

STATE OF ALASKA

Jay S. Hammond, Governor



Annual Performance Report for

EVALUATION OF CHINOOK SALMON
FISHERIES OF
THE KENAI PENINSULA

by

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RESEARCH PROJECT SEGMENT

State: ALASKA Name: Sport Fish Investigations
of Alaska
Project No.: F-9-9
Study No.: G-II Study Title: SPORT FISH STUDIES
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Salmon Fisheries of the
Kenai Peninsula

Period Covered: July 1, 1976 to June 30, 1977

ABSTRACT

The four-weekend fishery for chinook salmon, Oncorhynchus tshawytscha (Walbaum), on three lower Kenai Peninsula streams is discussed. Total angler effort in 1976 was estimated at 36,920 man-days, derived by vehicle counts on location. Harvest, estimated at 1,680 fish above 508 mm (20 inches), was derived by analysis of punch card returns from 16,054 cards issued to potential anglers.

Harvest and effort by date for the freshwater fisheries, Anchor River, Ninilchik River and Deep Creek, indicate 1976 was the most successful fishery since 1966, the year the punch card system was initiated. Estimated effort in man-days for each stream was: Anchor River, 12,594; Ninilchik River, 10,754; and Deep Creek, 13,572. Corresponding harvest estimates were: Anchor River, 830; Ninilchik River, 630; and Deep Creek, 220.

Age composition and sex ratio for the 1976 return are discussed. The predominant age class was 1.4 (brood year 1970). Punch cards were returned at the lowest rate (50.8%) since 1973, the first year that only the three streams were included in the punch card system. Since 1973 the average percent of punch card recipients who fish has been 52.9 and of those only 13.3% are successful. In 1976 angler success was slightly higher, 15.9%. Historical analysis of punch card returns are presented.

Chinook salmon escapement surveys conducted with both helicopter and ground observations resulted in the following estimates: Anchor River, 3,080; Ninilchik River, 1,180; and Deep Creek, 1,680.

The 1976 (saltwater) chinook salmon fishery in Cook Inlet near Deep Creek, monitored by creel census, produced the highest harvest since its inception in 1972. Harvest was estimated at 6,877 chinook salmon, 5,495 (79.9%) taken from the early run and 1,382 (20.1%) from the late run. Angler effort was estimated at 18,635 man-days, 12,270 (65.8%) during

the early run and 6,365 (34.2%) during the late run. Estimates were calculated on the basis of 194 instantaneous boat counts and 2,293 angler interviews. Data collected from 342 sport caught chinook salmon indicated the predominant age class was 1.4 (brood year 1970) contributing 74.9% to the total harvest. Methods of harvest and effort calculations are discussed as well as suggested reasons for the unusually large early run harvest. Harvest data for other species are also presented.

For the third consecutive year, a creel census has been employed on over 20 miles of the Kenai River to estimate angler effort and sport harvest of chinook salmon. Low water levels prevented the census from operating prior to June 7. Sample design and calculations including confidence intervals are presented. Results of an alternative method of calculation are compared and discussed. Total 1976 effort based on a creel census of boat anglers was estimated at 44,460 man-days, 16,430 (37%) occurring during the early run and 28,030 (63%) during the late run. The harvest of 6,031 chinook salmon over 20 inches was estimated for the season for both early and late runs. In addition, 1,663 precocial males were harvested. The majority (74.2%) of adults harvested were from the late run. Data regarding both runs including timing are discussed.

Estimates of harvest and effort from the Kenai chinook salmon fishery were made on the basis of 118 instantaneous angler counts, 8,136 angler interviews, and 924 chinook salmon creel checked. In addition, five aerial flights were used to obtain relative effort on the section not covered by the creel census. Data from 511 readable scales indicated age 1.4 chinook salmon (brood year 1970) were the largest contributors to both early and late runs, 43.2% and 40.2% respectively. Data regarding other age classes are also presented. A carcass survey conducted in mid-September positively identified 700 chinook salmon.

Application of a policy adopted by the Alaska Board of Fisheries regarding management of late run chinook salmon is discussed.

BACKGROUND

Chinook salmon fishing has been popular on the Kenai Peninsula for many years. Initially effort centered around the lower peninsula streams of Deep Creek, Ninilchik River and Anchor River. These streams have been managed by a variety of programs ranging from unregulated to complete closures. Since 1966 these streams have been managed on a limited season and bag limit basis, utilizing a punch card system.

Pertinent historical data are presented in Reports of Progress by Dunn (1961), Logan (1962, 1963, 1964), Engel (1965, 1966, 1967) Redick (1968), McHenry (1969), Watsjold (1970), Nelson (1971, 1972a, 1972b) and Hammarstrom (1974, 1975, 1976a).

In 1972 anglers discovered that chinook salmon could readily be taken in the waters of Cook Inlet in the vicinity of Deep Creek. This fishery grew from 3,610 man-days in 1972 to 18,640 man-days in 1976. The chinook salmon fished upon near Deep Creek are of mixed stocks, originating from

many streams of the Cook Inlet Basin. Annual harvest and effort have been monitored by creel census since 1972. Fluctuations in angler effort and success are primarily due to prevailing weather conditions in Cook Inlet. Historical data regarding this fishery are presented by Hammarstrom (1974, 1975, 1976b).

Historically, the recreational fishery on the Kenai River has been one of the more popular on the Kenai Peninsula. The Kenai River system is a productive body of water, contributing heavily to the commercial harvest of all salmon species except chum salmon. Anglers have utilized this stream for salmon, trout and char; but until recently, chinook salmon have not been major contributors to the creel. It is a large glacially turbid river, not conducive to the harvest of large fish by shore anglers.

In 1973, relatively large numbers of anglers in this system discovered chinook salmon were susceptible to harvest from boats. Bouncing a lure along the bottom from a drifting boat produced good catches of individual fish up to 80 pounds. In 1974 the Department of Fish and Game initiated a creel census program to monitor the harvest and effort on a 10-mile section of the river from Skilak Lake downstream to Naptowne Rapids (Hammarstrom 1975). The census project was expanded in 1975 to include anglers along an 11-mile section from the Soldotna Bridge downstream to Beaver Creek as well as shore anglers over the entire area open to chinook salmon fishing.

From 1966 to 1972 the chinook salmon harvest in the Kenai River was monitored by evaluating punch card returns (Nelson, 1972). Since returns declined to 42.2%, the cards were eliminated from the Kenai River fishery in 1973. In 1970 a relaxation of the regulation was initiated by the Alaska Board of Fish and Game and the season was extended to 62 days (May 30-July 31). In 1975 the Board further extended the season to 212 days (January 1 to July 31). However, fishing was actually only extended by three weeks since the earliest arrival of fish is in mid-May.

In 1975 the Board of fisheries adopted a management policy regarding the sport harvest of late run chinook salmon in the Deep Creek marine fishery and the Kenai River fishery. In essence, the sport harvest of late run fish from the Deep Creek marine and Kenai River fisheries would not be allowed to exceed the late run commercial set net harvest from areas 244-20,30,40 (see Figure 1) by more than 10% based on the regularly scheduled two 12-hour commercial fishing periods per week.

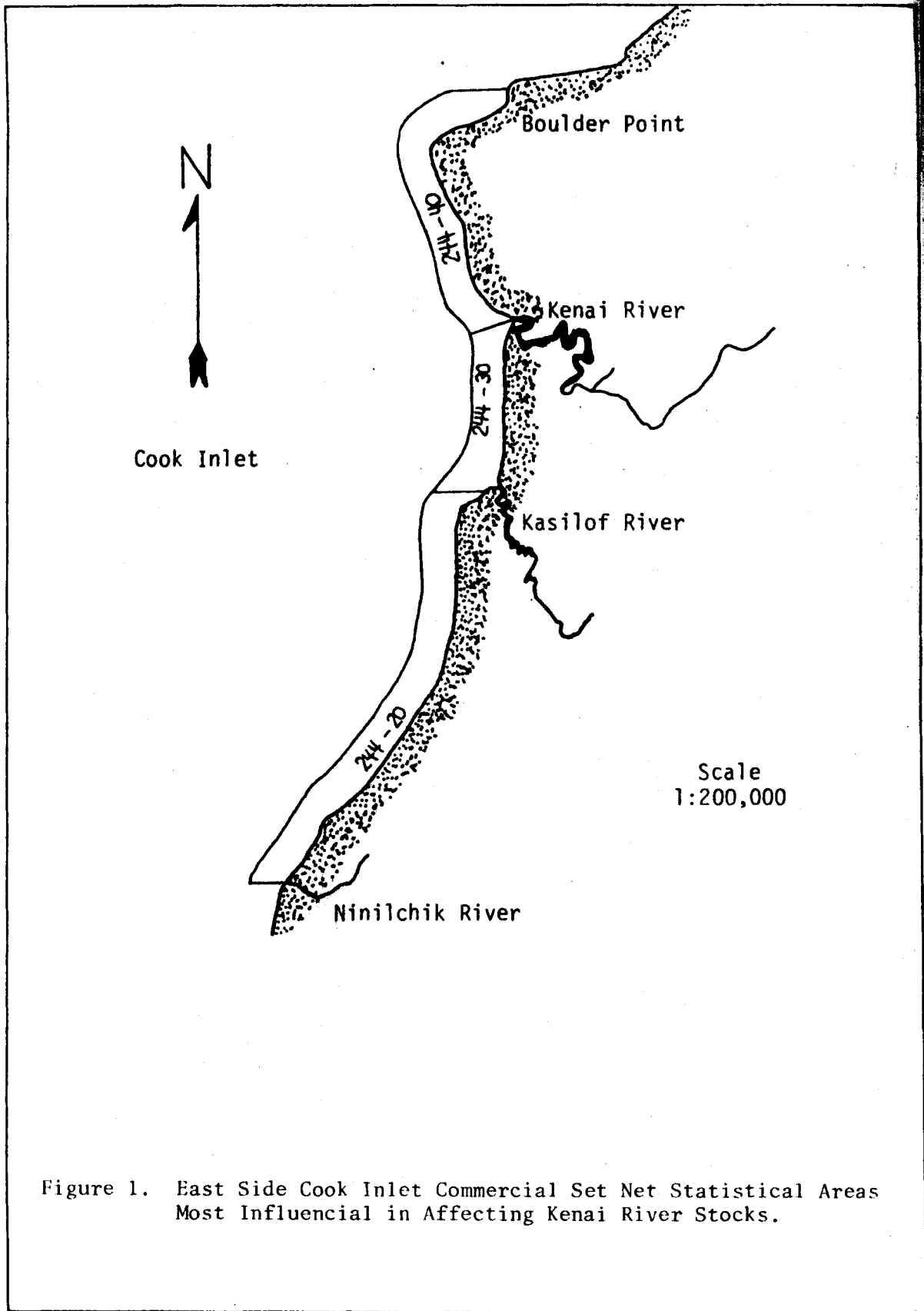


Figure 1. East Side Cook Inlet Commercial Set Net Statistical Areas Most Influential in Affecting Kenai River Stocks.

RECOMMENDATIONS

1. Explore possibilities of determining escapement of chinook salmon into the Kenai River.
2. Examine possibilities of determining racial separation of early run chinook salmon harvested in salt water.
3. Eliminate punch cards from lower Peninsula fishery.
4. Explore possibilities of tagging early run adult chinook salmon in salt water off Deep Creek.

OBJECTIVES

1. To determine the sport harvest of chinook salmon and evaluate angler pressure in the Kenai Peninsula area.
2. To determine spawning escapement into the major chinook salmon producing streams in the area.
3. To determine chinook salmon population trends in the major recreational waters of the Kenai Peninsula.
4. To determine and develop plans for the enhancement of chinook salmon stocks, to provide recommendations for their management, and to direct the course of future studies.

TECHNIQUES USED

Harvest, Effort and Escapement Estimation

Punch Card Fishery:

From 1966 until the present, the harvest of adult chinook salmon from three lower Kenai Peninsula streams has been monitored by punch cards. During the years 1966 to 1970 a harvest quota system was coupled with the punch card system. Since 1971 the system has been essentially unchanged, except for length of season. Punch card returns are the primary source of harvest data.

Cards are issued free of charge by license vendors. They are non-transferable and must be filled out and returned to the Department of Fish and Game regardless of whether an angler fished or not. There is an individual punch listed for each date on each stream that the season is open. Current bag regulations allow one chinook salmon over 20 inches fork length daily and two per season. Anglers are required to remove the appropriate punch immediately upon landing a fish.

Because of incomplete punch card returns, harvest estimates by non-returnees are based on data gathered by a telephone survey conducted in 1973 and 1974.

In addition to data gathered from punch card returns, informal harvest estimates are made for each stream on a daily basis during the fishery. The results of these estimates are used for in-season management decisions. Since no formal sampling design is employed, data gathered from angler interviews conducted throughout the day are analyzed to form a general impression of the fishery and a harvest estimate is made. Accuracy is dependent on familiarity with the fishery. Although these estimates vary by as much as 30% by stream when compared to punch card returns, the total estimated harvest for the entire fishery has varied only an average of 3% when compared to the estimates derived from punch card analysis.

Effort is estimated by car counts conducted each day at the various campgrounds and parking areas of each stream. Angler interviews conducted in previous years (only spot checked in recent years) indicate an average of 3.4 anglers per vehicle. Further studies indicate that a count made at noon is representative of 50% of the vehicles that use the fishery each day. The noon counts are doubled then multiplied by 3.4 to arrive at the daily effort in man-days. The term "man-day" is defined as a single angler fishing on a given day, regardless of time fished.

Biological samples of the sport harvest were collected throughout the fishery. Fish were measured to the nearest 5 mm, sex recorded and a scale sample taken from each specimen. Scales were pressed into cellulose acetate and read by a Bruning microfiche reader.

Escapement surveys were conducted in early August. A helicopter was used to make aerial estimates of the spawning population. Predesignated sections of approximately four miles were counted by a ground observer on each stream. Simultaneously, an observer using a helicopter made an aerial count of the same section. The remainder of the stream was then counted from the helicopter. The proportion of air to ground count determined in the predesignated section was then applied to the aerial count for the entire stream.

Deep Creek Marine Fishery:

Sport effort and harvest of chinook salmon are monitored by creel census, modified from that described by Neuhold and Lu (1957). Commencing May 22 and terminating August 8, five days were sampled weekly: each weekend day and holiday, and two or three randomly selected weekdays. The fishing day extends 16 hours, from 6 a.m. to 12 midnight; effort was assumed negligible between 12 midnight and 6 a.m. Two randomly selected 3.5 hour interview periods were chosen from each sample period. An instantaneous boat count was made at the beginning and end of each sample period. "Completed" angler interviews were conducted over the remainder of the period each day.

Records were kept of the number and species of fish harvested, hours fished, number in party, and location of capture. Length, weight, sex and scale samples were collected from each sampled chinook salmon for age analysis.

Total possible man-hours of fishing effort per day (p) was calculated as follows:

$$p = (\bar{c}) (\bar{a}) (16)$$

where

\bar{c} = mean boat count

\bar{a} = mean anglers per boat

Effort in man-days was determined by dividing total number of hours that anglers could have fished, by average hours fished per angler.

Harvest was calculated as follows:

$$h = (p) (\bar{r})$$

where

\bar{r} = mean catch per hour

Calculations were tabulated on a weekly basis. Weekdays results were expanded by multiplying the totals of the days sampled in any week by the number of possible days that week and dividing that product by the number of days sampled. These results were then added to the weekend/holiday totals for a weekly total.

Kenai River Fishery:

Since 1974, the Kenai River sport harvest and effort have been monitored by creel census. Essentially the design is based on Neuhold and Lu's (1957) sampling scheme although methods of calculation have varied as will be explained further.

For 1976, the calculating procedure more closely resembled that used by Neuhold and Lu (1957) than did the procedures used in 1975 by Hammarstrom (Hammarstrom, 1976). Although the 1976 procedures were used to verify the 1975 results, the 1975 technique was used for in-season harvest estimates.

The sampling scheme was identical to that used in 1975. However, shore anglers were not sampled for chinook salmon in 1976. Data regarding these anglers were projected based on the results determined in 1975.

The census began June 7 and terminated September 30. The fishing day was reduced from 20 hours to 16 hours for August and to 12 hours for September because of the changing daylight hours. Although all species harvested were recorded, the target species during August and September was coho salmon since the chinook salmon season closes July 31. Data regarding other species are presented in another report (Hammarstrom, 1977).

Harvest and effort figures were estimated separately in eight categories: early run upstream weekday, early run upstream weekend, late run upstream weekend, late run upstream weekday. Corresponding categories were utilized on the downstream section. Totals were arrived at by summing all categories.

Effort in man-hours (p) for an individual category was estimated as follows:

$$p = \bar{c} N$$

\bar{c} = mean hourly count

N = (20) (number of days possible) June and July

N = (16) (number of days possible) August

N = (12) (number of days possible) September

The 95 percent confidence interval was calculated as follows:

$$p \pm 1.96 \sqrt{NS \frac{p}{c}}$$

where

n = number of counts made

Total effort in man-hours (P) was calculated by summing the effort (p) of each category.

The total 95% confidence interval for effort was computed as follows:

$$P \pm 1.96 \sqrt{S_p^2}$$

$$S_p^2 = \frac{N_1^2 S_{c_1}^2}{n_1} + \frac{N_2^2 S_{c_2}^2}{n_2} + \dots + \frac{N_8^2 S_{c_8}^2}{n_8}$$

where

S_p^2 = total variance of effort

N_i = total possible hours for each category

$s_{c_i}^2$ = variance of the count for each category

n_i = number of counts in each category

Harvest (h) for each category was calculated as follows:

$$h = p \bar{r}$$

$$\bar{r} = \frac{\text{total number of fish reported}}{\text{total hours reported}}$$

The 95% confidence interval was calculated as follows:

$$C. L. .95 = h + 1.96 \sqrt{s_h^2}$$

where

$$s_h^2 = h^2 \left(\frac{s_p^2}{p^2} + \frac{s_r^2}{\bar{r}^2} \right)$$

$$s_{pi}^2 = \frac{N_i^2 S_{ci}^2}{n_i}$$

$$s_{\bar{r}}^2 = \bar{r}^2 \left(\frac{s_z^2}{\bar{z}^2} + \frac{s_{\bar{y}}^2}{\bar{y}^2} \right)$$

$$s_{\bar{z}}^2 = \frac{\text{variance of the number of fish reported}}{\text{number of anglers interviewed}}$$

$$\bar{z} = \frac{\text{number of fish reported}}{\text{number of anglers interviewed}}$$

$$s_{\bar{y}}^2 = \frac{\text{variance of the number of hours}}{\text{number of anglers interviewed}}$$

$$\bar{y} = \frac{\text{hours reported}}{\text{number of anglers interviewed}}$$

The total 95% confidence interval for the harvest was computed as follows:

$$C. L. .95 = H + 1.96 \sqrt{S_H^2}$$

$$S_H^2 = s_{h_1}^2 + s_{h_2}^2 + \dots + s_{h_g}^2$$

where

$$S_H^2 = \text{total harvest variance}$$

$$S_{hi}^2 = \text{harvest variance for category } i$$

Biological data were collected during the interview periods. Length, sex, weight and scale samples were collected from as many chinook salmon as practical.

A chinook salmon carcass survey was conducted in mid-September. A super cub was utilized to survey both banks of the river from Cook Inlet to Skilak Lake. By mid-September the glacial water had cleared somewhat and the stream level had dropped approximately 2 feet leaving carcasses stranded on the banks and bars.

Positive identification was made on 700 adult chinook salmon, although this figure is believed to be minimal due to the presence of large numbers of dead pink salmon. It is felt that many chinook salmon carcasses were obscured by the pink salmon carcasses.

FINDINGS

Punch Card Fishery

Effort during the 1976 chinook salmon, Oncorhynchus tshawytscha (Walbaum), punch card season increased by 88.4% over the 1975 season, from 19,600 man-days to 36,920 man-days. Average effort per day increased by 41.3%, from 3,266 man-days to 4,615 man-days. The increase in effort was the result of two factors, good fishing and the additional weekend open to fishing.

Historically, fishing has been more succesful on Saturdays than Sundays. During the 1976 season 2,716 more man-days were recorded on Saturdays than Sundays, 19,818 and 17,102, respectively. As the season progressed, angler effort decreased. The highest effort recorded was during the first weekend, and each successive weekend showed less effort.

As in years past, the Ninilchik River was the only stream in a fishable condition during opening weekend. Both Anchor and Deep Creek were high and turbid. All streams were in better condition on remaining weekends.

To preclude over-harvest in the face of record catches during the first two weekends, the Ninilchik River was closed by emergency order during the last two weekends, thus directing effort to the other two streams.

The 1976 sport harvest of chinook salmon was the highest recorded since 1966. Since Ninilchik River was the most fishable opening weekend, harvest was substantial, 348 fish in the first two days of the fishery. Harvest the second weekend was 282. The harvest during these two weekends was greater than in any season since 1966. Harvest and effort figures by date are presented in Table 1. Historical effort is presented in Table 2.

Harvest was determined by evaluating punch cards. The 1976 return of punch cards was the lowest since 1972, (Table 3) with only 50.8% of the anglers who received cards returning them. Nearly half the people who do return cards either do not fish or supply incomplete information which is of little value in estimating harvest. Of those who reported

Table 1. 1976 Punch Card Harvest and Effort (man-days) by Date.

Date	Anchor River		Deep Creek		Ninilchik River		Total	
	Harvest	Effort	Harvest	Effort	Harvest	Effort	Harvest	Effort
5/29	74	1,516	5	2,018	221	2,190	300	5,724
5/30	45	1,809	7	1,813	127	2,659	179	6,281
6/ 5	151	979	15	2,143	208	3,287	374	6,409
6/ 6	32	830	2	1,479	74	2,618	108	4,927
6/12	194	2,660	57	2,224	Closed		251	4,884
6/13	90	1,761	32	1,711	Closed		122	3,472
6/19	172	1,754	55	1,047	Closed		227	2,801
6/20	69	1,285	44	1,137	Closed		113	2,422
Total	827	12,594	217	13,572	630	10,754	1,674	36,920

1st weekend	119	3,325	12	3,831	348	4,849	479	12,005
2nd weekend	183	1,809	17	3,622	282	5,905	482	11,336
3rd weekend	284	4,421	89	3,935	Closed		373	8,356
4th weekend	241	3,039	99	2,184	Closed		340	5,223

Table 2. Fishing Effort Observed During the Chinook Salmon Punch Card Fishery on Lower Kenai Peninsula Streams, 1976.

Year	Man-Days	Length of Season (Days)	Average Effort/Day
1971	15,900	6	2,650
1972	13,520	4	3,380
1973	24,100	6	4,017
1974	21,000	6	3,500
1975	19,600	6	3,267
1976	36,920	8	4,615

Table 3. Summary of Chinook Salmon Punch Cards Issued and Returned, 1966-76.

Year	Number Issued	Number Returned	Percent Returned
1966	8,853	6,835	77.2
1967	5,977	4,909	82.1
1968	9,524	6,724	70.6
1969	6,680	4,651	69.6
1970	16,687	12,518	75.0
1971	23,419	10,435	44.6*
1972	23,991	10,138	42.2*
1973	12,069	7,188	59.6
1974	11,309	6,465	57.2
1975	9,808	5,443	55.5
1976	16,054	8,151	50.8

* Years in which a punch card was in effect on the Kenai River.

they had fished, only 15.9% reported being successful and only 3.4% reporting a seasonal limit of two fish. Tables 4 and 5 show the results of punch card returns from 1973-1976.

Scale samples were collected from 322 chinook salmon harvested from the three streams. The sex ratio (excluding age 1.1 precocial "jack" male fish) of the harvest was 1.1:1 males to females. Assuming the harvest is representative of the run, except for precocial males, the predominant age class was six year old fish (1.4) from the 1970 brood year. Because "jacks" are under 20 inches in length, they are not required to be reported on a punch card. Although no accurate figure is available for harvest of jacks, observations indicate this age class was not strong. Table 6 shows age composition of the sport harvest during the punch card fishery, while Table 7 compares fork length data of the various age classes.

Chinook salmon escapement surveys were conducted in early August. An average of 73% of the spawning fish seen in the index area of each stream by ground observers were also observed from the helicopter (Table 8). Aerial observations were similar to ground counts on the Ninilchik River, because of the lack of overhanging vegetation. Deep Creek had the poorest relationship. It is a relatively fast moving stream lined with tall trees. Escapement into each stream is as follows: Anchor River, 3,080; Deep Creek, 1,680; and Ninilchik River, 1,180. Table 9 summarizes historical data from the three streams.

Deep Creek Marine Fishery

Sport effort on chinook salmon in salt water south of Deep Creek increased by 131.5% over 1975 from 8,050 man-days to 18,635 man-day (Table 10). Most of the increase occurred during the early run. Fishing began in late May, slightly prior to creel census commencement. Angler effort during Memorial Day weekend was 2,865 man-days. The pressure remained high until mid-June. Effort was low between runs (June 25 used as separation date), but by July 1 effort was again high, although not nearly as high as in late May.

Some of the 1976 increase can be explained by the fact that the punch card fishery, held nearby on Deep Creek and Ninilchik River, occurs on those late May and early June weekends. The beaches south of Deep Creek are popular clam digging areas and good minus tides occurred during Memorial Day weekend and the second weekend of June. The primary reason, though, was the excellent fishing anglers were experiencing during the early run.

The total estimated harvest of chinook salmon was 6,877 fish over 20 inches in length with 5,495 and 1,382 from early and late run, respectively. Fish abundance and favorable weather conditions are the two most obvious reasons for the large catch.

Early run fish are theorized to be headed for the local streams, the Kenai and Kasilof Rivers and the Susitna River Basin. Late run fish are almost entirely Kenai, Kasilof River origin. Figure 2 compares length

Table 4. A Summary of Chinook Salmon Punch Card Utilization in Percent by Anglers, 1973-76.

Angler Returns	1973	1974	1975	1976	Mean
Fished	50.7	53.9	50.4	53.7	52.2
Did Not Fish	44.6	42.2	43.9	41.0	42.9
Incomplete Information	4.7	3.9	5.7	5.3	4.9

Table 5. A Summary of Chinook Salmon Punch Card Returns in Percent by Anglers Fishing, 1973-76.

Angler Returns	1973	1974	1975	1976	Mean
Unsuccessful	90.8	84.7	87.2	84.1	86.7
Successful (1 fish)	7.1	11.6	10.0	12.5	10.3
Successful (2 fish)	2.1	3.7	2.8	3.4	3.0

Table 6. Age Composition of Sport Caught Chinook Salmon Taken During the Punch Card Fishery from Three Lower Kenai Peninsula Streams, 1976.

	Age Class					Total
	1.1	1.2	1.3	1.4	2.2	
Number	3	53	118	145	1	320
Percent	0.9	16.6	36.9	45.3	0.3	100.0
	Brood Year				Total	
	1970	1971	1972	1973		
Number	145	119	53	3	320	
Percent	45.3	37.2	16.6	0.9	100.0	

Table 7. Fork Length Data from Major Age Classes of Chinook Salmon Taken in the Sport Fishery in the Lower Three Kenai Peninsula Streams, 1976.

	Age Class			
	1.1	1.2	1.3	1.4
n	3	50	118	141
Range	360-390	490-780	710-1010	810-1190
Mean	375.0	654.2	870.6	983.9
S.D.*	15.0	55.3	61.7	67.2

* Standard Deviation

Table 8. Chinook Salmon Escapement Surveys for Lower Kenai Peninsula Streams, 1976.

	Index Area			Remainder of Stream		
	Ground Count	Aerial Count	Percent Aerial	Aerial Count	Expanded Count	Total Count
Ninilchik River	470	381	81	575	710	1,180
Deep Creek	94	60	64	1,015	1,586	1,680
Anchor River	797	550	69	1,575	2,283	3,080

Table 9. Historical Harvest and Escapement Data for the Three Lower Kenai Peninsula King Salmon Streams from 1966 through 1976*.

Year	Anchor River			Deep Creek			Ninilchik River			Totals		Total Run
	Harvest	Escapement	% Harvest	Harvest	Escapement	% Harvest	Harvest	Escapement	% Harvest	Harvest	Escapement	
1966	290	1,330	18	50	540	9	220	670	25	560	2,450	3,100
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	31	620	1,180	1,800
1969	80	1,800	4	40	960	4	130	760	15	250	3,520	3,770
1970	170	1,850	8	60	Unknown	Unknown	280	Unknown	Unknown	510	1,850+	2,360+
1971	60	1,220	5	40	Unknown	Unknown	140	Unknown	Unknown	240	1,220+	1,460+
1972	180	1,890	9	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	27	350	510	36	1,080	2,250	3,240
1975	210	1,290	14	100	610	14	540	830	39	850	2,730	3,580
Mean 1966-75	253	1,338	17.8	138	509	24.8	255	698	26.8	646	2,533	3,180
Mean % 1966-75	39.2	52.6		21.4	20.0		39.4	27.4		100	100	
1976	800	3,080	21.2	220	1,680	11.6	630	1,180	34.8	1,680	6,940	7,620

* Figures rounded to nearest ten.
+ Excludes all 1970 and 1971 data.

Table 10. A Summary of Chinook Salmon Sport Harvest Catch Rates and Effort in Man-days from Deep Creek Marine Fishery 1972-1976.

Year	Anglers Interviewed	Early Run			Late Run			Total Run		
		Harvest	C/H*	Effort	Harvest	C/H*	Effort	Harvest	C/H*	Effort
1972	450	1,000	0.119	2,357	1,250	0.272	1,253	2,250	0.173	3,610
1973	1,300	519	0.028	5,245	491	0.050	2,795	1,010	0.034	8,040
1974	897	500	0.037	3,810	100	0.034	1,280	600	0.036	5,090
1975	1,143	540	0.061	3,370	345	0.031	4,680	885	0.044	8,050
1976	2,293	5,495	0.101	12,270	1,382	0.058	6,365	6,877	0.088	18,635

* C/H Catch Per Hour

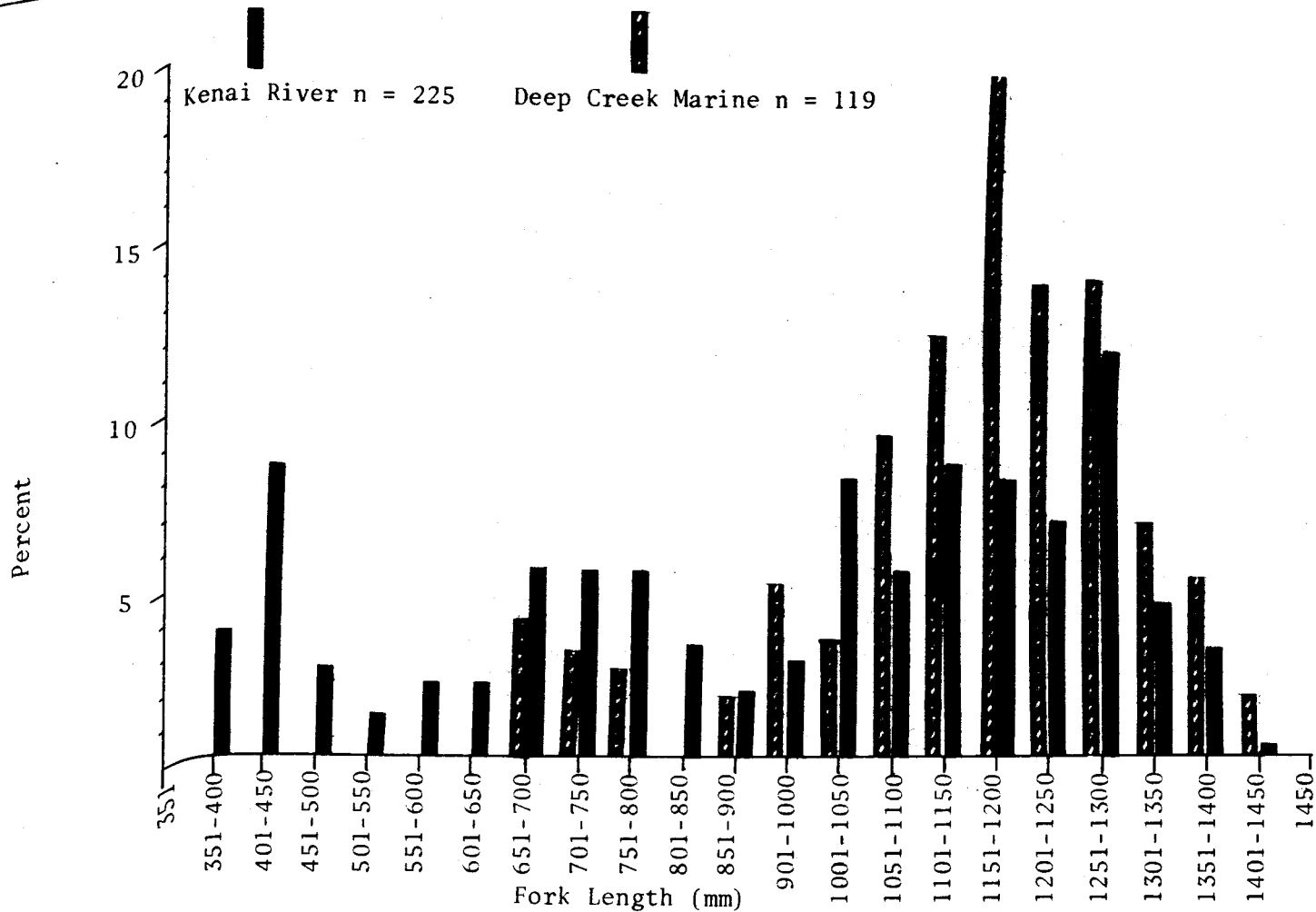


Figure 2. Length Marine Frequency Comparison for Sport Harvest of Late Run Chinook Salmon From Deep Creek Fishery and Kenai River Fishery, 1976.

frequency for the late run fish from the Kenai River and Deep Creek Marine Fisheries. Note the absence of "jacks" taken off Deep Creek.

Harvest and effort calculations were based on 194 instantaneous boat counts and 2,293 angler interviews. During the 1976 season 730 chinook salmon were creel checked, thus 12.3% of the effort and 10.3% of the harvest was physically contacted. Historical harvest and effort data are presented in Table 10.

Figure 3 is a graphic representation of angler effort and success rates. The early run peaked around May 25, while the late run peaked around July 5. As expected, effort was high on weekends but much higher generally during the early run with peak effort occurring during Memorial Day weekend.

Readable scale samples were collected from 342 sport caught chinook salmon taken in the Deep Creek Marine Fishery. The predominant age class for both the early and late run was six year old fish (1.4), 66.2% and 74.2% for early and late runs respectively. No "jacks" were reported during either run, but it is interesting to note that eight fish showed they had spent two years in freshwater (Table 11).

When fork lengths of comparative age classes from early and late runs were examined, all late run age classes had a higher mean length than did corresponding early run age classes (Table 12). Early run mean lengths from Deep Creek Marine chinook salmon were also smaller than early run mean lengths from the Kenai River and larger than mean lengths from the local streams of Deep Creek and Ninilchik River lending credibility to the theory that the Susitna Basin does contribute significantly to the Deep Creek Marine harvest of early run chinook salmon.

More females were harvested in salt water than males, 56.0% and 44.0% respectively. This represents an effective harvest of 3,851 females and 3,026 males.

In addition to chinook salmon, a harvest of 1,987 sockeye salmon O. nerka (Walbaum), 631 coho salmon, O. kisutch (Walbaum), and 2,200 pacific halibut, Hippoglossus stenolepis Schmidt, was estimated.

Kenai River Fishery

Because of low water levels the Kenai River creel census was not begun until June 7. Water levels also precluded much fishing effort prior to this date. During 1976 most of the angler effort on chinook salmon occurred during the late run. Of the 44,460 man-days expended, 16,430 and 28,030 man-days occurred during early and late runs, respectively. This represents a total increase of 48.2% over the 1975 effort.

Throughout the season the most popular area was the "downstream" segment of river from The Soldotna Bridge to Beaver Creek. This area received 52.9% of the total effort (Table 13). Because of run timing through the river, anglers in the downstream section fish more equally upon both runs. The early run was present in the downstream section for 26 days

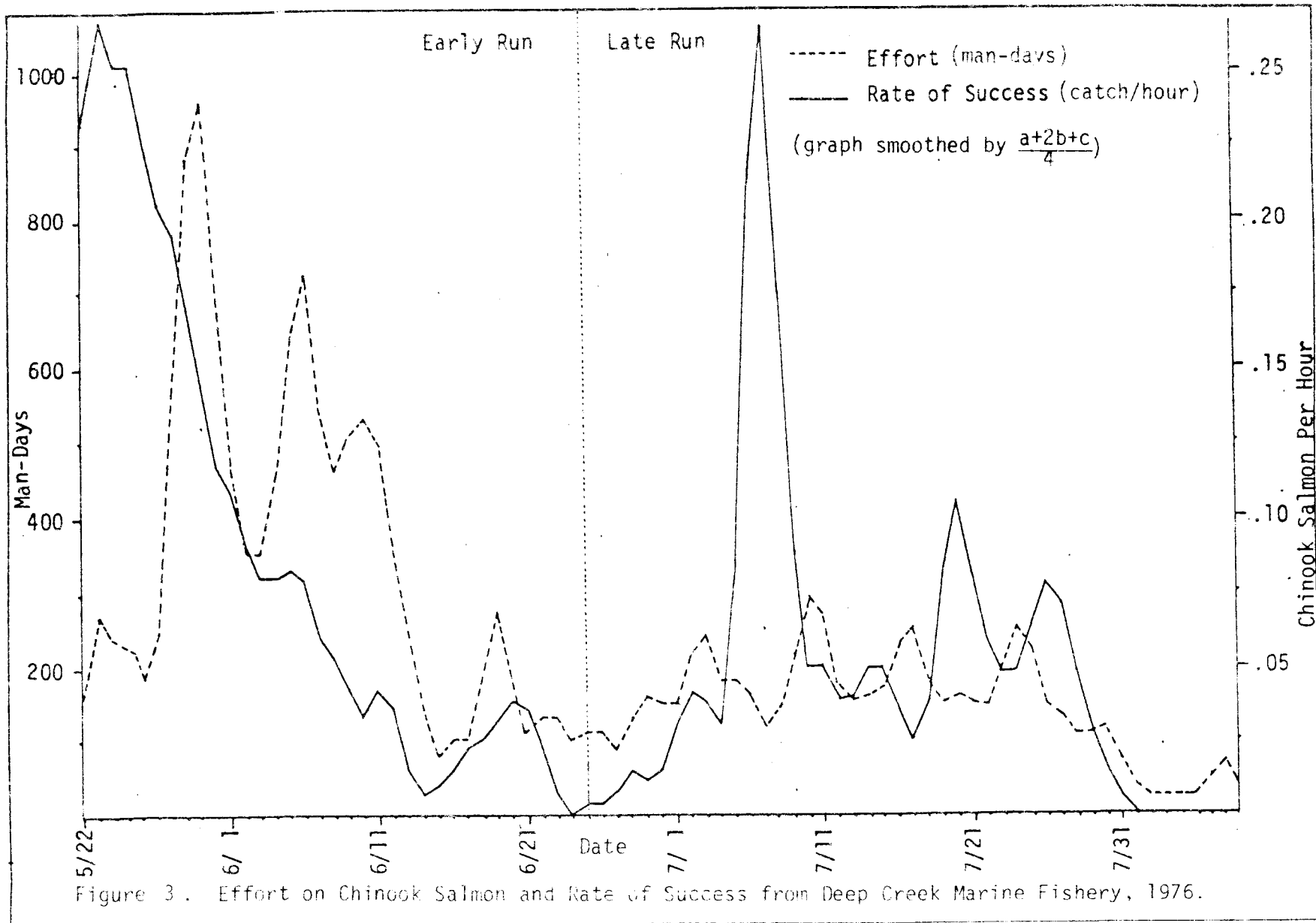


Table 11. Age Composition of Sport Caught Chinook Salmon Taken in Deep Creek Marine Fishery, 1976.

	<u>Age Class</u>								Total	
	1.2	1.3	1.4	1.5	1.6	2.2	2.3	2.4		
Number	24	38	147	4	<u>Early Run</u> 1		4	2	2	222
Percent	10.8	17.1	66.2	1.8	0.5	1.8	0.9	0.9	100.0	
Number	6	16	89	9	<u>Late Run</u>					120
Percent	5.0	13.3	74.2	7.5					100.0	
	<u>Brood Year</u>						Total			
	1968	1969	1970	1971	1972					
Number	1	6	<u>Early Run</u> 149		42	24	222			
Percent	0.5	2.7	67.1	18.9	10.8	100.0				
Number		9	<u>Late Run</u> 89		16	6	120			
Percent		7.5	74.2	13.3	5.0	100.0				

Table 12. Fork Length Data (mm) from Sport Caught Chinook Salmon Taken in the Deep Creek Marine Fishery 1976.

	<u>Age Class</u>			
	1.2	1.3	1.4	1.5
	<u>Early Run</u>			
n	24	38	147	4
Range	520-775	775-1030	820-1290	895-1190
Mean	651.5	886.1	1,013.2	1,050
S.D.*	58.2	61.0	74.9	134.5
	<u>Late Run</u>			
n	6	16	89	9
Range	665-790	735-1070	925-1335	1055-1300
Mean	702.8	941.3	1,151.1	1,202.2
S.D.*	41.7	114.1	95.1	108.1

* Standard Deviation

Table 13. Effort in Man-Days by Area on Kenai River Chinook Salmon, 1976.

	Downstream Section	Mid-Stream Section	Upstream Section	Shore Anglers	Total
Early Run	5,818	2,085	5,960	2,567	16,430
Late Run	17,718	3,559	2,371	4,382	28,030
Total	23,536	5,644	8,331	6,949	44,460
Percent Total	52.9	12.7	18.8	15.6	

while the late run was available for 29 days. In the upstream section (Skilak Lake to Naptowne Rapids) the early run was available for 42 days while the late run was available for only 13 days before the season closed on July 31.

Angler effort in the upstream and downstream sections was determined on the basis of 118 instantaneous angler counts. Weekdays accounted for 71.0% of the available fishing time, yet only 45.4% of the effort occurred on weekdays. Correspondingly, weekends and holidays represented 29.0% of available time and received 54.6% of the effort.

Effort in the midstream section was calculated on the basis of five aerial flights over the entire portion of river open to chinook salmon fishing. The average boat count of these five flights indicates that the midstream effort was 17.8% of the effort occurring in the other two sections of river. Shore angler effort was estimated from work done in 1975 in which shore effort equaled 21.8% of the upstream and downstream boat effort. Observations in 1976 indicate that this figure is still representative.

Catch-per-hour data was based on 8,136 interviews. This represents a angler sample of 18.3%. The total estimated harvest of chinook salmon was 7,694, 6,031 adults and 1,653 "jacks". Of the adult harvest over 20 inches in length, 1,554 were early run fish and 4,477 were late run fish. Only 273 "jacks" were estimated to have been harvested from the early run while 1,390 were estimated as late run fish. The harvest of "jacks" is substantially higher for shore anglers than for boat anglers.

During the early run, fish harvested in the downstream section by boat anglers accounted for 44.7% of the total early harvest while the upstream section accounted for only 26.9%. Corresponding figures for the late run are 70.1% downstream and 1.6% upstream. Catch distribution by river section is presented in Table 14. Table 15 presents historical data regarding the Kenai River chinook salmon fishery. Figure 4 depicts the timing of each run through the system.

During the 1976 season, 924 chinook salmon were creel checked which represents an estimated 12% of total chinook salmon harvested. From these fish, 511 readable scales were collected which provided data regarding age composition, length and sex.

Males were harvested at nearly 2:1 to females, 36.7% and 63.3% respectively. These figures do not include "jacks". If the estimated total adult harvest (6,031) is considered it is estimated that 2,213 females were caught.

Analysis of scales also indicated the predominate age class to be 1.4 (brood year 1970). Nearly four times as many jacks were reported from the late run than from the early run. Further analysis also showed late run fish of the same age class to be larger than early run fish. Tables 16 and 17 show age composition and length data from the 1976 run of chinook salmon into the Kenai River.

Table 14. Summary of Chinook Salmon Harvest on the Kenai River, 1976.

	<u>Early Run</u>				Total
	Downstream	Midstream	Upstream	Shore Anglers	
Adults	721	216	492	125	1,554
Jacks	96	17	0	160	273
Total	817	233	492	283	1,825
	<u>Late Run</u>				
Adults	3,370	616	89	402	4,477
Jacks	740	132	4	514	1,390
Total	4,110	748	93	916	5,867
	<u>Total Both Runs</u>				
Adults	4,091	832	581	527	6,031
Jacks	836	149	4	674	1,663
Total	4,927	981	585	1,201	7,694

Table 15. Summary of Chinook Salmon Harvest and Effort (man-days) Information from the Kenai River, 1974-76.

Year	Anglers Interviewed	Early Run			Late Run			Total Run		
		Harvest	C/H**	Effort	Harvest	C/H**	Effort	Harvest	C/H**	Effort
1974*	1,245	1,685	0.041	11,275	3,225	0.073	12,335	4,910	0.058	23,610
1975	5,131	615	0.011	15,047	2,355	0.044	14,943	2,970	0.024	29,990
1976	8,136	1,554	0.024	16,432	4,477	0.039	28,030	6,031	0.033	44,460

* Projected since only half the river was creel censused.

** C/H = Catch/Hour

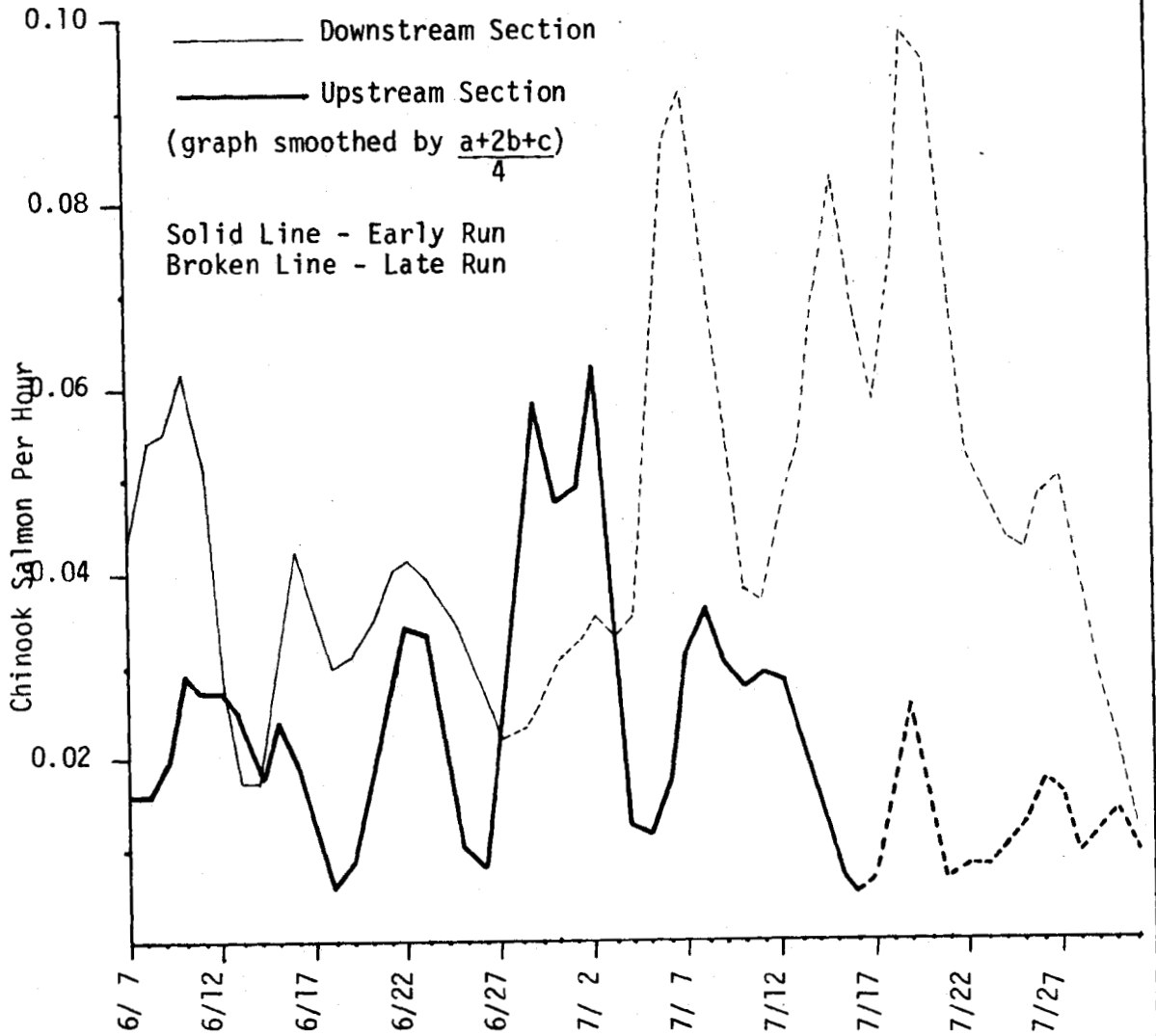


Figure 4. Early and Late Run Chinook Salmon Harvest Rate by Date in Downstream and Upstream Sections of the Kenai River, 1976.

Table 16. Age Composition of Sport Caught Chinook Salmon, Kenai River, 1976.

		<u>Age Class</u>							
		1.1	1.2	1.3	1.4	1.5	2.2	2.3	Total
		<u>Early Run</u>							
Number		8	54	49	86	5		2	204
Percent		3.9	26.5	24.0	42.2	2.4		1.0	100.0
		<u>Late Run</u>							
Number		33	83	56	123	11	1		307
Percent		10.7	27.0	18.2	40.2	3.6	0.3		100.0
		<u>BROOD YEAR</u>							
		1969	1970	1971	1972	1973			Total
		<u>Early Run</u>							
Number		5	88	49	54	8			204
Percent		2.5	43.1	24.0	26.5	3.9			100.0
		<u>Late Run</u>							
Number		11	123	57	83	33			307
Percent		3.6	40.1	18.6	27.0	10.7			100.0

Table 17. Fork Length Data from Sport Caught Chinook Salmon, Kenai River, 1976.

	<u>Age Class</u>				
	1.1	1.2	1.3	1.4	1.5
	<u>Early Run</u>				
n	7	50	40	74	4
Range (mm)	330-410	420-750	620-1070	900-1285	1140-1280
Mean (mm)	374.3	628.9	892.0	1,110.4	1,190.0
S.D.	33.6	72.8	108.4	91.5	61.6
	<u>Late Run</u>				
n	28	48	35	85	8
Range (mm)	360-460	460-820	710-1120	940-1320	1120-1400
Mean (mm)	421.4	684.7	959.6	1,164.0	1,232.5
S.D.	26.7	90.2	85.7	93.3	89.9

Chinook salmon are still entering the Kenai River system when the sport season closes. Historical commercial records indicate that an average of 35.5% of the run enters the system after July 31 (Table 18). Comparing commercial fisheries data with sport catch data indicate a week timing delay from the commercial fishery to the river, thus chinook salmon in Cook Inlet after July 24 are not subject to the sport fishery.

Calculations reflect the creel census design of Neuhold and Lu (1957). Total effort was estimated at 44,460 man-days. Calculations were also performed using the technique described by Hammarstrom, (1976). Results of both methods were very similar. The 1975 design differed by -3.8% for effort and -3.9% for harvest. These results lend creditability to the 1975 design which will facilitate in season estimates as the design calculates on a daily basis whereas the Neuhold and Lu scheme calculates at the end of the season.

Utilizing the 1975 technique to calculate harvest on a daily basis will make implementation of the Board Policy an effective management tool. The 1976 sport harvest of late run chinook salmon from the Kenai River and Deep Creek Marine Fishery totaled 5,859 while the commercial late run total of that species was 5,570 harvested during the weekly scheduled two twelve-hour periods. The sport harvest exceeded the commercial harvest by 5.2%, well within the 10% limit prescribed by the Board of Fisheries.

In mid-September a chinook salmon survey of the Kenai River was conducted. The water in the river had receded to a point that exposed sand bars and shore areas. The water was relatively clear allowing visibility to about three feet. The survey was made in a super cub starting from Cook Inlet upstream along the south bank to Skilak Lake then downstream along the north bank. A total of 700 spent chinook salmon carcasses were positively identified. Many more could have been counted, but due to the large number of pink salmon, *O. gorbuscha* (Walbaum), carcasses present, the chinook salmon were obscured. This figure in no way estimates the actual escapement but with more years of data it may be possible to utilize the count as a relative index.

DISCUSSION

The 1976 punch card fishery was the most successful since establishment of the punch card system. More anglers participated and the harvest and escapement were the highest since 1966.

It has been theorized the three lower Kenai Peninsula streams were being managed at close to carrying capacity since total returns have varied little since 1960 through 1975. Therefore, the obvious reason for unusually high return of chinook salmon in 1976 is above average marine survival.

The predominant brood year (1970) has been monitored since 1973 when large number of "jacks" were observed. In 1974, 31.4% of the harvest was comprised of 8-10 pound two-ocean fish. The progeny from this

Table 18. Number and Percentage of Late Run Kenai River Chinook Salmon Harvested by the Commercial Set Net Fishery (area 244) Exclusively After July 24, 1966-1976.

Year	Number	Percent
1966	2,579	37.7
1967	1,413	24.2
1968	1,219	43.9
1969	1,034	35.2
1970	1,489	31.8
1971	*	*
1972	921	17.8
1973	1,856	45.8
1974	3,041	54.7
1975	1,336	38.4
1976	2,088	25.3
Mean	1,697	35.5

* Data not applicable due to numerous closures.

parent year again manifested itself as five year old fish in 1975 by contributing 68.6% to the harvest. It is then estimated that an escapement of 1,850 in 1970 has produced 3,550 returnees over the last four years. This represents a return per spawner of 1.92. Since 1960 the mean return per spawner has been 1.39 for the three lower Peninsula streams.

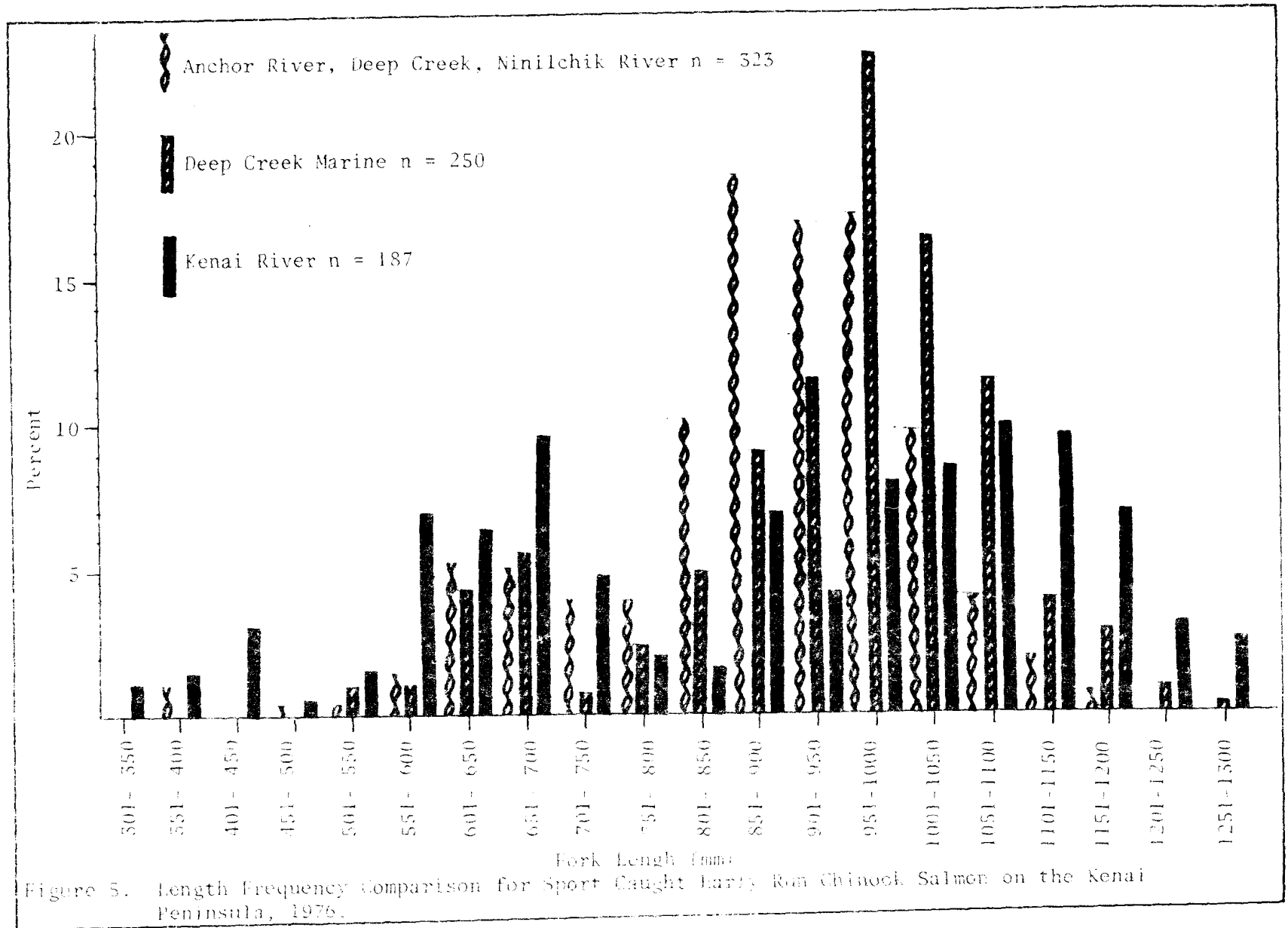
The punch card system has proved cumbersome, costly and poor in regard to data provided. Informal inseason harvest estimates made each year since 1973 have varied by only 3.0% of the results produced by punch cards. Since the informal estimates will continue to be used for management decisions during the season, elimination of the punch card system is justified.

The chinook salmon fishery off shore near Deep Creek produced a record harvest and level of angler effort although the total catch per hour was not quite as high as in 1972. It is felt the early run was comprised heavily of Upper Cook Inlet fish. There are several points that lead to this conclusion. Runs into the local streams were above average and the early run into the Kenai River was felt to be about average, but escape-ments into Susitna Basin streams were about five times higher than they have been in recent years.

Analysis of size and age structure of the northern run is not complete at this writing and therefore cannot be used to substantiate the hypothesis. The author does not feel the increased runs into the local streams could make up the difference in harvest that was recorded off Deep Creek during the early run. A length frequency curve is depicted in Figure 5 comprising early run chinook salmon from the three major fisheries. Notice the peak of fish taken off Deep Creek fall between those of the Kenai River and those of the lower three Kenai Peninsula streams.

The fishery on the Kenai River becomes more popular every year. The harvest and effort can be monitored yearly, but until some estimate can be made of escapement, the true health of the resource can only be surmised. The indicators available suggest the chinook salmon population is healthy and in no immediate danger. Gross catch per unit of effort data from commercial fishery statistics indicate abundance has nearly doubled during the five year period 1971-1976 compared to the period 1966-1970. Sport catches also indicate healthy runs; and observations made by creel census personnel after the season closed, as well as reports from anglers, indicate good numbers of spawning chinook present in the Kenai River.

A program utilizing a trap similar to a Sacramento River Hoop Net to capture and tag adult chinook salmon at the mouth of the Kenai River has been proposed and is awaiting approval and funding by the Alaska Legislature. Until such a program can be initiated, accurate estimates of escapement will not be possible. The current Board Policy will probably insure that irreparable damage is not done to the resource, but it is not as effective as sound management procedures.



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