2,435	14,433	3,789	0.169
1985	2,239	30,110	7,344	0.074	3,085	14,854	3,917	0.208
				Midstream				
1976	1,165	12,803	3,201	0.091	828	6,133	1,752	0.135
1977	617	4,976	1,131	0.124	198	2,087	444	0.095
1978	386	6,528	1,865	0.059	554	4,776	1,365	0.116
1979	918	5,646	1,027	0.163	290	2,423	638	0.120
1980	1,319	6,376	1,824	0.207	788	3,092	883	0.255
1981	1,804	13,087	3,153	0.138	817	6,472	1,618	0.126
1982	2,778	21,703	4,682	0.128	1,494	6,553	1,820	0.228
1983	1,083	9,747	2,354	0.111	636	3,897	753	0.163
1984	2,629	13,172	3,174	0.148*	1,640	6,907	1,775	0.237
Mean	1,411	10,449	2,490	0.130	805	4,704	1,228	0.164
1985	1,557	11,147	2,654	0.140	1,921	8,047	2,106	0.239

Table 17. (cont.) Historical Data from the Kenai River Recreational Fishery for Coho Salmon, 1976-1985.

Year	Early Run Harvest	Early Run Effort Hours**	Early Run Effort Days***	Early Run Catch Per Hour	Late Run Harvest	Late Run Effort Hours**	Late Run Effort Days***	Late Run Catch Per Hour
				Downstream				
1976	4,921	49,862	12,466	0.099	3,240	23,977	6,851	0.135
1977	3,449	30,711	6,980	0.112	1,275	16,883	3,592	0.076
1978	4,050	49,725	11,050	0.081	4,302	39,668	11,334	0.108
1979	8,373	39,205	7,128	0.214	1,217	10,489	2,760	0.116
1980	9,679	40,262	11,520	0.240	4,092	17,769	5,077	0.230
1981	8,157	57,064	13,749	0.143	2,947	25,690	6,423	0.115
1982	18,968	109,011	27,359	0.174	8,571	42,222	11,728	0.203
1983	9,775	71,085	17,081	0.138	5,370	31,187	5,698	0.172
1984	21,799	98,353	22,615	0.153*	26,999	104,759	26,930	0.258
Mean	9,908	60,586	14,439	0.150	6,446	34,738	8,933	0.157
1985	14,154	87,223	20,967	0.162	17,140	69,854	17,965	0.245
				Total				
1976	7,711	84,707	21,178	0.091	5,513	40,852	11,672	0.135
1977	7,415	59,733	13,576	0.124	2,371	24,990	5,317	0.095
1978	5,236	78,446	17,847	0.067	6,644	57,313	16,376	0.116
1979	11,122	68,413	12,439	0.163	3,510	29,339	7,721	0.120
1980	15,668	77,220	22,095	0.203	9,545	37,447	10,699	0.255
1981	14,680	106,543	25,670	0.138	6,664	52,790	13,198	0.126
1982	24,827	167,834	41,838	0.148	13,351	61,082	16,967	0.219
1983	12,851	114,973	27,938	0.112	7,549	46,260	8,934	0.163
1984	28,447	139,635	32,522	0.134*	32,029	134,810	34,655	0.238
Mean	14,217	99,723	23,900	0.131	9,686	53,876	13,949	0.154
1985	17,950	128,480	30,965	0.140	22,146	92,755	23,988	0.239

* Early Run 1984 CPUE reflects only the August fishery, Coho salmon taken incidental to chinook salmon in July were not included. July harvest of coho salmon was approximately 9,700.

** Angler-Hours

*** Angler-Days

open fishing area. By reviewing catch rates and effort for the days immediately preceding the 4-day extension, it was anticipated that approximately 1,000 additional fish would be harvested. Based on the data available, this additional harvest would not threaten the escapement.

Since this was the first extension of the chinook salmon fishery and because management history had been conservative, most guided and nonguided anglers were relatively unprepared for the additional fishing time. Resultant effort was somewhat reduced, compared to the last week of July. The estimated harvest during these last 4 days was approximately 500 fish.

The Kenai River chinook salmon fishery has grown into the state's largest recreational fishery. The tourist industry, through various public and private promotion programs, has gained wide acclaim for the system and its large fish. Participation promises to continue to increase, especially in the wake of the world-record fish that was captured in 1985. The controversy around this resource shows no signs of disappearing. Steps are being taken to find solutions to some of these problems.

Legislation passed in 1984 created the Kenai River Special Management Area. The area encompasses the water column extending from Kenai Lake to the Warren Ames Bridge (located at river mile 5.1) and the adjacent state-owned property. Responsibility for management of this area has been given to the Department of Natural Resources, Division of Parks and Outdoor Recreation, with the assistance of the KRSMA Advisory Committee. However, the responsibility of fisheries management still remains with the Board of Fisheries.

The Department of Natural Resources (DNR) has until June 1986, unless otherwise extended, to complete a comprehensive management plan for the KRSMA. Throughout the past 2 years, various subcommittees have been taking public testimony regarding various portions of the plan. One of the first problems to be dealt with is commercial guiding on the river. The next question to be addressed is in-river recreational use patterns and equipment.

The Social Recreation Committee, after taking public testimony, recommended that powered vessels using the Kenai River be limited to no more than 35 horsepower (outboard motors only), effective May 1, 1986. This recommendation was adopted by the KRSMA Advisory Committee, who made the same recommendation to DNR. The Division of Parks, after reviewing public testimony, recommended the limit be raised to 50 horsepower. There was considerable public outcry, and the Commissioner of DNR announced a compromise regulation calling for a 50-horsepower limit in 1986 and a 35-horsepower limit beginning May 1, 1987, thus allowing for a "phase-in" period. Unless changed in the courts, the 50-horsepower limit will be effective for 1986. The effects this regulation (35-horsepower limit) will have on the recreational fishery is unpredictable; however, the Board of Fisheries was asked to review current fishery restrictions from that perspective.

The Board of Fisheries rescinded the Sunday closure on guided vessels in May and June and closed boat fishing on Mondays from Skilak Lake downstream in May, June, and July, except Memorial Day. Members of the KRSMA Advisory Committee have publicly announced changes they would like to see DNR make on the Kenai River; many of these appear to encroach on the responsibility of the Board of Fisheries. The future management of the Kenai River promises to be emotionally charged, which will increase the necessity for sound biological data.

Kenai River Chinook Salmon Population Estimate:

The accuracy of the chinook salmon population estimate has improved each year; however, there are still a number of difficulties with the tagging data. A biometric review was conducted to analyze the field data. The following is a list of some of the problems and the probable effect that each will have on the population estimate.

Out-of-System Recoveries.

1). Presence of non-Kenai River chinook salmon. The tag recovery data indicate that the sample population is not entirely a discrete unit and that fish from other systems are present, most notably the Kasilof River (Crooked Creek) during the early run period. Effect on population estimate: the estimate will be high.

2). Tag recoveries from commercial catch. It is unknown if chinook salmon tagged in the lower river and recovered by the commercial fishery are (1) of Kenai origin and would eventually return to the river if not caught; (2) of non-Kenai origin and bound for other systems; or (3) of a mixture of (1) and (2). Effect on population estimate: the estimate will be high.

Tag loss.

1). Natural tag loss appeared to occur at a very low rate in 1985. Only one adipose-clipped fish was recovered by the sport harvest creel survey that did not have a tag. There were insufficient data to estimate tag loss in 1985, and the problem should be examined again with a change in the experimental design. Effect on population estimate: the estimate will be low, provided the rate of tag loss is known.

2) Removal of tags by sport fishermen and subsequent return of those live fish to the river. This appears to have occurred at a low rate in 1985. Effect on population estimate: the estimate would be high if the practice were widespread.

Double Recoveries of Tagged Fish.

There were two instances in 1985 where a tag was recovered both by the boat and campground creel surveys. This problem can be reduced by ensuring that tagged and untagged fish observed during either survey

interview be identified accordingly. Effect on population: the effect is unknown but could be determined by simulation.

Influence of Fish Length on the Probability of Recovery:

The length-frequency distribution of the tagged fish and the fish censused by the creel survey is significantly different. Small fish (<795 mm) are present at a lower rate in the creel surveys than were captured by gillnets for tag and release. The tag-recovery rates for small and large (>795 mm) fish were not significantly different. Effect on population estimate: the effect is unknown, but the precision of the estimate could be improved if it were possible to stratify the estimates by size.

Portions of the chinook salmon population that have not been defined are those entering the Kenai River before May 20 and after July 31. Based on the low CPUE data obtained from tagging efforts as early as May 20 and continuing beyond July 31, these populations are assumed to be relatively minor. An empirical estimate would be less than 2,000 fish in 1985.

LITERATURE CITED

Dunn, J.R. 1961. Creel census and population sampling of the sport fishes on the Kenai Peninsula. Alaska Department of Fish and Game. Federal Aid in Fish Restoration, Annual Report of Progress, 1960-1961, Project F-5-R-1, 2(2-B): 97-114.

Engel, L.J. and S.M. Logan. 1965. Evaluation of the king salmon fisheries on the lower Kenai Peninsula. Alaska Department of Fish and Game. Federal Aid in Fish Restoration, Annual Report of Progress, 1964-1965, Project F-5-R-6, 6(7-B-2): 147-154.

_____. 1966. Evaluation of the king salmon fisheries on the lower Kenai Peninsula. Alaska Department of Fish and Game. Federal Aid in Fish Restoration, Annual Report of Progress, 1965-1966, Project F-5-R-7, 7(7-B-2): 101-107.

Engel, L.J. 1967. Evaluation of the king salmon fisheries on the lower Kenai Peninsula. Alaska Department of Fish and Game. Federal Aid in Fish Restoration, Annual Report of Progress, 1966-1967, Project F-5-R-8, 8(7-B-2): 103-110.

Hammarstrom, S.L. 1974. Inventory and cataloging of Kenai Peninsula, Cook Inlet drainages and fish stocks. Alaska Department of Fish and Game. Federal Aid in Fish Restoration, Annual Performance Report, 1973-1974, Project F-9-6, 15(G-I-C): 23-65.

_____. 1975. Inventory and cataloging of Kenai Peninsula, Cook Inlet drainages and fish stocks. Alaska Department of Fish and Game. Federal Aid in Fish Restoration, Annual Performance Report, 1974-1975, Project F-9-7, 16(G-I-C): 27-68.

_____. 1976. Inventory and cataloging of Kenai Peninsula, Cook Inlet drainages and fish stocks. Alaska Department of Fish and Game. Federal Aid in Fish Restoration, Annual Performance Report, 1975-1976, Project F-9-8, 17(G-I-C): 35-62.

_____. 1977. Evaluation of chinook salmon fisheries of the Kenai Peninsula. Alaska Department of Fish and Game. Federal Aid in Fish Restoration, Annual Performance Report, 1976-1977, Project F-9-9, 18(G-II-L): 29-46.

_____. 1978. Evaluation of chinook salmon fisheries of the Kenai Peninsula. Alaska Department of Fish and Game. Federal Aid in Fish Restoration, Annual Performance Report, 1977-1978, Project F-9-10, 19(G-II-L): 42-56.

_____. 1979. Evaluation of chinook salmon fisheries of the Kenai Peninsula. Alaska Department of Fish and Game. Federal Aid in Fish Restoration, Annual Performance Report, 1978-1979, Project F-9-11, 20(G-II-L): 49-96.

_____. 1980. Evaluation of chinook salmon fisheries of the Kenai Peninsula. Alaska Department of Fish and Game. Federal Aid in Fish Restoration, Annual Performance Report, 1979-1980, Project F-9-12, 21(G-II-L): 59-90.

_____. 1981. Evaluation of chinook salmon fisheries of the Kenai Peninsula. Alaska Department of Fish and Game. Federal Aid in Fish Restoration, Annual Performance Report, 1980-1981, Project F-9-13, 22(G-II-L): 33-61.

Hammarstrom, S.L. and L.L. Larson. 1982. Evaluation of chinook salmon fisheries of the Kenai Peninsula. Alaska Department of Fish and Game. Federal Aid in Fish Restoration, Annual Performance Report, 1981-1982, Project F-9-14, 23(G-II-L): 47 pp.

_____. 1983. Evaluation of chinook salmon fisheries of the Kenai Peninsula. Alaska Department of Fish and Game. Federal Aid in Fish Restoration, Annual Performance Report, 1982-1983, Project F-9-15, 24(G-II-L): 36-67.

_____. 1984. Evaluation of chinook salmon fisheries of the Kenai Peninsula. Alaska Department of Fish and Game. Federal Aid in Fish Restoration, Annual Performance Report, 1983-1984, Project F-9-15, 25(G-II-L): 1-39.

Hammarstrom, S.L., L.L. Larson, M. Wenger, J. Carlon. 1985. Kenai River chinook and coho salmon studies - Kenai River chinook salmon hook and release study. Alaska Department of Fish and Game. Federal Aid in Fish Restoration; Anadromous Fish Study, Annual Performance Report, 1984-1985, Project F-9-17, 26(G-II-L/AFS-50-1): 60-149.

Logan, S.M. 1962. Evaluation of king salmon fisheries on the lower Kenai Peninsula. Alaska Department of Fish and Game. Federal Aid in Fish Restoration, Annual Report of Progress, 1961-1962, Project F-5-R-3, 3(7-B-2): 75-85.

_____. 1963. Evaluation of king salmon fisheries on the lower Kenai Peninsula. Alaska Department of Fish and Game. Federal Aid in Fish Restoration, Annual Report of Progress, 1962-1963, Project F-5-R-4, 4(7-B-2): 195-204.

_____. 1964. Evaluation of king salmon fisheries on the lower Kenai Peninsula. Alaska Department of Fish and Game. Federal Aid in Fish Restoration, Annual Report of Progress, 1963-1964, Project F-5-R-5, 5(7-B-2): 153-164.

McHenry, E. 1969. Anadromous fish population studies, southwestern Kenai Peninsula. Alaska Department of Fish and Game. Federal Aid in Fish Restoration, Annual Report of Progress, 1968-1969, Project F-9-1, 10(7-B-2): 151-178.

Nelson, D.C. 1971. Population studies of anadromous fish populations, southwestern Kenai Peninsula. Alaska Department of Fish and Game. Federal Aid in Fish Restoration, Annual Report of Progress, 1970-1971, Project F-9-3, 12(G-II-C): 35-44.

_____. 1972a. Population studies of anadromous fish populations, southwestern Kenai Peninsula and Kachemak Bay. Alaska Department of Fish and Game. Federal Aid in Fish Restoration, Annual Report of Progress, 1971-1972, Project F-9-4, 13(G-II-C): 13-29.

_____. 1972b. Unpublished report to the Alaska Board of Fisheries. On file at the Soldotna Fish and Game office.

Redick, R.R. 1968. Population studies of anadromous fish populations, southwestern Kenai Peninsula and Kachemak Bay. Alaska Department of Fish and Game. Federal Aid in Fish Restoration, Annual Report of Progress, 1967-1968, Project F-5-R-9, 9(7-B-2): 135-155.

Seber, G.A.F. 1973. The estimation of animal abundance. Charles Griffin and Company, London. 506pp.

Watsjold, D.A. 1970. Population studies of anadromous fish populations, southwestern Kenai Peninsula and Kachemak Bay. Alaska Department of Fish and Game. Federal Aid in Fish Restoration, Annual Report of Progress, 1969-1970, Project F-9-2, 11(7-B-2): 91-108.

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