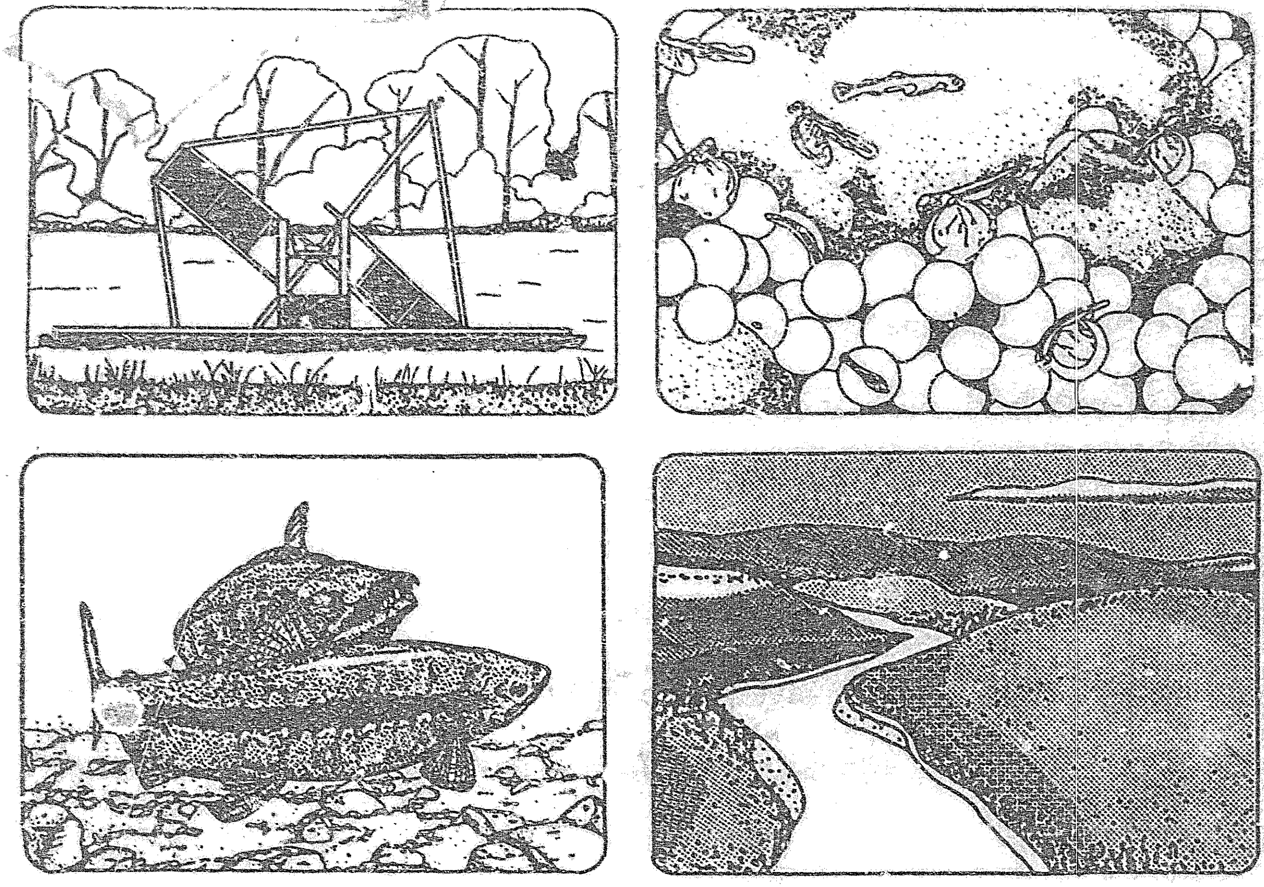

FIRST DRAFT

1983 PHASE II ADULT ANADROMOUS INVESTIGATIONS / SUSITNA RIVER HYDRO AQUATIC STUDIES

by

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SUS#244
V.1

PREFACE

This report was prepared for the Alaska Power Authority (APA) and its principal contractor, Harza-Ebasco Susitna Joint Venture by Alaska Department of Fish and Game (ADF&G) staff. It is one of several reports that will provide the basis for evaluating the proposed Susitna Hydroelectric project. The sole purpose of this report is to specifically address the 1983 adult anadromous fisheries studies contracted to ADF&G by APA. Other APA contracted investigators will evaluate development and operation impacts and appropriate migration measures for the proposed Susitna Hydroelectric project as pertinent to anadromous fish and other resources.

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1.0 OBJECTIVES

Investigations were conducted to accomplish three principal objectives:

1. Provide a third continuous year of salmon escapement evaluation to substantiate production and between year variability within sub reaches of the Susitna River drainage with major emphasis on the Talkeetna to Upper Devil Canyon reach.

2. Define where salmon spawning occurs upstream of RM 98.6 in slough and stream habitats.

3. Determine seasonal distribution and relative abundance of eulachon in the Susitna River.

Anadromous fish species addressed in this report are:

Eulachon	*Thaleichthys pacificus*
Pacific Salmon	*Onchorhynchus sp.*
Chinook Salmon	*O. tshawytscha*
Sockeye Salmon	*O. nerka*
Pink Salmon	*O. gorbuscha*
Chum Salmon	*O. keta*
Coho Salmon	*O. kisutch*
Bering Cisco	*Coregonus laurettae*

2.0 METHODS

2.1 Eulachon

2.1.1 Intertidal

From May 10 to June 8, 1983, a standard sinking gill net measuring 25 feet (ft.) long, 5 ft. deep with 1.5 inch (in.) stretch mesh was fished intermittently at two locations in the Susitna River intertidal, Sites II and III (Figure 2-2-1), according to the following schedule:

1. May 10 through May 16 - Once every high tide beginning on the second high tide on May 10.

2. May 17 through May 23 - Once every fourth high tide.

3. May 24 through June 8 - Once every fifth high tide minimum.

At each fishing location the net was released perpendicular to the river channel using a 20 ft. riverboat powered by a 75 horsepower (hp) jet outboard. The net was secured at each end by a 20 pound (lb.) navy anchor and marked at each surface end with a single 18 in. diameter buoy. (Plate 2-2-1).

Set net sites II and III were fished 30 minutes each during each selected high tide. The only exception to this was netting was terminated at any time in the 30 minute period of a set when a visual observation indicated 200 or more eulachon in the net. Fishing time began at Site II, 15 minutes following high tide and at Site III, 45 minutes preceding high tide. Fishing

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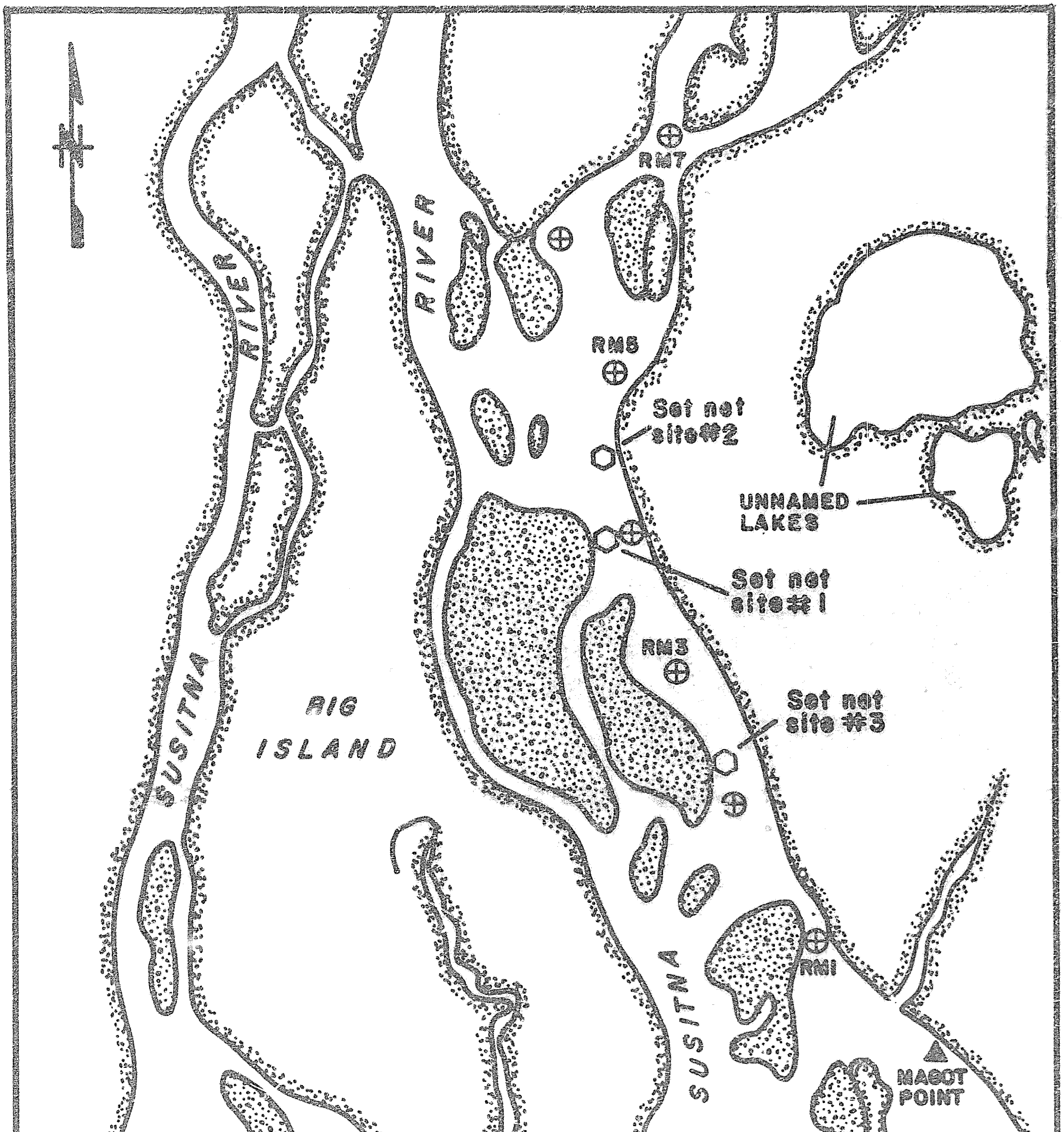


Figure 2-2-1. Susitna River intertidal with set net sites defined, Adult Anadromous Investigations, Su Hydro Studies, 1983.

time at each location was recorded to the nearest minute. The time of high tide for the Susitna River intertidal was determined by subtracting 36 minutes from the 1983 high tide table for the Anchorage District (U.S. Coast Guard, 1982).

Plate 2-2-1. Sinking gill net set in the Susitna River intertidal, Adult Anadromous Investigations, Su Hydro Studies, 1983.

The eulachon caught at each set net location were separated into two categories: immigrants and outmigrants. The pre-spawning and spawning condition eulachon were classified as immigrants and post-spawning condition eulachon as outmigrants. The rationale for placing pre-spawning and spawning condition eulachon into a single category was that after a net caught fish was taken out of the gear it was normally damaged to the extent that the distinction between the condition of pre-spawner and spawner was not clearly definitive (Plate 2-2-2). Net caught post-spawning eulachon, however, were easy to distinguish between pre and spawning condition eulachon and were classified as outmigrants. All spawning condition classifications were determined by morphological examination and when necessary by exerting slight hand pressure to the abdominal region of each fish.

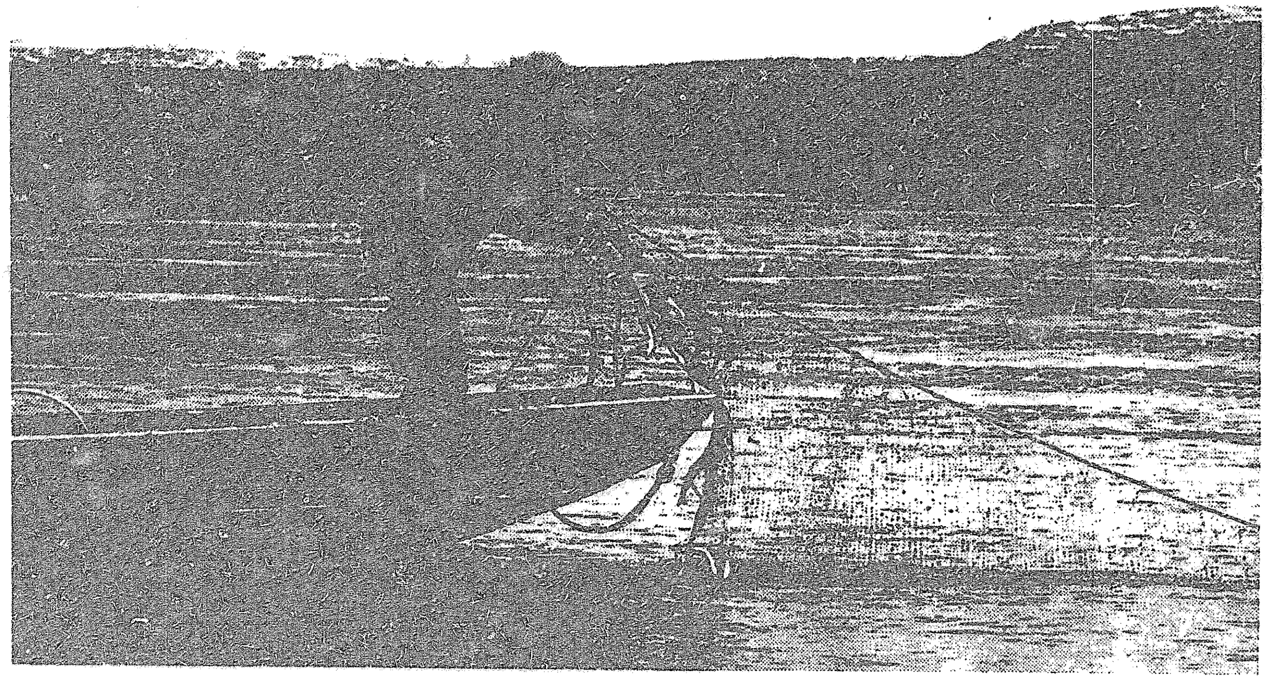


Plate 2-2-2. Removing eulachon from a set net set in the Susitna River intertidal, Adult Anadromous Investigations, Su Hydro Studies, 1983.

The criteria used to classify the male spawning development stages was somewhat subjective due to free expulsion of milt among male fish in the pre-spawning and spawning conditions. The criteria followed was:

Pre-spawners - bright coloration and thick milt.

Spawners - dark coloration and watery milt.

Post-spawners - essentially void of milt.

Female spawning condition classifications were determined by objective means by the following criteria:

Pre-spawners - eggs are not expelled freely.

Spawners - eggs are expelled freely.

Post-spawners - essentially void of eggs.

Using a hand held dip net 100 eulachon were collected for sex, age, length and weight composition data at Site II either prior to, or after set netting at the site. The minimum amount of time expended to obtain the 100 fish sample was 0.5 hrs. and the maximum, 1.0 hrs. All eulachon caught by dip netting were sorted and recorded by spawning condition and sex. Age, length and weight samples were taken from the first 10 pre-spawning eulachon per sex caught.

For age determination, the two otoliths were taken from each eulachon and stored in a water dampened paper towel in an individually labeled vial. The lengths were taken from the tip of mouth to the fork of tail to the nearest millimeter (mm). Weights were registered to the nearest decigram (0.1 g) with an Ohaus, Triple Beam balance. Sex was determined by morphological examination and when necessary by exerting slight hand pressure to the abdominal region of each fish.

2.1.2 Main Channel

The main channel reach between RM 4.5 and 60 was sampled daily for eulachon presence and spawning areas from May 15 to June 6, 1983 using a combination of an electroshocking equipped boat and hand held dip nets (Plate 2-2-3). The electroshocking unit was a Model VVP-3E Coffett electroshocker powered by a 3500 watt Homelite generator. Input into the electroshocker was 230 volts of alternating current (A.C.) and the output, direct current (D.C.). The output was set-up with the anode (+) electrode wired to a hand supported dip net and the cathode (-) electrode grounded to the boat hull. Activation of the circuit ranged from five to 10 seconds followed by a 20 to 40 second pause to avoid herding fish. The most effective output for electroshocking eulachon was 1.0 to 2.0 amps. Rubber hipboots and gloves were worn by the electroshocking crew, and a circuit breaker switch wired to the generator and in easy reach of the boat operator provided additional safety precautions.

The criteria used for determining whether a Susitna River main channel site was or was not a spawning area was based on a definition that from a single sampling using dip net or electroshocking gear a spawning area would produce 25 vigorous free-swimming eulachon with at least two of the 25 fish being females with one female in spawning condition. The basis for implementing this procedure can be found in the Phase II, ADF&G/Su Hydro Adult Anadromous Report, 1982 (ADF&G, 1982).

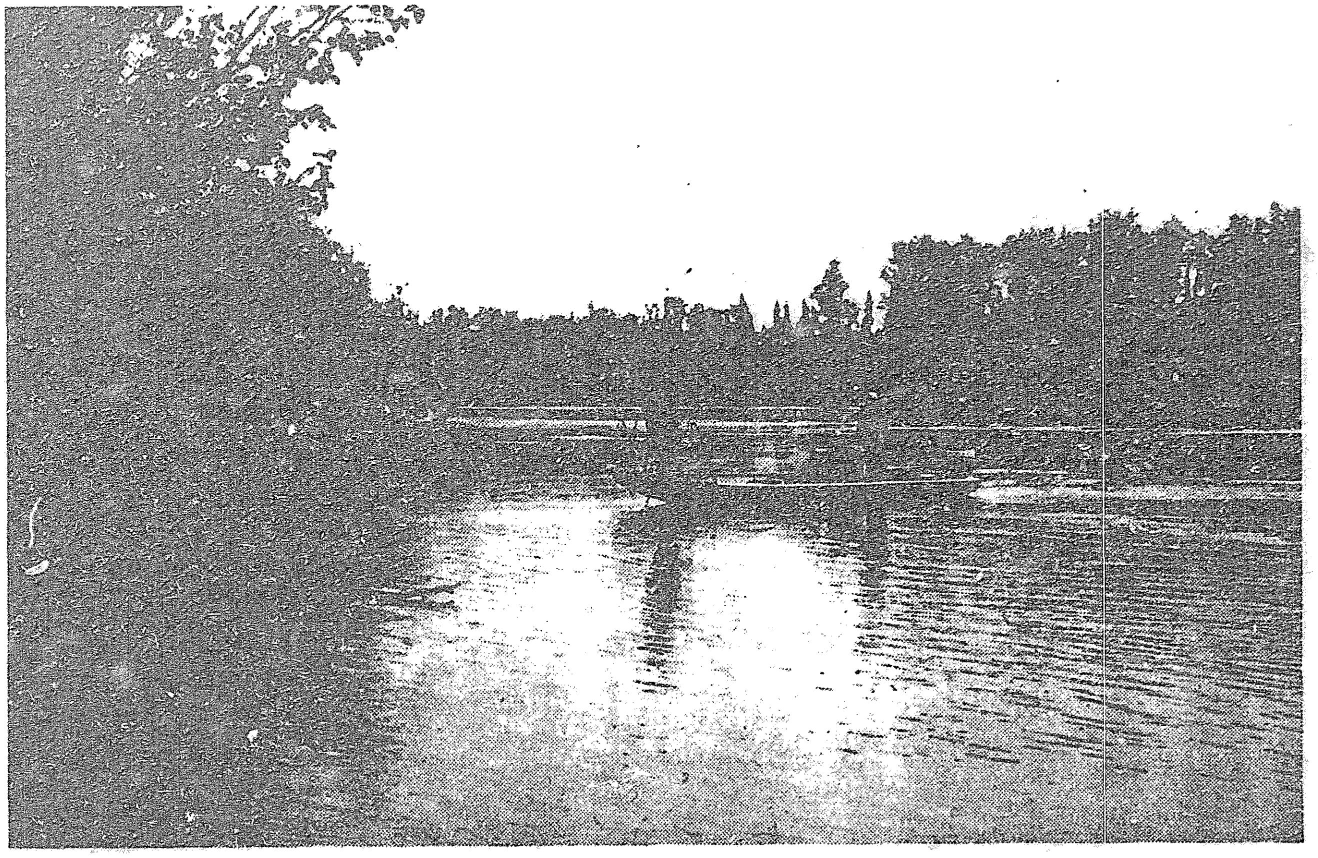


Plate 2-2-3. Electroshocking eulachon in the lower Susitna River, Adult Anadromous Investigations, Su Hydro Studies.

In addition to sampling the main channel Susitna River for eulachon presence and spawning areas, 10 pre-spawning eulachon per sex were collected by dip netting for age, length and weight data at three day intervals from May 15 to June 6, 1983.

2.2 Adult Salmon

2.2.1 Main Channel Escapement Monitoring

Four escapement monitoring stations were operated in 1983 on the Susitna and Yentna rivers at locations indicated in Figure 2-2-2 according to the schedule in Table 2-2-1. A map of each escapement monitoring station can be found in Appendix 2-A.

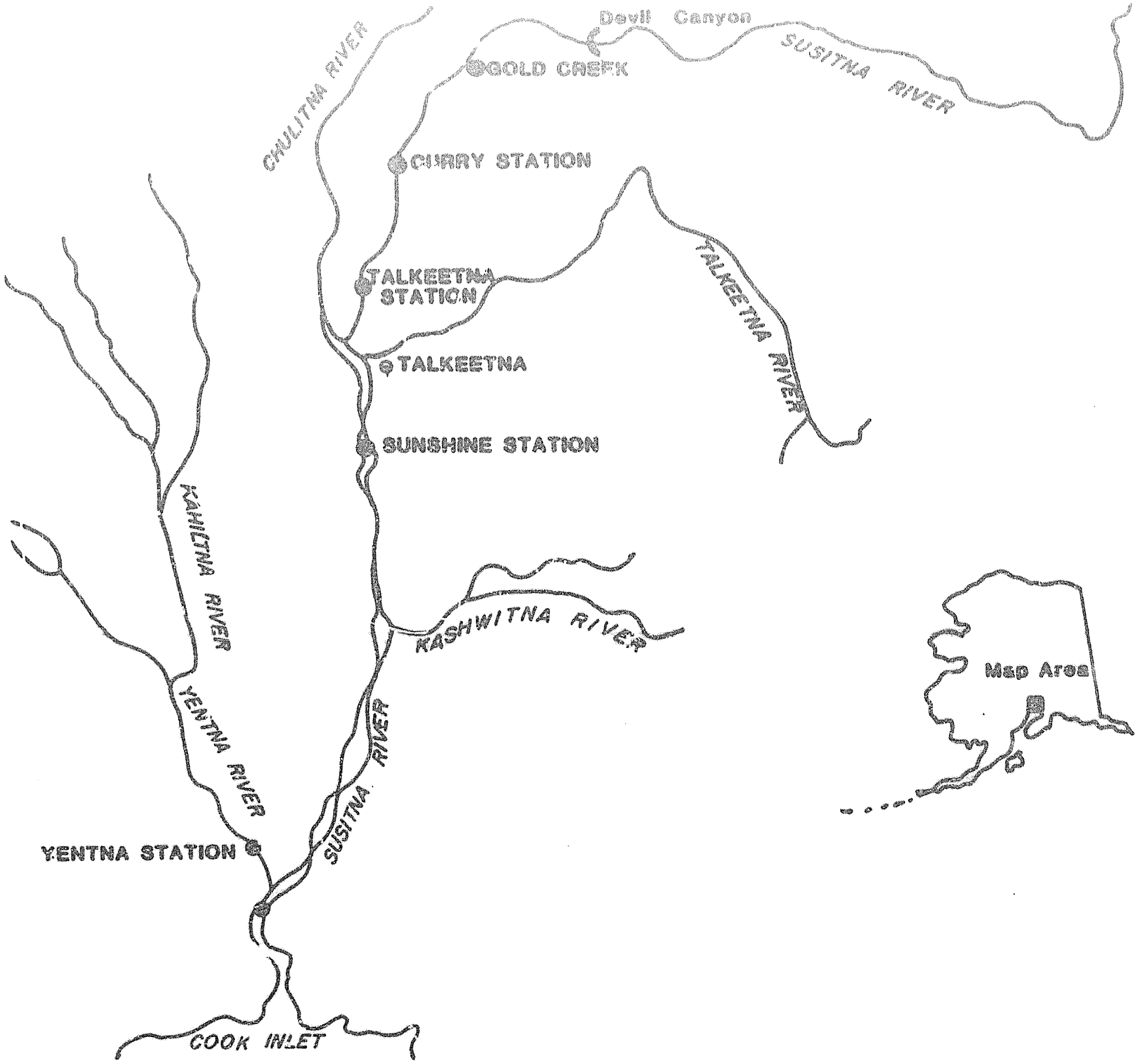


Figure 2-2-2. Susitna River basin map showing field stations and major glacial streams, Adult Anadromous Investigations, Su Hydro Studies, 1983.

Table 2-2-1. Operation schedules at main channel Susitna and Yentna River escapement monitoring stations, Adult Anadromous Investigations, Su Hydro Studies, 1983.

Sampling Site	Location		Period	
	River	River Mile	Begin	End
Yentna Station	Yentna	04	6/30	9/5
Sunshine Station	Susitna	80	6/3	9/11
Talkeetna Station	Susitna	103	6/7	9/12
Curry Station	Susitna	120	6/9	9/14

Two basic gear types were used to monitor Susitna and Yentna rivers salmon escapements. On the Yentna River (RM 28) at Yentna Station (TRM 04) two 1980 Model Bendix side scan sonar (SSS) counters were deployed in combination with two fishwheels. On the Susitna River at Sunshine (RM 80) and Talkeetna (RM 103) stations four fishwheels were operated at each of these sites. Further upstream on the Susitna River at Curry Station (RM 120) two fishwheels were used to intercept salmon escapements.

2.2.1.1 Sonar Operations

The two SSS counters, one off each bank, at Yentna Station (TRM 04) on the Yentna River (RM 28) were operated consistent with the 1980 Side Scan Sonar Counter Installation and Operation Manual by Bendix Corporation (1980). Counter accuracy was checked four or more times daily by hand tallying fish registered echos on a Model 323, Sony Oscilloscope. Counter adjustments were made when the percent agreement between hand tallied oscilloscope counts and SSS counts for a 30 or more minute period was less than 90 percent. Fish counts registered on each counter were apportioned by catch composite data from a nearby fishwheel operated on a scheduled 24 hour a day basis.

2.2.1.2 Fishwheel Operations

The fishwheels used at Yentna (TRM 04), Sunshine (RM 80), Talkeetna (RM 103) and Curry (RM 120) stations in 1983 were of a 1981 design by ADF&G/Su Hydro Adult Anadromous staff (Plate 2-2-4). Construction specifications,

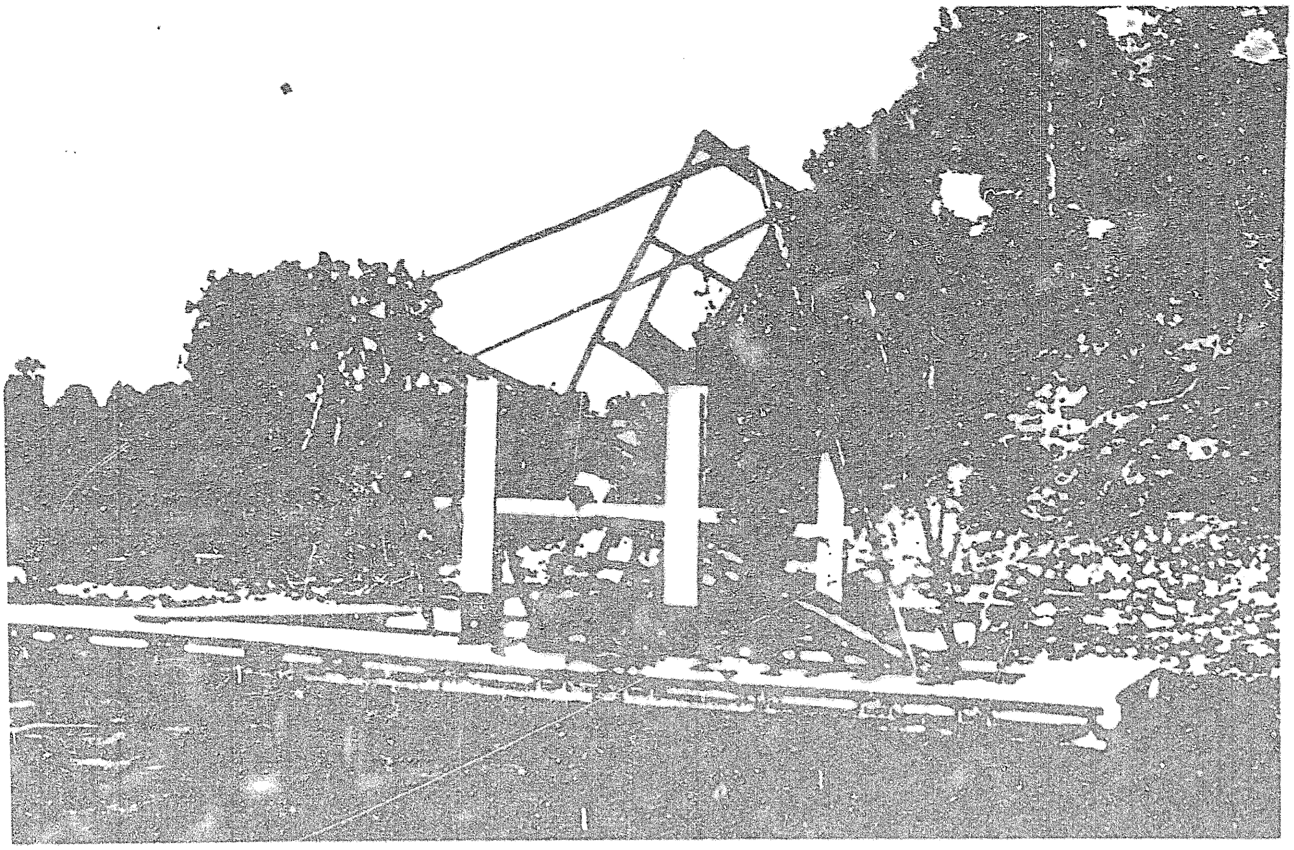


Plate 2-2-4. One of 12 fishwheels operated on the Yentna and Susitna rivers in 1983, Adult Anadromous Investigations, Su Hydro Studies, 1983.

maintenance and deployment procedures can be found in the 1981 Phase I, ADF&G/Su Hydro Adult Anadromous Report and 1982 and Phase II, ADF&G/Su Hydro Adult Anadromous Report (ADF&G, 1981 and 1982). All fishwheels used on the project were operated 24 hours a day except for occasional shut-downs for maintenance, debris and at Sunshine Station, excessive catches which could not always be processed because of safety and man-power limitations.

2.2.1.3 Tagging Operations

In 1983 all chinook ($\geq$ 351 mm length), sockeye, pink, chum and coho salmon caught in fishwheels at Sunshine (RM 80), Talkeetna (RM 103) and Curry (RM 120) stations were marked with color coded Petersen disc or Floy FT-4 spaghetti tags and released. (Plate 2-2-5 and 2-2-6). The Petersen disc tags were used for all chinook salmon and for the sockeye, pink, chum and coho salmon at Curry Station. At Sunshine and Talkeetna stations Floy FT-4 spaghetti tags were used for marking the sockeye, pink, chum, and coho salmon (Table 2-2-2). A percentage of the spaghetti and disc tags were numbered to provide data on travel time of species between stations. All recaptures made at upstream sampling locations were released following species identification and recording of tag type, color and number.

The methodology followed for applying the Petersen disc and Floy FT-4 spaghetti tags is covered in the Phase 1, ADF&G/Su Hydro Adult Anadromous Report, 1981 (ADF&G, 1981).

Table 2-2-2. Tag type and color code used at Sunshine, Talkeetna and Curry stations, Adult Anadromous Investigations, Su Hydro Studies, 1983.

Sampling Site	River Mile	Tag	
		Type	Color
Sunshine Station	80	FT-4/Spaghetti Petersen Disc	white and red pink
Talkeetna Station	103	FT-4/Spaghetti Petersen Disc	green blue
Curry Station	120	Petersen Disc	int. orange

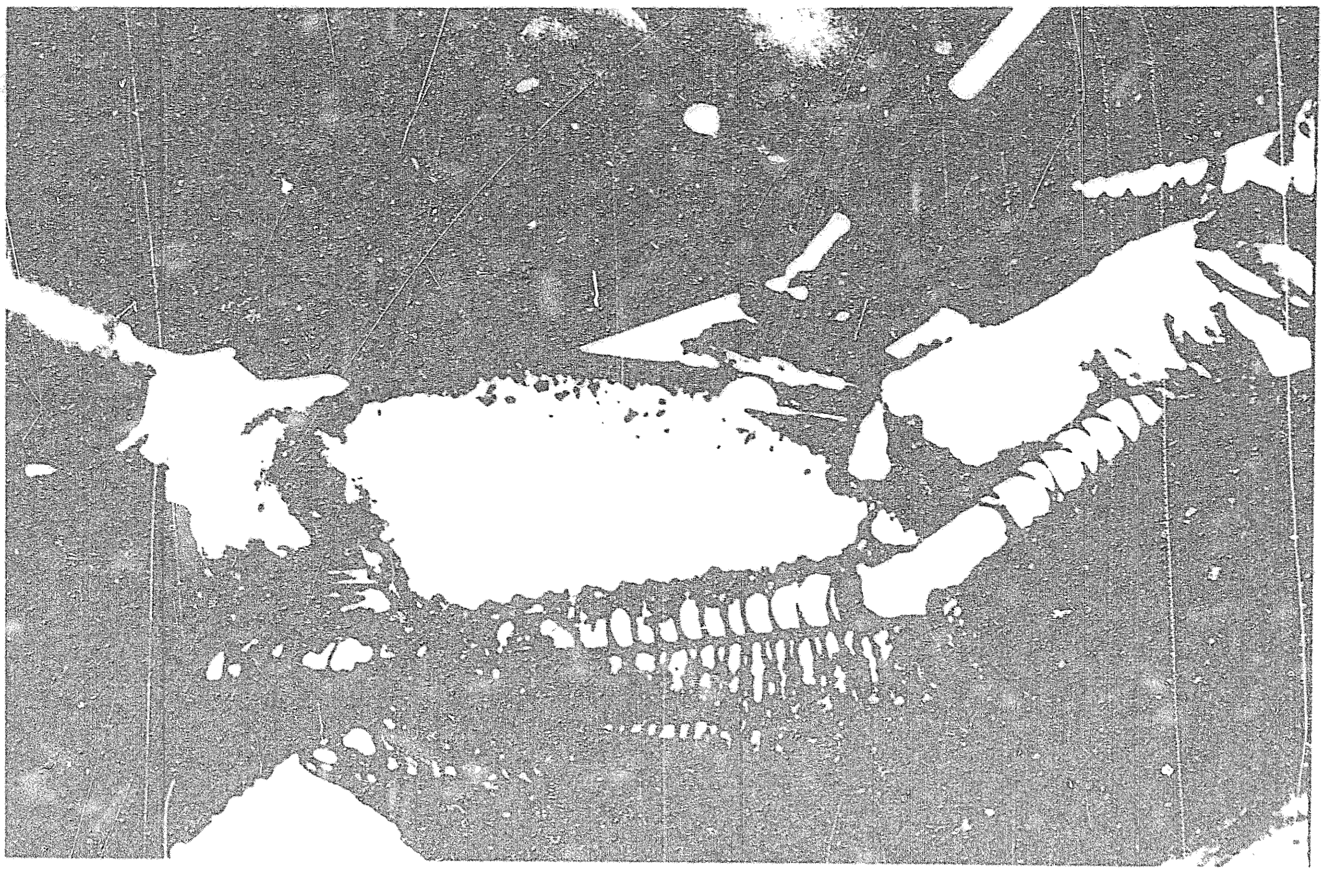


Plate 2-2-5. Chinook salmon being tagged with a Petersen disc tag, Adult Anadromous Investigations, Su Hydro Studies, 1983.

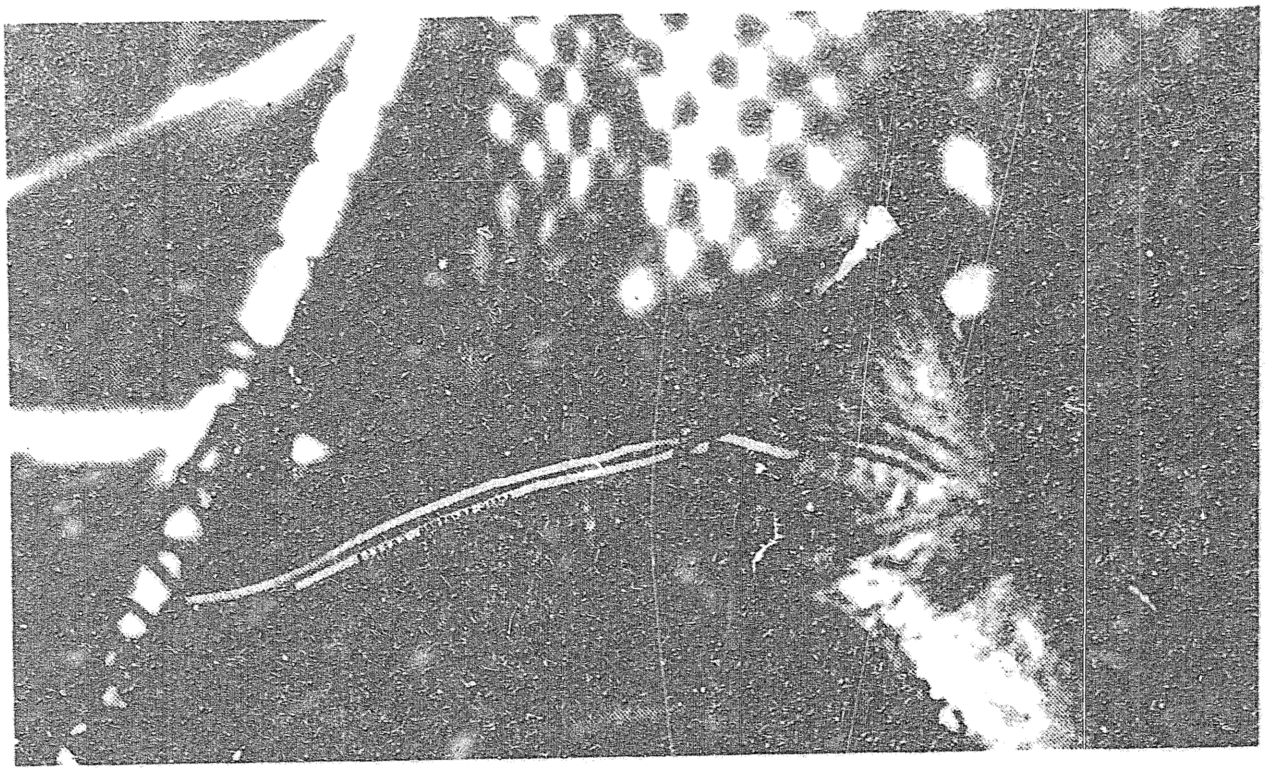


Plate 2-2-6. Chum salmon tagged with a Floy FT-4 spaghetti tag, Adult Anadromous Investigations, Su Hydro Studies, 1983.

2.2.1.4 Age, Length and Sex Composition Sampling

Sixty chinook, 30 sockeye, 20 chum and 20 coho salmon were sampled daily for age, length and sex from fishwheel catches in 1983 at Yentna (TRM 04), Sunshine (RM 80), Talkeetna (RM 103) and Curry (RM 120) stations. Thirty pink salmon were also sampled daily for length and sex data at these sites.

No age samples were obtained from pink salmon due to their generally recognized age of two years. Age sampling was accomplished by collecting the 'preferred scale' from each fish located two rows dorsal to the lateral line on a diagonal between the posterior insertion of the dorsal fin and the banterior insertion of the anal fin. All length measurements were taken from mid-eye to fork of tail to the nearest 10 mm on chinook salmon, and five mm on the other salmon species. Sex determinations were made from morphological examinations. The average time for composite age, length and sex sampling was about 25 seconds per fish. Each fish was released immediately following sampling.

2.2.1.5 Fecundity Sampling

In 1983, Susitna River sockeye, pink and chum salmon fecundities were determined from samples collected at Sunshine Station (RM 80). A total of 25 sockeye, 22 pink and 27 chum salmon were obtained between July 28 and 31 for use in the analysis. Samples were collected throughout population length ranges with emphasis placed on the 540-560 mm range for sockeye salmon and the 590-610 mm range for chum salmon. There was no emphasis placed on a specific length range when collecting pink salmon.

Prior to egg removal all salmon were measured to the nearest mm (FL) and weighed to the nearest gram (g). In addition, sockeye and chum salmon each had three scales removed from the preferred area and mounted on gum cards for later age determination.

The eggs were removed from the female salmon, bagged, placed in coolers and transported to Talkeetna for freezing. The counting process began by boiling the eggs of each sample for approximately five minutes Once the eggs had separated from each other the water was drained off and the eggs enumerated by means of a volumetric estimation method. Pink and chum salmon fecundities were derived by filling a 50 milliliter (ml) graduated cylinder to the 50 ml level with eggs and counting each egg in the graduated cylinder.

This process was repeated three times for each female. The mean number of eggs from the three sampling trials was multiplied by the number of times the 50 ml graduated cylinder was filled to the 50 ml level for each sample. Residual eggs for each sample (those left that did not fill a 50 ml volume) were individually counted and added to the total estimate obtained by the volumetric method. This can mathematically be represented by the following formula:

Total number of eggs in sample = A (Y) + r

where: A = Mean number of eggs in the three 50 ml volumetric sampling trials.

Y = Number of times the 50 ml graduated cylinder was filled for each sample.

r = Residual number of eggs from sample, individually counted.

Sockeye salmon egg diameters were smaller than pink and chum salmon and approximately one half of the total number of eggs filled a 50 ml volume.

Therefore, only one 50 ml sampling trial was performed. In all other respects the counting procedures used were identical to those of pink and chum salmon.

2.2.2 Spawning Ground and Tag Recovery Surveys

2.2.2.1 Sloughs and Streams

In 1983, all known and suspected chinook salmon spawning areas in the Susitna River drainage upstream of the Chulitna River confluence (RM 98.6) were twice surveyed between July 15 and August 9. The surveys were conducted by helicopter and where possible on foot. Each of the spawning areas were surveyed in its entirety except Chase Creek (RM 106.9) which was surveyed for the first mile.

Additional escapement surveys, non-specific to chinook salmon, were made near weekly between July 25 and October 11 of all probable salmon spawning streams and sloughs between RM 98.6 and 161.0 in 1983. The sloughs were surveyed in their entirety and streams to standard index areas on foot. The exceptions were Indian River (RM 138.6) and Portage Creek (RM 148.9) which were surveyed also by helicopter to their upper spawning limits, and Cheechako (RM 152.4), Chinook (RM 157.0) and Devil (RM 161.0) creeks located above Devil Canyon that were always surveyed by helicopter to their upper spawning limits.

Tag recovery surveys were also made in 1983. Crews surveyed selected spawning areas between RM 80 and 98.6 for live tagged and untagged fish. In addition tag recovery surveys were also conducted in conjunction with scheduled slough and stream escapement surveys above RM 98.6. The areas and schedule of tag recovering surveys conducted below RM 98.6 are presented in Table 2-2-3.

All spawning ground surveys including those conducted for tag recoveries were performed by trained observers outfitted with polaroid sunglasses and hand held tally counters.

Table 2-2-3. Location and schedule of tag recovery surveys of selected spawning areas between RM 84 and 98.6, Adult Anadromous Investigations, Su Hydro Studies, 1983.

Spawning Area	Location 1/	Period	Frequency
Answer Creek	84.1	9/15-28	Once
Question Creek	84.1	9/15-25	Once
Birch Creek	88.4	8/10-25	Once
(lower)		9/15-28	Once
Fish Creek	97.1	8/10-25	Twice
Clear Creek	97.1	7/20-8/7	Once
Prairie Creek	97.1	7/20-8/7	Once
Byers Creek	98.6	8/10-15	Once
Troublesome Creek	98.6	9/5-15	Once
Chulitna River	98.6	7/25-8/7	Once
Bunco Creek	98.6	7/25-8/7	Once

1/ Location designated by river mile for the confluence of the spawning area or the junction of its receiving waters with the Susitna River main channel. ?

Why [illegible]

2.2.2.1.1 Chinook Salmon Index Surveys

In 1983, index surveys of the chinook escapement were conducted in pre-selected spawning areas in the Susitna River drainage (ADF&G, 1981). The index surveys conducted above RM 98.6 were performed as defined in Section 2.2.1.5. The surveys in index areas downstream of RM 98.6 were conducted between July 13 and August 3 by ADF&G, Region II, Sport Fish Division staff with some assistance from ADF&G, Su Hydro personnel.

The chinook salmon index surveys in 1983 were performed by helicopter, foot and inflatable raft depending on accessibility. All observers conducting index surveys wore polaroid sunglasses and used hand held counters.

2.2.2.1.2 Observation Life Surveys

At Curry Station (RM 120) between July 6 and September 9, 1983 130 sockeye and 667 chum salmon were fishwheel caught then marked and released with large, individually numbered Petersen disc tags (Section 2.2.1.3). An additional 18 sockeye and 13 chum salmon were similarly marked and released off the mouths of Moose Slough (RM 123.5) and Slough 11 (RM 135.3) on August 11 and 14, 1983 respectively. These fish were captured using a standard beach seine (60 ft. long, 6 ft. deep, 1.5 in. stretch mesh).

In 1983, five slough habitats upstream of RM 120 were intensely surveyed for marked sockeye and chum salmon released from Curry Station (RM 120) and off the mouths of Moose Slough (RM 123.5) and Slough 11 (RM 123.5). The study sloughs were Moose (RM 123.5), A' (RM 124.6), 8A (RM 125.1), 9 (RM 128.3) and 11 (RM 135.3). The surveys were performed between August 11 and October 12 at minimum four day intervals. Ongoing with this work, enumeration surveys of live and dead salmon by species were conducted between July 26 and October 8 in these and other known sloughs between RM 98.6 and 161.0 at seven day intervals (Section 2.2.2).

Identification of individually tagged sockeye and chum salmon in the five study sloughs was accomplished on foot and through occasional use of a powered riverboat. The observers were outfitted with polarized sunglasses and polarized 7X35 Bushnell binoculars to improve observation. A record was kept of each tagged fish siting. Information recorded included the date of observation, fish tag number, species, sex, behavior and location within the habitat. There were two categories of fish behavior recorded for live tagged fish. These were: either a fish was milling (ripening) or it was spawning. Milling activity was assessed by a judgemental observation of there being no 'significant' caudal fin erosion, and spawning activity by the fish bearing 'significant' caudal fin erosion or observed spawning. Within slough locations fish sitings were recorded by habitat zone. These zones were standardized reaches between major riffles areas as depicted in Appendix Figures 2-G-2 thru 2-G-5. Due to an absence of major riffle groups in Slough A' (RM 124.6), no record was made of individual fish locations in this slough.

2.2.2.1.3 Egg Retention Sampling

In 1983 sockeye and chum salmon female carcasses were checked for egg retention in several slough and main channel spawning habitats between RM 98.6 and 161.0. There was no pre-defined minimum or maximum number of female sockeye or chum salmon sampled in this study. Sampling intensity was based on the availability of fish wherein whenever an escapement survey crew encountered an intact dead female sockeye or chum salmon the abdomen was incisioned and the eggs hand tallied and recorded.

2.3 Bering Cisco

In 1983, the Bering Cisco escapement into the Susitna River was not specifically sampled. However, a record was kept of the date and location of each catch made in association with other scheduled sampling operations.

2.4 Data Analysis and Evaluation

2.4.1 Eulachon

An analysis was conducted using the students T test (Dixon and Massey, 1969) and the Mann-Whitney median test (Daniel, 1978) to test a null hypothesis that lengths of first and second run eulachon were not significantly different at the 95 percent confidence levels.

2.4.2 Salmon Tag and Recapture Escapement Estimates

Adult salmon escapements to Sunshine (RM 80), Talkeetna (RM 103) and Curry (RM 120) stations were calculated using tag and recapture population estimation techniques with the exception of chinook salmon less than 351 mm in length which were considered separately. Escapements were derived according to the following formula (Ricker, 1975):

$$\hat{N} = (m+1)\ (c+1)/(r+1)$$

where:

m = Number of fish successfully marked = (number originally tagged) $\cdot$ (tag retention (R) factor)

c = Total number of fish examined for marks (tags) during sampling census

r = Total number of marked (tagged) fish observed during sampling census

$\hat{N}$ = Population estimate

The 95 percent confidence limits around N were determined by using the following formula (Dixon and Massey, 1969):

$$r/c + 1.96 \sqrt{\frac{r/c\ (1-r/c)}{c}} < r/c < r/c - 1.96 \sqrt{\frac{r/c\ (1-r/c)}{c}} = .95$$

$$\text{and;} \qquad r/c_{\text{upper}}\ (1/m) < 1/N < r/c_{\text{lower}}\ (1/m)$$

Tag losses for all adult salmon species except chinook salmon were estimated for each station from data collected during repetitive surveys of spawning areas. Data used for this determination were restricted to those surveys in which visibility conditions allowed positive identification of shed tags, tag scarred fish (where applicable) and live tagged fish (Appendix Table 2-G-2). Tag retention by tag type and tagging location was calculated in the following manner:

$$R = \frac{T}{S + T}$$

where:

T = Number of live tagged fish observed by tag type and tagging station.

S = Number of shed tags by tag type and tagging station and or when applicable number of tagged scarred fish.

R = Tag retention factor

Chinook salmon tag losses were calculated in essentially the same manner with the exception that tag loss information from fishwheel recaptures were included in the analysis. Survey and fishwheel tag retention factors were calculated, weighted by sample size and reported as the overall tag retention factor for chinook salmon (Appendix Table 2-G-1).

The formula used to estimate the number of chinook salmon length (FL) 350 mm and less migrating to Sunshine, Talkeetna and Curry stations was:

$$J = \frac{\hat{N}b}{e}$$

where:

$\hat{N}$ = Population estimate for fish larger than 350 mm length (FL).

b = number of fish intercepted at tagging location length (FL) 350 mm and less.

e = number of fish intercepted at tagging location larger than 350 mm length (FL).

J = Population estimate of fish length (FL) 350 mm and less.

2.4.3 Calculation of Main Channel Escapement Timing

Escapement timing by species was determined for each of the main channel stations through interpretation of fishwheel catch rate data wherein the migration was defined to have 'started', 'reached a midpoint' and 'ended' on the date when 5.0 percent, 50.0 percent and 95.0 percent respectively of the cumulative daily mean hourly fishwheel catch was attained at the respective station.

2.4.4 Age Determination

Adult salmon age determination was accomplished by standard scale analysis techniques using a portable microfiche reader (Clutter and Whitesel, 1956). Age classes are described using Gilbert-Rich notation. By this notation ages are presented in X_{i+1} format where X is the total age of the fish and the subscript i+1, the number of freshwater annuli plus one. The addition of one to the freshwater age accounts for the year spent in freshwater prior to the formation of the first annulus. For example, age 5_2 fish are those fish which return to spawn in their fifth year of life having migrated or smolted from freshwater to the marine environment in their second year of life after having spent one winter (plus one winter in which no annulus was formed) rearing in freshwater.

Total age for adult salmon, as reported in this text, represents only the age at which the fish returned to spawn regardless of their freshwater life histories.

Eulachon ages were determined from otoliths and are not reported in Gilbert-Rich notation but instead aged as to the total number of annuli observed. For example, eulachon reported to be age 3 would actually be in its fourth year of life.

Is there a reference for this methodology?

2.4.5 Slough Escapement

Individual slough escapements of sockeye and chum salmon were calculated using 1983 observation life data and slough survey counts. Slough survey counts were plotted against date and areas beneath the curves were expressed in terms of fish-days. Areas were determined using a Numonic DigiTablet digitizer. The total number of fish-days per slough was divided by the mean observation life to estimate total slough escapement. For 1983 data individual observation life values were used in calculating total escapement for study sloughs and all other 1983, 1982 and 1981 total slough escapements were calculated using the 1983 composite mean observation life values. There were two exceptions to this method: 1) when peak slough survey counts were less than 15 fish and 2) when spawning fish were counted on only one survey. Total slough escapements in these cases were calculated by adjusting the peak live and dead survey count. The adjustment was made as follows:

Trade name?

How?

$$x = \frac{A}{B} (T)$$

where: x = estimated slough escapement

A = estimated total escapement of sloughs with peak surveys greater than 50 fish

B = peak live and dead survey counts in sloughs where counts totalled greater than 50 fish

T = slough surveys where peak live and dead counts were less than 15 fish or when fish were counted on one survey only.

Slough escapement estimates for pink salmon were made by adjusting peak live and dead survey counts. Peak surveys for a species with short spawning duration, as exhibited by pink salmon, may account for 80 to 90 percent of the spawning population (Cousens et al., 1982). Less than ideal survey conditions made it appropriate to use the lower value for adjustment and all peak surveys were increased by a factor of 1.2 to estimate total slough escapement.

3.0 RESULTS AND DISCUSSION

3.1 Eulachon

3.1.1 Intertidal

In 1983, eulachon entered the intertidal reach of the Susitna River in two distinct migrations. The first migration began on or about May 10, peaked on May 14 and ended on May 17 determined by set net and dip net catches (Tables 2-3-1 and 2-3-2). The second eulachon migration began on May 19, peaked on May 23 and ended on June 6, approximately.

The first migration of eulachon in 1983 was considerably smaller in magnitude than the second migration. The highest daily set net catch of inmigrant (pre-spawning and spawning condition) eulachon in the first migration was 3.7 per net minute fished (CPUE) recorded on May 13 while in the second migration, there were three days where daily set net catches were higher with CPUE's recorded of 11.3, 13.0 and 3.8 on May 21, 23 and 26, respectively (Plate 2-3-1). The highest dip net catches of inmigrants (pre-spawners) made during the first migration were 2.2 and 1.7 eulachon per dip net (CPUE) recorded on May 13 and 14, respectively. During the second migration the highest dip net catches of pre-spawners were 41.7 CPUE and 49.0 CPUE on May 21 and 23, respectively. An estimated 7 to 72 (That's quite a range) times more eulachon entered the Susitna River in the second migration than in the first migration based on an interpretation of set net and dip net CPUE values (Tables 2-3-1 and 2-3-2).

In 1983, spawning and post-spawning eulachon were intercepted by dip net in the intertidal zone (Table 2-3-2). Catches of spawners were principally made

Table 2-3-1. Eulachon set net catches in Susitna River intertidal, Adult Anadromous Investigations, Su Hydro Studies, 1983.

	Tide 1/		Location		Fishing Time			Eulachon Catch 5/			
					Net		Total	In-	Out-	Total	CPUE
Date	Ht.	Time 2/	Site # 3/	RM 4/	In	Out	Min.	Migrants	Migrants		6/
5/10/83	27.8	1722	#3	2.3	1647	1710	23	2	0	2	0.2
5/10/83	27.8	1722	#2	4.5	1737	1807	30	7	0	7	
5/11/83	29.8	0532	#3	2.3	0512	0530	18	4	0	4	0.5
5/11/83	29.8	0532	#2	4.5	0547	0617	30	21	0	21	
5/11/83	28.8	1802	#3	2.3	1720	1750	30	8	0	8	0.5
5/11/83	28.8	1802	#2	4.5	1817	1847	30	19	0	19	
5/12/83	30.7	0604	#3	2.3	0619	0649	30	7	0	7	0.7
5/12/83	30.7	0604	#2	4.5	0720	0750	30	32	0	32	
5/12/83	29.5	1844	#3	2.3	1759	1829	30	11	0	11	1.2
5/12/83	29.5	1844	#2	4.5	1859	1929	30	58	0	58	
5/13/83	31.4	0636	#3	2.3	0551	0621	30	86	0	86	2.5
5/13/83	31.4	0636	#2	4.5	0651	0721	30	61	0	61	
5/13/83	29.7	1926	#3	2.3	1845	1915	30	66	0	66	3.7
5/13/83	29.7	1926	#2	4.5	1941	2011	30	157	0	157	
5/14/83	31.7	0711	#3	2.3	0631	0701	30	28	0	28	3.3
5/14/83	31.7	0711	#2	4.5	0726	0756	30	171	0	171	
5/14/83	29.6	2009	#3	2.3	1924	1954	30	96	0	96	2.8
5/14/83	29.6	2009	#2	4.5	2024	2054	30	69	0	69	
5/15/83	31.5	0749	#3	2.3	0704	0734	30	27	0	27	1.6
5/15/83	31.5	0749	#2	4.5	0804	0834	30	70	0	70	
5/15/83	29.2	2055	#3	2.3	2010	2041	31	10	0	10	1.4
5/15/83	29.2	2055	#2	4.5	2110	2140	30	75	0	75	

Table 2-3-1. Continued.

Date	Tide 1/		Location		Fishing Time			Eulachon Catch 5/			CPUE 6/
					Net		Total	In-	Out-	Total	
	Ht.	Time 2/	Site # 3/	RM 4/	In	Out	Min.	Migrants	Migrants		
5/16/83	30.7	0832	#3	2.3	0750	0820	30	1	0	1	1.3
5/16/83	30.7	0832	#2	4.5	0847	0917	30	78	1	79	
5/17/83	29.5	0922	#3	2.3	0837	0907	30	4	1	5	0.8
5/17/83	29.5	0922	#2	4.5	0937	1007	30	44	8	52	
5/19/83	26.6	1129	#3	2.3	1044	1114	30	10	0	10	0.7
5/19/83	26.6	1129	#2	4.5	1144	1214	30	29	2	31	
5/21/83	26.5	1420	#3	2.3	1335	1405	30	260	0	260	11.3
5/21/83	26.5	1420	#2	4.5	1435	1445	10	190	0	190	
5/23/83	28.5	1634	#3	2.3	1549	1604	15	140	0	140	13.0
5/23/83	28.5	1634	#2	4.5	1649	1702	13	225	0	225	
5/26/83	30.4	0604	#3	2.3	0521	0551	30	113	54	167	3.8
5/26/83	30.4	0604	#2	4.5	0619	0649	30	115	56	171	
5/28/83	29.0	2008	#3	2.3	1923	1953	30	94	87	181	2.6
5/28/83	29.0	2008	#2	4.5	2023	2053	30	61	78	139	
5/31/83	26.6	0844	#3	2.3	0759	0829	30	7	7	14	2.4
5/31/83	26.6	0844	#2	4.5	0859	0929	30	135	70	205	
6/03/83	22.5	1121	#3	2.3	1036	1106	30	0	0	0	1.3
6/03/83	22.5	1121	#2	4.5	1136	1206	30	77	38	115	

Table 2-3-1. Continued.

Date	Tide 1/ Ht.	Tide 1/ Time 2/	Location Site # 3/	Location RM 4/	Fishing Time Net In	Fishing Time Net Out	Fishing Time Total Min.	Eulachon Catch 5/ In-Migrants	Eulachon Catch 5/ Out-Migrants	Eulachon Catch 5/ Total	CPUE 6/
6/05/83	22.6	1356	#3	2.3	1311	1341	30	0	1	1	0.3
6/05/83	22.6	1356	#2	4.5	1411	1441	30	15	6	21	
6/06/83	23.8	1509	#3	2.3	1424	1454	30	0	0	0	0.1
6/06/83	23.8	1509	#2	4.5	1524	1554	30	6	53	59	
6/07/83	25.3	1608	#3	2.3	1523	1553	30	0	1	1	0.0
6/07/83	25.3	1608	#2	4.5	1623	1653	30	0	15	15	
6/08/83	26.7	1658	#3	2.3	1613	1643	30	0	0	0	0.0
6/08/83	26.7	1658	#2	4.5	1713	1743	30	0	0	0	

1/ High Tide In Feet
2/ Military Time
3/ Site #3: (T14N R7W Section 17 AAC)
Site #2: (T14N R7W Section 5 AAC)
4/ River Mile
5/ Eulachon catch divided into in-migrants and out-migrants wherein in-migrants include both pre-spawners and spawners, and out-migrants represent post-spawners
6/ CPUE = Mean Number of In-Migrants/Net Minute

Table 2-3-2. Dip net catches of eulachon in the Susitna River intertidal at river mile 4.5 with corresponding water temperatures, Adult Anadromous Investigations, Su Hydro Studies, 1983.

	Eulachon Catch							CPUE 2/			Water
	Males			Females							Temperature
Date	Pre-	Spawning	Post-	Pre-	Spawning	Post-	Fishing Effort 1/	Pre-	Spawning	Post-	(°C)
5/10	0	0	0	2	0	0	80	0.0	0.0	0.0	4.8
5/11	3	0	0	1	0	0	70	0.1	0.0	0.0	3.5
5/11	7	0	0	2	0	0	50	0.2	0.0	0.0	4.5
5/12	39	6	0	12	0	0	64	0.8	0.1	0.0	5.2
5/12	19	2	0	5	0	0	35	0.7	0.1	0.0	5.4
5/13	63	4	0	31	2	0	43	2.2	0.1	0.0	5.5
5/14	39	14	0	45	2	0	49	1.7	0.3	0.0	6.0
5/15	2	1	0	0	0	0	64	0.0	0.0	0.0	5.8
5/15	11	0	0	3	0	0	186	0.1	0.0	0.0	6.8
5/16	10	3	0	4	0	0	100	0.1	0.0	0.0	6.0
5/17	10	1	4	5	1	0	230	0.1	0.0	0.0	5.8
5/19	12	24	10	22	0	0	125	0.3	0.2	0.1	7.6
5/21	39	9	0	86	0	0	3	41.7	3.0	0.0	9.2
5/23	37	13	0	61	0	0	2	49.0	6.5	0.0	8.3
5/26	58	203	96	10	13	16	78	0.9	2.8	1.4	9.0
5/28	5	156	203	0	1	13	30	0.2	5.2	7.2	9.2
5/31	0	173	130	0	9	3	55	0.0	3.3	2.4	10.0
6/3	0	17	18	1	0	1	100	0.0	0.2	0.2	--
6/5	0	1	0	0	0	1	80	0.0	0.0	0.0	8.2
6/6	0	0	6	0	0	50	75	0.0	0.0	0.8	12.2
6/7	0	0	2	0	0	28	100	0.0	0.0	0.3	12.8
6/8	0	0	0	0	0	4	75	0.0	0.0	0.1	13.4

1/ Number of dip net sub-samples.

2/ Catch per unit effort for pre-, spawning and post- spawning eulachon.

in the two periods from May 13 to 14 (first migration) and May 26 to 31 (second migration). Post-spawning eulachon catches were made from May 17 to 19 (first migration), and from May 26 to June 8 (second migration). The largest post-spawning eulachon catches were recorded from May 26 to 31 at an average of 2.0 CPUE in the set nets and 4.2 CPUE in the dip nets (Table 2-3-1).

Plate 2-3-1. Eulachon set net catch at RM 4.5 on May 23, 1983, Adult Anadromous Investigations, Su Hydro Studies, 1983.

Sex composition data (not weighted by CPUE) collected from dip net caught eulachon at RM 4.5 indicate pre-spawning males in 1983 were more numerous than females in the first migration (May 10-17) and pre-spawning females were more numerous than males in the second migration (May 19 - June 8). The respective male to female ratios were 1.8:1 and 0.8:1 (Table 2-3-3). Comparatively, among spawning condition eulachon the male to female ratios were 6.2:1 in the first migration and 25.9:1 in the second migration. The increase of males to females in spawning condition indicate that individual male eulachon ripen earlier and spawn over a longer period than their female counterparts. A probable advantage of male eulachon having a longer spawning life than female eulachon would be that the eggs released by a female would have a higher chance of being fertilized by available males due to the longer time individual males are in spawning condition compared to females.

Table 2-3-3. Summarization of sex composition samples (not weighted by CPUE) from eulachon dip net catches at RM 4.5 in 1983, Adult Anadromous Investigations, Su Hydro Studies, 1983.

Development Stage	First Migration 1/ Sample Size Males	Females	M:F Ratio	Second Migration 2/ Sample Size Males	Females	M:F Ratio
Pre-Spawners	203	110	1.8:1	151	180	0.8:1
Spawners	31	5	6.2:1	596	23	25.9:1
Post-Spawners	4	0	-	465	116	4.0:1

1/ First migration samples collected from 5/10-5/17 for pre-spawners, 5/10-5/22 for spawners and 5/10-5/23 for post-spawners.

2/ Second migration samples collected from 5/18-6/6 for pre-spawners, 5/23-6/6 for spawners and 5/24-6/6 for post-spawners.

Age composition samples collected in 1983 from pre-spawning condition eulachon (weighted by set net CPUE data) indicate the first migration was comprised of two, three and four year old fish (Table 2-3-4 and Figure 2-3-1). Most of the first migration fish were three year olds which accounted for 92.6 percent of the males and 97.2 per cent of the females sampled. The same age groups were represented in the second migration of eulachon as in the first. The three year olds again were the most numerous representing 92.3 percent of the males and 92.1 percent of the females sampled.

The 1983 results of length (TL) and weight composition sampling of dip net caught pre-spawning condition eulachon are presented in Table 2-3-4. The results, weighted by CPUE set net data of inmigrants, indicate three year old fish averaged 212 mm among the males and 203 mm among the females in the first migration, and 207 mm and 201 mm respectively in the second migration. The average weights of three year old males and females were 69.1 g and 60.2 g respectively in the first migration and 67.1 g and 59.7 g in the second migration. The same size difference pattern was evident among the two and four year old fish of the first migration wherein they were generally larger in length and weight than corresponding age fish in the second migration. Students T and Mann-Whitney tests established that there was no significant differences in lengths at the 90 percent confidence level among the first and second migration female eulachon sampled. For the age three male eulachon, both tests established at the 99 percent confidence level significant differances in lengths wherein the males were larger in the first migration than the males in the second migration.

Table 2-3-4. Length and weight of pre-spawning condition first and second migration eulachon segregated by age and sex from dip net samples in the Susitna River intertidal, Adult Anadromous investigations, Su Hydro Studies, 1983.

			Length (mm)					Weight (g)				
Age	Sex	Migration	Sample Size	Range Limits	Mean	95% Conf. Interval	Median	Sample Size	Range Limits	Mean	95% Conf. Interval	Median
2	M	1st	2	191-216	203	---	202	2	50.6-68.8	59.1	---	58.6
3	M	1st	50	186-229	212	210-215	213	50	45.1-86.0	69.1	66.9-71.2	69.3
4	M	1st	2	200-222	211	---	211	2	59.4-78.7	69.1	---	69.1
2	F	1st	1	195-195	195	---	195	1	54.3-54.3	54.3	---	54.3
3	F	1st	35	180-222	203	199-206	204	35	45.1-74.8	60.2	57.4-63.1	60.3
2	M	2nd	1	182-182	182	---	182	1	44.2-44.2	44.2	---	44.2
3	M	2nd	36	187-228	207	204-210	207	36	44.3-82.8	67.4	64.7-69.4	67.6
4	M	2nd	2	219-231	220	---	219	2	89.4-93.5	89.6	---	89.5
2	F	2nd	2	174-193	191	---	192	2	43.4-48.0	47.3	---	47.6
3	F	2nd	35	186-218	201	198-203	199	35	48.8-71.3	59.7	57.5-62.0	59.6
4	F	2nd	1	203-203	203	---	203	1	60.6-60.6	60.6	---	60.6
All 1/	All	All	202	179-231	205	204-206	204	202	43.4-93.5	64.2	63.0-65.4	63.6

1/ Composite of all aged and non-aged eulachon.

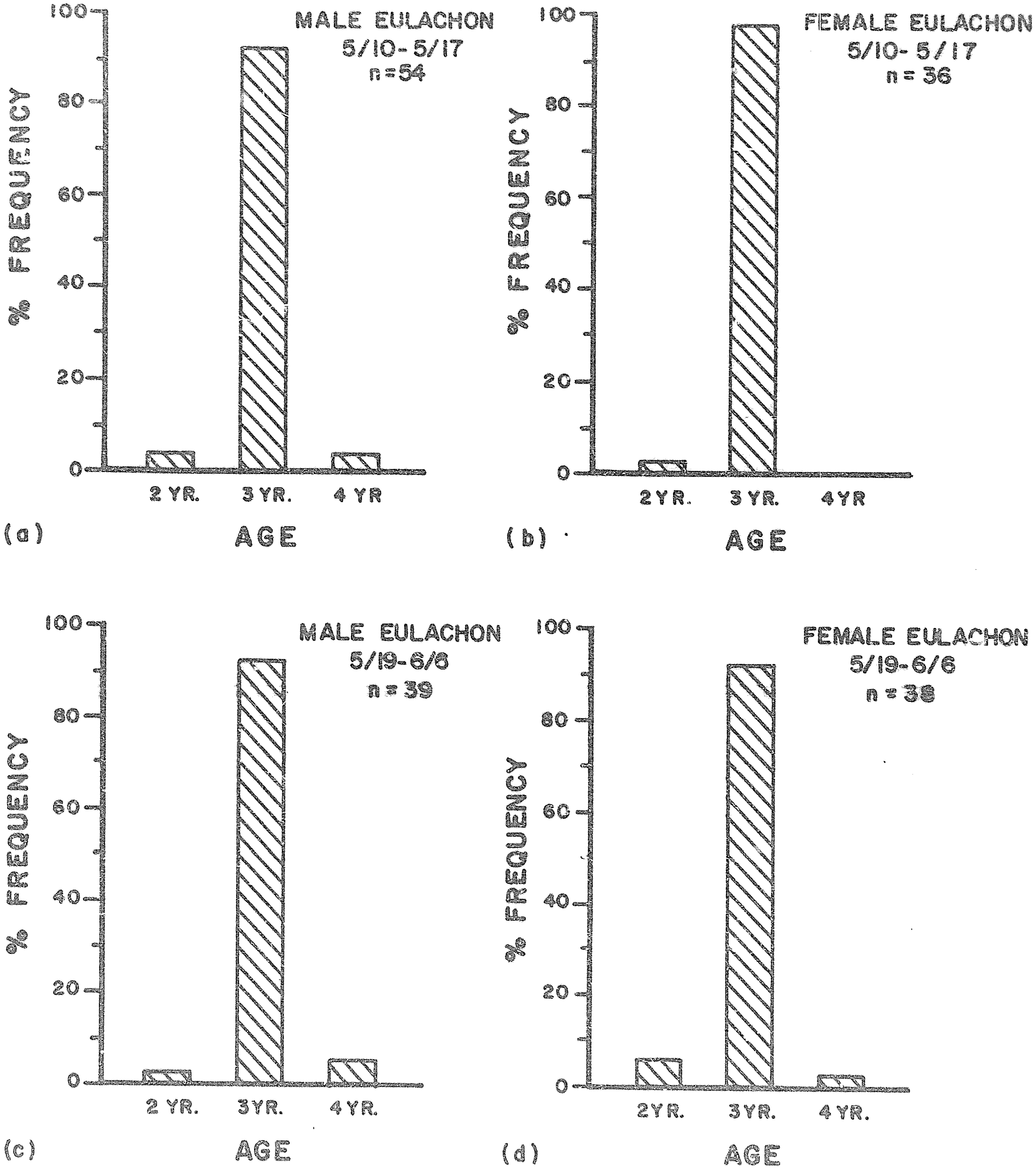


Figure 2-3-1. Age composition by sex of first (a-b) and second (c-d) migrant pre-spawning condition eulachon collected from the Susitna River intertidal, Adult Anadromous Investigations, Su Hydro Studies, 1983.

A comparison of 1983 Cook Inlet tidal heights and Susitna River water temperatures and eulachon inmigrant catches is provided in Figure 2-3-2. The inmigrant (pre-spawning and spawning condition) eulachon set net catches occurred in the Susitna River at high tides ranging from 27.8 to 31.7 feet and water temperatures between 4.5 and 7.5°C. The first eulachon migration peak catch was made on May 13 at a high tide of 29.7 feet and water temperature at 6.6°C. Comparatively the second migration catches of inmigrants occurred at high tides ranging from 22.1 to 30.5 feet with water temperatures ranging from 6.0 to 10.5°C (Figure 2-3-2). When set net catches peaked on May 23 the high tide was 28.5 feet and the water temperature 8.3°C (Figure 2-3-2).

A comparison of 1983 Susitna River water temperatures and Cook Inlet high tide heights with intertidal set net catches of inmigrant eulachon shows no apparent correlation (Figure 2-3-2). The onset of the eulachon migration into the Susitna River may, however, be influenced by water temperature. In the Stikine River (Alaska) the eulachon migration begins with ice breakup at temperatures below 4°C (Franzel and Nelson, 1981). In 1983, the lower (RM 0-10) Susitna River was substantially free of ice after May 8. On May 10 eulachon were just beginning to enter the Susitna River and the water temperature was 4.8°C (at RM 4.5) which would indicate a generally similar situation as reported for eulachon in the Stikine River with an exception that slightly warmer water temperatures were recorded at the onset of the migration in the Susitna River.

On the Columbia River (Washington), Smith and Scalfeld (1955) found the eulachon migration and availability to be correlated with temperatures around

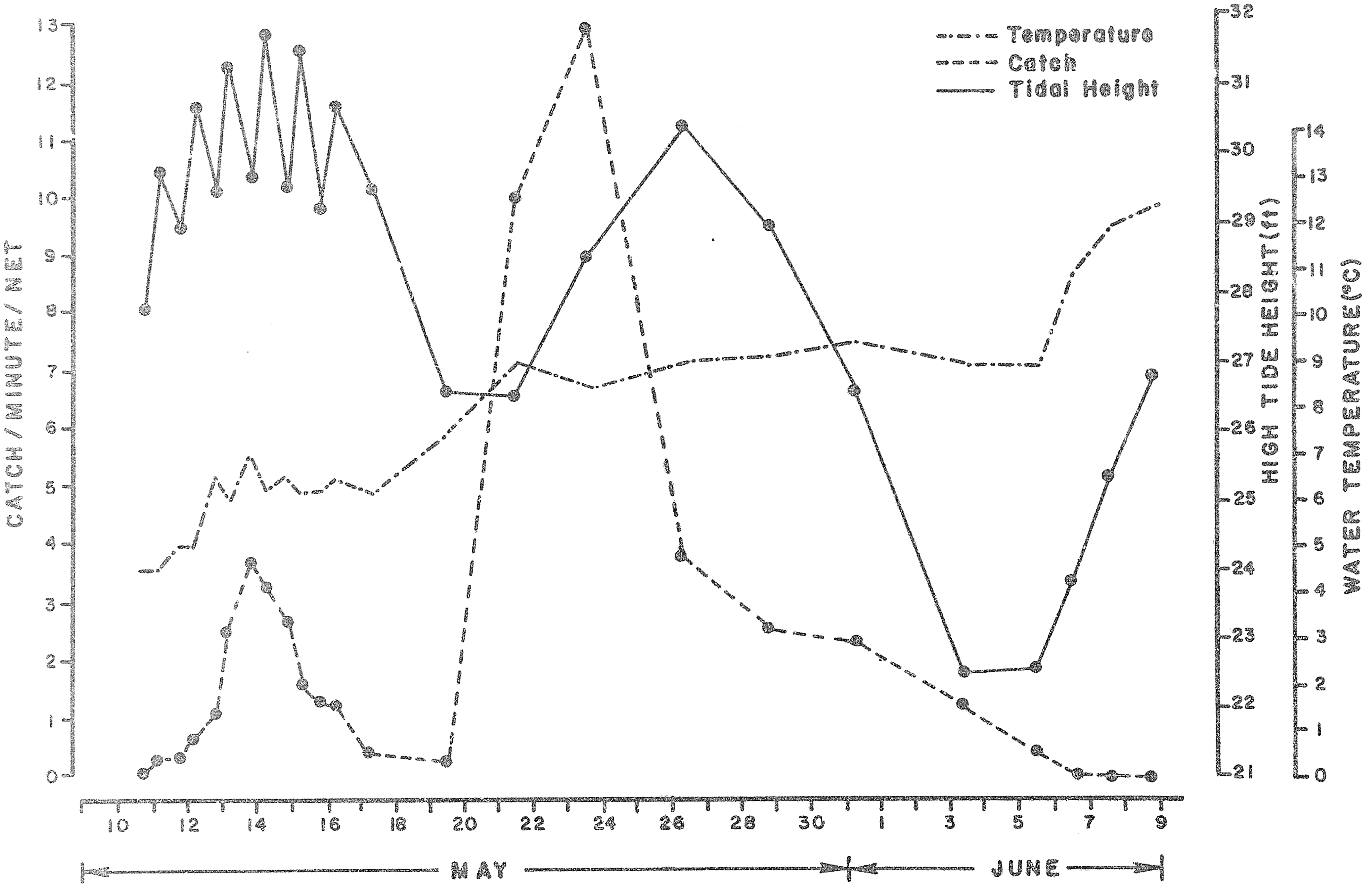


Figure 2-3-2. Eulachon set net catches at RM 4.5 with associated water temperatures and high tide heights, Adult Anadromous Investigations, Su Hydro Studies, 1983.

7 to 8°C. In the Susitna River intertidal reach in 1983 approximately 50 percent of the set net catches of first migration inmigrant eulachon were made between May 13 and 14 with water temperatures ranging between 6.0 and 7.5°C. During the second migration approximately 50 percent of the catches were made between May 21 and 23, 1983 at water temperatures between 8.0 and 9.0°C. It can be generally concluded that the major movement of eulachon into the Susitna River occurs following ice-out between water temperatures of 6.0 and 9.0°C.

3.1.2 Main Channel

The results of sampling the Susitna River main channel (RM 4.5 - 60.0) in 1983 for eulachon presence, spawning habitat and sex composition are presented in Table 2-3-5.

The first migration of eulachon which passed through the intertidal reach between May 10 and 17, 1983 initiated spawning in the Susitna River main channel on or about May 15 and concluded spawning on May 22, approximately (Table 2-3-5). The second migration, which was intercepted in the intertidal reach from May 19 to June 6, began spawning in the Susitna River main channel on or about May 23. Spawning was essentially over among second migration fish by June 5.

In 1983 the upper spawning limit of first migration eulachon in the Susitna River main channel was approximately RM 28.5 and among fish of the second migration, RM 50.5 (Table 2-3-5). The largest concentrations of eulachon in both migrations were found downstream of RM 28.0 (Yentna River confluence).

Table 2-3-5. Eulachon spawning areas in Susitna River main channel, Adult Anadromous Investigations, Su Hydro Studies, 1983.

Date	Spawning Location		Water 2/			Substrate	Eulachon Catch 3/						General
							Male			Female			Habitat
	RM 1/	Geographic Code	Temp.	Depth	Velocity	Type	Pre-	Sp.	Post-	Pre-	Sp.	Post-	Notes
5/15	12.5	S15N07W11ACD	-	130	1.0	100% silty sand	10	4	2	7	1	1	cutbank
5/15	13.8	S15N07W02ADA	6.4	140	1.5	100% silty sand	24	48	18	18	5	4	
5/17	23.0	S17N07W33BBB	5.8	170	2.0	75% gravel 25% sand	4	11	2	7	1	0	
5/20	9.8	S15N07W10DDB	7.4	100	1.5	100% silty sand	22	10	2	10	2	0	
5/20	12.5	S15N07W11ACD	7.4	130	1.0	100% silty sand	18	33	1	10	6	0	cutbank
5/20	18.2	S16N07W22AAD	-	100	1.0	90% sand 10% gravel	14	13	8	3	3	0	
5/21	15.0	S16N07W35BCD	8.1	130	1.5	60% sand 40% gravel	54	64	0	22	7	0	
5/21	25.5	S17N07W22ACA	-	120	2.0	100% silty sand	17	13	3	5	2	0	cutbank
5/22	25.5	S17N07W22ACA	7.8	120	2.0	100% silty sand	16	14	0	17	2	0	cutbank
5/22	27.1	S17N07W23BAD	7.8	130	1.5	100% silty sand	38	3	1	18	2	0	cutbank
5/22	27.3	S17N07W13DCD	7.6	110	1.0	100% silty sand	11	21	2	5	3	0	cutbank
5/22	27.7	S17N07W13DCA	7.6	150	-	100% silty sand	21	47	0	30	2	0	back eddy; cutbank
5/23	9.0	S15N07W15ADA	8.0	110	1.0	100% silty sand	6	15	0	26	5	0	
5/23	9.7	S15N07W10CDA	7.6	100	0.5	100% sand and gravel mix	10	14	0	38	5	0	cutbank
5/23	21.4	S16N07W09CCD	8.4	160	1.0	100% silty sand	26	14	0	25	2	0	beach
5/23	22.1	S16N07W09ACB	8.6	-	-	-	16	10	0	34	1	3	
5/23	23.0	S17N07W33BBB	7.8	170	2.0	75% gravel 25% sand	28	21	0	43	5	0	
5/24	12.5	S15N07W11ACD	6.6	-	-	100% silty sand	3	11	1	50	10	1	cutback
5/24	13.1	S15N07W12BBB	6.6	80	2.0	100% silty sand	2	15	0	69	15	0	cutbank
5/24	13.3	S15N07W01DDC	6.6	110	1.5	100% silty sand	1	4	0	35	8	0	cutbank
5/24	13.4	S15N07W02CCC	7.6	120	1.5	100% silty sand	4	20	0	20	4	0	
5/24	13.8	S15N07W02ADA	6.7	-	-	100% sand	5	12	0	38	9	1	
5/24	13.8	S15N07W02ACA	7.8	130	1.0	100% silt	5	8	0	8	1	3	gradual slope
5/24	14.7	S16N07W35CDA	8.0	40	3.0	100% sand and gravel mix	6	15	0	19	8	0	gradual slope
5/24	14.9	S16N07W35BCD	6.8	-	-	100% silty sand	2	19	0	45	21	0	
5/24	15.0	S16N07W35ADB	7.6	-	-	100% sand and gravel mix	7	30	0	26	8	0	
5/24	15.5	S16N07W35BAD	7.0	120	2.0	100% silty sand	4	16	[illegible]	[illegible]	14	0	cutbank

Table 2-3-5. Continued.

	Spawning Location		Water 2/			Substrate	Eulachon Catch 3/						General
							Male			Female			Habitat
Date	RM 1/	Geographic Code	Temp.	Depth	Velocity	Type	Pre-	Sp.	Post-	Pre-	Sp.	Post-	Notes
5/24	15.5	S16N07W35ABD	7.8	130	3.0	100% silty sand	2	12	0	32	29	1	cutbank
5/24	15.7	S16N07W35BAA	6.8	100	-	100% silty sand	4	18	0	50	9	0	back eddy
5/24	16.2	S16N07W26CDB	8.0	-	-	100% silty sand	4	14	0	5C	5	0	beach
5/24	16.5	S16N07W26BCD	7.0	130	1.0	100% silty sand	3	3	0	60	10	0	
5/24	17.1	S16N07W26BBC	7.4	130	-	100% silty sand	1	8	0	39	8	0	
5/24	17.2	S16N07W26BBB	7.2	100	1.5	100% silty sand	1	46	0	3	6	0	
5/24	17.7	S16N07W23DAB	8.2	150	2.0	100% silty sand	24	54	0	50	9	0	
5/24	18.2	S16N07W22AAD	7.2	100	1.0	90% sand 10% gravel	6	94	0	4	28	2	
5/24	18.7	S16N07W22ABA	7.4	130	1.0	75% gravel 25% sand	0	25	5	0	3	1	
5/24	19.3	S16N07W22BBA	6.8	140	-	100% silty sand	2	39	1	1	3	4	back eddy
5/24	19.8	S16N07W16ADD	7.1	100	3.0	100% silty sand	0	32	0	7	10	2	cutbank
5/24	19.8	S16N07W09CDD	8.4	80	1.5	100% silty sand	0	47	3	9	7	8	
5/24	21.3	S16N07W08ACC	9.6	80	2.0	100% silty sand	0	42	7	4	7	12	
5/24	22.5	S16N07W05ABD	7.4	120	4.0	100% silt	0	25	0	0	12	0	cutbank
5/24	23.7	S17N07W33BAB	8.0	100	-	100% sand	0	40	2	12	7	2	back eddy; cutback
5/24	24.8	S17N07W28ACB	8.6	90	1.5	50% sand 50% gravel	0	54	0	20	18	0	
5/25	6.1	S16N07W09DCB	8.0	-	-	100% silty sand	2	11	16	0	2	5	
5/25	9.0	S15N07W15BCD	7.6	120	1.0	-	3	22	0	1	3	0	
5/25	9.8	S15N07W10DDB	7.6	-	-	100% silt and gravel mix	1	18	2	2	7	1	
5/25	11.7	S15N17W11CCB	8.0	90	2.0	100% silt and gravel mix	1	35	2	1	7	0	cutback
5/25	14.3	S15N07W02ABA	7.4	150	2.5	100% silty sand	0	24	3	2	4	1	cutback
5/25	17.1	S15N07W16CBD	8.1	-	-	100% silty sand	0	27	0	0	42	0	cutback
5/25	19.0	S16N07W22BBB	7.4	140	3.0	100% silty sand	0	12	1	3	11	2	gradual slope
5/25	22.0	S16N07W04BDA	7.8	80	2.0	100% sand	0	8	1	5	18	0	gradual slope
5/25	24.3	S17N07W33ABB	9.4	90	1.5	100% silty sand	1	19	2	5	22	2	gradual slope
5/25	27.8	S17N07W13BCA	8.4	70	1.5	100% silty sand	0	18	0	2	12	0	
5/25	29.6	S17N06W07CCC	8.5	70	1.5	100% silty sand	0	24	0	4	6	0	gradual slope
5/25	32.0	S17N06W04ABA	8.2	100	2.0	100% silty sand	1	23	0	15	9	0	

Table 2-3-5. Continued.

Date	Spawning Location		Water [2/]			Substrate	Eulachon Catch [3/]						General
							Male			Female			
	RM [1/]	Geographic Code	Temp.	Depth	Velocity	Type	Pre-	Sp.	Post-	Pre-	Sp.	Post-	Habitat Notes
5/25	34.0	S18N06W28DCD	10.2	80	-	98% silty sand 2% organic	0	23	0	7	12	0	back eddy
5/25	36.0	S18N06W22BBB	9.2	70	1.5	100% silt and gravel mix	1	22	0	14	13	0	
5/25	38.2	S18N06W11BDB	9.4	70	1.5	50% sand 50% gravel	5	24	0	10	4	0	
5/25	41.6	S19N06W25DDB	11.4	80	3.5	100% silty sand	3	25	0	2	8	1	
5/25	44.0	S19N05W20CBD	10.8	70	3.5	50% sand 50% gravel	0	20	0	4	5	0	
5/25	44.9	S19N05W17CCC	10.2	80	2.0	50% sand 50% gravel	3	12	0	1	9	1	
5/25	47.0	S19N05W04CCA	9.8	60	1.5	50% sand 50% gravel	3	8	0	10	5	0	
5/25	49.2	S20N06W28AAA	10.0	40	2.0	50% sand 50% gravel	9	40	0	0	5	0	
5/26	4.5	S14N07W05AAC	9.0	-	-	100% silty sand	58	203	96	10	13	16	gradual slope
5/26	12.0	S15N07W11BAB	10.2	80	1.5	100% silty sand	0	29	2	2	4	0	gradual slope
5/26	25.5	S17N07W22CCA	-	-	-	100% sand and gravel mix	12	65	95	22	34	50	
5/27	41.5	S19N06W24BCA	9.8	90	3.5	100% silty sand	1	64	14	0	7	2	
5/27	41.7	S19N06W25DDC	8.6	110	1.5	100% sand and gravel mix	0	121	5	1	19	1	cutbank
5/27	50.5	S20N05W22DDA	9.2	90	0.5	100% silty sand	0	37	5	0	4	50	
5/28	26.2	S17N07W23DAB	-	-	-	-	0	13	0	0	34	0	
5/29	27.5	S17N07W24BBA	10.0	-	-	100% silty sand	0	30	5	0	3	0	
5/30	25.5	S17N07W22ACA	-	-	-	100% silty sand	0	81	6	0	43	1	cutbank
5/31	4.5	S14N07W05AAC	10.0	-	-	100% silty sand	0	173	130	0	9	13	gradual slope
5/31	6.4	S16N07W09DCB	-	-	-	100% silty sand	0	41	0	0	31	0	
5/31	12.5	S15N07W11ACD	8.2	-	-	100% silty sand	0	43	27	0	4	2	cutbank

1/ RM = River Mile

2/ Temperature recorded to nearest 0.1°C, depth to nearest 10cm and surface velocity to nearest 0.5 ft/sec.

3/ Eulachon catch: Pre- = pre-spawners; Sp. = spawners; Post- = post-spawners

Although extent of utilization was not determined both migrations penetrated the Yentna River (RM 28.0).

A total of 61 separate eulachon spawning areas were identified in the Susitna River main channel in 1983. Ten of the locations supported first migration spawning and 57 of the sites supported spawning by second migration fish. At least six of the ten spawning areas identified as first migration spawning areas were also used for spawning by second migration fish. Approximately 70 percent of all the first and second migration spawning areas located were between RM 12 and 27.

In 1983 the first migration eulachon spawning areas identified were located in moderate surface velocity areas near cutbanks where the riverbed composition was mainly loose sands and gravels. The surface velocity at these sites ranged from 1.0 to 2.0 ft/sec and averaged 1.5 ft/sec. Depths averaged 130 cm and ranged from 100 to 170 cm. Water temperatures ranged from 5.8 to 8.1°C and averaged 7.3°C.

The spawning areas located for the second migration of eulachon in 1983 were characteristically similar to those identified for the first migration. However, overall the second migration spawners spawned in higher velocity areas and showed less preference toward areas offshore of cutbanks. Surface velocities at the second migration eulachon spawning areas ranged from 0.5 to 3.5 ft/sec and averaged 2.0 ft/sec. Depths ranged from 40 to 170 cm and averaged 100 cm. The water temperatures ranged from 6.6 to 11.4°C and averaged 8.3°C.

The minor variation in spawning habitat utilization among first migration eulachon and second migration eulachon in 1983 was probably due in part to the marked difference in abundance between the two migrations. The first migration was at least seven times smaller than the second migration. Space was probably less of a limiting factor for first migration eulachon than for second migration fish. Inasmuch as the majority of all spawning sites used by first migration spawners were utilized by second migration spawners, crowding likely forced second migration fish to utilize 'less preferred' spawning habitats or die prior to spawning as subsequently addressed (Plate 2-3-2).

Plate 2-3-2. Dead and dying pre-spawning eulachon, mainly females, at RM 17 on May 24, 1983, Adult Anadromous Investigations, Su Hydro Studies, 1983.

In addition to the suspected utilization of 'less preferred spawning habitat' by second migration eulachon, observations made at one location indicate that the 1983 second eulachon migration into the Susitna River experienced crowding to a level that introduced stress with associated mortality. The observations referenced were noted on May 24, 1983, one day following the peak catch of second migration fish in the intertidal reach. On this date, hundreds of thousands (visual estimate) of eulachon were migrating along the banks of the Susitna River between RM 12.5 and 24.3. At the same time eulachon were spawning between RM 17.2 and 18.2. These fish which were spawning were noticeably thin, had dull coloration, and fin erosion, not atypical of spawning condition fish. By contrast, nearly all of the second migration eulachon around and below RM 17.1 were in pre-spawning condition with bright coloration and no recognized fin erosion, a typical appearance of pre-spawning condition fish. Atypical of pre-spawners however, was that these fish were crowded near shore to the extent that the ones closest to the surface were half out of the water and rolling over on their sides (Plate 2-3-3). The banks adjacent to this location (RM 17.1) were littered with dead, unspawned eulachon in depths up to four feet (Plate 2-3-4). The majority (80%) of these were female carcasses. Comparatively, where spawning was occurring above RM 17.1 between RM 17.2 and 18.2, approximately 80% of the fish were live, spawning males. The masses of dead, unspawned female eulachon observed in the area of RM 17.1 and the spawning activity noted just upstream can not be fully explained. However, there may possibly be a physiological mechanism that causes pre-spawning females to stop migration and die rather than enter a spawning area that already supports 'high' densities of spawners. Lagler et al (1962) indicate that many elements of fish behavior and physiology are density dependant, and population density at any instant is the function of natality versus mortality. The natural regulation of pre-spawning eulachon into a spawning area may be toward insuring optimum egg fertilization.

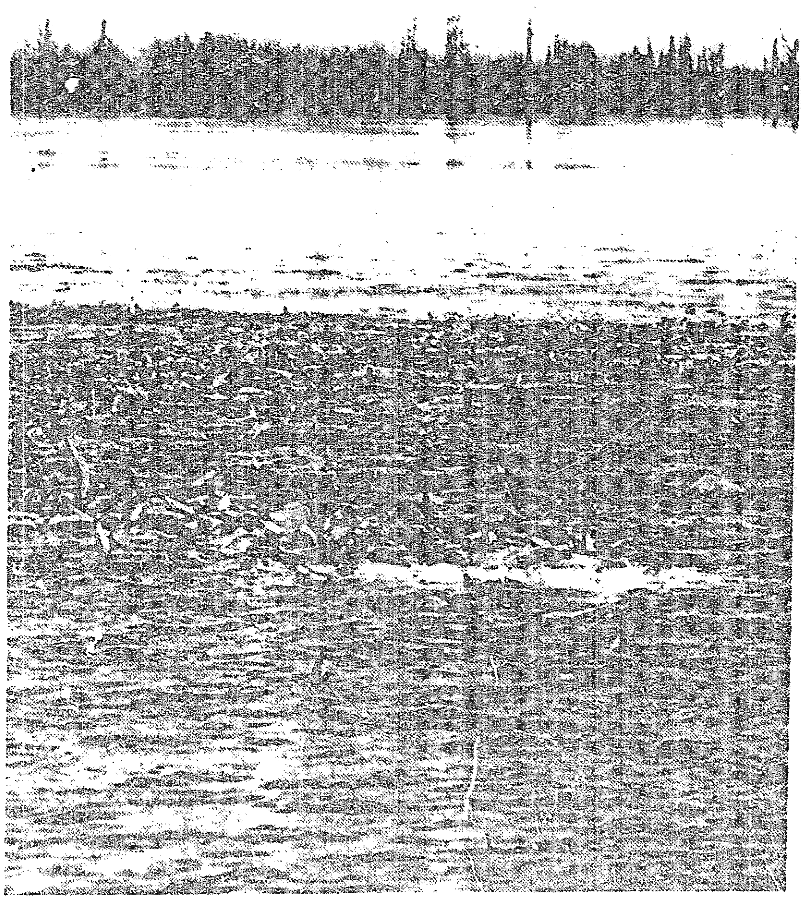


Plate 2-3-3. Thousands of 'stressed', pre-spawning condition eulachon dying at RM 17, May 24, 1983, Adult Anadromous Investigations, Su Hydro Studies, 1983.

Plate 2-3-4. Dead unspawned eulachon in the Susitna River at RM 17.1, Adult Anadromous Investigations, Su Hydro Studies, 1983.

Sex composition sampling of first and second migration eulachon in 1983 indicated that male to female eulachon ratios differ between spawning development stages (Table 2-3-6). Unweighted catch samples collected of first migration fish showed male to female average ratios for pre-spawners at 1.2:1, spawners at 18.9:1 and post-spawners at 15.6:1. In the second migration, pre-spawner ratios averaged 0.6:1, spawners 4.7:1 and post spawners 3.4:1. The changes in sex ratios are due to differences in length of spawning time between sexes wherein individual males ripen earlier and remain in the river longer than individual females, and a stress associated mortality in the female population at 'high' spawning densities.

Table 2-3-6. Summarization of sex composition samples collected in the 1983 season by dip netting and electroshocking between Susitna river mile 4.5 and 60.0, Adult Anadromous Investigations, Su Hydro Studies, 1983.

Development Stage	First Migration 1/ Sample Size Males	Females	M:F Ratio	Second Migration 2/ Sample Size Males	Females	M:F Ratio
Pre-Spawners	316	253	1.2:1	1341	2084	0.6:1
Spawners	1320	70	18.9:1	3730	788	4.7:1
Post-Spawners	249	16	15.6:1	1388	403	3.4:1

1/ First migration samples collected from 5/10-5/17 for pre-spawners, 5/10-5/22 for spawners and 5/10-5/23 for post-spawners.

2/ Second migration samples collected from 5/18-6/6 for pre-spawners, 5/23-6/6 for spawners and 5/24-6/6 for post-spawners.

Variations in second migration eulachon sex ratios between spawning development stages is further illustrated through Figure 2-3-3. The sex composition samples collected from 1,956 second migration fish between RM

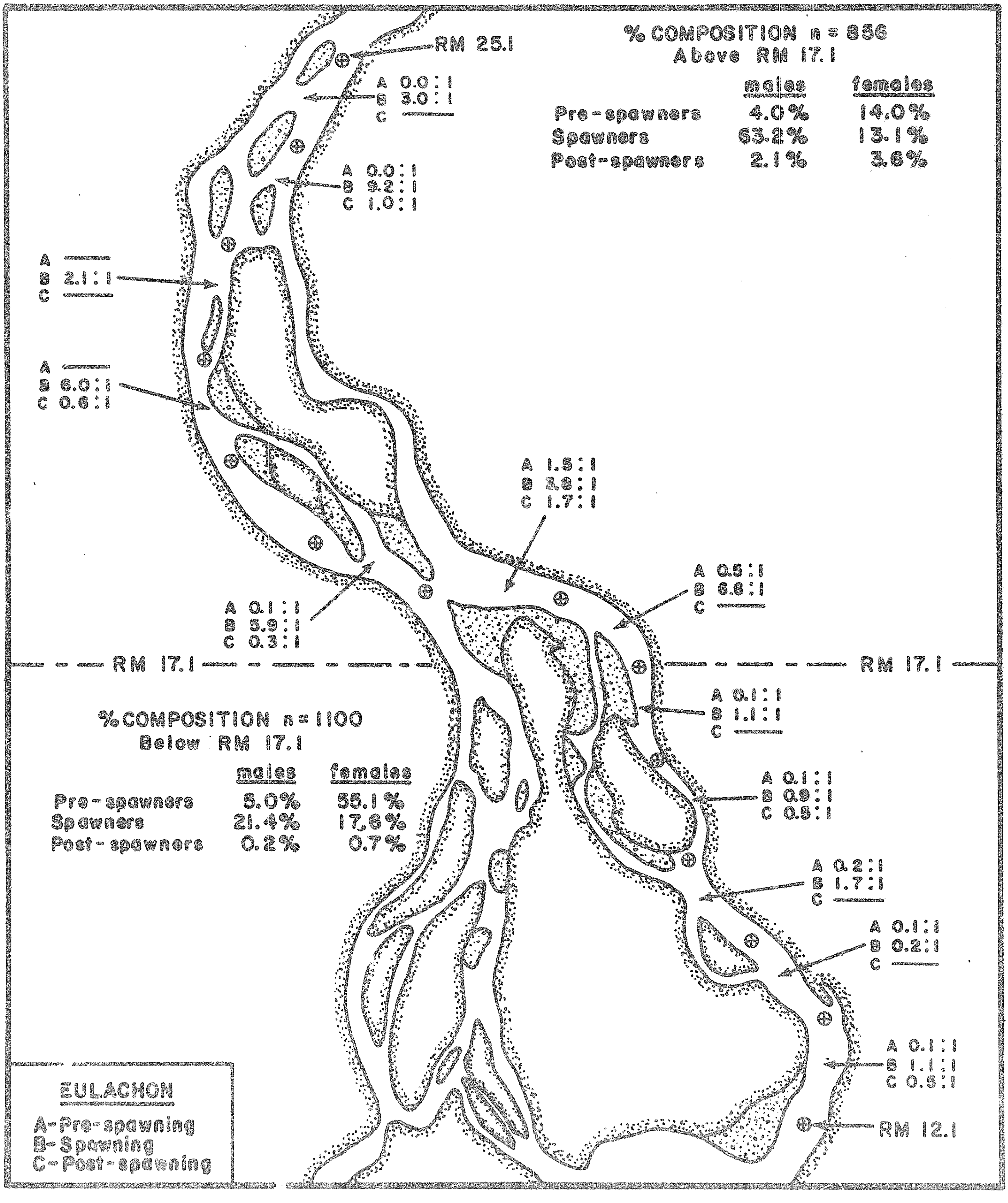


Figure 2-3-3. Percent composition of eulachon spawning conditions per sex, sampled from RM 12.1 to 25.1 on May 24, 1983, Adult Anadromous Investigations. Su Hydro Studies, 1983.

12.1 and 25.1 on May 24, 1983 indicate that overall, female eulachon were more abundant than males by a ratio of 0.8:1. In comparing subsample collections above and below RM 17.1 where the previously referenced stress associated mortality was noted, the data indicates that more females were in pre-spawning condition than males, more males were in spawning condition than females and lastly, more females were in post spawning condition than male eulachon. Whereas the overall male to female ratio between RM 12.1 and 25.1 was 0.8:1 the subsample ratios above RM 17.1 averaged 2.3:1 and below RM 17.1, 0.4:1. Differential male and female migration rates, spawning time, sexual development and mortality are probable causes for the observed differences in sex ratios.

A total of 267 first and second migration eulachon were successfully aged from sampling efforts in 1983 between RM 4.5 and 60. The information has been summarized in Table 2-3-7 along with corresponding length, weight and sex. The data in Table 2-3-6 were not weighted by CPUE due to variations in sampling intensity and collection sites. The results indicate that three year old eulachon comprised the majority of both migrations and two and four year old eulachon were present in both migrations. The three year old fish accounted for approximately 90.4 percent of the males and 95.5 percent of the females sampled in the first migration, and 83.3 percent of the males and 91.4 percent of the females in the second migration samples. As indicated in Table 2-3-7, there were no notable differences in the unweighted length and weight data between the samples of first and second migration fish.

No empirical estimate of the total 1983 escapement of first and second migration eulachon is available for the Susitna River. General crew

Table 2-3-7. Length and weight of pre-spawning condition eulachon segregated by age and sex from samples collected in the Susitna River intertidal and main channel, Adult Anadromous Investigations, Su Hydro Studies, 1983.

			Length					Weight				
Age	Sex	Migration	n	Range	$\bar{x}$	95% C.I. 1/	Median	n	Range	$\bar{x}$	95% C.I. 1/	Median
2	M	1st	4	191-216	199	---	195	4	50.6-68.8	57.1	---	54.5
3	M	1st	57	178-229	210	208-212	210	57	39.4-86.0	67.1	64.7-69.6	67.1
4	M	1st	2	200-222	211	---	211	2	59.4-78.7	69.1	---	69.1
2	F	1st	2	188-195	192	---	192	2	53.0-54.3	53.7	---	53.7
3	F	1st	43	180-222	202	199-205	202	43	42.3-76.6	59.7	57.1-62.2	59.2
4	F	1st	0	---	-	---	-	0	-	-	---	-
2	M	2nd	4	182-208	198	---	201	4	44.2-65.1	55.7	---	56.8
3	M	2nd	65	187-228	209	207-211	210	65	44.3-84.3	68.1	66.1-70.1	68.5
4	M	2nd	9	213-231	221	---	219	9	66.9-93.5	79.8	---	79.3
2	F	2nd	4	179-193	185	---	183	4	40.4-48.0	43.8	---	43.4
3	F	2nd	74	176-221	203	201-205	203	74	45.3-77.3	60.7	59.1-62.3	60.1
4	F	2nd	3	199-212	205	---	203	3	60.2-71.1	64.0	---	60.6
All 2/	All	All	308	176-231	206	205-207	206	308	39.4-93.5	64.2	63.2-65.3	64.4

1/ Confidence Interval

2/ Composite of all aged and non-aged eulachon observations of eulachon densities particularity associated with the second migration indicate that the Susitna River in 1983 supported an escapement ranging in the millions of fish.

In 1983, there was only a minor amount of sport fishing effort was expended in the Susitna River for eulachon. In the thirty days of crew sampling operations only two parties of fishermen were observed dip netting eulachon on the Susitna River main channel. Overall, the total sport fish catch of eulachon below RM 28 in 1983 was probably in the range of 500 to 2,000 fish.

3.2 Adult Salmon

The estimated escapements of Pacific salmon into the Susitna River basin for 1983 with exception of chinook salmon are reported in Table 2-3-8. These estimates should be considered conservative as they do not account for salmon escapements to systems between RM 0 and 80 except the Yentna River (RM 28). Minimum salmon escapements for the Susitna River reach above RM 80 are quantified in sections 3.2.1.1 and 3.2.1.2.1 of this report.

Specific results of the 1983 salmon escapement work follow by order of species and river reach. The order of presentation of salmon species are: chinook, sockeye, pink, chum and coho salmon. The river reach divisions are: (1) from the intertidal (RM 0.0) to Talkeetna (RM 98.6); and (2) from Talkeetna to Upper Devil Canyon (RM 161.0).

Table 2-3-8. Minimum Susitna River salmon escapements for sockeye, pink, chum and coho salmon in 1983, Adult Anadromous Investigations, Su Hydro Studies, 1983.

Year	Escapement Estimates 1/				
	Sockeye 2/	Pink	Chum	Coho	Total
1983	176,200	101,300	276,800	24,100	578,400

1/ Defined as the summation of the Yentna River escapement obtained by side scan sonar at Yentna Station and the Susitna River escapement obtained by tag/recapture population estimates at Sunshine Station. These estimates do not include escapements to Susitna River tributaries above RM 6 and below RM 77 excluding the Yentna River (RM 28).

2/ Sockeye salmon escapement estimates do not include first run sockeye salmon.

3.2.1 Chinook Salmon

3.2.1.1 Intertidal to Talkeetna

3.2.1.1.1 Main Channel Escapement Monitoring

In 1983 a percentage of the chinook salmon escapement into the Yentna River (RM 28) passed over the two SSS counters and were caught in the two fishwheels operated at Yentna Station (TRM 04) (Appendix 2-C and 2-D). However, most of the escapement had already passed Yentna Station by June 30, 1983 the first day this station was fully operational (ADF&G, 1982). For this reason the 1983 chinook salmon escapement into the Yentna River can not be quantified.

The 1983 chinook salmon escapement to Sunshine Station (RM 80) on the Susitna River was monitored. The escapement was an estimated 91,200 fish (Tables 2-3-9 and 2-3-10). This estimate includes 45,300 fish larger than 350 mm in length and 1,700 fish smaller than this which migrated along the east side of the river, and 42,000 fish larger than 350 mm in length and 2,300 fish smaller than this which migrated along the west side of the Susitna River at RM 80 (Tables 2-3-9 and 2-3-10).

Table 2-3-9. Escapement of chinook salmon 350 mm or less in length at Sunshine, Talkeetna and Curry stations, Adult Anadromous Investigations, Su Hydro Studies, 1983.

Chinook Salmon Escapement ≤ 350				
Sunshine Station			Talkeetna	Curry
East Bank	West Bank	Total	Station	Station
1,671	2,259	3,930	2,723	562

The reason the (1983) chinook salmon escapement to Sunshine Station (RM 80) was computed into two sub-estimates of the number of fish which traveled along the east and west banks of the Susitna River at Sunshine Station was due to differences in tag to untagged ratios. The surveys performed on the east side of the Susitna River which is defined as the reach between RM 80 and 98.6 and the upper Susitna River drainage above RM 98.6 revealed an overall ratio of tagged to untagged chinook salmon spawners of 1:15.3. Tag recovery surveys on the west side of the Susitna River of west side entering tributaries between RM 80 and 98.6, provided tagged to untagged ratios

Table 2-3-10. Petersen population estimates with associated 95% confidence intervals of chinook salmon migration to Sunshine, Talkeetna and Curry stations, Adult Anadromous Investigations, Su Hydro Studies, 1983.

Parameter 1/	Population Estimate Location 2/				
	Sunshine Station			Talkeetna Station	Curry Station
	East Bank	West Bank	Total 3/		
m	2,777	308	3,085	650	792
c	3,770	5,178	8,948	1,290	275
r	231	38	269	71	23
$\hat{N}$	45,322	41,969	87,291	11,810	9,470
95% C.I.	40,288- 51,793	31,872- 61,429	72,160- 113,222	9,632- 15,261	6,807- 15,555

1/ m = Number of fish marked (adjusted).

c = Total number of fish examined for marks during sampling census.

r = Total number of marked fish observed during sampling census.

$\hat{N}$ = Population estimate.

C.I. = Confidence interval around $\hat{N}$.

2/ Chinook salmon escapements do not include fish 350 mm and less in length (FL).

3/ All totals are a summation of east and west bank values and do not represent calculated population estimates.

averaging 1:136.3. These ratios indicate two possibilities: (1) the chinook salmon escapement to RM 80 was segregated with the Chulitna River stocks (RM 98.5) migrating along the west side of the river at RM 80, and the east side tributary and Susitna River stocks above RM 98.6 migrating along the east river bank at RM 80; and (2) the chinook salmon escapement to RM 80 was not sampled equally on the east and west sides of the river even though fishing effort was identical with two fishwheels operated on each side. Based on these probable factors it was decided that east and west bank migrating fish should be treated independently as two separate populations in estimating the total chinook salmon escapement to RM 80. In accomplishing this the tagged chinook salmon release data generated on the east side of the Susitna River at RM 80 was combined with tag recovery survey data collected from east side spawning areas to compute an east side escapement estimate. The west side escapement was computed in the same manner using west side tag release and tag recovery data.

From fishwheel catches at Yentna Station (TRM 04) it can be determined that the 1983 migration of chinook salmon into the Yentna River (RM 28) began sometime before June 30 and ended in the first week of August (Appendix Table 2-D-3 and Figure 2-3-4). It can be further concluded that there was no strong migrational preference for chinook salmon movement along one bank or the other after June 30. The north bank Yentna Station fishwheel intercepted 57.5 percent and the south bank fishwheel captured 42.5 percent of the total station catch (Appendix Tables 2-D-1 and 2-D-2).

The overall timing of the 1983 chinook salmon migration at Sunshine Station (RM 80) can be determined from the total catch of 3,832 fish in the four fishwheels operated at this location between June 3 and September 11 (Table 2-3-11 and Figure 2-3-4). The migration essentially covered a 31 day period which began on June 9, reached a midpoint on June 18 and ended on July 9. The peak migration occurred on June 14. The average fishwheel catch on this date was approximately 3.7 chinook salmon per hour. A plot of the

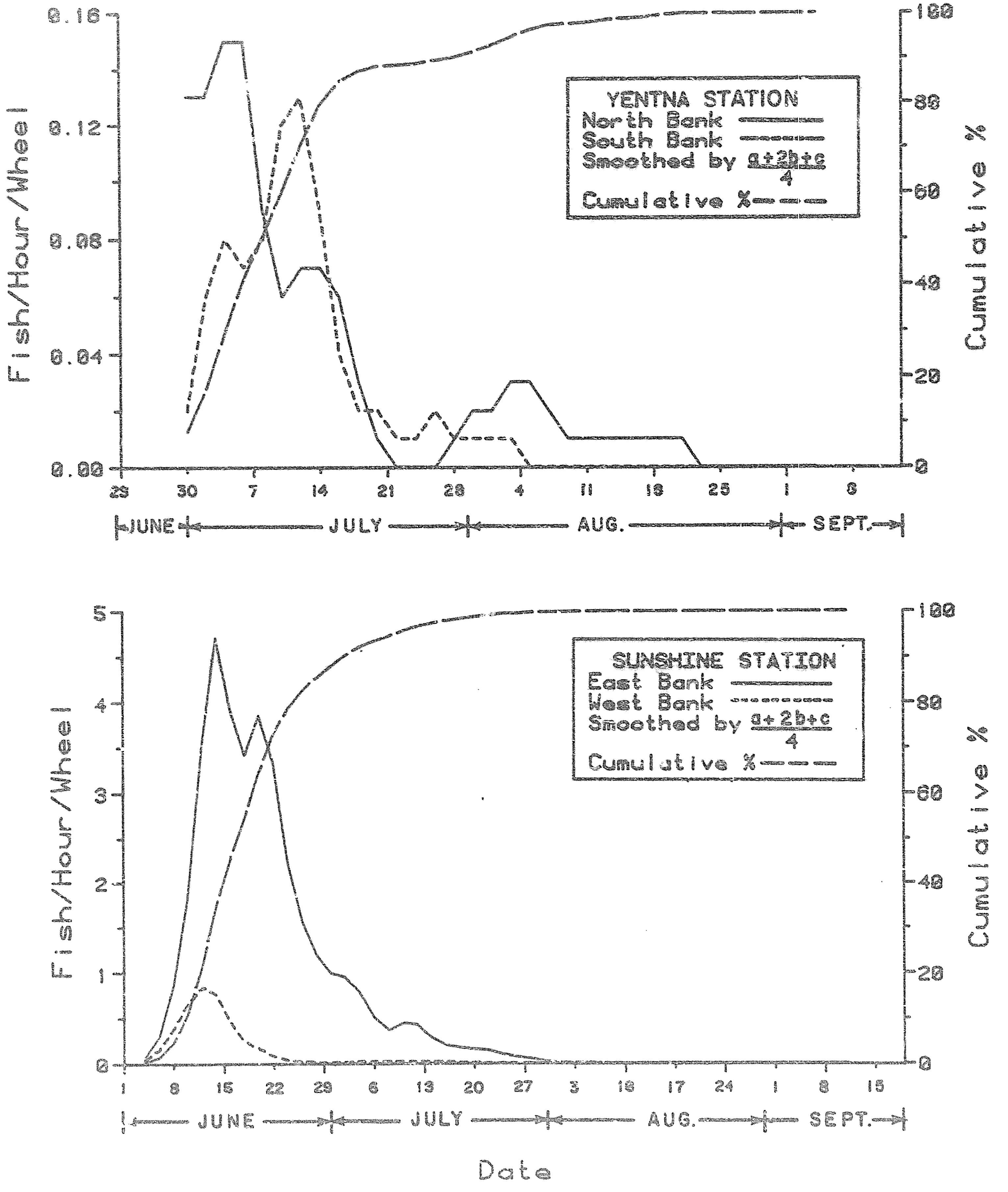


Figure 2-3-4. Mean hourly and cumulative percent fishwheel catch of chinook salmon by two day periods at Yentna and Sunshine stations, Adult Anadromous Investigations, Su Hydro Studies, 1983.

daily east and west bank fishwheel catches at Sunshine Station indicate that the majority of the escapement traveled along the east side of the river based upon 90.3 percent of the total station catch being caught in the east bank fishwheels (Appendix 2-D). The results from tag recovery surveys performed upstream of RM 80 on the east and west sides of the river indicated the difference in interception ratios between the east and west bank fishwheels was primarily related to fishwheel efficiency where the east bank fishwheels caught in the range of six percent of the escapement on the east side of the river and the west bank fishwheels intercepted about one percent of the west bank escapement.

Table 2-3-11. Summary of fishwheel catches by species and sampling locations, Adult Anadromous Investigations, Su Hydro Studies, 1983.

Sampling Location	River Mile	Catch				
		Chinook	Sockeye	Pink	Chum	Coho
Yentna Station	04	87	4,648	4,489	775	574
Sunshine Station	80	3,832	8,147	3,085	17,600	2,254
Talkeetna Station	103	1,030	536	2,213	2,467	422
Curry Station	120	1,064	201	589	861	93

The results of sampling chinook salmon for age at Yentna River (RM 28) and Sunshine Station (RM 80) are summarized in Table 2-3-12 and Figure 2-3-5. An insufficient number of samples were collected at Yentna Station (TRM 04) to define other than that the escapement included fish ranging from three to

Table 2-3-12. Analysis of chinook salmon lengths, in millimeters, by age class from escapement samples collected at Yentna, Sunshine, Talkeetna and Curry stations, Adult Anadromous Investigations, Su Hydro Studies, 1983.

Collection Site	Age Class	n		Range Limits		Mean		95% Conf. Interval 3/		Median	
		M 1/	F 2/	M	F	M	F	M	F	M	F
Yentna Station	3_2	5	-	286-367	-	323	-	-	-	325	-
	4_2	1	1	442	524	442	524	-	-	442	524
	5_2	-	2	-	542-785	-	664	-	-	-	664
	6_2	2	2	825-845	750-872	835	811	-	-	835	811
	7_2	1	1	940	945	940	945	-	-	940	945
	ALL 4/	58	25	286-940	436-985	530	741	470-591	680-802	399	779
		83		286-985		594		544-644		590	
Sunshine Station	3_2	19	-	325-410	-	373	-	363-382	-	370	-
	4_2	41	10	360-720	445-690	522	548	495-548	494-604	515	555
	5_1	1	-	635	-	635	-	-	-	635	-
	5_2	338	170	420-1015	455-1100	631	670	620-642	649-692	610	630
	6_2	238	352	550-1200	505-1250	879	873	861-896	862-883	900	890
	7_2	46	92	710-1250	715-1040	993	927	963-1022	915-940	1000	923
	ALL 4/	936	810	325-1250	430-1250	714	815	702-726	805-826	655	870
		1746		325-1250		761		752-769		790	
Talkeetna Station	3_1	9	-	300-400	-	343	-	-	-	340	-
	3_2	140	-	290-430	-	346	-	342-349	-	350	-
	4_1	1	-	430	-	430	-	-	-	430	-
	4_2	56	5	330-680	460-530	492	494	464-520	-	515	490
	5_1	5	2	530-720	590-730	616	660	-	-	620	660
	5_2	178	41	460-860	500-840	616	623	605-628	597-650	610	600
	6_2	60	126	680-1100	630-1000	854	840	828-879	828-853	840	840
	7_2	9	32	870-1040	830-1050	956	927	-	904-949	960	915
	ALL 4/	634	268	290-1100	460-1050	555	795	541-570	779-811	560	820
		902		290-1100		626		613-640		620	

Table 2-3-12. Continued.

Collection Site	Age Class	n		Range Limits		Mean		95% Conf. Interval 3/		Median	
		M 1/	F 2/	M	F	M	F	M	F	M	F
Curry Station	3_1	[illegible]	-	280-345	-	313	-	-	-	313	-
	3_2	65	-	300-400	-	346	-	340-352	-	345	-
	4_2	27	1	360-680	510	499	510	463-529	-	500	510
	5_2	158	16	460-810	600-790	627	675	617-637	643-707	630	670
	6_2	129	180	530-1100	700-970	845	841	829-861	834-849	840	840
	7_2	31	103	840-1140	800-1070	1001	924	977-1025	916-932	1000	930
	ALL 4/	535	372	280-1140	510-1070	665	855	645-683	847-864	650	860
		907		280-1140		743		731-756		803	

1/ Males.
2/ Females.
3/ Confidence Interval of the Mean.
4/ Composite of all aged and non-aged samples.

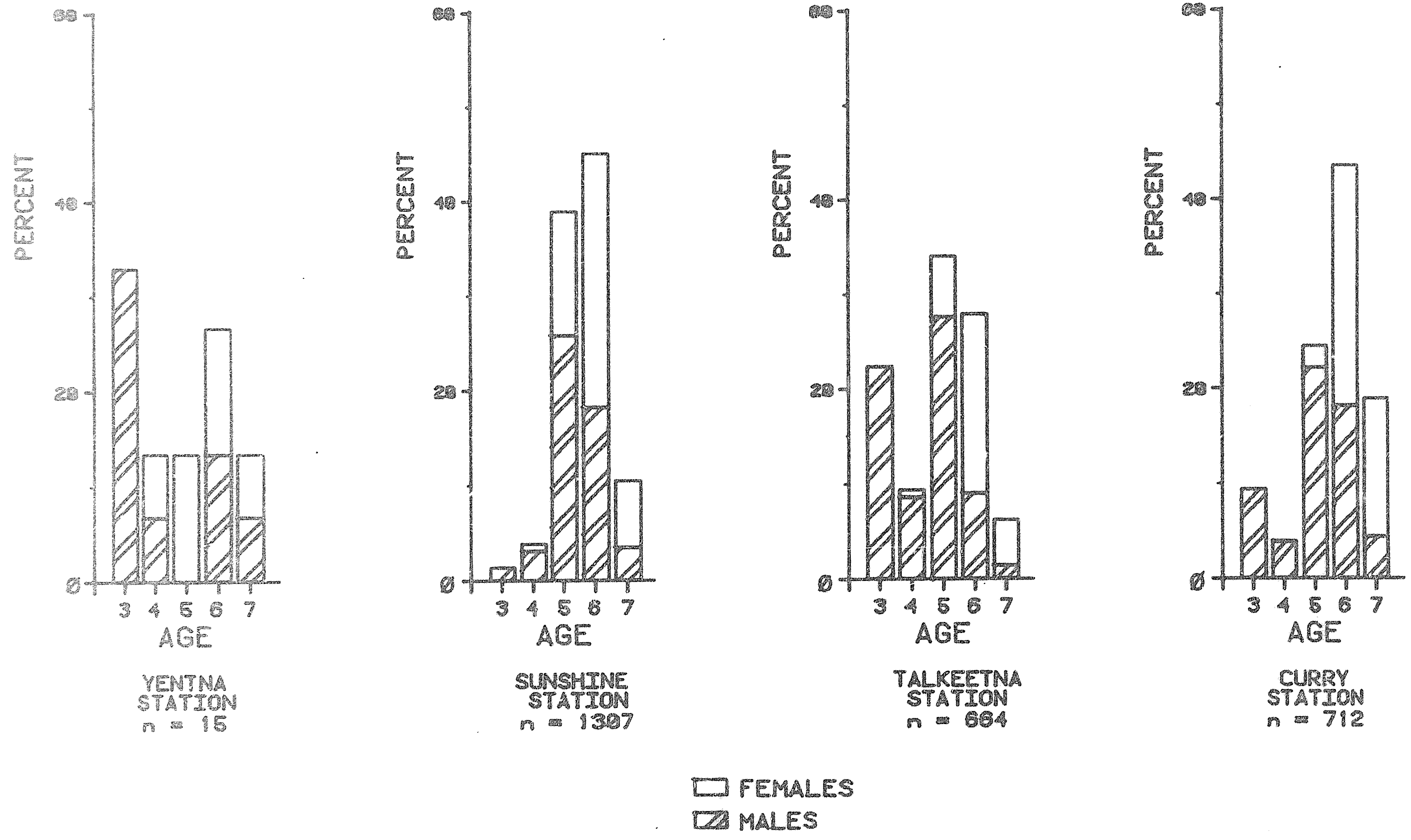


Figure 2-3-5. Age composition of fishwheel intercepted chinook salmon at Yentna, Sunshine, Talkeetna and Curry stations, Adult Anadromous Investigations, Su Hydro Studies, 1983.

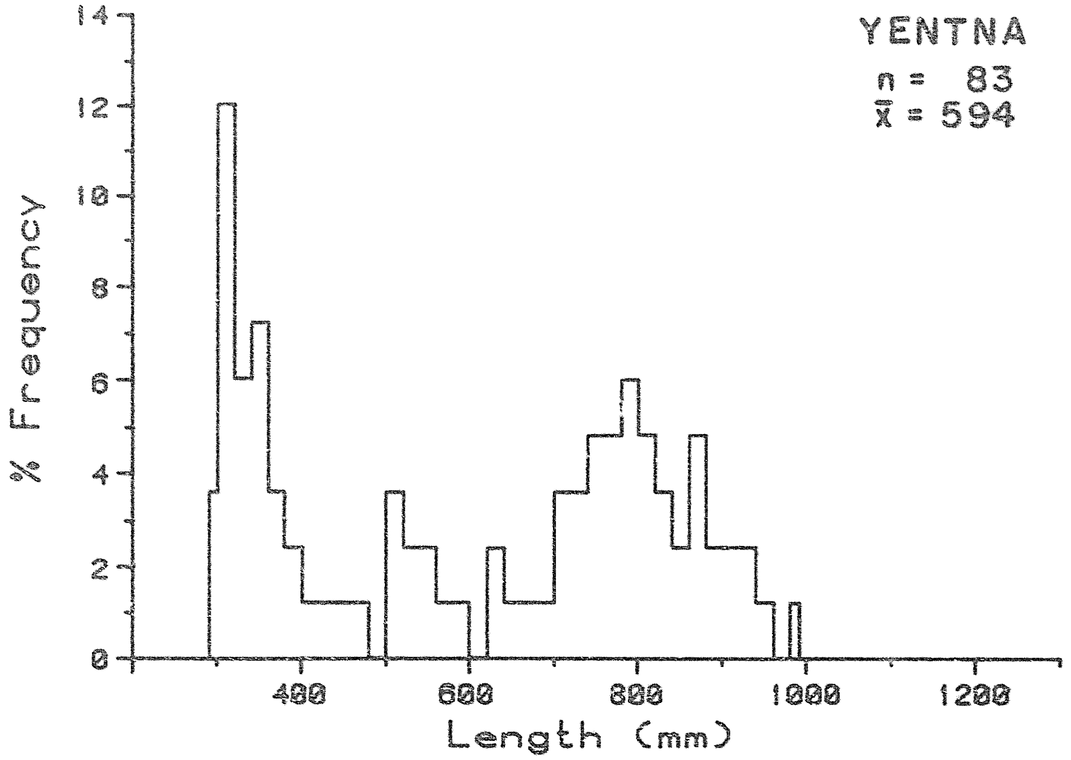
seven years old. At Sunshine Station 1,307 legible scales collected indicated the escapement was approximately 85 percent five and six year old fish (Figure 2-3-5). The balance of the escapement sample was comprised of fish seven, four and three years old in order of abundance. Nearly all the fish sampled for age from Sunshine Station were fish that had gone to sea in their second year of life (Table 2-3-13).

Table 2-3-13. Analysis of chinook salmon age data by percent from escapement samples collected at Yentna, Sunshine, Talkeetna and Curry stations, Adult Anadromous Investigations, Su Hydro Studies, 1983.

Collection Site	n	Age Class 1/							
		3_1	3_2	4_1	4_2	5_1	5_2	6_2	7_2
Yentna Station	15	-	33.3	-	13.3	-	13.3	26.7	13.3
Sunshine Station	1307	-	1.5	-	3.9	0.1	38.9	45.0	10.6
Talkeetna Station	664	1.4	21.1	0.2	9.2	1.1	32.9	27.9	6.2
Curry Station	712	0.3	9.1	-	3.9	-	24.4	43.5	18.8

1/ Gilbert-Rich Notation

Length composition data was collected from fishwheel caught chinook salmon at Yentna (TRM 04) and Sunshine (RM 80) stations in 1983. The results are summarized in Figure 2-3-6 and Table 2-3-12. The data indicates a near linear relationship between chinook salmon age and length at both stations. The average chinook salmon length measured at Yentna Station was 594 mm and at Sunshine Station, 761 mm. Sex composition data collected at these stations indicates males were more numerous than females among the three and



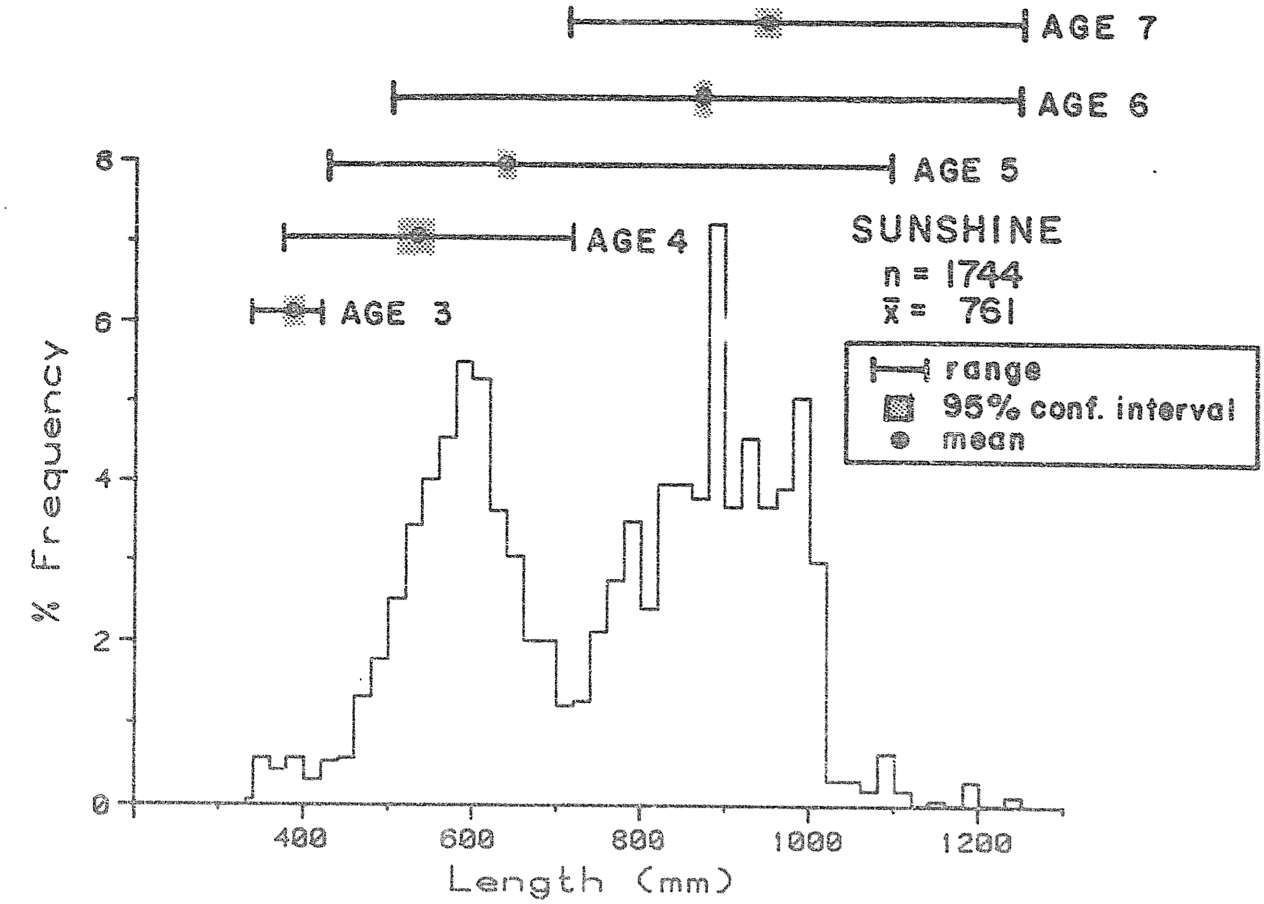


Figure 2-3-6. Length frequency distribution of chinook salmon at Yentna Station and length and age distribution of chinook salmon at Sunshine Station in 1983, Adult Anadromous Investigations, Su Hydro Studies, 1983.

four year old fish, and more females than males among fish five, six and seven years old (Table 2-3-14).

3.2.1.2 Talkeetna To Upper Devil Canyon

3.2.1.2.1 Main Channel Escapement Monitoring

The 1983 escapement of chinook salmon at Talkeetna Station (RM 103) was an estimated 14,500 fish. Represented in this estimate are 11,800 chinook salmon larger than 350 mm in length and 2,700 fish smaller than this length (Tables 2-3-9 and 2-3-10).

The 1983 chinook salmon escapement at Curry Station (RM 80) was an estimated 10,000 fish or about 1,800 fish less than the estimate for Talkeetna Station (RM 103) (Tables 2-3-9 and 2-3-10). About 9,500 of the 10,000 chinook salmon escapement estimate to Curry Station were fish larger than 350 mm in length. The balance of the estimate were fish smaller than this length.

Migration timings of the 1983 chinook salmon escapements to Talkeetna (RM 103) and Curry (RM 120) stations have been determined by interpretation of fishwheel catches (Figure 2-3-7). At Talkeetna Station, the migration began on June 18, reached a midpoint on June 28 and ended on July 21. The migration peaked on June 22 at an average catch rate of 0.8 fish per fishwheel hour. Seventeen miles up river at Curry Station, the chinook migration began on June 18, reached a midpoint on June 25 and ended on July 13. The highest daily catch rate at this site occurred on June 23 with 1.9 fish per fishwheel hour being recorded (Appendix 2-D).

Table 2-3-14. Sex ratios of male and female chinook salmon by age from escapement samples collected at Yentna, Sunshine, Talkeetna and Curry Stations, Adult Anadromous Investigations, Su Hydro Studies, 1983.

Collection Site	Age	Sample Size	Number		Sex Ratio (M:F)
			Males	Females	
Yentna Station	3	5	5	0	-
	4	2	1	1	1.0.1
	5	2	0	2	-
	6	4	2	2	1.0:1
	7	2	1	1	1.0:1
	All 1/	83	58	25	2.3:1
Sunshine Station	3	19	19	0	-
	4	51	41	10	4.1:1
	5	509	339	170	2.0:1
	6	590	238	352	0.7:1
	7	138	46	92	0.5:1
	All 1/	1746	936	810	1.2:1
Talkeetna Station	3	149	149	0	-
	4	62	57	5	11.4:1
	5	226	183	43	4.3:1
	6	186	60	126	0.5:1
	7	41	9	32	0.3:1
	All 1/	902	634	268	2.4:1
Curry Station	3	67	67	0	-
	4	28	27	1	27.0:1
	5	174	158	16	9.9:1
	6	309	129	180	0.7:1
	7	134	31	103	0.3:1
	All 1/	907	535	372	1.4:1

1/ Includes all aged and non-aged samples.

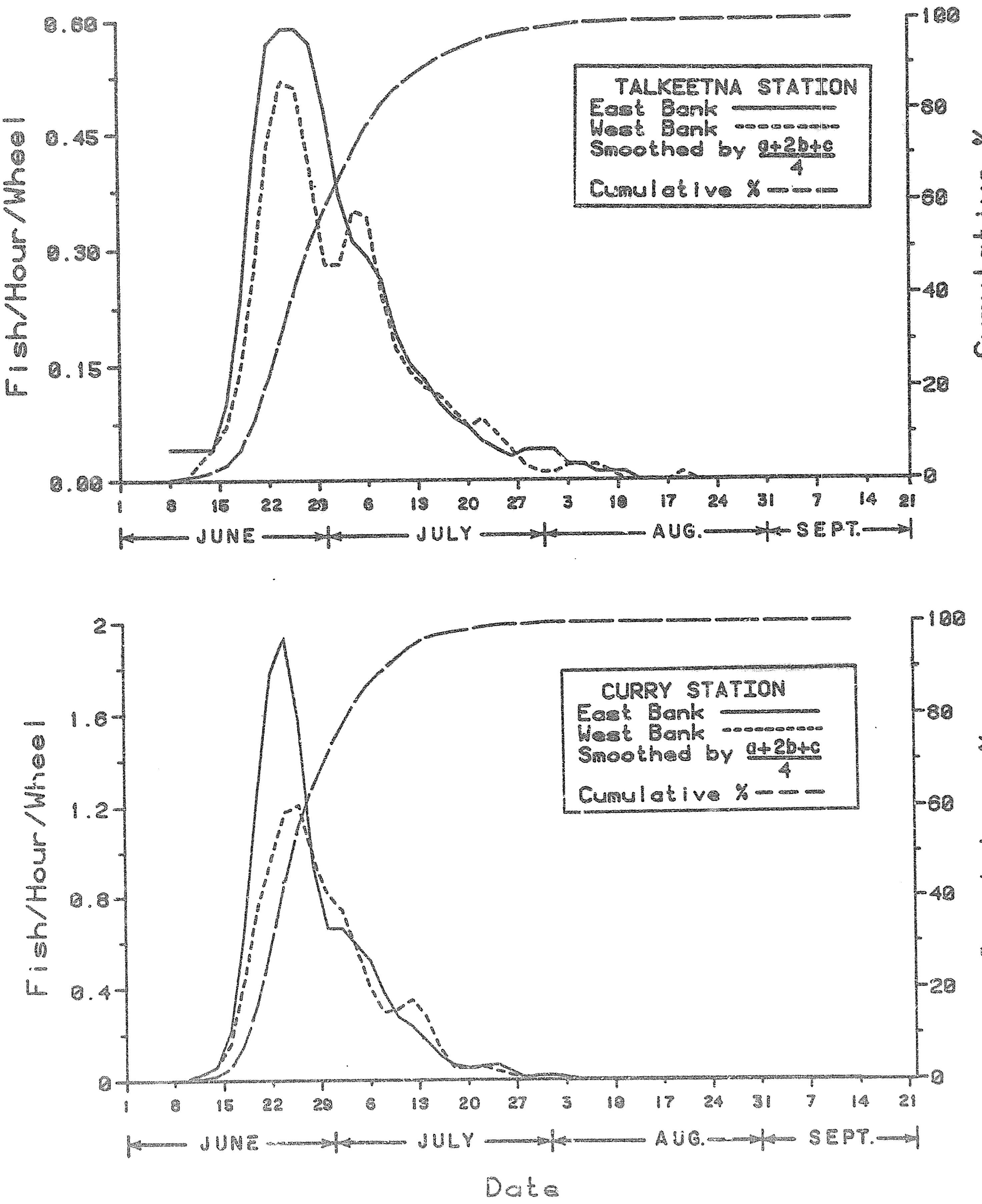


Figure 2-3-7. Mean hourly and cumulative percent fishwheel catch of chinook salmon by two day periods at Talkeetna and Curry stations, Adult Anadromous Investigations, Su Hydro Studies, 1983.

In 1983, the majority of the chinook escapement migrated along the east bank of the Susitna River at both Talkeetna (RM 103) and Curry (RM 120) stations. Approximately 55 percent of the total 1,034 chinook salmon fishwheel catch at Talkeetna Station and 55 percent of the total 1,064 fishwheel catch at Curry Station were made by east bank fishwheels at these locations (Appendix Tables 2-D-9 and 2-D-12). Inseason catch trends held relatively consistent between the east and west bank fishwheels at both locations as indicated in Figure 2-3-7.

The chinook salmon in 1983 averaged a migrational travel time between Talkeetna (RM 103) and Curry (RM 120) stations of 6.4 days based on a sample of 50 fish (Figure 2-3-8). Computed to a daily travel rate these fish averaged a net speed of 2.7 miles per day between RM 103 and 120. In comparing migrational rates of fish tagged at Sunshine Station and later recaptured at Talkeetna and Curry stations it is evident that chinook salmon in 1983 either traveled at a faster rate or spent less time milling the further they ascended upstream. Fish tagged at Sunshine Station averaged a net migration speed for the 23 miles to Talkeetna Station of 1.8 miles per day whereas to Curry Station, 40 miles above Sunshine Station their migration was faster at an average of 3.0 miles per day.

The results of age samples collected in 1983 from from 664 and 712 chinook salmon caught in fishwheels at Talkeetna (RM 103) and Curry (RM 120) stations are summarized in Table 2-3-13. Approximately 62 percent of the escapement sampled from Talkeetna Station were five and six year old fish. The balance of the sample was comprised of fish three, four and seven years old in respective order. About 97 percent of the escapement sample from Talkeetna

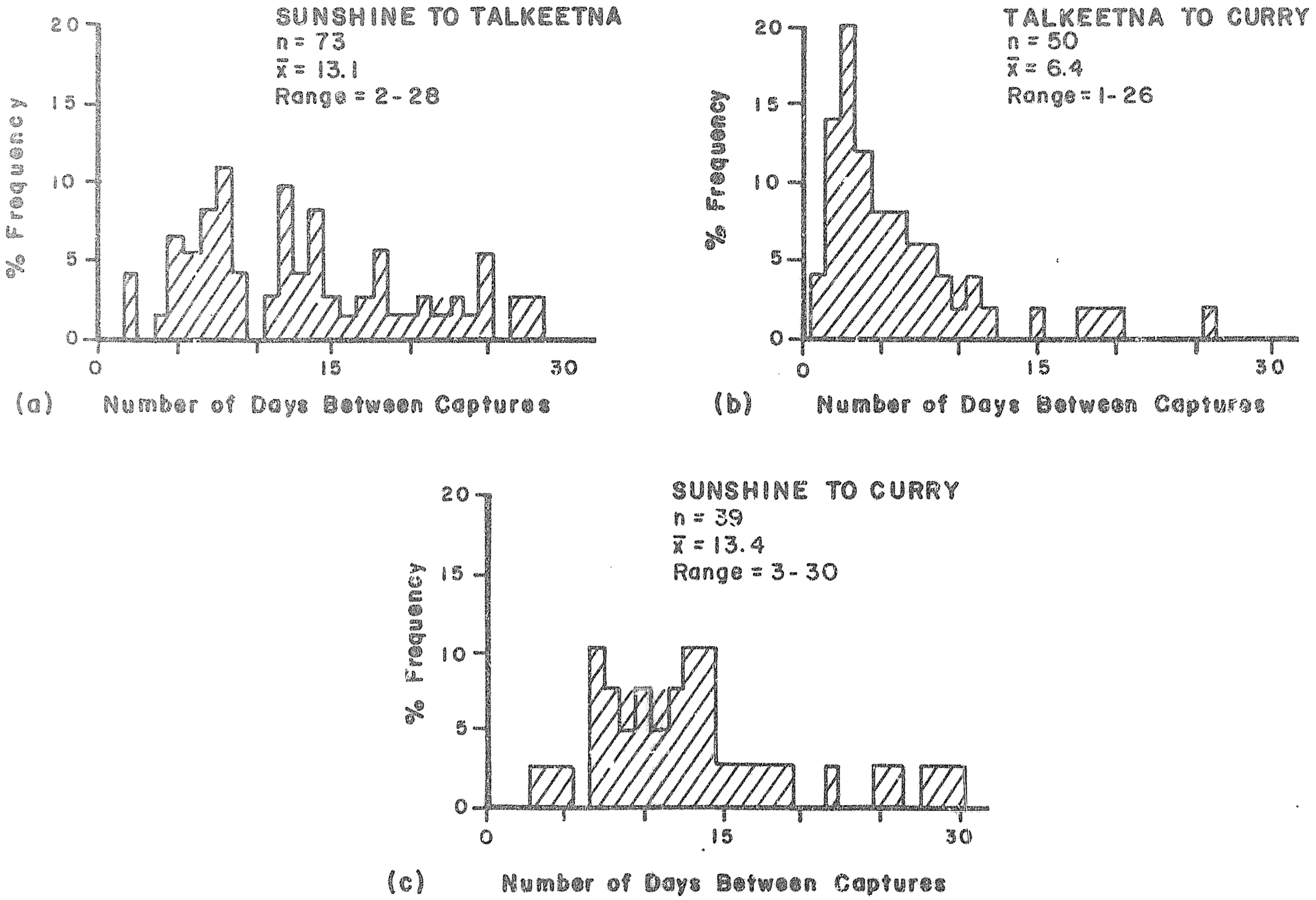


Figure 2-3-8. Migrational rates of chinook salmon between (a) Sunshine and Talkeetna stations, (b) Talkeetna and Curry stations and (c) Sunshine and Curry stations, Adult Anadromous Investigations, Su Hydro Studies, 1983.

Station were fish that had gone to sea in their second year of life. The remainder of the sample had gone to sea in their first year of life. At Curry Station five and six year old fish represented 68 percent of the escapement sample with the remaining 32 percent represented by fish seven, three and four years old in order of contribution. Nearly all (97.7%) the escapement sampled for age from Curry Station were fish that had gone to sea in their second year of life.

Length composition data of chinook salmon sampled at Talkeetna (RM 103) and Curry (RM 120) stations in 1983 are presented in Table 2-3-12 and Figure 2-3-9. The data indicate that the chinook salmon sampled at Talkeetna Station had about 115 mm less length than the fish sampled at Curry Station. The chinook salmon at Talkeetna Station averaged a length of 626 mm and at Curry Station, 743 mm.

Sex composition data collected at Talkeetna (RM 103) and Curry (RM 120) stations in 1983 are presented in Table 2-3-14. The sex ratio data indicate on overall male to female ratio of 2.1:1 and 1.4:1 respectively for samples collected at Talkeetna and Curry stations. At both stations there were more females among the six and seven year old fish than males. Among the three, four and five year old fish males were more numerous than females.

3.2.1.2.2 Spawning Ground Surveys

3.2.1.2.2.1 Main Channel

In 1983, there was no specific sampling for chinook salmon spawning in the Susitna River main channel. General observations in 1983 by the crews

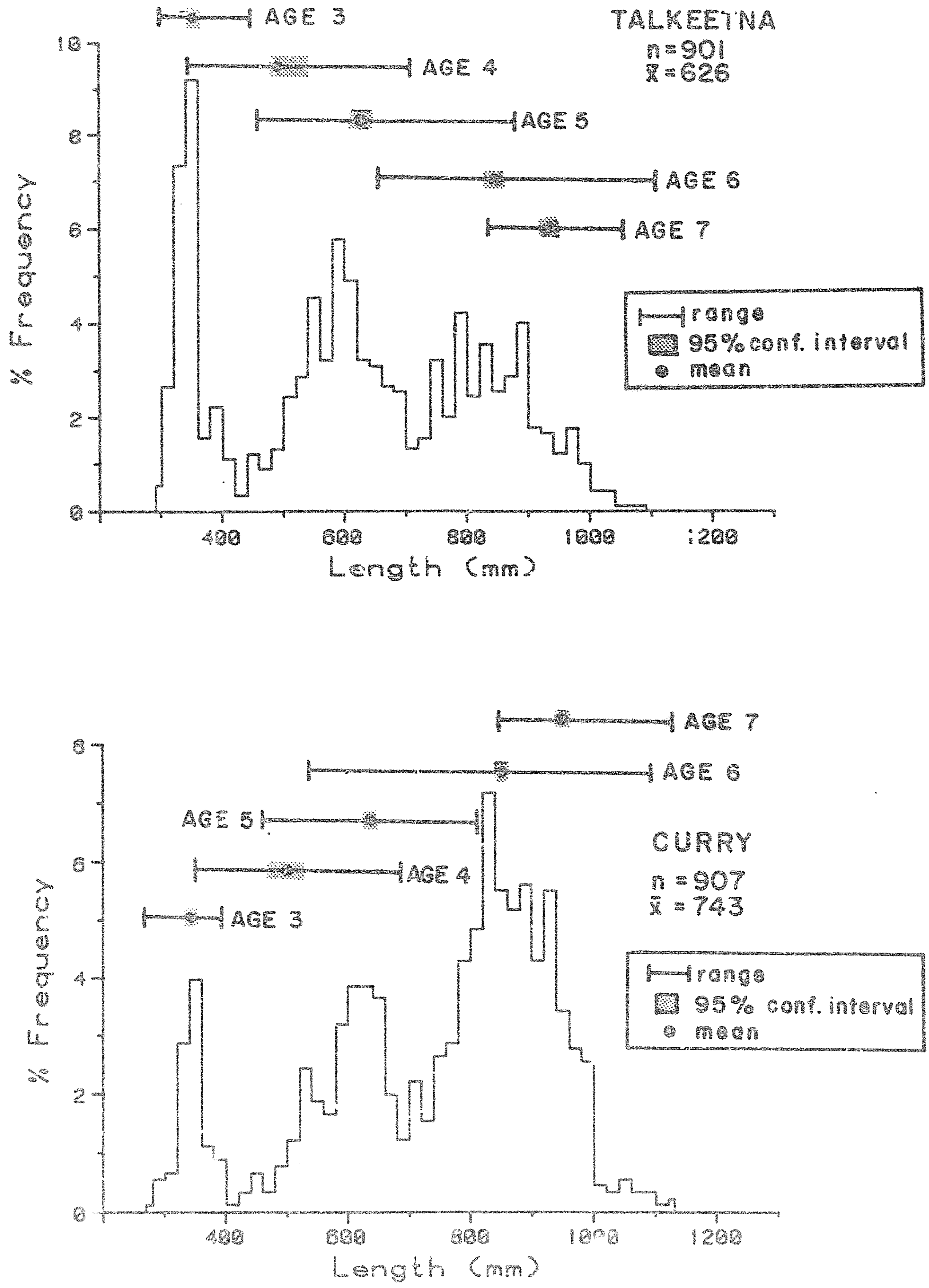


Figure 2-3-9. Length frequency distribution of chinook salmon sampled for age in 1983 at Talkeetna and Curry stations, Adult Anadromous Investigations, Su Hydro Studies, 1983.

assigned to main channel stations at RM 80, 103 and 120 and at Gold Creek (RM 136.7) provided no evidence that chinook salmon spawned in the Susitna River main channel. While these crews did not sight any chinook salmon spawning this should not be conside d conclusionary that chinook salmon did not spawn in the Susitna River main channel in 1983.

3.2.1.2.2.2 Sloughs and Streams

A total of 35 slough habitats between RM 98.6 and 161.0 were routinely surveyed for salmon escapements between July 25 and October 11, 1983. Twenty streams were likewise surveyed in this reach between July 15 and October 8, 1983.

The results of the sloughs surveyed above RM 98.6 indicate adult chinook salmon did not use these habitats in 1983 for spawning or milling. A single chinook salmon carcass was located in Slough 15 (RM 137.2) on July 25, 1983. Considering the close proximity of Slough 15 to Indian River (RM 138.6) it is likely this carcass was a wash out from Indian River.

In 1983 chinook salmon were found in 11 streams above RM 98.6 (Table 2-3-15). A total of 4,432 chinook salmon were enumerated in the peak survey counts of these streams. The majority (97.8%) of these counts were recorded at Indian River (RM 138.6) and Portage Creek (RM 148.9). The remaining nine streams accounted for 2.2 percent of the total peak count (Table 2-3-15).

It should be recognized that a peak survey count of chinook salmon probably does not represent more than about 52 percent of the total escapement

Table 2-3-15. Chinook salmon peak escapement counts for stream habitats above RM 98.6 in order of contribution, Adult Anadromous Investigations, Su Hydro Studies, 1983.

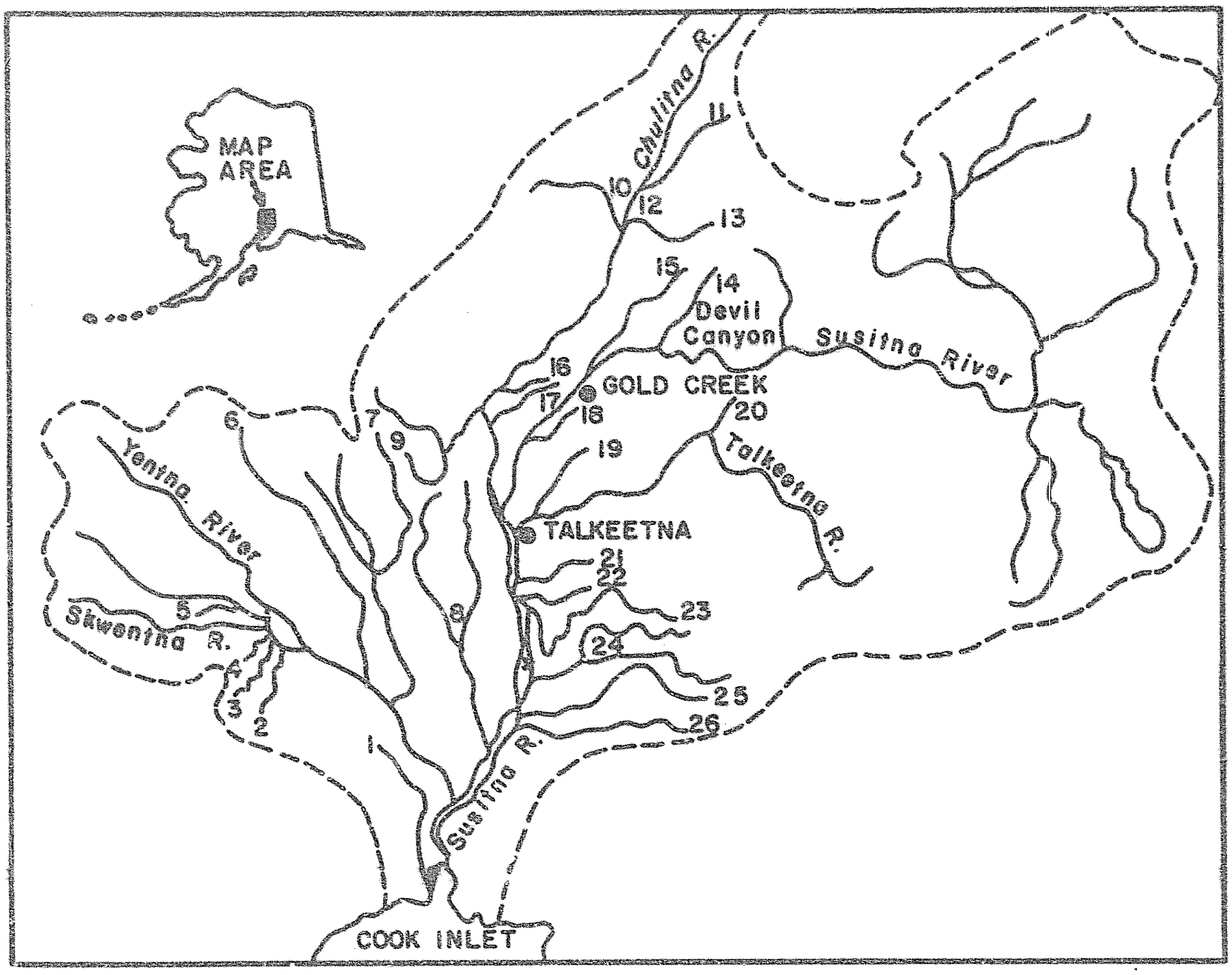
Stream	Location (RM) 1/	Date	Number Counted			Percent
			Live	Dead	Total	Contribution
Portage Creek	148.9	7/25	3,123	17	3,140	70.8
Indian River	138.6	7/25	1,172	21	1,193	26.9
Cheechako Creek	152.5	8/1	25	0	25	0.6
Gold Creek	136.7	7/24	19	4	23	0.5
Chase Creek	106.9	8/11	8	7	15	0.3
Lane Creek	113.6	8/2	10	2	12	0.3
Chinook Creek	156.8	8/1	8	0	8	0.2
Whiskers Creek	101.4	8/4	3	0	3	0.1
4th of July Creek	131.0	8/2	4	2	6	0.1
Jack Long Creek	144.5	8/1	3	3	6	0.1
Devil Creek	161.0	8/1-2	1	0	1	< 0.1
		TOTAL	4,376	56	4,432	100.0

1/ River Mile

(Neilsen and Geen, 1981). The total peak survey count in 1983 of 4,432 fish to 11 stream habitats above RM 98.3 probably represents an escapement in the range of 8,500 fish. Inasmuch as there has been no record of chinook salmon spawning in the main channel of the Susitna River above RM 98.6 and there was a complete survey of all suspected and known salmon spawning tributaries above RM 98.6 in 1983, it would be reasonable to assume that the 14,500 (1983) escapement estimate for Talkeetna Station (RM 103) represents a combination of both milling fish that reached RM 103 but spawned below RM 103 and fish which migrated past RM 103 to upstream spawning areas. Milling behavior characterized by salmon ascending a river beyond their final spawning designation has been reported in several studies of Susitna River salmon escapements. Barrett (1974) reported that a portion of the adult salmon escapement that reached RM 103 in 1974 spawned in downstream spawning areas. Radio telemetry observations of four chinook salmon released at RM 103 in 1981 revealed that three of the four fish spawned above RM 103 and the remaining one fish spawned below this location (ADF&G, 1981). In 1982 five of seven radio tagged chinook salmon released at RM 103 spawned in tributaries below RM 103, including the Talkeetna River (RM 97.1) (ADF&G, 1982). Chinook salmon tag recovery surveys conducted in Talkeetna River and Chulitna River (RM 98.5) tributaries this year further substantiate that a portion of the 1983 escapement to RM 103 descended to downstream spawning areas (Appendix Table 2-G-4).

3.2.1.3 Escapement Index Surveys

In 1983, escapement surveys were conducted at 19 of 26 designated chinook salmon spawning index streams in the Susitna River drainage (Figure 2-3-10 and Table 2-3-16). The results indicate escapements in 11 of the 19 index streams in 1983 were higher than the previous seven year average and nine of these streams supported escapements higher than any year between 1976 and 1982 (Table 2-3-17). Overall, the 1983 chinook salmon escapement in the Susitna River drainage index streams was approximately six percent higher than the escapement average for the previous seven years (1976-1982).



1. ALEXANDER CREEK	10. CHULITNA MIDDLE FORK	19. CLEAR CREEK
2. TALACHULITNA	11. CHULITNA EAST FORK	20. PRAIRIE CREEK
3. QUARTZ CREEK	12. CHULITNA RIVER	21. MONTANA CREEK
4. CANYON CREEK	13. HONOLULU CREEK	22. GOOSE CREEK
5. RED CREEK	14. PORTAGE CREEK	23. SHEEP CREEK
6. LAKE CREEK	15. INDIAN RIVER	24. KASHWITNA RIVER NORTH FORK
7. PETERS CREEK	16. BYERS CREEK	25. LITTLE WILLOW CREEK
8. DESHKA RIVER	17. TROUBLESOME CREEK	26. WILLOW CREEK
9. BUNCO CREEK	18. LANE CREEK	

Figure 2-3-10. Susitna River basin with chinook salmon index streams defined, Adult Anadromous Investigations, Su Hydro Studies, 1983.

Table 2-3-16. 1983 escapement surveys of chinook salmon index streams in the Susitna River drainage, Adult Anadromous Investigations, Su Hydro Studies, 1983.

Stream Surveyed	Survey			No. of Chinook Salmon Counted		
	Date	Method	Conditions	Live	Dead	Total
Alexander Creek (Mouth to Lake)	7/19	Hel.	Good	3,755	0	3,755
Wolverine Creek (Alexander Cr. drainage)	7/19	Hel.	Good	491	0	491
Sucker Creek (Alexander Cr. drainage)	7/19	Hel.	Good	597	0	597
Bunco Creek	8/2	Foot	Good	277	2	523
Canyon Creek	7/13	S.Cub	Excellent	575	0	575
Cheechako Creek (Devil Canyon)	7/24 8/1	Hel. Hel.	Excellent Excellent	16 25	0 0	16 25
Chinook Creek (Devil Canyon)	7/24 8/1	Hel. Hel.	Excellent Excellent	4 8	0 0	4 8
Chulitna River (Middle Fork)	7/19 8/3	Raft Raft	Excellent Excellent	3,842 883	4 75	3,846 958
Clear Creek	8/1	Hel.	Good	758	48	806
Deshka River	7/26	Hel.	Excellent	19,237	0	19,237
Devil Creek	8/2	Hel.	Excellent	1	0	1
Goose Creek	7/18	Hel.	Fair	472	5	477
Indian River	7/25 8/2	Hel. Hel.	Excellent Excellent	1,172 417	21 76	1,193 493
Kashwitna River (North Fork)	7/18	Hel.	Good	297	0	297
Lake Creek	7/26	Hel.	Excellent	7,025	50	7,075
Camp Creek (Lake Cr. drainage)	7/29	Hel.	Excellent	1,050	0	1,050
Sunflower Creek (Lake Cr. drainage)	7/29	Hel.	Excellent	2,250	0	2,250
Lane Creek	8/2	Hel.	Excellent	[illegible]	2	12

Table 2-3-16. Continued.

Stream Surveyed	Survey			No. of Chinook Salmon Counted		
	Date	Method	Conditions	Live	Dead	Total
Little Willow Creek	7/19	Hel.	Good	1,039	3	1,042
Montana Creek	7/14	Foot	Excellent	1,638	3	1,641
Peters Creek	7/14	Hel.	Excellent	2,272	0	2,272
Portage Creek	7/25	Hel.	Excellent	3,123	17	3,140
	8/1	Hel.	Excellent	2,172	384	2,556
Prairie Creek	7/20	Foot & Cessna	Excellent	871	0	3,200
Sheep Creek	8/18	Hel.	Fair	942	3	945
Talachulitna River	7/29	Hel.	Excellent	9,714	300	10,014
Willow Creek						
Parks Hwy to Mouth	7/18	Hel.	Good	83	0	83
Canyon to Highway	7/19	Raft	Excellent	690	4	694

Table 2-3-17. Chinook salmon peak survey escapement counts of Susitna River Basin streams from 1976 to 1983, Adult Anadromous Investigations, Su Hydro Studies, 1983.

Stream	Year							
	1976	1977	1978	1979	1980	1981	1982	1983
Alexander Creek	5,412	9,246	5,854	6,215	a/	a/	2,546	3,755
Deshka River	21,693	39,642	24,639	27,385	a/	a/	16,000 e/	19,237
Willow Creek	1,660	1,065	1,661	1,086	a/	1,357	592 d/	777
Little Willow Creek	833	598	436	324 c/	a/	459	316 d/	1,042
Kashwitna River (North Fork)	203	336	362	457	a/	557	156 d/	297
Sheep Creek	455	630	1,209	778	a/	1,013	527 d/	945
Goose Creek	160	133	283	b/	a/	262	140 d/	477
Montana Creek	1,445	1,443	881	1,094 c/	a/	814	887 d/	1,641
Lane Creek	b/	b/	b/	b/	b/	40	47	12
Indian River	537	393	114	285	a/	422	1,053	1,193
Portage Creek	702	374	140	190	a/	659	1,253	3,140
Prairie Creek	6,513	5,790	5,154	a/	a/	1,900	3,844	3,200 e/
Clear Creek	1,237	769	997	864 c/	a/	a/	982	806
Chulitna River (East Fork)	112	168	59	a/	a/	a/	119 d/	b/
Chulitna River (MF)	1,870	1,782	900	a/	a/	a/	644 d/	3,846
Chulitna River	124	229	62	a/	a/	a/	100 d/	b/
Honolulu Creek	24	36	13	37	a/	a/	27 d/	b/
Byers Creek	53	69	a/	28	a/	a/	7 d/	b/
Troublesome Creek	92	95	a/	a/	a/	a/	36 d/	b/
Bunco Creek	112	136	a/	58	a/	a/	198	523
Peters Creek	2,280	4,102	1,335	a/	a/	a/	a/	2,272
Lake Creek	3,735	7,391	8,931	4,196	a/	a/	3,577	7,075
Talachulitna River	1,319	1,856	1,375	1,648	a/	2,129	3,101	10,014
Canyon Creek	44	135	b/	b/	b/	84	b/	575
Quartz Creek	b/	8	b/	b/	b/	8	b/	b/
Red Creek	b/	1,511	385	b/	b/	749	b/	b/

a/ No total count due to high turbid water
b/ Not counted
c/ Poor counting conditions
d/ Counts conducted after peak spawning
e/ Estimated peak spawning count

Chinook salmon escapements to index streams in 1983 averaged approximately 50 percent more fish than in 1982 (Table 2-3-17). For the west side of the Susitna River below RM 97 the 1983 escapement was approximately 60 percent more than the 1982 escapement. The east side Susitna River index streams below RM 97 were not surveyed during the peak of spawning in 1982 and therefore no comparison can be made with the 1983 escapement data. The Talkeetna River drainage (RM 97.1) index streams in 1983 supported about 15 percent less escapement than in 1982. For the Chulitna River drainage (RM 98.5) the escapements were about 430 percent higher in 1983 than in 1982. In the Susitna River reach above RM 98.6 approximately 80 percent higher escapements were realized in 1983 than in the previous year.

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3.2.2 Sockeye Salmon

3.2.2.1 Intertidal to Talkeetna

3.2.2.1.1 Main Channel Escapement Monitoring

3.2.2.1.1.1 First Run

The first run sockeye salmon escapement into the Yentna River (RM 28) was not monitored at Yentna Station (TRM 04) in 1983. This station was operational in late June 1983 which is after first run sockeye passed through the lower Yentna River.

Sunshine Station (RM 80) on the Susitna River main channel was operated early enough in the 1983 season to record the first run sockeye salmon escapement. An estimate of 3,300 first run sockeye salmon migrated past this location in 1983. The 95 percent confidence interval associated with this estimate was computed at 3,000 to 3,700 fish (Table 2-3-18). Based on fishwheel catches the migration essentially began on June 6 at Sunshine Station, reached a midpoint on June 10 and ended on June 19. The peak of migration occurred on June 14 at 3.7 fish per fishwheel hour (Appendix Table 2-D-6).

Table 2-3-18. Petersen population estimate .f the first run sockeye salmon escapement to Sunshine Station, Adult Anadromous Investigations, Su Hydro Studies, 1983.

Population Estimate Location	River Mile	Tagged (m)	Examined for Tags (c)	Recaptures (r)	Population Estimate 1/ ($\hat{N}$)	95% Confidence Interval
Sunshine Station	80	415	2,296	286	3,332	3,006-3,737

1/ Migration period of first run sockeye salmon extended from June 5 through June 28, 1983.

In 1983, the escapement of first run sockeye salmon passed essentially along the east side of the Sunshine River at Sunshine Station (RM 80). The two east bank station fishwheels caught 399 first run fish and the two fishwheels operated off the west side caught only one (Appendix Table 2-D-6).

Age composition data was collected from 290 first run fish at Sunshine Station (RM 80) in 1983 (Table 2-3-19). The data indicated the escapement was comprised mainly of four (26.9%) and five (71.4%) year old fish which had gone to sea after one winter in freshwater (Table 2-3-19).

Length data was collected from 334 first run sockeye salmon at Sunshine Station (RM 80). The results are presented in Table 2-3-20. The five and six year old males sampled at this station averaged a larger length than the

Table 2-3-26. Analysis of sockeye salmon lengths, in millimeters, by age class from escapement samples collected at Yentna, Sunshine, Talkeetna and Curry stations, Adult Anadromous Investigations, Su Hydro Studies, 1983.

Collection Site	Age Class	n		Range Limits		Mean		95% Conf. Interval 3/		Median	
		M 1/	F 2/	M	F	M	F	M	F	M	F
Yentna Station	3_1	4	-	380-436	-	403	-	-	-	399	-
	3_2	47	1	291-465	403	329	403	-	-	324	403
	4_1	3	1	448-502	570	469	570	-	-	456	570
	4_2	377	308	342-622	422-566	473	484	469-478	481-485	464	483
	4_3	8	1	324-388	571	358	571	-	-	361	571
	5_1	2	3	584-587	535-554	586	543	-	-	586	539
	5_2	134	98	442-645	439-615	577	548	571-582	541-555	583	552
	5_3	13	5	426-551	492-522	490	507	-	-	499	510
	6_2	-	2	-	540-587	-	564	-	-	-	564
	6_3	10	7	520-600	498-568	564	544	-	-	569	546
	ALL 4/	722	493	291-652	403-615	488	502	483-494	499-506	481	495
		1215		291-652		494		490-498		[illegible]	
Sunshine Station First Run	4_2	39	39	355-565	370-640	477	499	460-495	478-520	480	505
	5_2	119	88	355-690	400-615	527	521	516-538	512-529	540	520
	5_3	-	2	-	430-480	-	455	-	-	-	455
	6_2	2	1	505-590	505	548	505	-	-	548	505
	ALL 4/	186	148	355-690	370-650	515	514	506-524	506-522	525	515
		334		355-690		515		508-521		520	
Sunshine Station Second Run	3_1	-	-	400	-	400	-	-	-	400	-
	4_1	-	1	-	460	-	460	-	-	-	460
	4_2	309	321	325-665	390-580	476	482	470-481	478-486	470	480
	4_3	3	2	360-405	370-550	382	460	-	-	380	460
	5_1	-	1	-	565	-	565	-	-	-	565
	5_2	165	170	400-655	420-640	573	541	567-579	536-547	580	540

Table 2-3-20. Continued.

Collection Site	Age Class	n M [1/]	n F [2/]	Range Limits M	Range Limits F	Mean M	Mean F	95% Conf. Interval [3/] M	95% Conf. Interval [3/] F	Median M	Median F
Sunshine	5_3	8	9	400-580	430-520	506	483	-	-	515	485
Station	6_3	-	4	-	485-560	-	530	-	-	-	538
Second Run	ALL [4/]	554	584	325-695	370-640	510	502	504-515	499-506	510	500
(Continued)		1138		325-695		506		503-509		505	
Talkeetna	3_1	1	-	420	-	420	-	-	-	420	-
Station	3_2	13	1	320-435	365	343	365	-	-	340	365
	4_2	101	74	330-625	375-600	472	496	462-482	487-505	465	500
	4_3	17	-	320-460	-	355	-	-	-	350	-
	5_2	73	58	480-670	480-690	590	561	583-597	550-571	595	560
	5_3	4	2	440-570	515-550	521	533	-	-	538	533
	ALL [4/]	267	171	320-690	365-690	498	526	487-509	518-534	500	525
		438		320-690		509		502-516		515	
Curry	3_1	1	-	400	-	400	-	-	-	400	-
Station	3_2	7	-	300-405	-	337	-	-	-	320	-
	4_2	51	31	420-640	435-545	467	502	-	-	450	505
	4_3	3	-	320-365	-	347	-	-	-	355	-
	5_1	1	-	485	-	485	-	-	-	485	-
	5_2	7	15	520-605	480-580	569	551	-	-	580	560
	5_3	1	1	570	380	570	380	-	-	570	380
	ALL [4/]	82	50	300-640	380-580	459	515	443-475	504-526	450	515
		132		300-640		481		469-492		488	

1/ Males

2/ Female

3/ Confidence Interval of the Mean.

4/ Composite of all aged and non-aged samples.

Table 2-3-19. Analysis of sockeye salmon age data by percent from escapement samples collected at Yentna, Sunshine, Talkeetna and Curry stations, Adult Anadromous Investigations, Su Hydro Studies, 1983.

Collection Site	n	Age Class 1/									
		3_1	3_2	4_1	4_2	4_3	5_1	5_2	5_3	6_2	6_3
Yentna Station	1024	0.4	4.7	0.4	66.8	0.9	0.5	22.6	1.8	0.2	1.7
Sunshine Station											
First Run	290	-	-	-	26.9	-	-	71.4	0.7	1.0	-
Second Run	994	0.1	-	0.1	63.4	0.5	0.1	33.7	1.7	-	0.4
Talkeetna Station	344	0.3	4.1	-	50.9	4.9	-	38.1	1.7	-	-
Curry Station	118	0.8	5.9	-	69.6	2.5	0.8	18.7	1.7	-	-

1/ Gilbert-Rich Notation

females. The four year old females averaged a larger length than the four year old males. The overall average length of all male and female first run sockeye salmon sampled at Sunshine Station was 515 mm.

Figure 2-3-11 provides a percent comparison of the male and female first run sockeye salmon sampled for age at Sunshine Station (RM 80) in 1983. The comparison indicates there were about an equal number of male and female four year old fish and about 25 percent more males than females among the five year old fish. The overall male to female ratio of all aged and non aged first run sockeye salmon sampled at this station was 1.3:1 (Table 2-3-21).

3.2.2.1.1.2 Second Run

The 1983 escapements of second run sockeye salmon were determined in the Yentna River (RM 28) at Yentna Station (TRM 04) by SSS counters and in the

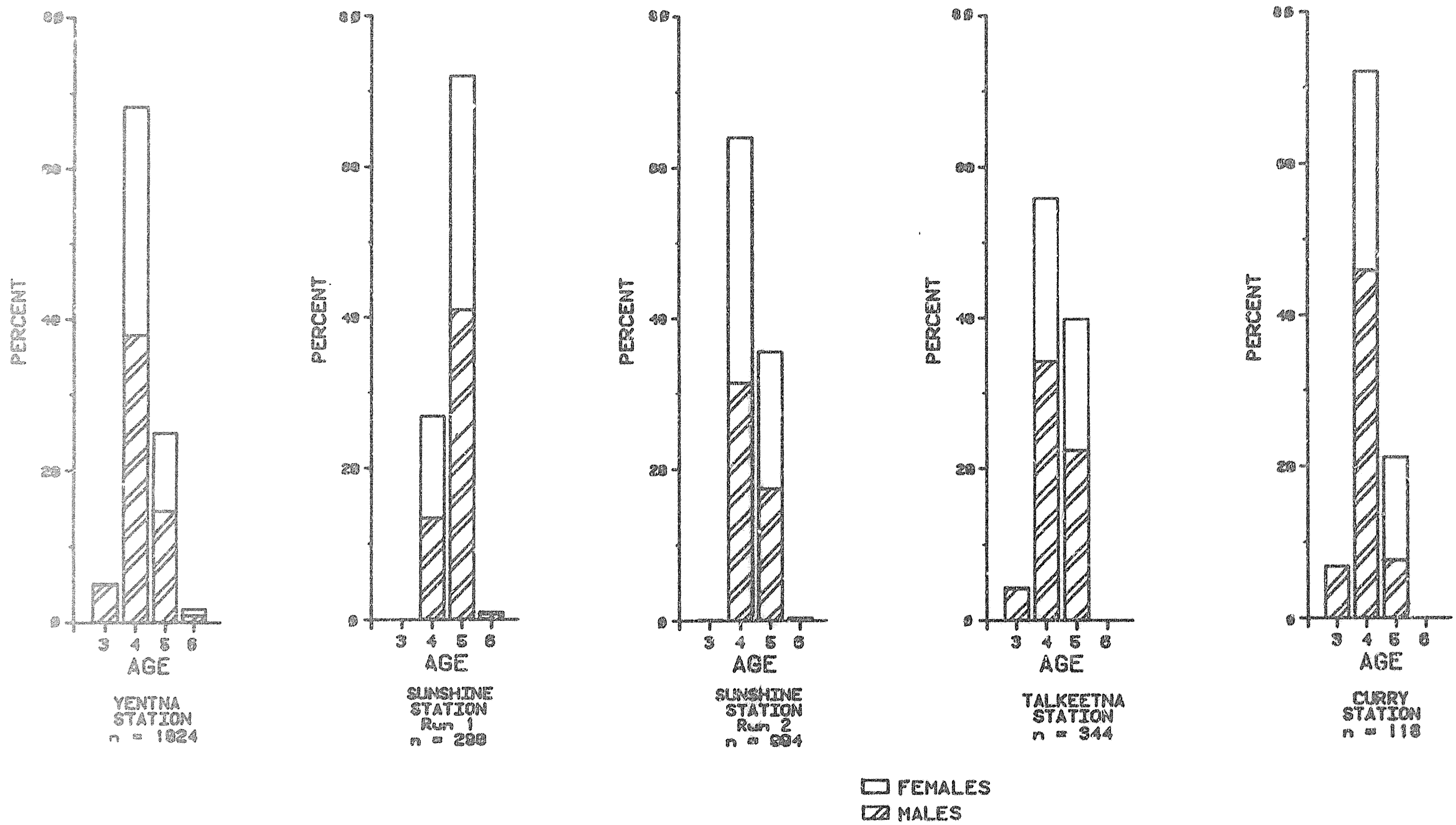


Figure 2-3-11. Age composition of fishwheel intercepted sockeye salmon at Yentna, Sunshine, Talkeetna and Curry stations, Adult Anadromous Investigations, Su Hydro Studies, 1983.

Table 2-3-21. Sex ratios of male and female sockeye salmon by age from escapement samples collected at Yentna, Sunshine, Talkeetna and Curry Stations, Adult Anadromous Investigations, Su Hydro Studies, 1983.

Collection Site	Age	Sample Size	Number		Sex Ratio (M:F)
			Males	Females	
Yentna Station	3	52	51	1	51.0:1
	4	698	388	310	1.3:1
	5	255	149	106	1.4:1
	6	19	10	9	1.1:1
	All 1/	1215	722	493	1.5:1
Sunshine Station First Run	3	0	0	0	-
	4	78	39	39	1.0:1
	5	209	119	90	1.3:1
	6	3	2	1	2.0:1
	All 1/	334	186	148	1.3:1
Second Run	3	1	1	0	-
	4	636	312	324	1.0:1
	5	353	173	180	1.0:1
	6	4	0	4	-
	All 1/	1138	554	584	0.9:1
Talkeetna Station	3	15	14	1	14.0:1
	4	192	118	74	1.6:1
	5	137	77	60	1.3:1
	All 1/	438	267	171	1.6:1
Curry Station	3	8	8	0	-
	4	85	54	31	1.7:1
	5	25	9	16	0.6:1
	All 1/	132	82	50	1.6:1

1/ Includes all aged and non-aged samples.

Susitna River at Sunshine Station (RM 80) by the Petersen mark/recapture method (Table 2-3-8). The 1983 escapement into the Yentna River (RM 28) was an estimated 104,400 fish (Table 2-3-22). For the Susitna River at Sunshine Station (RM 80) the escapement was estimated to be 71,700 fish (Table 2-3-23).

The migrational timing of the 1983 second run sockeye salmon escapements to Yentna (TRM 04) and Sunshine (RM 80) stations can be calculated from station fishwheel catches (Figure 2-3-12). Based on fishwheel catch rates, the Yentna River (RM 28) migration began on July 14, reached a midpoint on July 22 and ended on August 15. In the Susitna River at Sunshine Station the escapement migration began on July 17, reached a midpoint on July 23 and ended on August 14.

Fishwheel catches of second run sockeye salmon in the Yentna River (RM 28) at Yentna Station (TRM 04) and in the Susitna River at Sunshine Station (RM 80) indicate a migrational preference by the species to passage along the south bank at Yentna Station and the east bank of Sunshine Station assuming mixed stocks and no differential fishwheel selectivity. At Yentna Station the north bank fishwheel caught approximately 80 percent of the total station catch of 4,648 second run sockeye salmon (Appendix Table 2-D-1). The remaining percentage (20%) was landed in the south bank fishwheel. At Sunshine Station, the two east bank fishwheels caught approximately 67 percent of the total 7,707 station catch and the two west bank fishwheels caught the remaining 33 percent (Appendix Table 2-D-4).

Table 2-3-22. Apportioned sonar counts of chinook, sockeye, pink, chum and coho salmon at Yentna Station, Adult Anadromous Investigations, Su Hydro Studies, 1983.

Sampling Location	Operational Period	Apportioned Sonar Counts				
		Chinook	Sockeye	Pink	Chum	Coho
Yentna Station	6/30 to 9/5	613	104,414	60,661	10,802	8,867

Table 2-3-23. Petersen population estimates with associated 95% confidence intervals of the sockeye salmon escapements to Sunshine, Talkeetna and Curry stations, Adult Anadromous Investigations, Su Hydro Studies, 1983.

Parameter 1/	Population Estimate Location		
	Sunshine Station 2/	Talkeetna Station	Curry Station
m	7,677	421	130
c	2,570	1,675	1,474
r	275	166	102
$\hat{N}$	71,745	4,248	1,879
95% C.I.	64,537- 80,766	3,712- 4,965	1,582- 2,311

1/ m = Number of fish marked (adjusted).
c = Total number of fish examined for marks during sampling census.
r = Total number of marked fish observed during sampling census.
$\hat{N}$ = Population estimate.
C.I. = Confidence interval around $\hat{N}$.

2/ Sockeye salmon escapement estimate for Sunshine Station does not include the population estimate for first run sockeye.

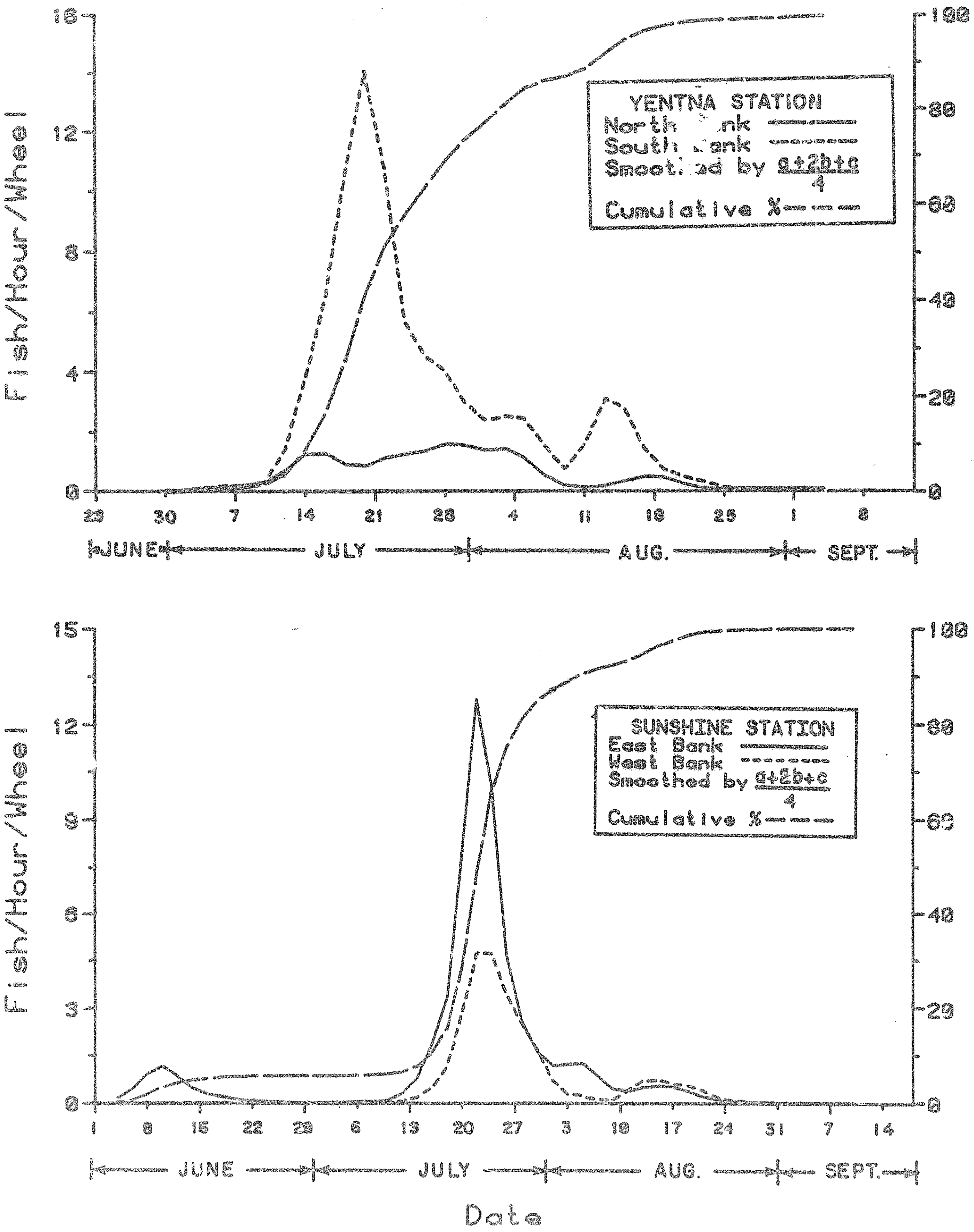


Figure 2-3-12. Mean hourly and cumulative percent fishwheel catch of sockeye salmon by two day periods at Yentna and Sunshine stations, Adult Anadromous Investigations, Su Hydro Studies, 1983.

Age composition data of second run sockeye salmon sampled in 1983 at Yentna (TRM 04) and Sunshine (RM 80) stations are provided in Table 2-3-19. The results indicate the escapement into the Yentna River (RM 28) in 1983 was primarily four (66.8%) and five (22.6%) year old fish that had traveled to sea in their second year of life. Also represented in the Yentna River escapement sample were three (5.1%) and six (1.9%) year old fish, and four (1.3%) and five (2.3%) year old fish that had migrated to sea in their first or third years of life. Age samples collected at Sunshine Station (RM 80) in the Susitna River indicate the majority of the escapement was comprised of four (63.4%) and five (33.7%) year old fish that had left freshwater in their second year of life. Three and six year old fish represented less than one percent of the escapement sample from Sunshine Station.

Length data from second migration sockeye salmon sampled at Yentna (TRM 04) and Sunshine (RM 80) stations in 1983 have been summarized in Table 2-3-20. The data indicate the sockeye salmon in the Yentna River (RM 28) averaged about 12 mm smaller than the fish sampled in the Susitna River at Sunshine Station. The average length measured at Yentna Station was 494 mm and at Sunshine Station 506 mm.

Sex composition data from escapement sampling of second migration sockeye salmon at Yentna (TRM 04) and Sunshine (RM 80) stations are presented in Table 2-3-21. Results indicate a higher number of males than females at both stations. The overall male to female ratio of the Yentna River (RM 28) escapement sample calculates at 1.5:1 and for the Susitna River at Sunshine Station 0.9:1.

3.2.2.1.1.3 Fecundity

In 1983, sockeye salmon fecundities were determined for Susitna River stocks from samples collected at Sunshine Station (RM 80). A total of 25 female sockeye salmon were sampled for number of eggs between July 28 and 30. The mean number of eggs per female sockeye salmon was approximately 3,543 and ranged in value from 2,954 to 4,792 eggs (Table 2-3-24).

Table 2-3-24. Number of eggs, length, weight and associated statistics for all sockeye salmon sampled for fecundity at Sunshine Station, Adult Anadromous Investigations, Su Hydro Studies, 1983.

Variables	Statistic				
	Sample Size	Mean	Standard Deviation	Standard Error of the Mean	Range
Number of Eggs	25	3,543	530.7	106.1	2,954 - 4,792
Length (mm)	25	513	36.8	7.4	465 - 575
Weight (g)	25	1,979	495.4	99.1	1,325 - 2,775

The relationship between length and the number of eggs per female sockeye salmon was determined using regression and correlation analysis with the results of these analyses presented in Figure 2-3-13. The correlation between the two variables is 'good' as indicated by a coefficient of correlation (r) value of 0.73. Replacing length with weight as the independent variable also provides a 'good' linear relationship (r= 0.78) as portrayed in Figure 2-3-13.

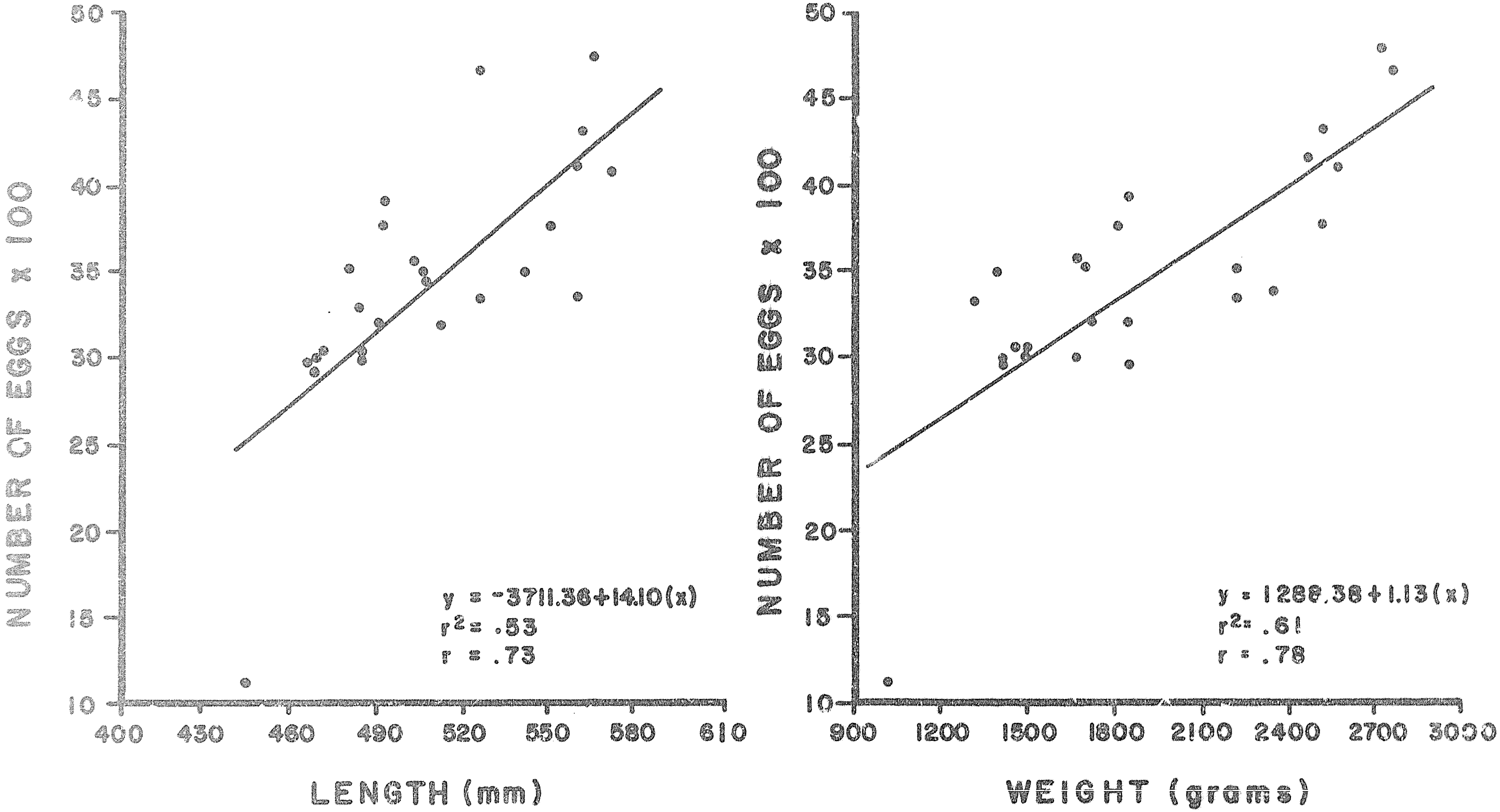


Figure 2-3-13. Number of eggs for sockeye salmon sampled at Sunshine Station as a function of length and weight, Adult Anadromous Investigations, Su Hydro Studies, 1983.

Susitna River sockeye salmon fecundities can also be predicted by utilizing the following multiple regression equation:

$$y_c = 597.93 + 1.83\,(x_1) + 1.01\,(x_2)$$

where: Y_c = predicted number of eggs

x_1 = length measurement

x_2 = weight measurement

and: coefficient of determination (r^2) = .61

correlation coefficient (r) = .78

Any further analysis of these data for the purposes of predicting egg deposition should provide for sockeye salmon egg retention. This information is provided in report section 2.4. It should also be noted, for further analysis, that it was assumed there was essentially no differences in fecundities between Susitna River sockeye salmon stocks.

Analyses are also provided for sockeye salmon fecundities segregated by age. This information is presented in Appendix 2-F but because of the small sample sizes should be considered as informative and not analytical in nature.

3.2.2.1.2 Spawning Ground Surveys

3.2.2.1.2.1 Sloughs and Streams

3.2.2.1.2.1.1 First Run

In 1983, Papa Bear Lake and its inlet stream were surveyed to provide tag recapture data for determining the first run sockeye salmon escapement to Sunshine Station. Papa Bear Lake and its inlet stream are located in the

Talkeetna River watershed (RM 97.1) as shown in Figure 2-3-14. The tag recovery results are provided in Table 2-3-25.

The inlet stream of Papa Bear Lake was the only apparent area where first run sockeye salmon spawned in 1983. Tag recovery collections and ground and aerial escapement surveys of other Susitna River tributaries in association with other work reported in Section 3.2 provided no information of first run escapement spawning elsewhere.

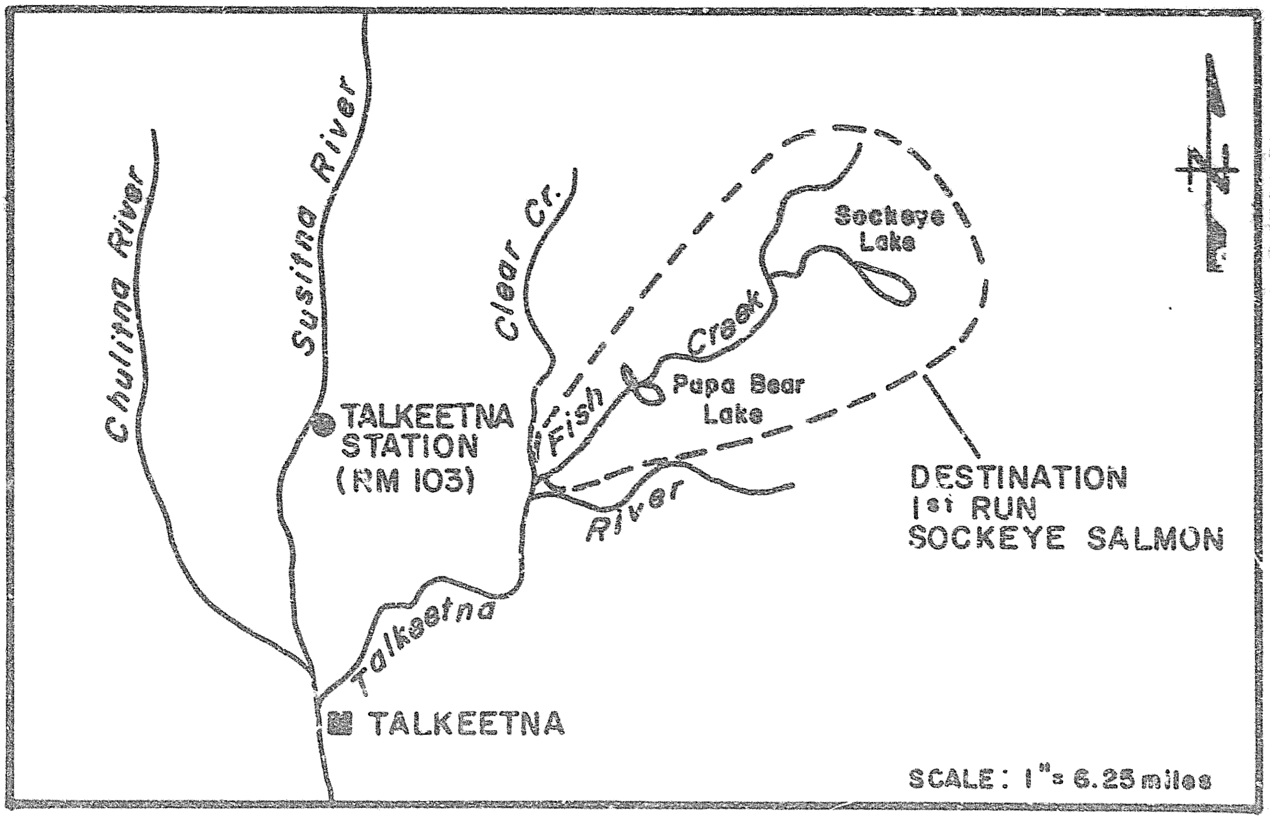


Figure 2-3-14. Destination of first run sockeye salmon tagged at Sunshine Station on the Susitna River in 1983, Adult Anadromous Investigations, Su Hydro Studies, 1983.

Based on escapement surveys conducted at Papa Bear Lake and its inlet stream, first run sockeye salmon reached peak spawning between the second and fourth weeks of July 1983 (Table 2-3-25). On the June 29 and 30 surveys of this area, nearly all the fish observed were holding off the mouth of the Papa Bear inlet stream with the exception of one fish which had ascended the inlet stream. On July 19, a relatively low number of fish (50-100) were holding off the mouth of Papa Bear Lake inlet stream and approximately 1300 fish had ascended the creek and were actively spawning.

Table 2-3-25. Escapement survey counts of tagged and untagged first run sockeye salmon tagged at Sunshine Station, Adult Anadromous Investigations, Su Hydro Studies, 1983.

Area Surveyed	River Mile 1/	Date	Survey Conditions	Sunshine Tags: Tagged (r)	Untagged	Total (c)	Ratio (c/r)
Papa Bear Lake	97.1	6/29	Good	134	676	810	6.1
Papa Bear Lake Inlet Stream	97.1	6/29	Excellent	0	1	1	0.0
Papa Bear Lake	97.1	6/30	Excellent	22	149	171	7.8
Papa Bear Lake	97.1	7/19	Poor 2/				
Papa Bear Lake Inlet Stream	97.1	7/19	Good	128	1175	1303	10.2

1/ Confluence of stream or receiving system with Susitna River mainstem.

2/ Fish not surveyed for tag recovery data. Approximately 50-100 sockeye salmon were milling at the lake inlet.

3.2.2.1.2.1.2 Second Run

In 1983, second run sockeye salmon escapement surveys were conducted in five tributaries which enter the Susitna River reach between RM 80 and 97.8.

These surveys were performed exclusively to provide tag recovery data for use in calculating an escapement estimate to Sunshine Station (RM 80). The results have been tabulated in Appendix Table 2-G-5. The tag to untagged ratios recorded for samples greater than 10 fish ranged from 1:2.3 to 1:18.3. Generally the highest ratios were recorded in the Chulitna River drainage (RM 97.8) and the lowest in the Talkeetna River drainage (RM 97.1).

3.2.2.2 Talkeetna to Upper Devil Canyon

3.2.2.2.1 Main Channel Escapement Monitoring

3.2.2.2.1.1 First Run

The four fishwheels operated in the Susitna River in 1983 at Talkeetna Station (RM 103) caught a total of 11 first run sockeye salmon between June 12 and 24 (Appendix Table 2-D-9). Four of the 11 fish were caught in the two day period between June 21 and 22. Two of the 11 fish caught were recaptures from Sunshine Station (RM 80). The first recapture at RM 103 was made on June 13 of a fish that on June 9 had been released at RM 80. The second recapture occurred on June 16 of a fish that had been tagged four days earlier Sunshine Station.

No estimate was made of the 1983 escapement of first run sockeye salmon to Talkeetna Station (RM 103) due to the lack of recaptures at Curry Station (RM 120) and the absence of first run fish spawning areas above RM 103. The first run sockeye salmon that migrated to Talkeetna Station in 1983 were probably milling fish which spawned below RM 103.

The two fishwheels at Curry Station (RM 120) on the Susitna River ran continuously between June 9 and July 5, 1983 without making any sockeye salmon catches (Appendix Table 2-D-12). From this observation it can be concluded that first run sockeye salmon did not migrate to or above RM 120 in 1983.

3.2.2.2.1.2 Second Run

The 1983 escapement of second run sockeye salmon to Talkeetna Station (RM 103) is estimated at approximately 4,200 fish and at Curry Station (RM 120), 1,900 fish (Table 2-3-23). The 95 percent confidence interval associated with these estimates are provided in Table 2-3-23.

The migrational timing of the 1983 escapements to Talkeetna (RM 103) and Curry (RM 120) stations have been determined from an analysis of the fishwheel catch data (Section 2.4.3). At Talkeetna Station the second run migration of sockeye salmon began on July 15, reached a midpoint on August 1 and ended on August 18. The peak migration occurred on August 3 with 41 fish being caught in the four fishwheels. Upstream at Curry Station, the migration began on July 17, reached a midpoint on August 5 and ended on August 25 (Figure 2-3-15). The peak catches were made on August 2, 12 and 13. Ten fish were landed each of these days in the two station fishwheels.

Based on fishwheel catches, 1983 second run fish had no strong preference to migration along the east or west banks of the Susitna River at Talkeetna Station (RM 103). The preference at Curry Station (RM 120) in 1983 was towards the east bank. About 80 percent of the station catch was made by the east bank fishwheel.

In 1983, a total of 101 second run sockeye salmon were recaptured at Talkeetna (RM 103) and Curry (RM 120) stations that had been earlier tagged at Sunshine Station (RM 80). Another 17 recaptures were made at Curry Station from releases at Talkeetna Station. The migration timing of these fish has been graphed in Figure 2-3-16. In comparing the average travel times between Sunshine, Talkeetna and Curry stations it appears that migration speed increased and/or milling behavior decreased the further distance fish traveled upstream. The average net speed traveled between Sunshine and Talkeetna stations was 2.4 mpd, between Talkeetna and Curry stations 3.0 mpd, and between Sunshine and Curry stations 3.8 mpd (Figure 2-3-16).

Age composition data of second run sockeye salmon sampled at Talkeetna (RM 103) and Curry (RM 120) stations in 1983 are presented in Table 2-3-19. The results indicate the majority of the escapements to both locations were four and five year old fish which had traveled to sea after spending one winter in freshwater. Also represented were three year old fish which accounted for less than seven percent of the sample from each station.

Length measurements collected from second run sockeye salmon at Talkeetna (RM 103) and Curry (RM 120) stations are summarized in Table 2-3-20. In 1983 the second run fish averaged about 28 mm larger length at Talkeetna Station than at Curry Station. The average length measured at Talkeetna Station was 509 mm and at Curry Station 481 mm.

Results of sampling second migration sockeye salmon for sex at Talkeetna (RM 103) and Curry (RM 120) stations are provided in Figure 2-3-11 and

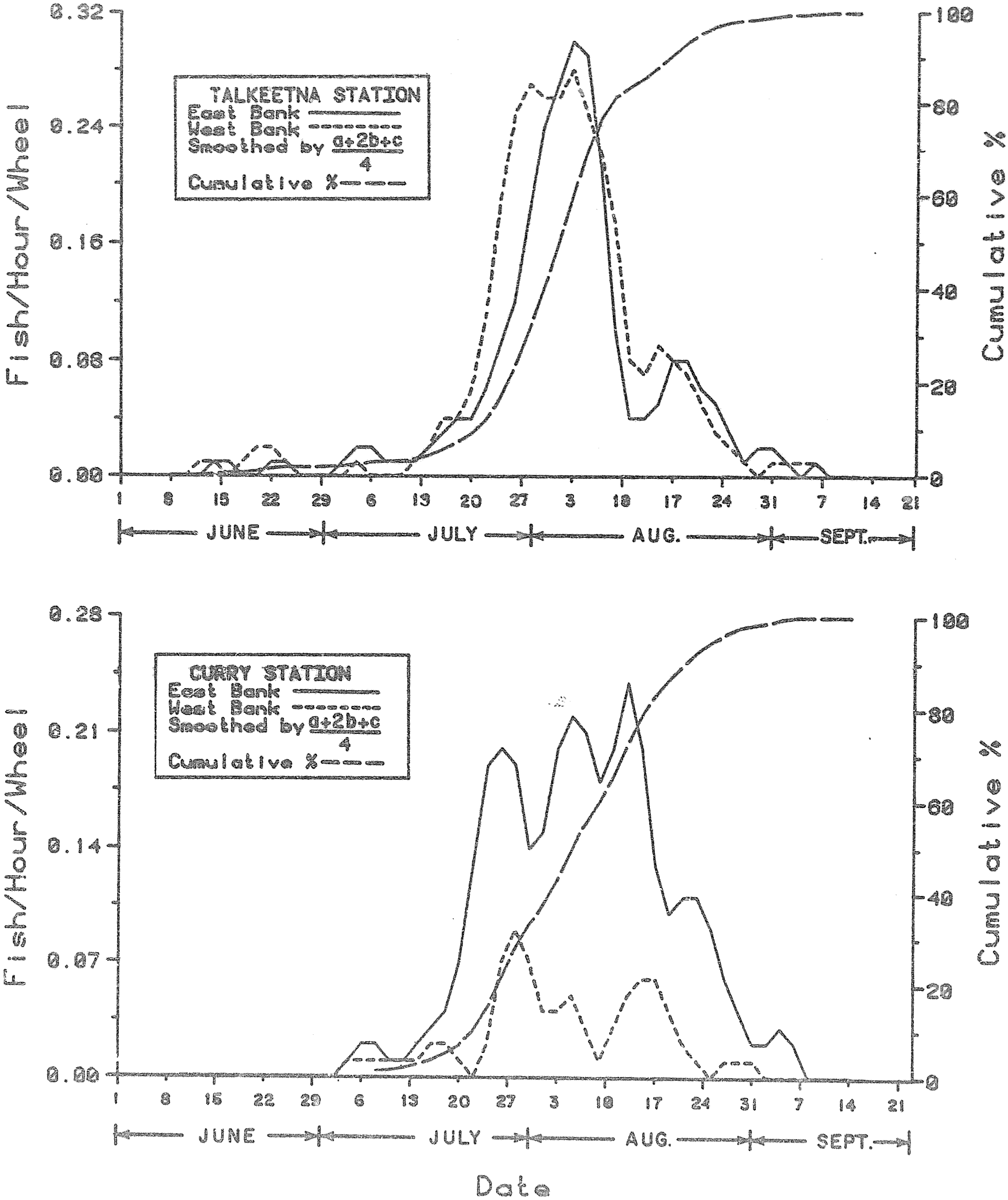


Figure 2-3-15. Mean hourly and cumulative percent fishwheel catch of sockeye salmon by two day periods at Talkeetna and Curry stations. Adult Anadromous Investigations, Su Hydro Studies, 1983.

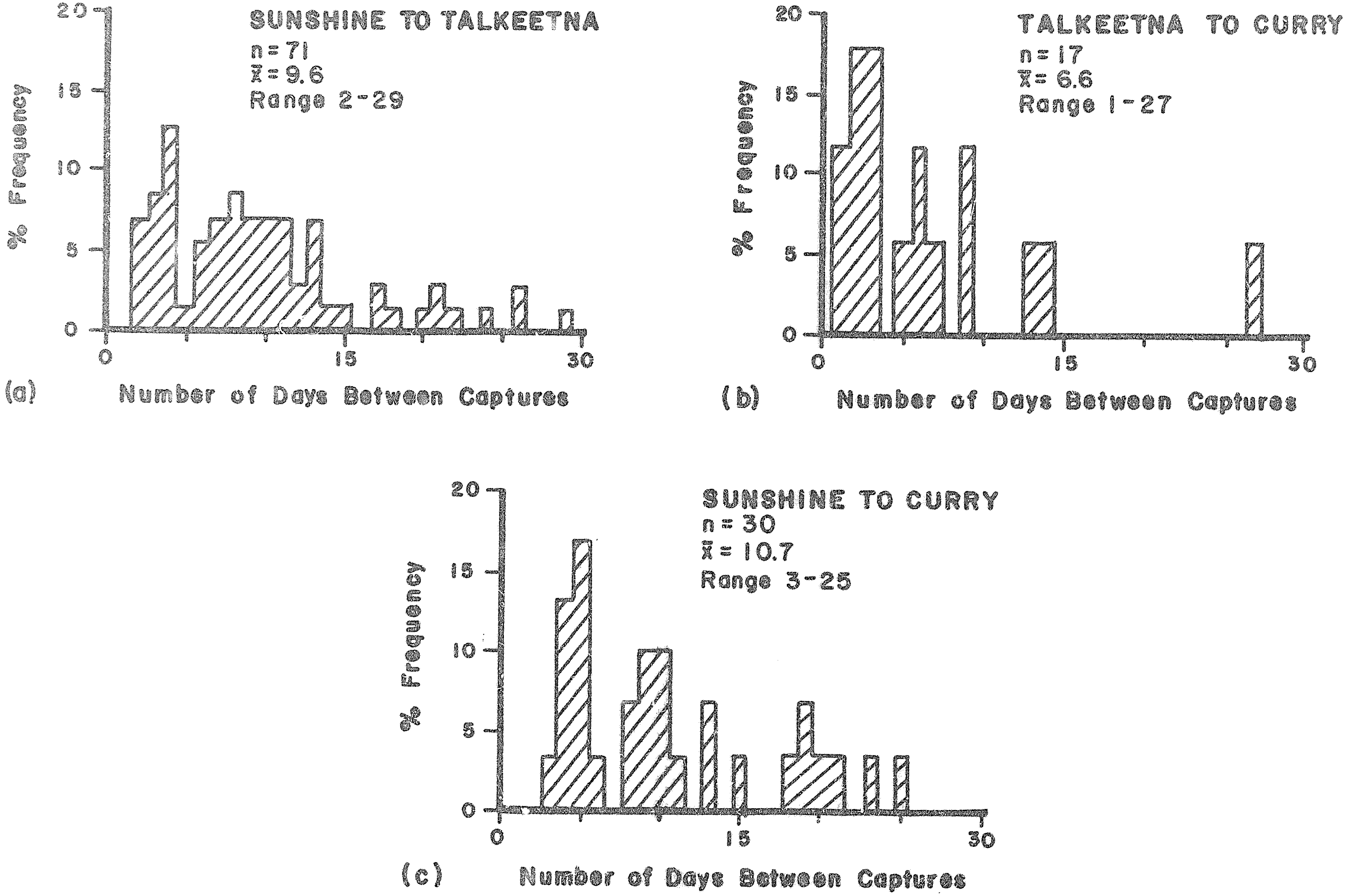


Figure 2-3-16. Migrational rates of sockeye salmon between (a) Sunshine and Talkeetna stations, (b) Talkeetna and Curry stations and (c) Sunshine and Curry stations, Adult Anadromous Investigations, Su Hydro Studies, 1983.

Table 2-3-21. The data indicate there were a higher number of males than females in nearly every age class sampled at both stations. The overall male to female sex ratio at Talkeetna Station was 1.6:1 and at Curry Station 1.6:1.

3.2.2.2.2 Spawning Ground Surveys

3.2.2.2.2.1 Main Channel

In 1983, there was no inclusive sampling of the Susitna River main channel for sockeye salmon spawning. Project crews assigned to main channel escapement monitoring sites at Talkeetna (RM 103) and Curry (RM 120) stations did not observe any main channel spawning by this species in 1983. The stream and slough survey crew based at Gold Creek (RM 136.7) located a single spawning site that extended along the west bank of the Susitna River main channel between RM 138.6 and 138.9 (Appendix Table 2-G-1). This site was located on September 15, and on that date it supported approximately 11 spawning sockeye salmon. A map depicting the location can be found in Appendix Table 2-G.-10

3.2.2.2.2.2 Streams

A total of 20 stream habitats were surveyed in 1983 for sockeye salmon between RM 98.6 and 161.0. The results are presented in Appendix Table 2-G-3. A single sockeye salmon was observed in Indian River (RM 138.6) on August 19. This was the only sockeye salmon observed in any Susitna River stream habitat in 1983. It can be concluded that sockeye salmon spawning did not occur in stream habitats above RM 98.6 in 1983.

3.2.2.2.2.3 Sloughs

3.2.2.2.2.3.1 Observation Life

A total of 77 sockeye salmon were monitored to define the average number of days a single fish could be visually seen in sloughs Moose (RM 123.5), 8A (RM 125.1) and 11 (RM 135.3). The results, presented in Table 2-3-26, indicate differences existed between the observation life of male and female sockeye wherein generally, the individual male sockeye salmon spent less time in a slough habitat than the individual female. The combined average observation life of both male and female sockeye salmon was 8.1 days in Moose Slough, 13.0 days in Slough 8A and 14.5 days in Slough 11. The differences between these numbers can be partially explained by differences in visibility in these sloughs (Figure 2-3-17). The lowest average observation life was recorded in Moose Slough, the slough which had the highest frequency of restricted visibilities. Comparatively, in Slough 11 where the average observation life was the highest, visibility was the least restricted. The problem of restricted visibility however does not limit the usefulness of the data for computing total sockeye salmon escapement to slough habitats. The observation life surveys were conducted during the same time that regular escapement counts were conducted with both crews encountering similar visibility conditions. For example, several times the Susitna River breached the head of Moose Slough and restricted fish visibility. When this occurred the crew making individual fish observations were often unable to locate fish previously identified. At least some of the previously identified fish were probably present but not visible and therefore considered absent. The crew conducting escapement counts encountered the same conditions and registered

Table 2-3-26. Summary of mean number of days individual sockeye salmon were observed in sloughs Moose, 8A and 11, Adult Anadromous Investigations, Su Hydro Studies, 1983.

Slough + RM 1/	Males			Females			Combined		
	n	Range (days)	Mean (days)	n	Range (days)	Mean (days)	n	Range (days)	Mean (days)
Moose RM 123.5	3	2.0-12.0	9.1	4	8.0-10.5	6.7	7	2.0-12.0	8.1
8A RM 125.1	13	2.0-38.0	10.2	3	18.0-35.0	25.0	16	2.0-38.0	13.0
11 RM 135.3	35	0.5-37.0	13.0	20	2.0-40.0	17.2	55	0.5-40.0	14.5
							Mean average =		11.8

1/ RM = River Mile

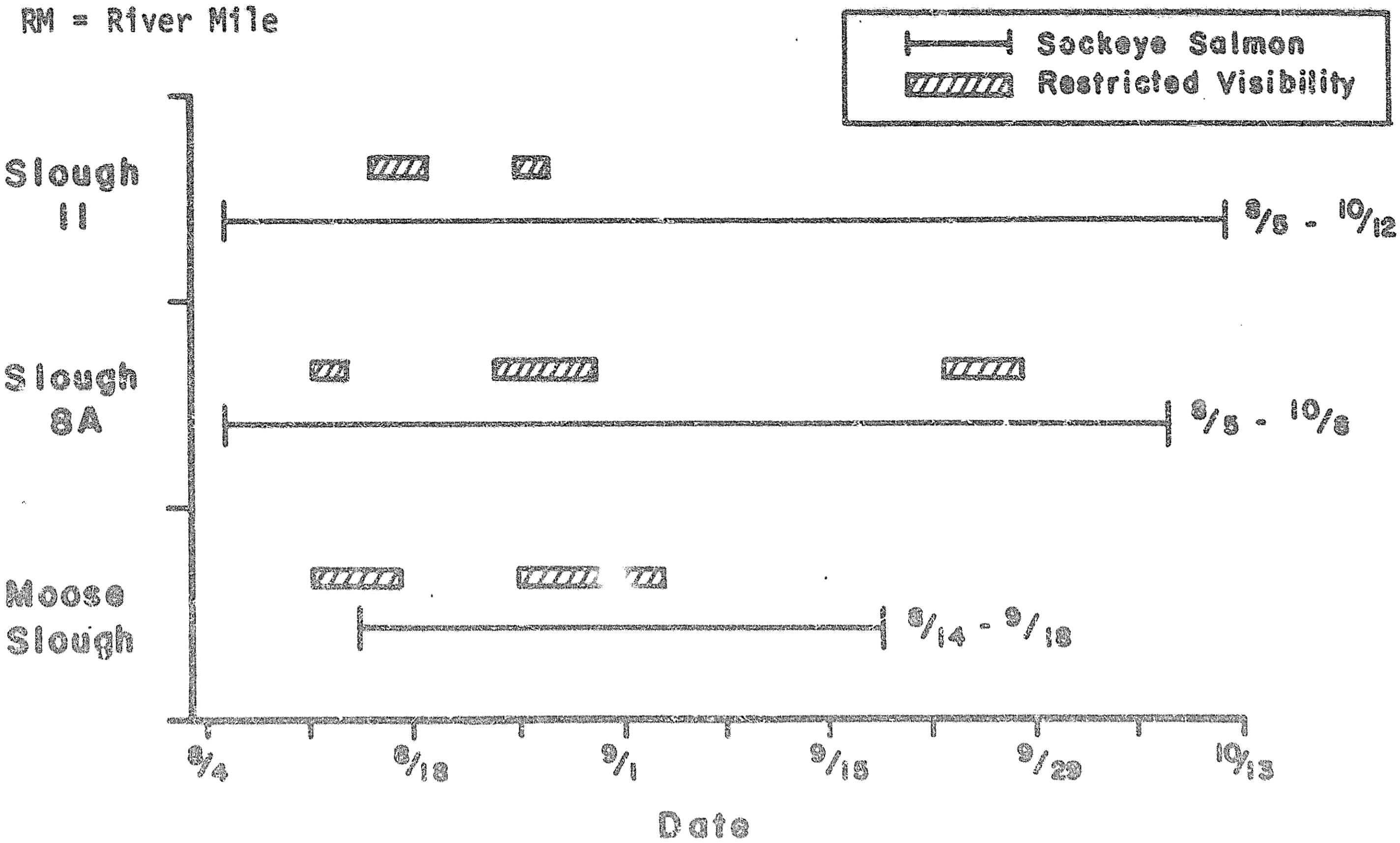


Figure 2-3-17. Periodicies of restricted visibility conditions and sockeye salmon life observations in 1983 at sloughs Moose, 8A and 11, Adult Anadromous Investigations, Su Hydro Studies, 1983.

corresponding results with the counts reflecting the presence of less fish then were probably present.

The average observation life of a sockeye salmon using slough habitats in 1983 was 11.8 days determined by averaging the observation life means from results recorded at sloughs Moose (RM 23.5), 8A (RM 125.1) and 11 (RM 135.3) (Table 2-3-26). This estimate will subsequently be applied with the regular escapement count data to calculate the escapement to sloughs other than Moose, 8A and 11 between RM 98.6 and 161.0 where respective peak survey counts exceeded 15 fish. Escapement to sloughs Moose, 8A and 11 will be determined in Section 3.2.2.2.2.3.2 by using the respective slough observation life estimate in conjunction with the respective slough escapement count data. The mathematical method for calculating total escapement by respective slough habitat can be found in Section 2.4.

In 1983 between 57.1 and 76.4 percent of the sockeye salmon monitored for observation life in sloughs Moose (RM 123.5), 8A (RM 125.1) and 11 (RM 135.3) initiated or completed spawning in the slough of first recorded entry, (Table 2-3-27). The remainder (23.6-42.9%) did not spawn. These fish either departed the slough or died from bear predation or stranding. At least one of the seven sockeye salmon monitored in Moose Slough spawned elsewhere, as a fish observed in Moose Slough in mid August was later found in mid September at Slough 11 where it was observed to have spawned. Of 55 sockeye salmon monitored in Slough 11 one fish experienced pre-spawning mortality by being stranded in a riffle. At sloughs Moose and 8A there were no recorded mortalities associated with stranding.

Table 2-3-27. Percentages of sockeye salmon monitored for observation life that spawned by habitat zone in sloughs Moose, 8A and 11, Adult Anadromous Investigations, Su Hydro Studies, 1983.

Slough with RM 1/	n 2/	Percent Spawning	Spawning Location by Habitat Zone 3/ 1	2	3	4	5	6	7	Percent Non-spawning 4/
Moose RM 123.5	7	57.1	50.0	50.0	0.0	-	-	-	-	42.9
8A RM 125.1	16	75.0	8.3	0.0	91.7	-	-	-	-	25.0
11 RM 135.3	55	76.4	7.1	7.1	0.0	45.3	0.0	28.6	11.9	23.6

1/ RM = River Mile

2/ Total sample for all sloughs equals 78 fish; actually 77 individual fish were monitored with one individual occupying both Moose Slough and Slough 11.

3/ Habitat zones defined in Appendix Figures 2-G-2 thru 2-G-5, Adult Anadromous Investigations, Su Hydro Studies, 1983.

4/ Includes milling fish and also bear killed and other non-spawning mortalities.

In the process of monitoring sockeye salmon for observation life a record was kept of where these fish spawned in sloughs Moose (RM 123.5), 8A (RM 125.1) and 11 (RM 135.3) in 1983 (Table 2-3-27). At Slough 11 where 42 spawning fish were monitored, approximately 86 percent of them spawned in the middle to upper reach of the slough above habitat zone 3 (Appendix Figure 2-G-5). In Slough 8A, the predominate spawning area was zone 3 (Appendix Figure 2-G-3). And at Moose Slough, half of the sockeye salmon spawned in zone 1 and the balance used zone 2 (Appendix Figure 2-G-2).

3.2.2.2.2.3.2 Escapement

A total of 35 slough habitats between RM 98.6 and 161.0 were surveyed in 1983 for sockeye salmon. The results are provided in Appendix Table 2-G-2.

The following 11 sloughs were found to contain sockeye salmon in 1983:

1. Slough 3B (RM 101.4)
2. Moose Slough (RM 123.5)
3. Slough 8A (RM 125.1)
4. Slough B (RM 126.3)
5. Slough 9 (RM 128.3)
6. Slough 9A (RM 133.8)
7. Slough 10 (RM 133.8)
8. Slough 11 (RM 135.3)
9. Slough 17 (RM 138.9)
10. Slough 19 (RM 139.7)
11. Slough 21 (RM 141.1)

The sockeye salmon observed in these sloughs were considered second run escapement as determined from fishwheel catches and tag releases at Talkeetna (RM 103) and Curry (RM 120) stations (Section 3.2.2.2.1).

Sockeye salmon spawned in all but three of the sloughs listed above. Sloughs 9, 9A and 10 were not considered spawning areas. Relatively few fish were seen in these sloughs and those observed were not paired-up or engaged in spawning (Appendix Table 2-G-2).

The total peak count of sockeye salmon to slough habitats above RM 98.6 in 1983 was 558 fish less four fish recorded in peak counts of sloughs 9, 9A and 10 (Table 2-3-28). This total peak count of 554 does not represent total escapement or even a consistent portion of the total escapement, due to variability in spawning timing and duration. A peak count is at best an escapement index (Cousens, et al). A more reliable estimate of escapement to slough habitats can be obtained by developing, for each slough, a spawner abundance curve expressed in number of live fish days and then calculating escapement on the basis of mean observation life data provided in report Section 3.2.4.2.2.3.1. These calculations have been accomplished in Table 2-3-29 for sloughs Moose, 8A, 11 and 21 where the peak survey counts exceeded 15 fish. The escapements to sloughs 3B, B, 17 and 19 were computed by multiplying the respective peak survey count by 1.9. This value represents the summation of the value of the estimated slough escapement divided by the summation of the total peak survey count for those sloughs with a peak survey count of more than 49 fish.

Table 2-3-28. Sockeye salmon peak survey counts of slough habitats above RM 98.6, Adult Anadromous Investigations, Su Hydro Studies, 1983.

Slough	Location (RM) 1/	Date	Number Counted		
			Live	Dead	Total
3B	101.4	9/19	5	0	5
Moose	123.5	9/9	21	0	22
8A	125.1	9/11	63	3	66
B	126.3	9/18	5	0	5
9	128.3	9/7	2	0	2
9A	133.8	9/11	1	0	1
10	133.8	10/1	1	0	1
11	135.3	9/11	237	11	248
17	138.9	9/22	6	0	6
19	139.7	9/9	4	1	5
21	141.1	9/9	180	17	197
		TOTAL	525	32	558

1/ River Mile

Table 2-3-29. Total 1983 sockeye salmon slough escapements between RM 98.6 and 161.0, Adult Anadromous Investigations, Su Hydro Studies, 1983.

Slough	River Mile	Total Fish Days 1/	Peak Live-Dead Survey Count	Mean Observation Life in Days 2/	Slough Escapement	% of Total Slough Escapement	% of Curry Station Escapement 4/
3B	101.4		5		10 2/	0.9	0.5
Moose	123.5	249.5	22	8.1	31	2.9	1.6
8A	125.1	1,687.8	66	13.0	130	12.3	6.8
B	126.3		5		10 2/	0.9	0.5
11	135.3	8,182.0	248	14.5	564	53.2	29.7
17	138.9		6		11 2/	1.1	0.6
19	139.7		5		10 2/	0.9	0.5
21	141.1	3,470.4	197	11.8	294	27.8	15.5
TOTAL		13,589.7	554	-	1,060	100.0	55.7

1/ Number of fish days were calculated for sloughs that had peak survey counts > 15 fish. Refer to Section 2.4 for detailed data analysis procedures.

2/ Total slough escapement into sloughs having peak live-dead survey counts of ≤15 fish were computed by multiplying the peak live-dead survey count by 1.9. This value represents the summation of the estimated slough escapement divided by the summation of the peak live-dead survey counts for all sloughs with peak survey counts ≥ 50 fish.

3/ 1983 Curry Station sockeye salmon escapement was approximately 1,900 fish.

In 1983 the total sockeye escapement to the slough habitats above RM 98.6 was approximately 1,060 fish as calculated by the manner previously described (Table 2-3-29). About 93 percent of this escapement occurred in sloughs 11, 21 and 8A in order of contribution.

The estimated (1,060 fish) escapement of sockeye salmon to slough habitats above RM 98.6 in 1983 is approximately 44 percent less than the same year estimated escapement (1,900) to the Susitna River at Curry Station (RM 80). The approximate 800 fish difference represents a combination of several factors. An unquantifiable number of milling fish reached RM 120 which spawned below RM 98.6 (Appendix Table 2-G-5). A percentage of the sockeye escapement spawned in the Susitna River main channel above RM 98.6. The 1,900 fish population estimate for Curry Station has a 95 percent confidence interval of 1,582 to 2,311 fish. The observation life and peak survey count data have some undefined levels of error. While all of these factors contributed to the 800 fish difference between the estimated total slough escapement and Curry Station escapement estimate, the two factors most likely to have the greatest influence are the percentage of fish which migrated to RM 120 and then spawned below RM 98.6, and the 700 fish confidence level spread on the Curry Station escapement estimate.

Assuming the two 1983 escapement estimates of second migration sockeye salmon to Curry Station (RM 120) and slough habitats above RM 98.6 are accurate and that less than 100 sockeye salmon spawned in the Susitna River main channel above RM 98.6 in 1983, the best estimate of milling activity at Curry Station is that approximately 39 percent of the 1,900 fish escapement that reached this station in 1983 spawned below RM 98.6. By the same analysis about 72 percent of the estimated 4,200 fish that reached Talkeetna Station in 1983 were probably milling fish that spawned below RM 98.6.

3.2.2.2.2.3.3 Egg Retention

In 1983, a total of 56 female sockeye salmon carcasses were sampled for egg retention for four slough habitats between RM 98.6 and 161.0. The results presented in Table 2-3-30 indicate an average retention of approximately 250 eggs per female from combined samples at sloughs Moose (RM 123.5), 8A (RM 125.1), 11 (RM 135.3) and 21 (RM 141.1). Nearly all the females sampled in these sloughs had completely spawned. Approximately 79 percent of the females had retained less than 25 eggs each (Figure 2-3-18). About seven percent of the sample were from fish that had retained more than 1,000 eggs each.

Table 2-3-30. Egg retention of sockeye salmon at selected slough habitats between RM 98.6 and 161, Adult Anadromous Investigations, Su Hydro Studies, 1983.

		Egg Retention		
Slough with RM [1/]	Sample Size	Mean	Median	Range
Moose Slough RM 123.5	1	7.0	-	-
Slough 8A RM 125.1	2	0.0	-	0
Slough 11 RM 135.3	33	384.7	1.5	0-3542
Slough 21 RM 141.1	20	62.7	2.0	0-858
Composite of all sloughs sampled	56	249.2	2.0	0-3542

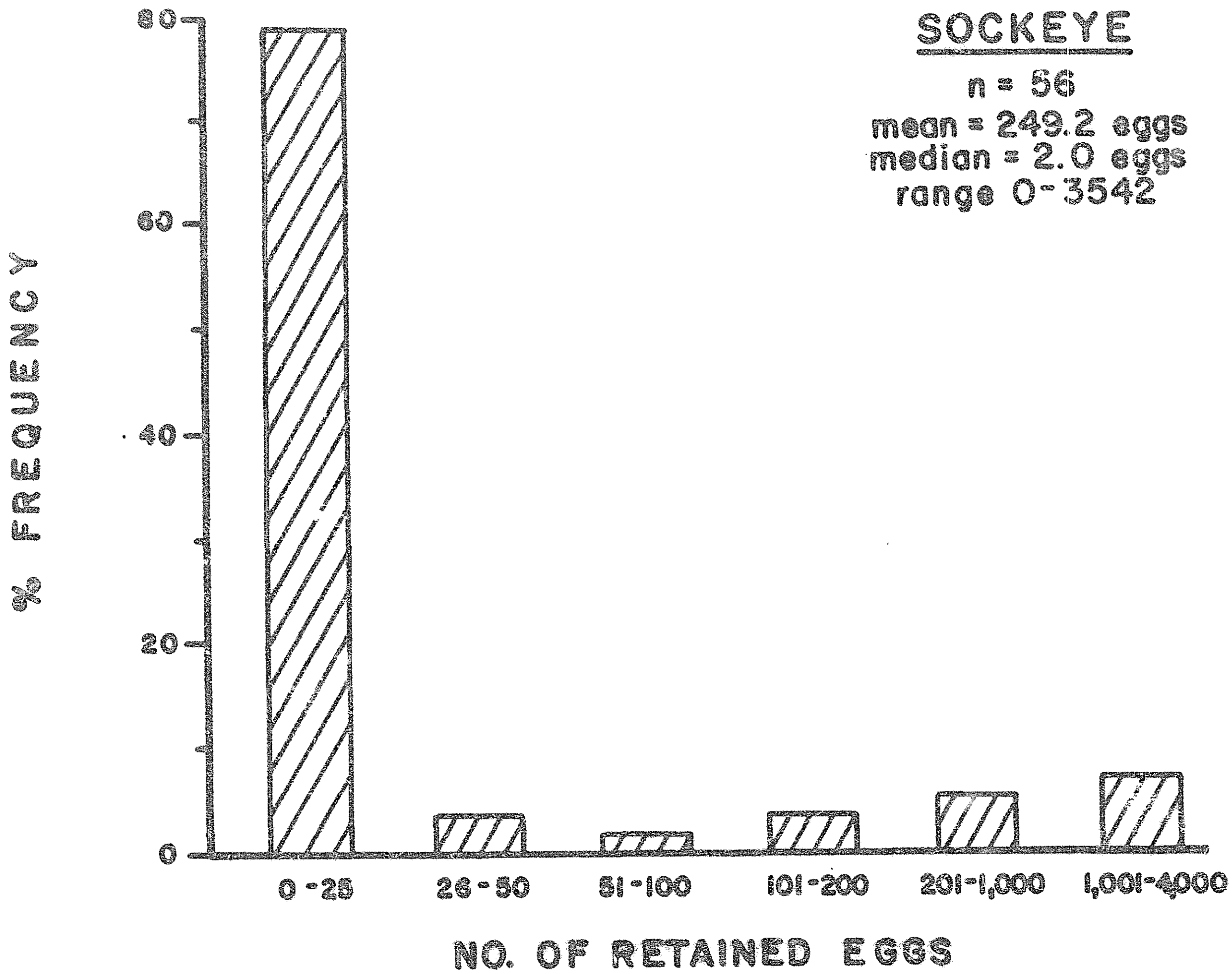


Figure 2-3-18. Percent frequency of egg numbers retained by female sockeye salmon sampled in slough habitats above RM 98.6 in 1983, Adult Anadromous Investigations, Su Hydro Studies, 1983.

3.2.3 Pink Salmon

3.2.3.1 Intertidal to Talkeetna

3.2.3.1.1 Main Channel Escapement Monitoring

Escapement estimates for Susitna River pink salmon were obtained for Yentna (TRM 04) and Sunshine (RM 80) stations in 1983 (Table 2-3-22 and 2-3-31). The 1983 pink salmon escapement to the Yentna River (RM 28) based upon the sonar counts at Yentna Station (TRM 04) was approximately 60,700 fish (Table 2-3-22). Daily and cumulative SSS counts for Yentna Station are presented in Appendix 2-C.

Table 2-3-31. Petersen population estimates with associated 95% confidence intervals of pink salmon migration to Sunshine, Talkeetna and Curry stations, Adult Anadromous Investigations, Su Hydro Studies, 1983.

Parameter 1/	Population Estimate Location		
	Sunshine Station	Talkeetna Station	Curry Station
m	2,942	1,987	446
c	6,816	3,548	2,851
r	494	743	232
$\hat{N}$	40,592	9,488	5,481
95% C.I.	37,415- 44,360	8,918- 10,136	4,879- 6,252

1/ m = Number of fish marked (adjusted).
c = Total number of fish examined for marks during sampling census.
r = Total number of marked fish observed during sampling census.
$\hat{N}$ = Population estimate.
C.I. = Confidence interval around $\hat{N}$.

For the Susitna River at Sunshine Station (RM 80) the escapement was estimated to be 40,600 fish as determined by the Petersen method (Table 2-3-31). The 95% confidence interval for this estimate was computed at between 37,400 and 44,400 fish.

The two fishwheels at Yentna Station (TRM 04) captured 4,489 pink salmon in 1983 (Table 2-3-11 and Appendix Table 2-D-3). Daily fishwheel catches indicate the migration began, reached a midpoint and ended on July 14, 26 and August 15, respectively (Figure 2-3-19). The migration peak occurred on

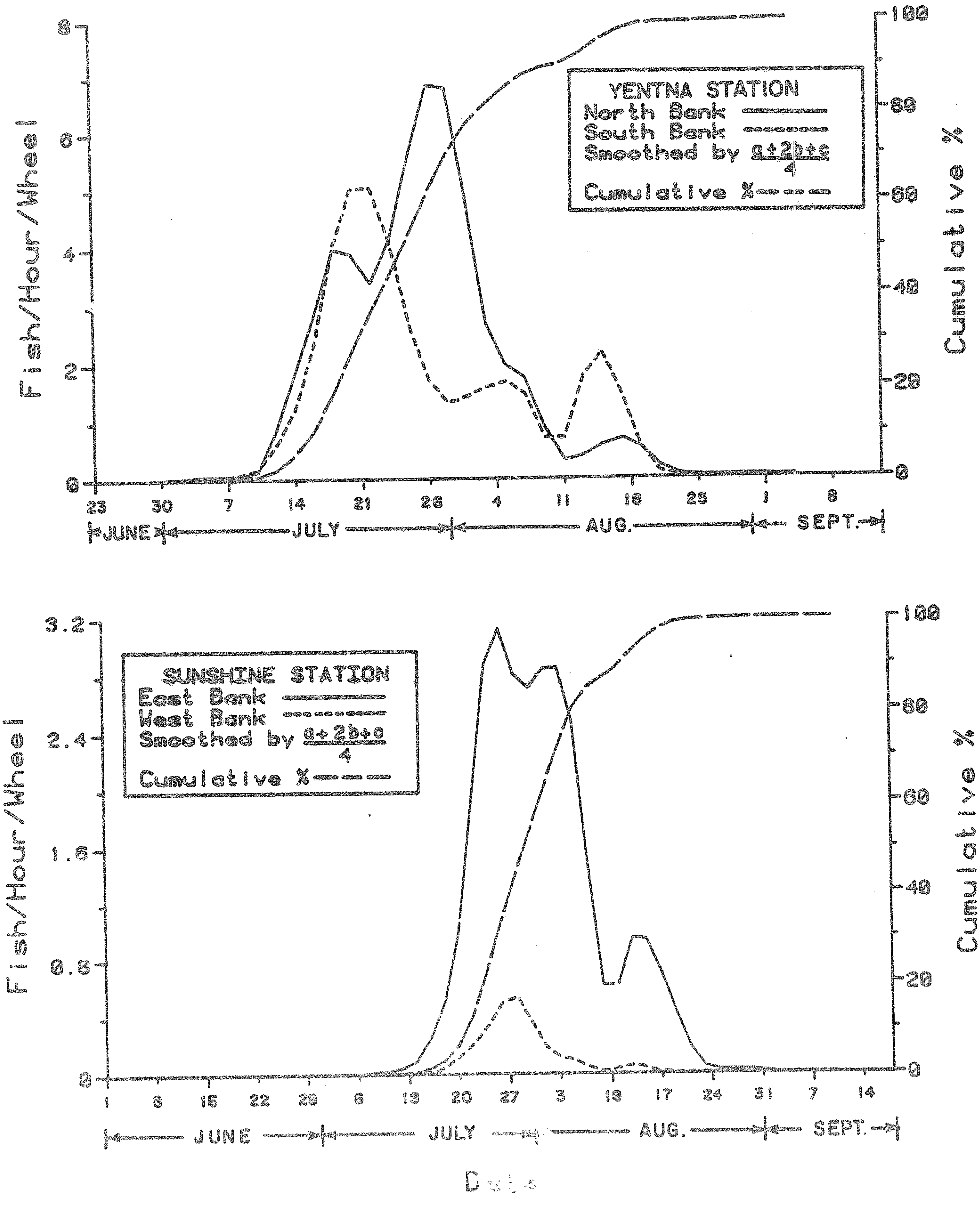


Figure 2-3-19. Mean hourly and cumulative percent fishwheel catch of pink salmon by two day periods at Yentna and Sunshine stations, Adult Anadromous Investigations, Su Hydro Studies, 1983.

July 24 with 298 pink salmon caught in the two fishwheels for an average catch rate of 6.2 fish per hour. Pink salmon showed little migrational preference for either the north or south bank. The north bank fishwheel intercepted 59.4 percent of the pink salmon and the south bank fishwheel captured the remaining 41.6 percent (Appendix 2-D).

At Sunshine Station (RM 80), fishwheels intercepted 3,085 pink salmon in 1983 (Table 2-3-11 and Appendix Table 2-D-6). Based on these catches, the migration began on July 20, reached a midpoint on July 30 and terminated on August 15 (Figure 2-3-19). The peak fishwheel catch occurred on July 25. Of the 3,085 fish intercepted at Sunshine Station, 91.6 percent were captured by the east bank fishwheels.

Length (FL) data associated with 1,126 Yentna Station (TRM 04) pink salmon samples and 987 fish from Sunshine Station (RM 80) are summarized in Table 2-3-32 and Appendix 2-E. The average overall lengths at Yentna and Sunshine stations were 426 and 429 mm respectively. Females at Yentna Station were 11 mm smaller in length than males while Sunshine Station females averaged 12 mm less than males. Of the 1,126 pink salmon sampled at Yentna Station 535 were males for a male to female sex ratio of 0.9:1 and 503 of the 987 fish sampled at Sunshine Station were males for a sex ratio of 1.0:1 (Table 2-3-32).

3.2.3.1.2 Fecundity

In 1983 Susitna River pink salmon fecundities were determined from 22 samples collected at Sunshine Station (RM 80). These samples were obtained between

Table 2-3-32. Analysis of pink salmon lengths, in millimeters, from escapement samples collected at Yentna, Sunshine, Talkeetna and Curry stations, Adult Anadromous Investigations, Su Hydro Studies, 1983.

Collection Site	n			Sex Ratio	Range Limits			Mean			95% Conf. Interval 3/			Median		
	M 1/	F 2/		(M:F)	M	F		M	F		M	F		M	F	
Yentna Station	535	591	1126	0.9:1	335-531	312-485	312-531	432	421	426	430-434	419-423	425-428	431	421	425
Sunshine Station	503	484	987	1.0:1	350-590	345-570	345-590	435	423	429	432-438	421-425	427-431	430	420	425
Talkeetna Station	309	365	674	0.8:1	310-605	330-580	310-605	428	426	427	425-431	423-429	425-429	425	425	425
Curry Station	199	192	391	1.0:1	365-645	370-490	365-645	425	425	425	421-428	422-429	422-428	420	425	420

1/ Males.

2/ Females.

3/ Confidence Interval of the Mean.

July 29 and 31. Fecundities averaged 1,475 eggs per female and ranged from 1,125 to 1,975 eggs (Table 2-3-33).

Susitna River pink salmon fecundities appear to be similar to other Alaskan and Canadian stocks. McPhail and Lindsey (1970) report large females may contain up to 2,000 eggs. Morrow (1980) lists the fecundity range between 800 and 2,000 eggs with larger females generally containing more eggs.

For the pink salmon sampled, length and weight were excellent indicators of the number of eggs per female as illustrated by correlation coefficients (r) of 0.97 and 0.87 respectively in the two regression analyses shown in Figure 2-3-20. The greatest predictive precision came from a multiple regression in which length and weight were both used as independent variables. The equation of the line had the form of:

$$Y_c = 3288.81 + 11.15\ (x_1) + (0.06)\ (x_2)$$

where: Y_c = predicted numbers of eggs

x_1 = length measurement

x_2 = weight measurement

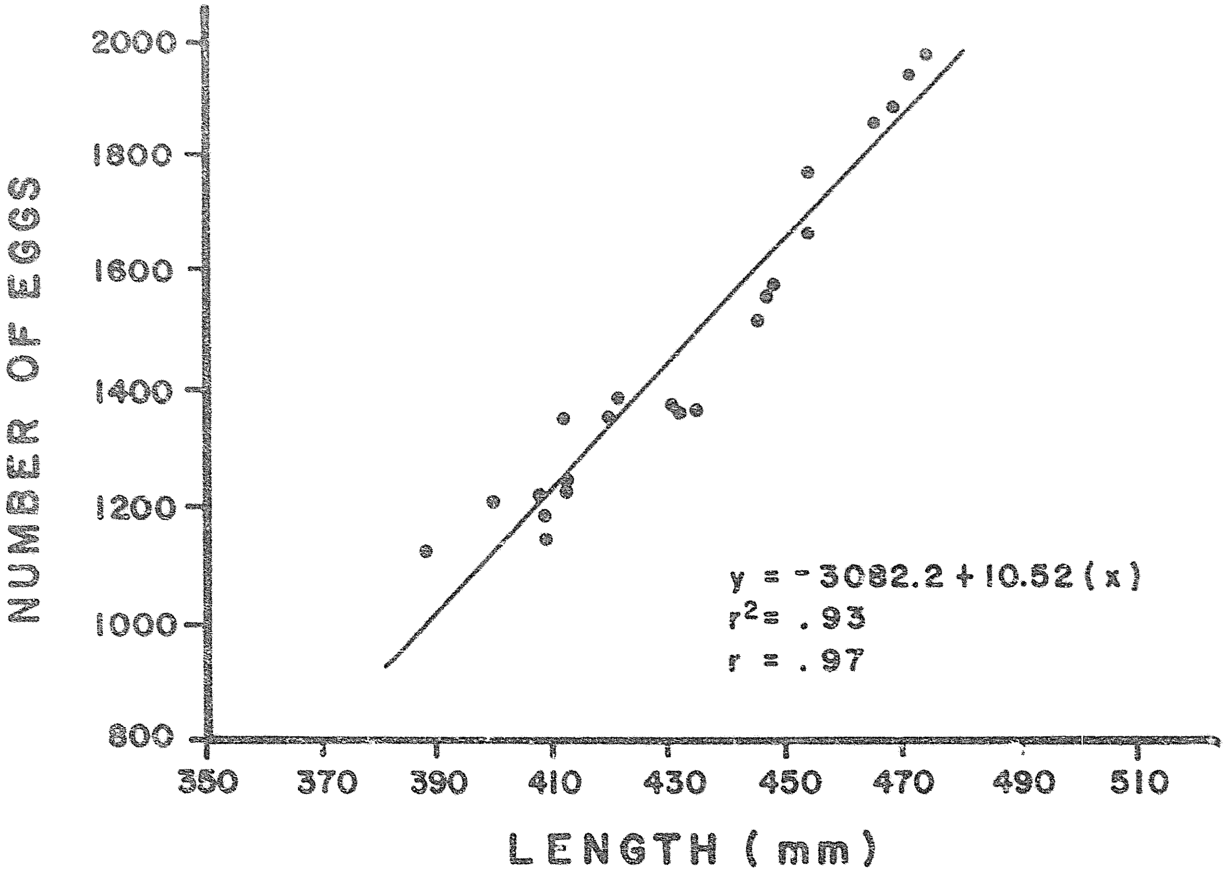
and: coefficient of determination $(r^2) = 0.93$

correlation coefficient $(r) = 0.97$

Given the difficulty in collecting weight values from large numbers of fish in field situations and the small difference in multiple and length regression r^2 factors a very good estimate of pink salmon fecundities can be

Table 2-3-33. Number of eggs, length, weight and associated statistics for all pink salmon sampled for fecundity at Sunshine Station, Adult Anadromous Investigations, Su Hydro Studies, 1983.

Variables	Statistic				
	Sample Size	Mean	Standard Deviation	Standard Error of the Mean	Range
Number of Eggs	22	1,469	273.3	58.3	1,124 - 1,982
Length (mm)	22	433	25.1	5.4	388 - 474
Weight (g)	22	1,044	269.5	57.5	500 - 1,500



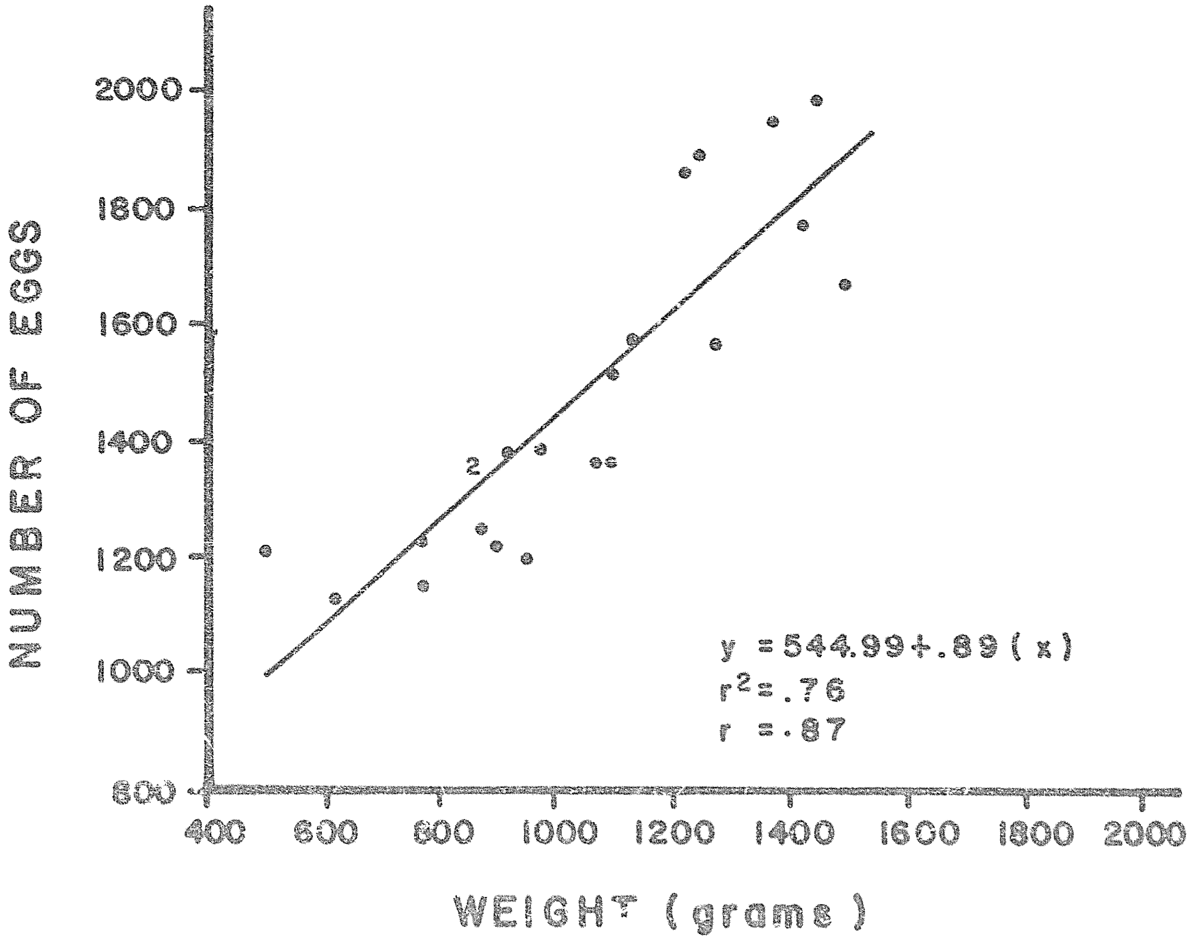


Figure 2-3-20. Number of eggs for pink salmon sampled at Sunshine Station as a function of length and weight, Adult Anadromous Investigations. Su Hydro Studies, 1983.

obtained by using a length/number of eggs regression as illustrated in Figure 2-3-20. These values assume that there is essentially no difference in fecundities of Susitna River pink salmon stocks.

3.2.3.2 Talkeetna to Upper Devil Canyon

3.2.3.2.1 Main Channel Escapement Monitoring

The 1983 pink salmon escapement to Talkeetna Station (RM 103) was estimated to be 9,500 fish. The 95% confidence interval was calculated at 8,900 to 10,100 fish (Table 2-3-31). At Curry Station (RM 120) the pink salmon escapement in 1983 was 5,500 fish, about 4,000 less than the Talkeetna Station estimate (Table 2-3-31).

The four fishwheels at Talkeetna Station (RM 103) in 1983 caught a total of 2,213 pink salmon with 64.6 percent of the catch made by the two west bank fishwheels (Table 2-3-11 and Appendix Table 2-D-9). Based on fishwheel catch rate interpretation, the pink salmon migration began on July 23, simultaneously reached a midpoint and peak on July 30 and ended on August 8 (Figure 2-3-21). The peak catch rate on July 30 was an average 3.2 fish per hour.

A total of 589 pink salmon were intercepted by the two fishwheels at Curry Station (RM 120) in 1983 (Table 2-3-11 and Appendix Table 2-D-12). The migration began and terminated on July 24 and August 12 with the peak and midpoint catch both occurring on August 1. Of all pink salmon captured at Curry Station 64.2 percent were intercepted by the east bank fishwheel and 35.8 percent by the west bank fishwheel showing a preference for migration along the east side of the Susitna River (Figure 2-3-21).

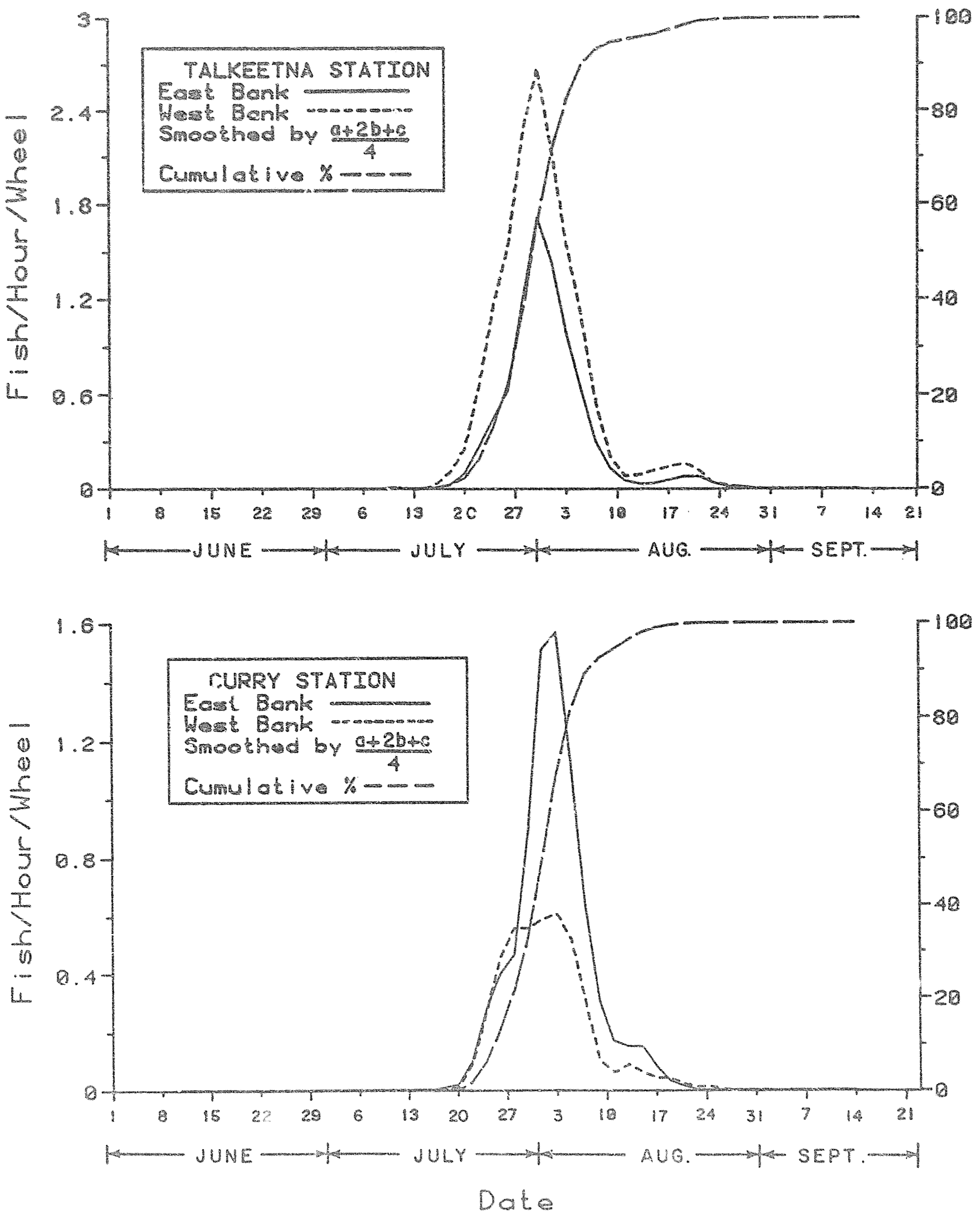


Figure 2-3-21. Mean hourly and cumulative percent fishwheel catch of pink salmon by two day periods at Talkeetna and Curry stations, Adult Anadromous Investigations, Su Hydro Studies, 1983.

In 1983, based on tagged fish recapture data, pink salmon averaged 3.9 days travelling between Sunshine (RM 80) and Talkeetna (RM 103) stations or 5.8 miles per day (Figure 2-3-22). The travel time between Talkeetna and Curry (RM 120) stations, based on 85 tag recaptured pink salmon at Curry Station, was 7.1 miles per day. The minimum recorded time between these two stations was one day and the maximum, fourteen days. Curry Station captured 26 Sunshine Station tagged pink salmon which computed to an upstream migrational speed of 7.5 miles per day between the two stations (Figure 2-3-22).

A total of 674 and 391 pink salmon were sampled for length (FL) and sex data at Talkeetna (RM 103) and Curry (RM 120) stations in 1983, respectively (Table 2-3-32). At Talkeetna Station approximately 8.4 percent more females than males were sampled for a male to female sex ratio of 0.8:1 ratio. The data indicates females averaged 2 mm less in length than the male samples. At Curry Station only 1.8 percent more males were sampled for a 1.0:1 ratio. Male and female pink salmon both averaged 425 mm in length at Curry Station in 1983.

3.2.3.2.2 Spawning Ground Surveys

3.2.3.2.2.1 Main Channel

In 1983, no sampling crews were assigned the duty of assessing the Susitna River main channel for adult salmon spawning activity. Personnel assigned to main channel escapement monitoring at Talkeetna (RM 103) and Curry (RM 120) stations in addition to the Gold Creek stream and slough survey crew found no pink salmon spawning in the main channel above RM 98.6.

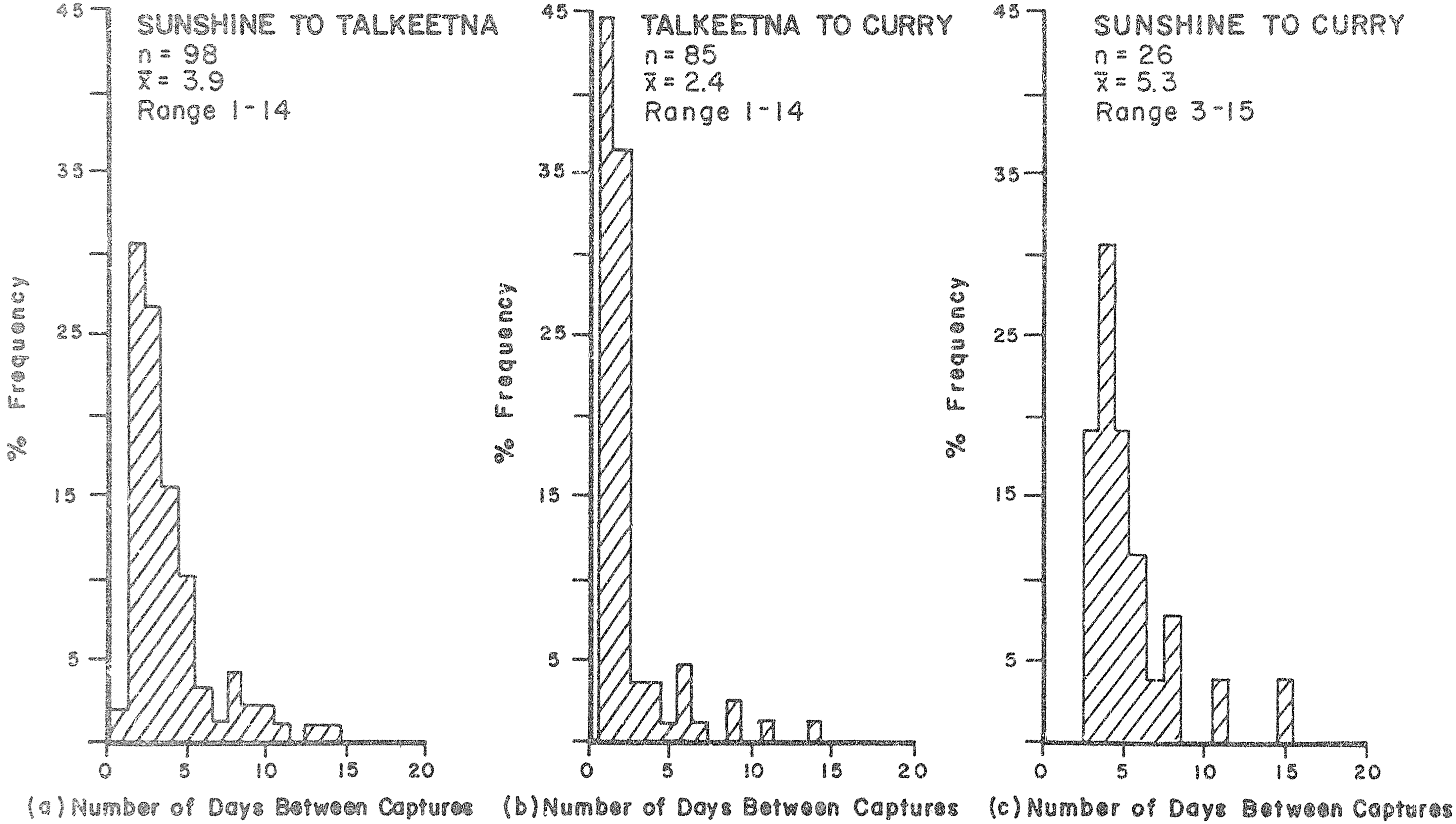


Figure 2-3-22 Migrational rates of pink salmon between (a) Sunshine and Talkeetna stations, (b) Talkeetna and Curry stations and (c) Sunshine and Curry stations, Adult Anadromous Investigations, Su Hydro Studies, 1983.

3.2.3.2.2.2 Slough and Streams

In 1983, 35 slough habitats and 20 streams were surveyed for salmon presence between RM 98.6 and 161.0 (Appendix Table 2-G-2 and 2-G-3).

A total of 14 pink salmon were observed in 6 of the 35 sloughs surveyed above RM 98.6 in 1983. The majority of these fish (50%) were observed in Slough 20 (RM 140.0) while the remaining 50% were in sloughs 8 (RM 124.7), 8A (RM 125.7), 15 (RM 137.2), 19 (RM 129.7) and 21 (RM 141.1). All 14 of these fish were considered milling not spawning pink salmon and consequentially pink salmon slough escapement in 1983 was reported as zero fish (Appendix Table 2-G-11).

A total of 1,329 pink salmon were counted in the peak survey counts of 11 streams between RM 98.6 and 161.0 (Table 2-3-34). The majority (88.1%) were observed in Indian River (RM 138.6) and Portage Creek (RM 148.9). The remaining 11.9 percent were located in the other 9 streams surveyed. It should be recognized these counts do not represent total pink salmon escapement but provide a measure of relative abundance.

Peak spawning of pink salmon in stream habitats in 1983 occurred during the first and third weeks of August (Table 2-3-34). Based on helicopter and foot surveys of Indian River (RM 138.6) and Portage Creek (RM 148.9) peak pink salmon spawning occurred between August 4 and 27 in both of these tributaries (Figure 2-3-23).

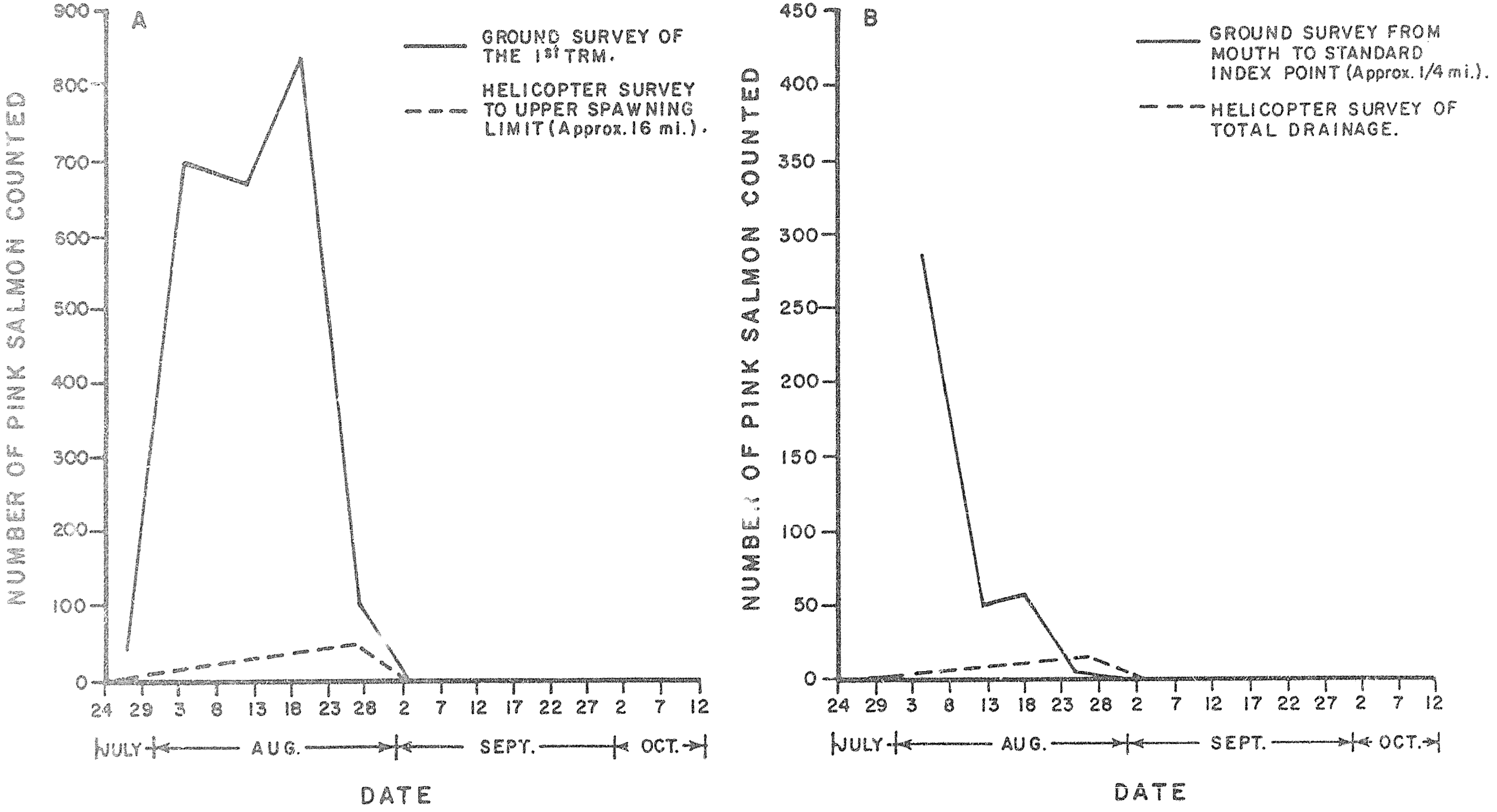


Figure 2-3-23. Peak pink salmon ground and helicopter survey counts of (a) Indian River and (b) Portage Creek, Adult Anadromous Investigations, Su Hydro Studies, 1983.

Table 2-3-34. Pink salmon peak escapement counts for stream habitats above RM 98.6 in order of contribution, Adult Anadromous Investigations, Su Hydro Studies, 1983.

Stream	Location (RM) 1/	Date	Number Counted Live	Number Counted Dead	Number Counted Total	Percent Contribution
Indian River	138.6	8/19	837	49	886	66.7
Portage Creek	148.9	8/4	285	0	285	21.4
4th of July Creek	131.0	8/20	63	15	78	5.9
Lane Creek	113.6	8/15	28	0	28	2.1
Lower McKenzie Creek	116.2	8/15	17	0	28	1.3
5th of July Creek	123.7	8/13	9	0	9	0.7
Gold Creek	136.7	8/7	7	0	7	0.5
Little Portage Creek	117.7	8/22	7	0	7	0.5
Chase Creek	106.9	8/12	5	1	6	0.5
Jack Long Creek	144.5	8/12	5	0	5	0.4
Skull Creek	124.7	8/20	1	0	1	0.1
		TOTAL	1,264	65	1,329	100.0

1/ River Mile

3.2.4 Chum Salmon

3.2.4.1 Intertidal to Talkeetna

3.2.4.1.1 Main Channel Escapement Monitoring

In 1983 chum salmon escapements were monitored in the Yentna River (RM 28) at Yentna Station (TRM 04) and the Susitna River at Sunshine Station (RM 80) (Table 2-3-8). The Yentna River escapement determined by SSS counters was estimated to be 10,800 fish (Table 2-3-22). The Susitna River escapement at

Sunshine Station was an estimated 266,000 fish derived by the Petersen mark/recapture method (Table 2-3-35).

Table 2-3-35. Petersen population estimates with associated 95% confidence intervals of chum salmon migration to Sunshine, Talkeetna and Curry stations, Adult Anadromous Investigations, Su Hydro Studies, 1983.

Parameter [1/]	Population Estimate Location		
	Sunshine Station	Talkeetna Station	Curry Station
m	16,845	2,086	667
c	16,533	12,139	11,238
r	1,047	502	355
$\hat{N}$	265,997	50,442	21,115
95% C.I.	251,266- 282,561	46,463- 55,167	19,154- 23,523

[1/] m = Number of fish marked (adjusted).
c = Total number of fish examined for marks during sampling census.
r = Total number of marked fish observed during sampling census.
$\hat{N}$ = Population estimate.
C.I. = Confidence interval around $\hat{N}$.

The migrational timings of the 1983 chum salmon escapements into the Yentna River (RM 28) at Yentna Station (TRM 04) and Susitna River at Sunshine Station (RM 80) can be determined by fishwheel catch rate data (Appendix 2-D). From this information base the migration at Yentna Station began on July 15, reach a midpoint on July 30 and ended on August 23. At

Sunshine Station the onset of the migration began on July 22, reached a midpoint in August 1 and ended on September 2.

A comparison of the inseason (1983) fishwheel catches at Yentna (TRM 04) and Sunshine (RM 80) indicates the chum salmon escapements passed these locations in two distinct waves (Figure 2-3-24). The bimodal migration recorded at these locations may be related to: (1) differential commercial fishing effort in Cook Inlet; (2) stock separation such as timing differences between stream and sloughs spawning stocks; and (3) variations in river discharge levels which caused migration cessation and or altered fishwheel catch efficiency. A preliminary review of the 1983 commercial salmon fishing data for Upper Cook Inlet indicates that fishing pressure was relatively static between early July and early August except for an eight day period beginning and ending on July 17 and 23 when extra fishing time was given to the inlet drift net fisherman. This extra fishing time resulted in 'very strong' catches. In fact the highest 1983 chum salmon catch in the Central District drift fleet was recorded on July 20 at approximately 123,000 fish. Sockeye, pink and coho salmon were also caught at seasonal high levels during the July 17 to 23 commercial openings (Ruesch, pers. comm.). Preliminary results of 1983 tag recovery data indicate that chum salmon averaged a 10 day travel time between the inlet fishery and the lower (RM 26) Susitna River (Tarbox, pers. comm.). It is therefore likely that the dramatic drop in inseason chum salmon catches at Yentna and Sunshine stations were at least partially influenced by commercial fishing in Cook Inlet as the first migration wave at Yentna and Sunshine stations ended in the first week of August about 11 and 16 days respectively after the peak commercial catch. In terms of whether an influencing factor of the chum salmon migration was stock separation, there

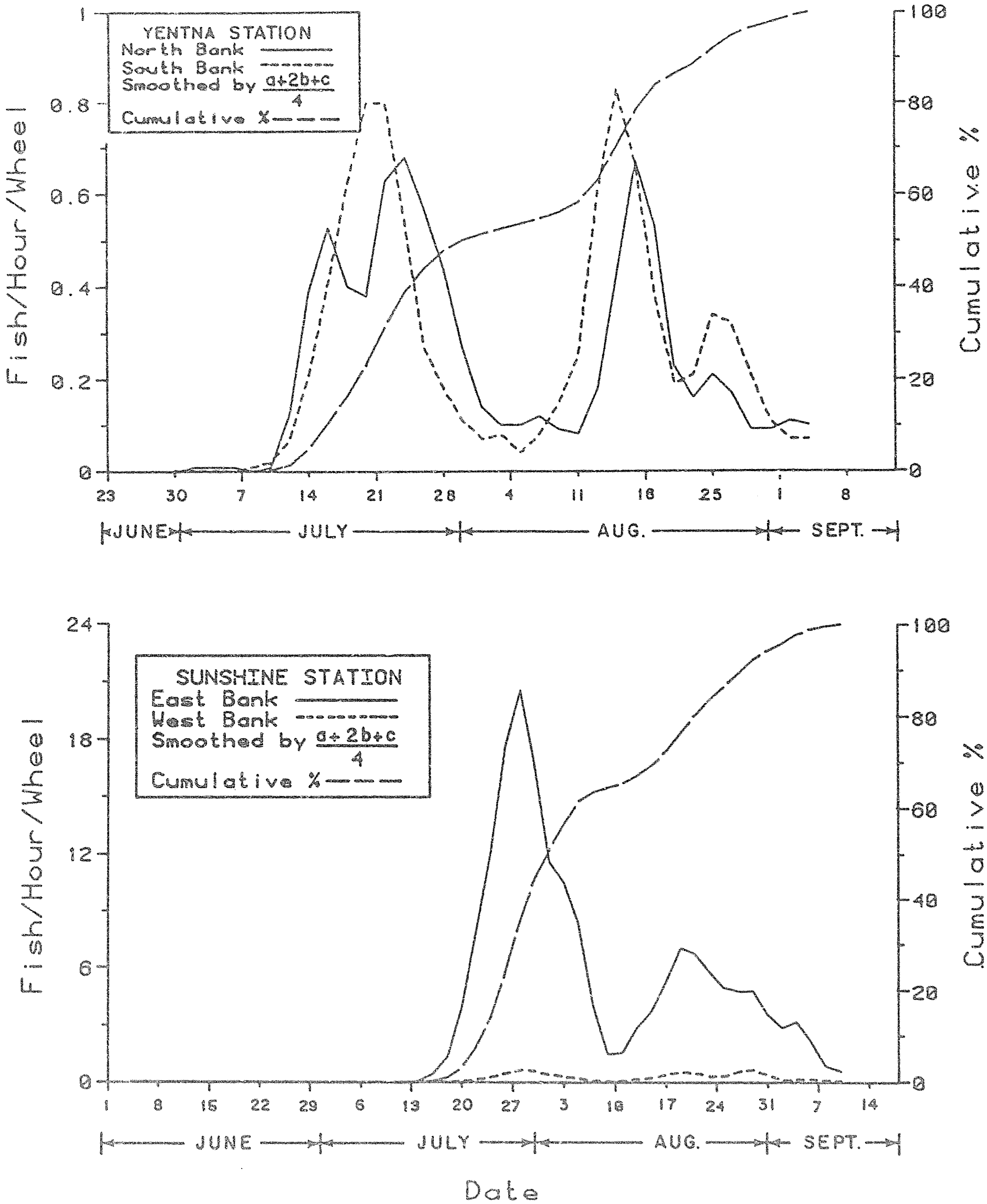


Figure 2-3-24. Mean hourly and cumulative percent fishwheel catch of chum salmon by two day periods at Yentna and Sunshine stations, Adult Anadromous Investigations, Su Hydro Studies, 1983.

unfortunately was no concerted effort made to collect tags from carcasses from either sloughs or streams entering the Susitna River above Sunshine Station nor were there any spawning ground surveys performed in the Yentna River drainage for a data base to accurately determine this. However, stream and slough escapement were conducted in 1983 upstream of Sunshine Station and the data indicate chum salmon were not segregated by time of entrance to these habitats. The surveys indicate that chum salmon were abundant in both habitats during the last week of July in 1983. It can therefore be surmised that the first migration wave that passed Sunshine Station between July 22 and August 7 was comprised of both slough and stream spawning fish as the second migration wave did not began at Sunshine Station until after the second week of August. The second migration wave that passed Sunshine Station may well have been exclusively slough spawning fish but there is insufficient data to provide confirmation.

The third potential agent influencing chum migration in 1983 at Yentna (TRM 04) and Sunshine (RM 80) stations was river discharge levels. A plot of the 1983 Yentna River (RM 28) and Susitna River USGS provisional flow data for the months of July and August show that both river systems reached peak flows in the first week of August (Figure 2-3-25). This was the same time fishwheels catches declined at Yentna and Sunshine stations (Appendix 2-D). The sonar counts at Yentna Station also declined in this period. It appears that high water flows in early August may have caused a temporary delay in the chum salmon migrations at Yentna and Sunshine stations and corresponding declines in station fishwheel catches. At both stations when flows returned to pre-high water levels chum salmon catches increased in the fishwheels and at the same time sonar counts also increased at Yentna Station.

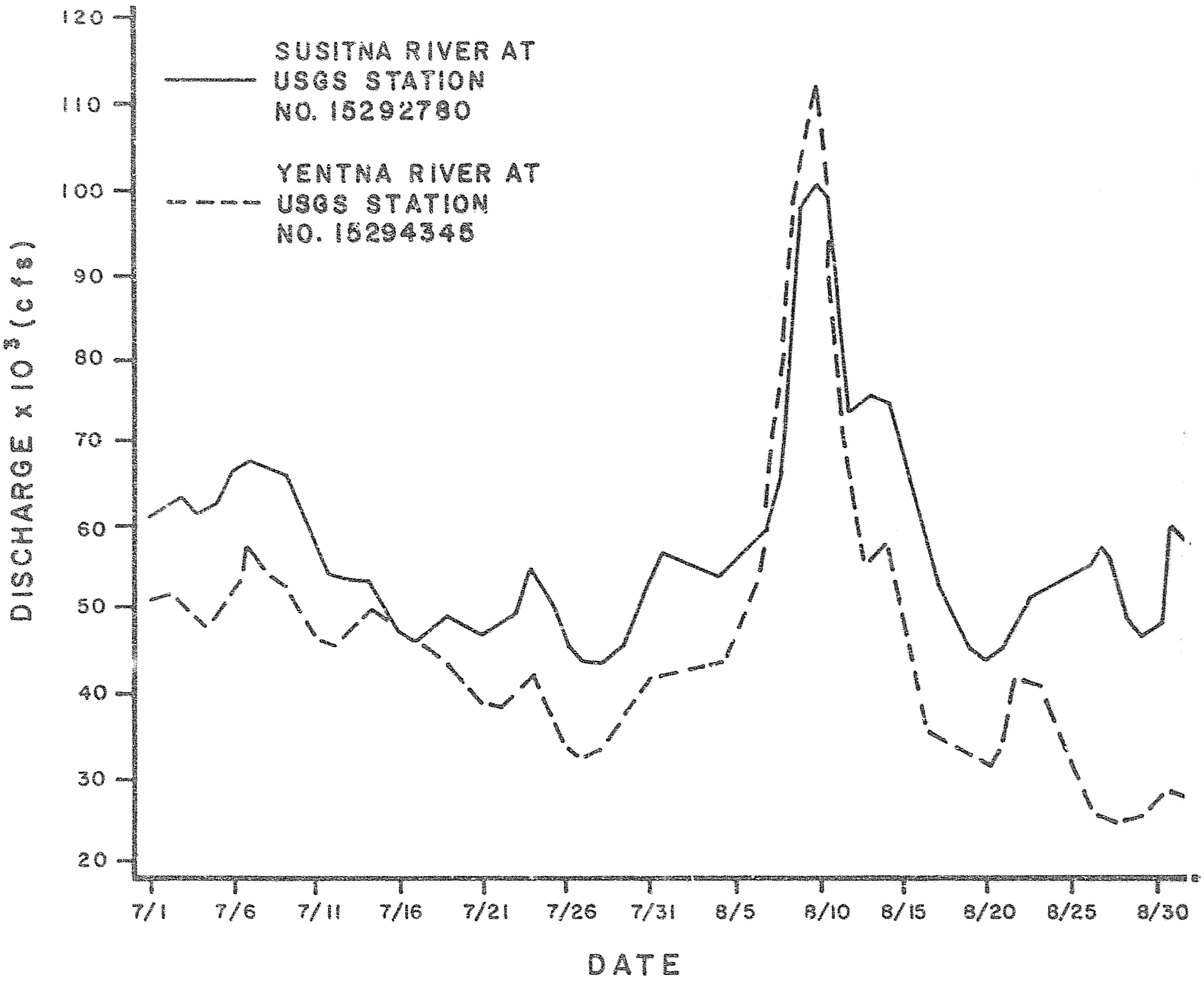


Figure 2-3-25. Provisional discharge data from July 1 through August 30 for the Susitna and Yentna rivers, Adult Anadromous Investigations, Su Hydro Studies, 1983.

Fishwheel catches recorded in 1983 at Yentna Station (TRM 04) indicate chum salmon had no strong migrational preference for the south or north bank of the Yentna River (RM 28) at this location (Appendixes Table 2-D-1 and 2-D-2). The south bank Yentna Station fishwheel caught approximately the same number of fish (50.2%) as caught by the north bank fishwheel (49.8%) (Appendix 2-D).

In the Susitna River at Sunshine Station (RM 80) approximately 96 percent of the station catch was made in the two east bank operated fishwheels and the remaining four percent of the catch was made in the two west bank wheels. This would indicate a strong migrational preference of chum salmon at Sunshine Station to passage along the east side of the river compared to the west side based on the assumptions that stocks were mixed and fishwheel catch efficiency remained constant.

Age composition data was collected from 553 chum salmon at Yentna Station (TRM 04) and 1,043 chum salmon at Sunshine Station (RM 80) in 1983. The results have been presented in Table 2-3-36. The majority of the escapement sampled at both stations were five and four year old fish in order of abundance (Figure 2-3-26). Other ages sampled included fish three and six years old. These ages accounted for less than three percent of the total age sample from each station.

Table 2-3-36. Analysis of chum salmon age data by percent from escapement samples collected at Yentna, Sunshine, Talkeetna and Curry stations, Adult Anadromous Investigations, Su Hydro Studies, 1983.

Collection Site	n	Age Class 1/			
		3_1	4_1	5_1	6_1
Yentna Station	553	2.2	46.1	51.3	0.4
Sunshine Station	1043	0.3	40.1	58.4	1.2
Talkeetna Station	620	0.8	30.3	68.7	0.2
Curry Station	456	-	27.9	72.1	-

1/ Gilbert-Rich Notation

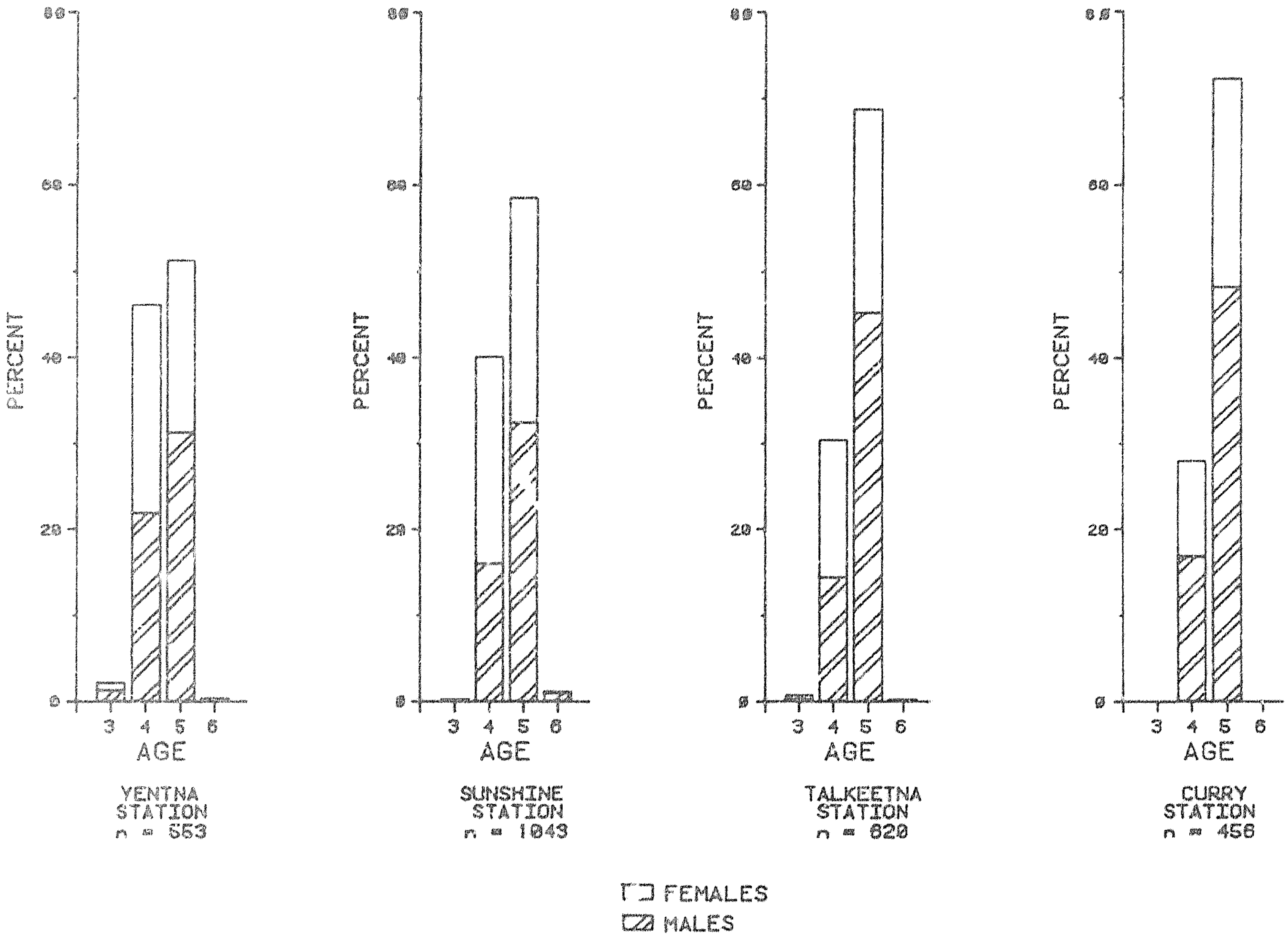


Figure 2-3-26. Age composition of fishwheel intercepted chum salmon at Yentna, Sunshine, Talkeetna and Curry stations, Adult Anadromous Investigations, Su Hydro Studies, 1983.

Length composite data from (1983) escapement sampling chum salmon at Yentna (TRM 04) and Sunshine (RM 80) stations are presented in Table 2-3-37 and Appendix Tables 2-E-13 and 2-E-14. The data indicate ch salmon averaged a slightly smaller length in the Yentna River than in the Susitna River at Sunshine Station. The respective aver_ge lengths were 593 mm and 595 mm. At Yentna and Susitna rivers sampling locations female chum salmon were about 20 to 30 mm larger in length than the males.

Sex ratio data collected in 1983 from fishwheel caught chum salmon at Yentna (TRM 04) and Sunshine (RM 80) stations are summarized in Table 2-3-38. At both stations males were more numerous among the three, five and six year old fish sampled, and females out numbered males among the four year old fish sampled. The chum salmon male to female sex ratio without respect to age was computed to be 1.3:7 and for Sunshine Station 1.0:1.

3.2.4.1.2 Fecundity

Fecundities of 27 Susitna River female chum salmon were determined from samples collected at Sunshine Station (RM 80) between July 29 and 31, 1983. The mean fecundity was 3,189 eggs per female chum salmon and ranged in number from 2,478 to 4,076 eggs (Table 2-3-39).

Generally, the greater the length of a female salmon the more eggs it will contain. This relationship is apparent from the chum salmon sample collected at Sunshine Station (RM 80). A regression of length with the number of eggs per female resulted in an 'excellent' linear relationship (r = 0.83) as illustrated in Figure 2-3-27. Also portrayed in Figure 2-3-27 is the

Table 2-3-37. Analysis of chum salmon lengths, in millimeters, by age class from escapement samples collected at Yentna, Sunshine, Talkeetna and Curry stations, Adult Anadromous Investigations, Su Hydro Studies, 1983.

Collection Site	Age Class	n		Range Limits		Mean		95% Conf. Interval 3/		Median	
		M 1/	F 2/	M	F	M	F	M	F	M	F
Yentna Station	3_1	7	5	492-528	452-553	508	515	-	-	504	526
	4_1	121	134	462-666	489-652	582	570	575-589	566-575	584	572
	5_1	173	111	448-700	509-658	616	598	611-622	593-604	621	600
	6_1	2	-	558-610	-	584	-	-	-	584	-
	ALL 4/	351	280	448-700	452-658	602	582	597-606	578-586	606	583
		631		448-700		593		590-596		596	
Sunshine Station	3_1	-	3	-	515-540	-	525	-	-	-	520
	4_1	168	250	410-685	450-650	579	561	573-585	557-565	580	560
	5_1	339	271	495-750	460-750	622	598	618-626	593-603	625	600
	6_1	10	2	500-895	650-720	664	685	-	-	648	685
	ALL 4/	560	565	410-895	450-750	609	580	605-613	577-584	610	580
		1125		410-895		595		592-597		600	
Talkeetna Station	3_1	2	3	510-510	500-520	510	512	-	-	510	515
	4_1	89	99	470-6[illegible]	465-630	585	572	577-593	566-579	590	575
	5_1	281	145	515-700	510-710	625	610	621-629	605-615	630	610
	6_1	1	-	650	-	650	-	-	-	650	-
	ALL 4/	441	287	470-700	365-710	614	594	611-618	589-599	620	600
		728		365-710		606		603-609		610	
Curry Station	4_1	77	50	505-640	470-640	586	579	579-592	569-588	590	590
	5_1	220	109	500-715	555-690	631	618	627-635	613-623	630	620
	ALL 4/	319	168	500-715	445-690	619	605	615-623	599-610	620	610
		487		445-715		614		611-617		615	

1/ Males 2/ Females 3/ Confidence Interval of the Mean. 4/ Composite of all aged and non-aged samples.

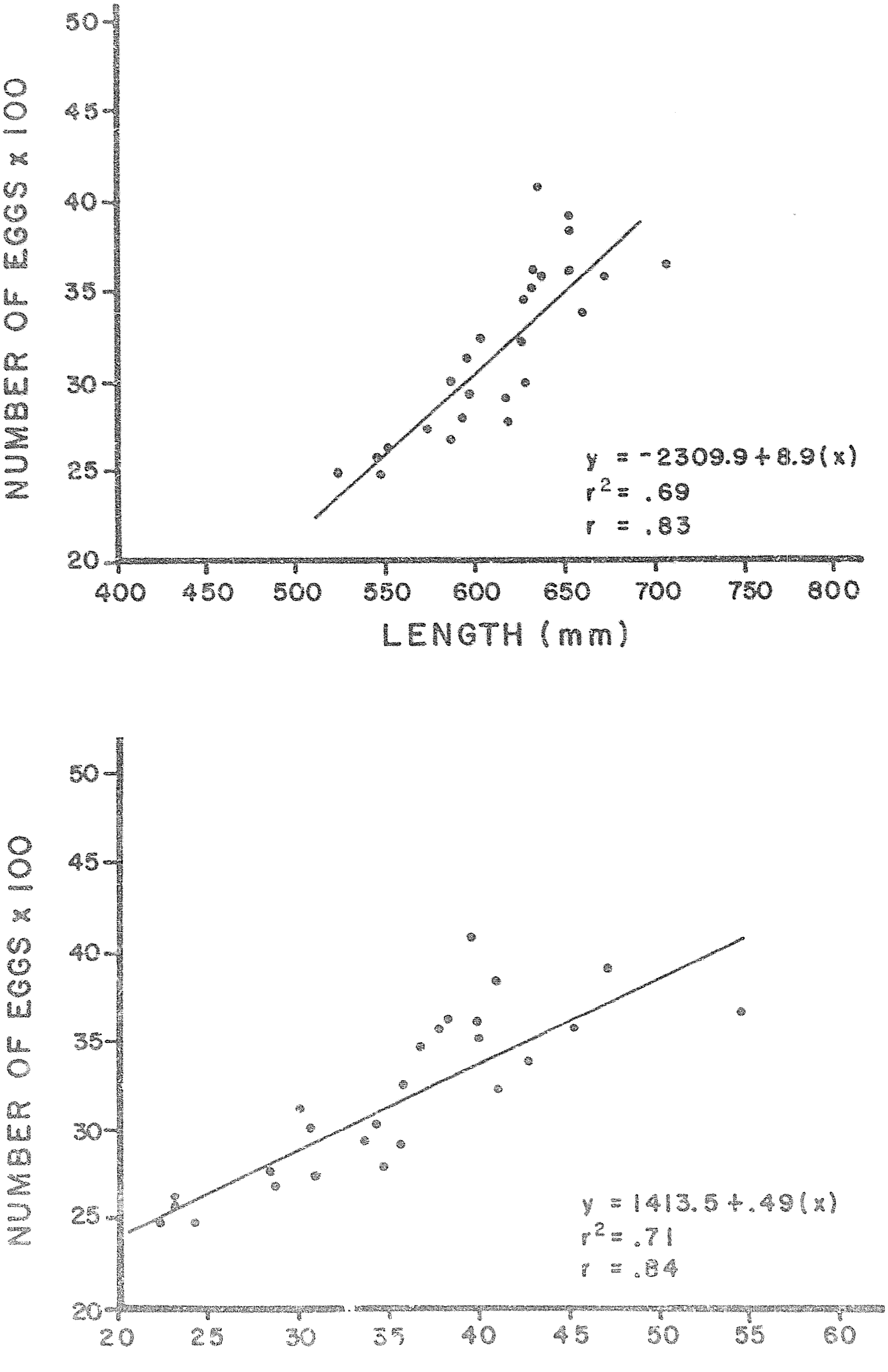


Figure 2-3-27. Number of eggs for chum salmon sampled at Sunshine Station as a function of length and weight, Adult Anadromous Investigations, Su Hydro Studies, 1983.

Table 2-3-38. Sex ratios of male and female chum salmon by age from escapement samples collected at Yentna, Sunshine, Talkeetna and Curry stations, Adult Anadromous Investigations, Su Hydro Studies, 1983.

Collection Site	Age	Sample Size	Number		Sex Ratio (M:F)
			Males	Females	
Yentna Station	3	12	7	5	1.4:1
	4	255	121	134	0.9:1
	5	284	173	111	1.6:1
	6	2	2	0	-
	All 1/	631	351	280	1.3:1
Sunshine Station	3	3	0	3	-
	4	418	168	250	0.7:1
	5	610	339	271	1.3:1
	6	12	10	2	5.0:1
	All 1/	1125	560	565	1.0:1
Talkeetna Station	3	5	2	3	0.7:1
	4	188	89	99	0.9:1
	5	426	281	145	1.9:1
	6	1	1	0	-
	All 1/	728	441	287	1.5:1
Curry Station	4	127	77	50	1.5:1
	5	329	220	109	2.0:1
	All 1/	487	319	168	1.9:1

1/ Includes all aged and non-aged samples.

Table 2-3-39. Number of eggs, length, weight and associated statistics for all chum salmon sampled for fecundity at Sunshine Station, Adult Anadromous Investigations, Su Hydro Studies, 1983.

Variables	Statistic				
	Sample Size	Mean	Standard Deviation	Standard Error of the Mean	Range
Number of Eggs	27	3,189	462.0	88.9	2,475 - 4,076
Length (mm)	27	617	43.1	8.3	524 - 708
Weight (g)	27	3,566	783.3	150.8	2,225 - 5,475

relationship between weight and fecundity which also has an 'excellent' correlation coefficient factor ($r = 0.84$).

Utilizing both length and weight as independent predictor variables the following multiple regression equation was derived:

$$Y_c = 15.38 + 3.25\,(x_1) + 0.33\,(x_2)$$

where: Y_c = predicted number of eggs

x_1 = measured length

x_2 = measured weight

and: coefficient of determination (r^2) = 0.72

coefficient of correlation (r) = 0.85

Utilization of this data for predictive purposes must include an adjustment for egg retention. This information, for chum salmon, is provided in Section 3.2.4.2.2.3.3. It should also be noted that in calculating chum salmon fecundities it was assumed that there were essentially no stock differences in number of eggs per individual female for Susitna River stocks.

Chum salmon fecundity data was further reduced for analysis by age class. This information is presented in Appendix Table 2-G-15 but due to insufficient samples sizes should be considered informative and not analytical in nature.

3.2.4.2 Talkeetna to Upper Devil Canyon

3.2.4.2.1 Main Channel Escapement Monitoring

In 1983 chum salmon escapement estimates were obtained for the Susitna River channel at Talkeetna (RM 103) and Curry (RM 120) stations by the Petersen mark/recapture method (Table 2-3-35). By this method the escapement to Talkeetna Station was estimated at 50,400 fish and to Curry Station at 21,100 fish. The 95 percent confidence limits associated to these estimates calculated at 46,500 - 55,200 and 19,200 - 23,500 fish, respectively.

The migrational timings of the 1983 chum salmon escapements to Talkeetna (RM 103) and Curry (RM 120) stations can be determined by fishwheel catches made at these locations (Appendix 2-D). At Talkeetna Station the chum salmon migration began on July 25, reached a midpoint on August 1 and ended on August 29. Upstream 17 miles at Curry Station, the migration began on July 22, reached a midpoint on August 3 and ended on August 29.

In 1983, chum salmon fishwheel catches at Talkeetna Station (RM 103) totaled 2,467 fish and at Curry Station, 861 fish (Table 2-3-11). Catches were nearly equally distributed between the east and west bank fishwheels at Talkeetna Station (Figure 2-3-28). The two east bank fishwheels caught 47.3 percent of the station catch and the two west bank fishwheels landed the remaining 52.7 percent. These catch percentages indicate chum salmon had a slight preference for movement along the west bank at this location. Upstream at Curry Station, chum salmon were more numerous along the east bank than the west bank (Figure 2-3-28). The east bank fishwheel caught 68.4 percent of the station catch. The remaining 31.6 percent was landed by the west bank fishwheel. The reported preference of chum salmon for migration along the west bank at Talkeetna Station and east bank at Curry Station should be considered valid assuming no stock differention or difference in catch efficiency between east and west bank operated fishwheels at either station. Probable factors influencing chum salmon migration along a particular bank preference are velocity, channel configuration and water depth.

The results of sampling the 1983 chum salmon escapements to Talkeetna (RM 103) and Curry (RM 120) stations for age are provided in Table 2-3-36. The data indicate the escapements to both stations were comprised nearly exclusively of five and four year old fish by respective order (Figure 2-3-26). Three and six year old chum salmon were represented at a minimal level at Talkeetna Station and were not at all present in the escapement sampled at Curry Station.

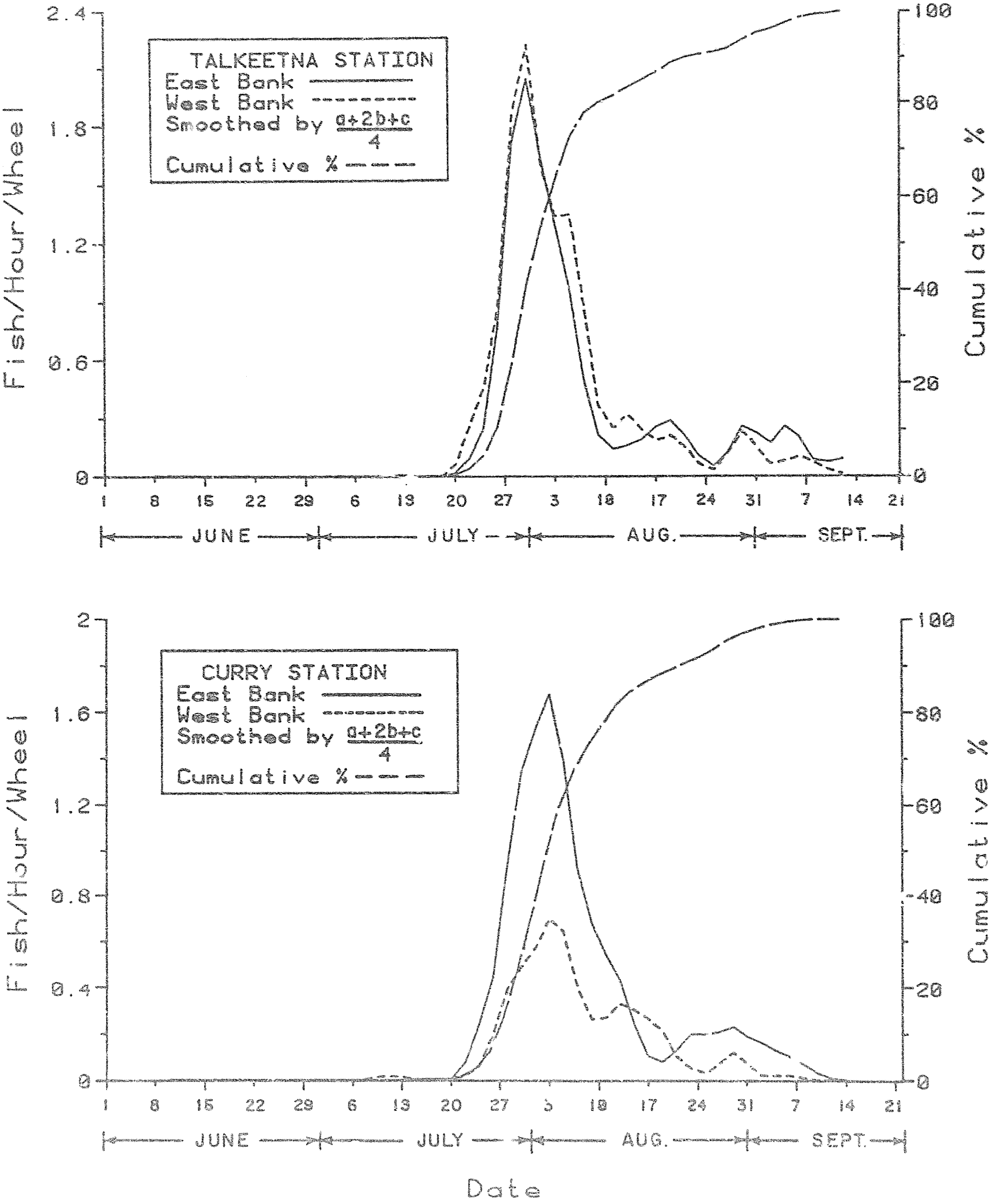


Figure 2-3-28. Mean hourly and cumulative percent fishwheel catch of chum salmon by two day periods at Talkeetna and Curry stations, Adult Anadromous Investigations, Su Hydro Studies, 1983.

In 1983 chum salmon tagged at Sunshine Station (RM 80) were recaptured at Talkeetna (RM 103) and Curry (RM 120) stations. Recaptures were also made at Curry Station of fish released at Talkeetna Station. The results are provided in Figure 2-3-29. The data indicates chum salmon migrated upstream at an average rate of 3.8 mpd for the 23 miles between Sunshine and Talkeetna stations. Between the 17 miles from Talkeetna to Curry stations the average migration speed was less at 3.6 mpd. The overall travel rate between Sunshine and Curry stations was an average 4.7 mpd. The data, with outliners removed, would indicate that generally chum salmon ascended at a faster rate between Talkeetna and Curry stations than in the 23 miles reach downstream. (Figure 2-3-29).

Length composition data collected in 1983 at Talkeetna (RM 103) and Curry (RM 120) stations are provided in Table 2-3-37 and Appendix 2-F. Generally the male chum salmon sampled at these stations were a larger length than the females. The average chum salmon length measured at Talkeetna Station was 606 mm and at Curry Station, 614 mm.

Sex composition (1983) data collected from escapement sampling of the Susitna River main channel above Talkeetna (RM 97.1) are provided in Table 2-3-38. The male to female chum salmon sex ratio computed for Talkeetna Station (RM 103) at 1.5:1. Upstream 17 miles at Curry Station (RM 120) the ratio was 1.9:1.

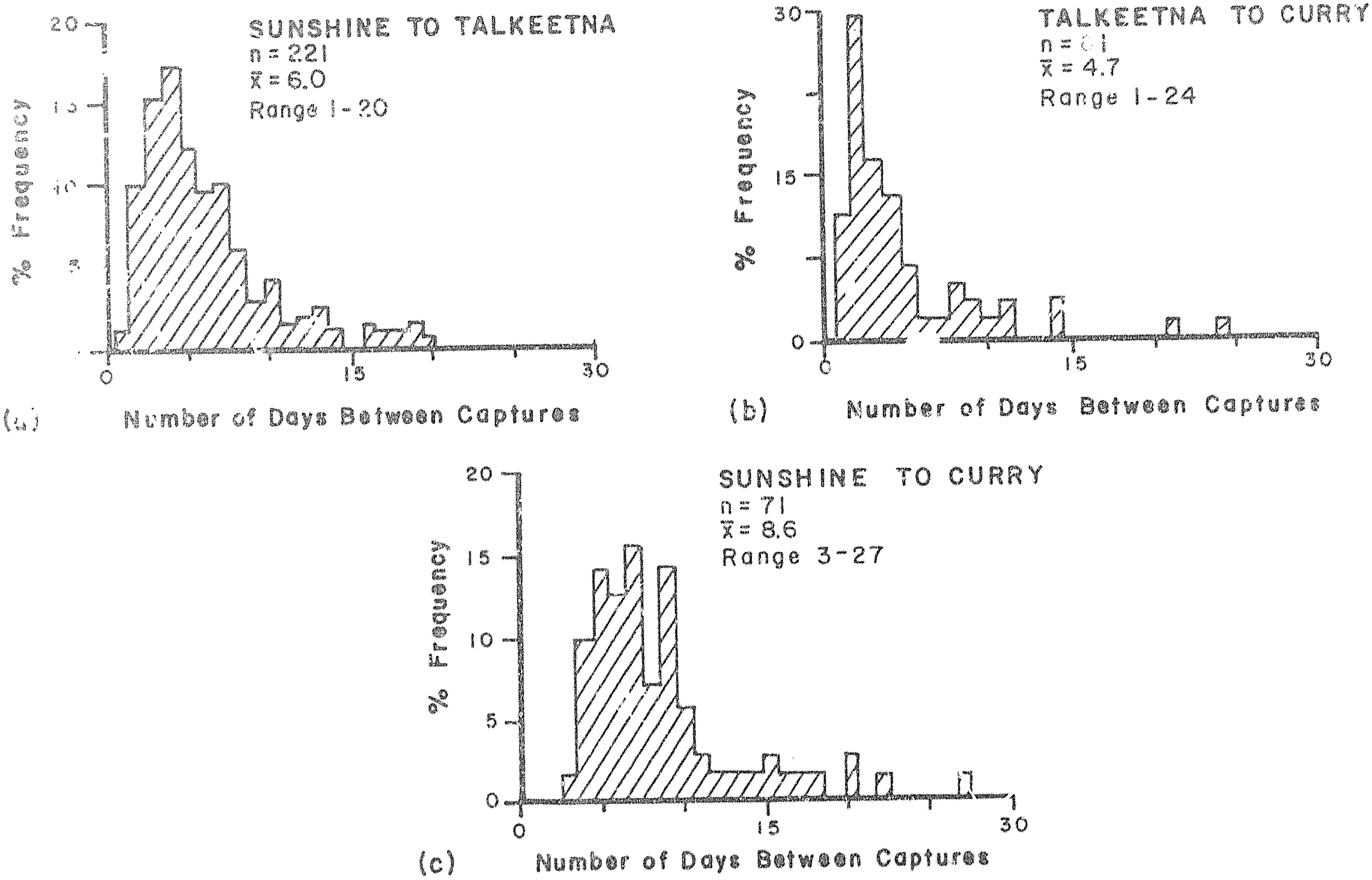


Figure 2-3-29. Migrational rates of chum salmon between (a) Sunshine and Talkeetna stations, (b) Talkeetna and Curry stations and (c) Sunshine and Curry stations, Adult Anadromous Investigations, Su Hydro Studies, 1983.

3.2.4.2.2 Spawning Ground Surveys

3.2.4.2.2.2.1 Main Channel

In 1983 no inclusive main channel spawning ground surveys were conducted. However, six main channel chum salmon spawning areas were found by the stream and slough survey crew stationed at Gold Creek (RM 137). A list of these spawning areas are provided in Appendix Table 2-G-1. Maps of these locations are provided in Appendix 2-G.

The six main channel spawning locations identified in 1983 were found between RM 115.0 and 138.9 (Appendix Table 2-G-1). The spawning was recorded between September 9 and October 1. The site supporting the highest number of spawners was located downstream of the mouth of Slough 11 (RM 136.3) at RM 136.1 (Appendix Figure 2-G-9). At this location a total of 177 chum salmon were observed on September 9 110 and 17 67, 1983. The numbers of spawning chum salmon observed at the other five locations ranged from 4 to 56 fish.

3.2.4.2.2.2.2 Streams

In 1983 a total of 20 streams were surveyed for salmon presence between RM 98.6 and 161.0. The results are provided in Appendix Table 2-G-3.

Seven streams above RM 98.6 were found to contain chum salmon in 1983 (Table 2-3-40). Peak spawning ground counts substantiated a minimum escapement of 1,411 fish into these streams. The majority (88.4%) of the fish were counted in Indian River (RM 138.6) and Portage Creek (RM 148.9).

Table 2-3-40. Chum salmon peak escapement counts for stream habitats above RM 98.6, Adult Anadromous Investigations, Su Hydro Studies, 1983.

Stream	Location (RM) 1/	Date	Number Counted		
			Live	Dead	Total
Lane Creek	113.6	8/15	6	0	6
Lower McKenzie Creek	116.2	8/15	1	0	1
5th of July Creek	123.7	8/5	6	0	6
4th of July Creek	131.0	8/27	143	5	148
Indian River	138.6	8/27	287	435	722
Jack Long Creek	144.5	8/12	2	0	2
Portage Creek	148.9	8/26	424	102	526
		TOTAL	869	542	1,411

1/ River Mile

In 1983 fewer chum salmon were enumerated in Indian River (RM 138.6) by helicopter than were actually present based on a comparison of what was counted on the ground in the first mile of stream and the aerial counts by helicopter of the total 16 mile reach of stream from the mouth (Figure 2-3-30). Considering 16 miles of stream were surveyed by air and less fish were observed during the aerial census than on foot over the first stream mile, it could be concluded, aside from aerial counts providing a poor measure of Indian River escapement, that the first mile reach of Indian River in 1983 was an essential chum salmon spawning habitat of possibly more value than the remaining (15 miles) upstream reach.

It could be but should it?

At Portage Creek (RM 148.9) in 1983, more chum salmon were counted by helicopter in the total 25 mile reach of stream than on foot in the first

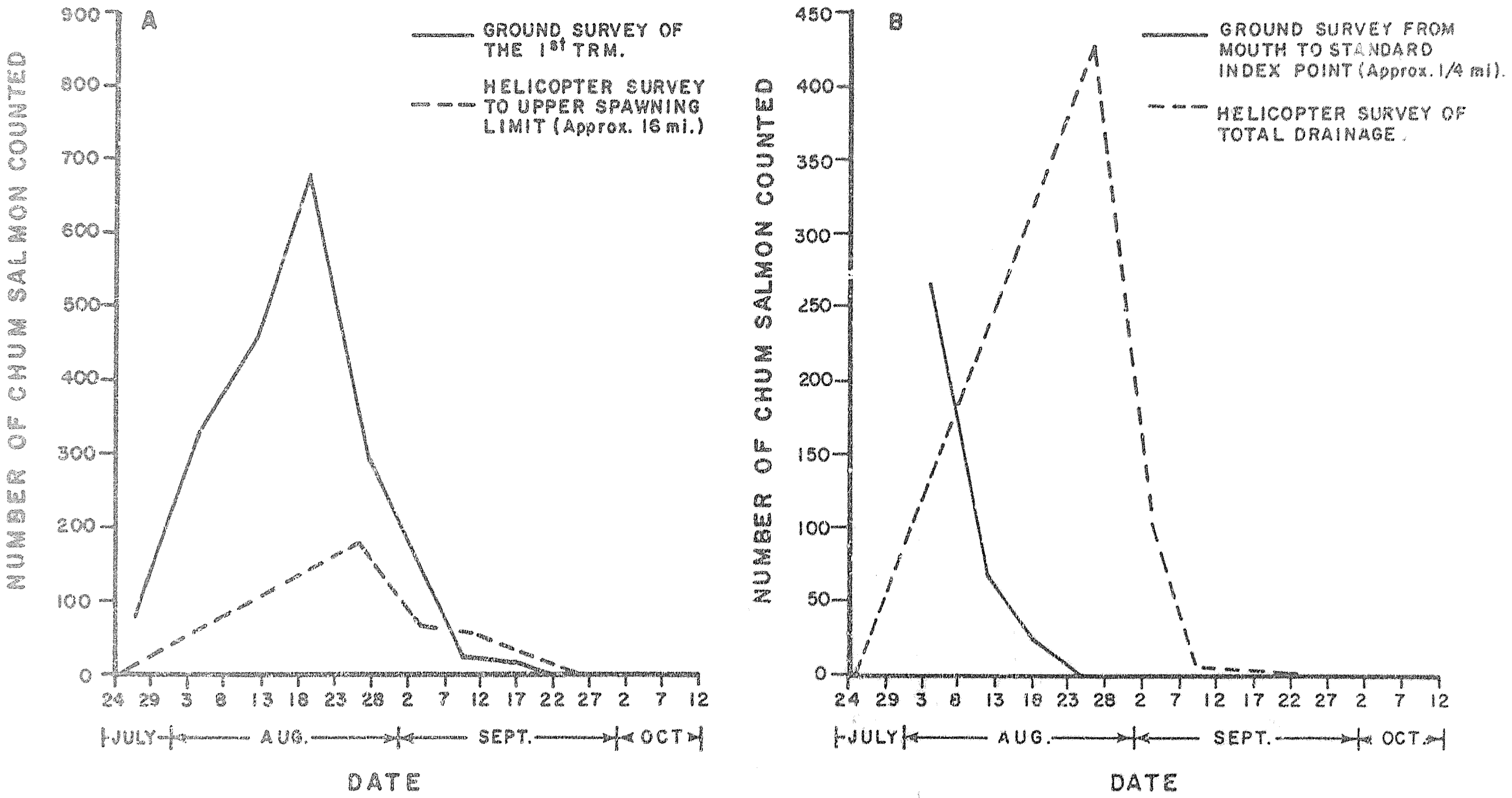


Figure 2-3-30. Peak chum salmon ground and helicopter survey counts of (a) Indian River and (b) Portage Creek, Adult Anadromous Investigations, Su Hydro Studies, 1983.

quarter mile reach (Appendix 2-G-3). From a comparison of the timing differences between the ground and helicopter counts, it could be concluded that the first quarter mile reach of Portage Creek is mainly a migrational corridor and the majority of the fish enumerated in this reach on the ground counts were fish that spawned upstream (Figure 2-3-30). If the first quarter mile reach of Portage Creek were of similar spawning habitat value as the upper stream reach the difference in timing of the peak counts would not be as apparent as illustrated in Figure 2-3-30.

For 1983, the chum salmon escapement counts of stream habitats above RM 98.6 provided a basis to determine when spawning occurred. From this information base chum salmon spawned in stream habitats from the last week of July through the second week of September (1983) with the peak of spawning occurring between the first and last weeks of August.

3.2.4.2.2.3 Sloughs

3.2.4.2.2.3.1 Observation Life

In 1983, a total of 67 chum salmon were monitored for observation life in sloughs Moose (RM 123.5), A' (RM 124.6), 8A (RM 123.1), 9 (RM 128.3) and 11 (RM 135.3) The results are presented in Table 2-3-41.

The average observation life of a chum salmon in a slough habitat was 6.9 days as determined from the results of five sloughs studied in 1983 (Table 2-3-41). However, observation life averages varied between sloughs and between male and female chum salmon. For example chum salmon averaged 4.1

Table 2-3-41. Summary of mean number of days individual chum salmon were observed in sloughs Moose, A', 8A, 9 and 11, Adult Anadromous Investigations, Su Hydro Studies, 1983.

Slough + RM 1/	Males			Females			Combined		
	n	Range (days)	Mean (days)	n	Range (days)	Mean (days)	n	Range (days)	Mean (days)
Moose RM 123.5	6	2.5-11.0	9.6	1	---	11.0	7	2.5-11.0	9.8
A' RM 124.6	10	2.0-14.5	7.4	3	2.0-8.0	5.5	13	2.0-14.5	6.7
8A RM 125.1	3	4.0-6.0	4.7	2	8.5-10.0	9.3	5	4.0-10.0	6.5
9 RM 128.3	8	1.0-10.0	3.1	7	2.0-10.0	5.3	15	1.0-10.0	4.1
11 RM 135.3	13	1.5-15.5	4.8	16	1.5-30.5	9.7	29	1.5-30.5	7.5
							Mean Average		6.9

1/ RM = River Mile

observation days in Slough 9 (RM 128.3) whereas in slough 11 (RM 135.3) the average was 7.5 days. In these same sloughs the average observation life of male chum salmon was less than that recorded of female chum salmon. The difference in chum salmon observation life between sloughs can be partially attributed to variations in the visibility of fish in the sloughs. For example, as shown in Figure 2-3-31, visibility in 1983 was restricted in Slough 9 much of the time chum salmon were present and it was here that chum salmon averaged the lowest observation life of 4.1 days. In those sloughs such as Slough 9 where restricted visibility conditions were often encounted it was difficult to locate fish. This generally lead to less observation time per fish being recorded in these habitats. There may be some differences in the average stream life of chum salmon between sloughs, with stream life being defined as a measure of the number of days a fish is physically present in a habitat without regard to visibility. However, a limitation of the observation life data is that influences of visibility and stream life can not be separated with a relatively small sample of fish such as in our case.

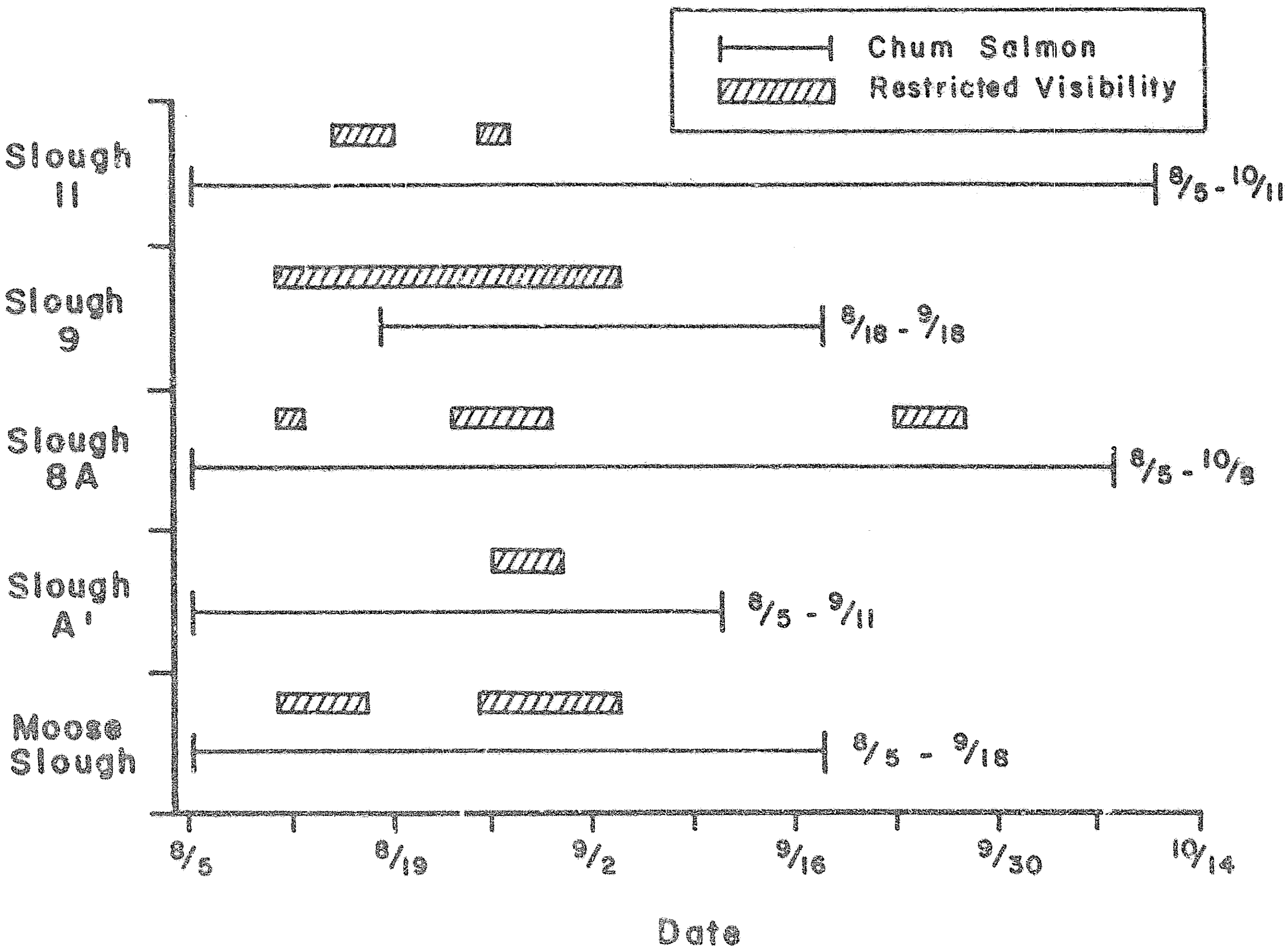


Figure 2-3-31. Periodicities of restricted visibility conditions and chum salmon life observations in 1983 at sloughs Moose, 8A and 11, Adult Anadromous Investigations, Su Hydro Studies, 1983.

In 1983, not all the fish monitored for observation life were confirmed spawners (Table 2-3-42). The percentage of non-confirmed spawners varied between sloughs. At sloughs A' (RM 124.6) and 8A (RM 125.1) all the fish monitored were observed at one time or another to be spawning. At Moose Slough (RM 123.5) only one of the seven fish monitored spawned. In slough 9 (RM 128.3) and 11 (RM 135.3), 71.4 and 79.3 percent of the fish sampled respectively were observed spawning. The high percentage of non-spawners in Moose Slough can be attributed in part to milling activity. Of the seven fish monitored six were classified as milling fish. Two of these fish later spawned in Slough 11.

Table 2-3-42 in combination with Appendix Figures 2-G-2 thru 2-G-5 summarize where the chum salmon monitored for observation life in 1983 spawned within sloughs Moose (RM 123.5), 8A (RM 125.1), 9 (RM 128.3) and 11 (RM 135.3). The most obvious finding was that chum salmon generally had a higher preference towards the lower slough habitat zones for spawning than sockeye salmon. For example at Slough 11 approximately 90 percent of the chum salmon spawned in habitat zones 1 and 2 whereas about 85 percent of the sockeye salmon spawned above habitat zone 3 (Section 3.2.2.2.2.3.1).

3.2.4.2.2.3.2 Escapement Counts

In 1983 a total of 35 sloughs habitats above RM 98.6 were surveyed for salmon presence. The results are presented in Appendix Table 2-G-2.

Twenty three of the 35 sloughs surveyed above RM 98.6 were found to contain chum salmon in 1983 (Table 2-3-43). Eighteen of these sloughs were used for spawning. Sloughs 3B (RM 101.4), 5 (RM 107.6), 6A (RM 112.3), 8D (RM 121.8) and 10 (RM 133.8) were considered to be only milling areas based on the absence of carcasses and spawning activity.

Table 2-3-42. Percentages of chum salmon monitored for observation life that spawned by habitat zone in sloughs Moose, A', 8A, 9 and 11, Adult Anadromous Investigations, Su Hydro Studies, 1983.

Slough with RM 1/	n	Percent Spawning	Spawning Locations by Habitat Zone 2/ 1	2	3	4	5	6	7	Percent Non-spawning 3/
Moose RM 123.5	7	14.3	100.0	0.0	-	-	-	-	-	85.7
A' RM 124.6	13	100.0	-	-	-	-	-	-	-	0.0
8A RM 125.1	5	100.0	20.0	80.0	0.0	-	-	-	-	0.0
9 RM 128.3	14	71.4	0.0	40.0	60.0	-	-	-	-	28.6
11 RM 135.3	29	79.3	39.1	52.2	0.0	8.7	0.0	0.0	0.0	20.7

1/ RM = River Mile

2/ Habitat zones defined in Appendix Figures 2-G-2 thru 2-G-5, Adult Anadromous Investigations, Su Hydro Studies, 1983.

3/ Includes milling fish and also bear killed and other non-spawning mortalities.

The highest concentrations of spawning chum salmon were found in sloughs 11 (22.9%), 21 (16.3%) and 9 (14.6) between the second week of August and the last week of September, 1983. Spawning peaked in these habitats between the last week of August and the first week of September (Figure 2-3-32 and Appendix 2-G).

Table 2-3-43. Chum salmon peak escapement counts for slough habitats above RM 98.6, Adult Anadromous Investigations, Su Hydro Studies, 1983.

Slough	Location (RM) 1/	Date	Number Counted Live	Dead	Total
2	100.2	9/12	37	12	49
3B	101.4	8/26	3	0	3
5	107.6	8/15	1	0	1
6A	112.3	9/5	6	0	6
8D	121.8	8/3	1	0	1
8C	121.9	9/9	2	2	4
8B	122.2	9/9	104	0	104
Moose	123.5	8/5	68	0	68
A'	124.6	8/15	76	1	77
A	124.7	8/27	1	1	2
8A	125.1	8/30	34	3	37
B	126.3	9/11	3	4	7
9	128.3	9/11	105	64	169
9A	133.8	9/18	88	17	105
10	133.8	10/1	1	0	1
11	135.3	9/18	94	144	238
13	135.9	9/1	0	4	4
15	137.2	8/25	1	1	2
17	138.9	8/25	89	1	90
19	139.7	9/3	2	1	3
20	140.0	9/3	33	30	63
21	141.0	9/9	149	170	319
22	144.5	8/18	109	5	114
		TOTAL	1,007	460	1,467

1/ River Mile

In 1983 the total peak spawning count of chum salmon to slough habitats above RM 98.6 was 1,467 fish less 12 fish recorded in peak counts of sloughs 3B, 5, 6A, 8D and 10. (Table 2-3-44). This count of 1,455 fish represents an index of the total escapement (Cousens et. al.). An estimate of the total spawning escapement has been provided in Table 2-3-44 of 2,950 fish. This estimate represents about 14 percent of the estimated chum salmon escapement to Curry

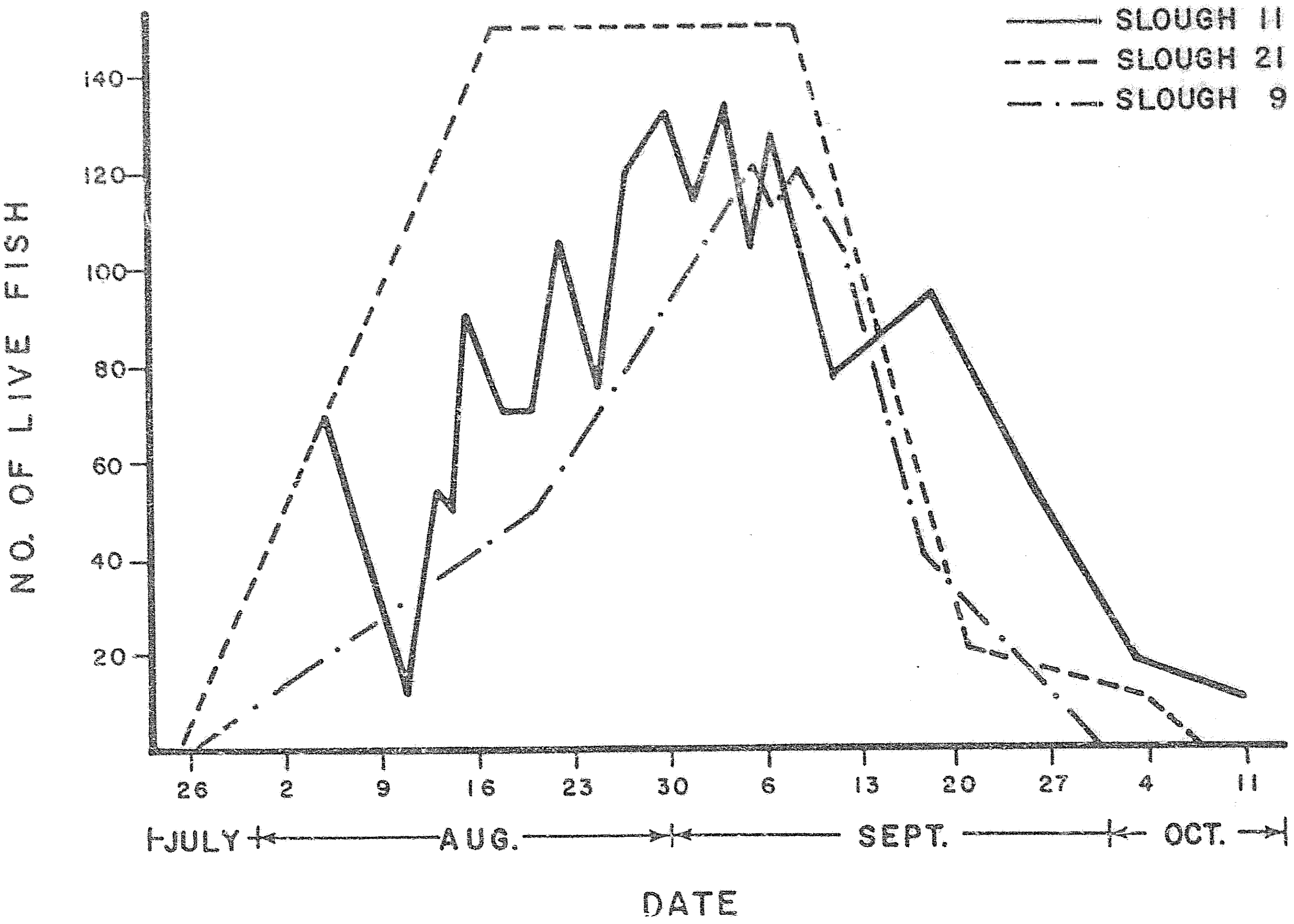
Table 2-3-44. Total 1983 chum salmon slough escapements between RM 98.6 and 161.0, Adult Anadromous Investigations, Su Hydro Studies, 1983.

Slough	River Mile	Total Fish Days [1]	Peak Live-Dead Survey Count	Mean Observation Life in Days	Slough Escapement	% of Total Slough Escapement	% of Curry Station Escapement [3]
2	100.2	659.0	49	6.9	96	3.3	0.5
8C	121.9		4		8 [2]	0.3	0.1
8B	122.2	1,799.8	104	6.9	261	8.9	1.2
Moose	123.5	846.1	68	9.8	86	2.9	0.4
A'	124.6	1,036.8	77	6.7	155	5.3	0.7
A	124.7		2		4 [2]	0.1	0.1
8A	125.1	730.0	37	6.5	112	3.8	0.5
B	126.3		7		14 [2]	0.5	0.1
9	128.3	1,765.0	169	4.1	430	14.6	2.0
9A	133.8	1,595.6	105	6.9	231	7.9	1.1
11	135.3	5,055.2	238	7.5	674	22.9	3.2
13	135.9		4		8 [2]	0.3	0.1
15	137.2		2		4 [2]	0.1	0.1
17	138.9	1,143.4	90	6.9	166	5.6	0.8
19	139.7		3		6 [2]	0.2	0.1
20	140.0	713.1	63	6.9	103	3.5	0.5
21	141.1	3,321.0	319	6.9	481	16.3	2.3
22	144.5	722.8	114	6.9	105	3.5	0.5
TOTAL		19,387.8	1,455	-	2,944	100.0	13.8

1/ Number of fish days were calculated for sloughs that had peak survey counts 15 fish. Refer to Section 2.4 for detailed data analysis procedures.

2/ Total slough escapement into sloughs having peak live-dead survey counts of 15 fish were computed by multiplying the peak live-dead survey count by 2.0. This value represents the summation of the estimated slough escapement divided by the summation of the peak live-dead survey counts for all sloughs with peak survey counts 50 fish.

3/ 1983 Curry Station chum salmon escapement was approximately 21,100 fish.



yr².

Figure 2-3-32. Chum salmon live counts by date in sloughs 9, 11 and 21, Adult Anadromous Investigations, Su Hydro Studies, 1983.

use the same Neilson & Geen 1981 reference as used for chinook salmon - would
an escapement of ~ 2700 for tribs above RM 98.6 2700 + 3000 = 5700 leaves
(Tribs) (Sloughs)
~ 15,000 as milling fish that spawned below RM 98.6 ... a bit high

Station (RM 120) of 21,100 fish. If about 3,000 chum salmon spawned in slough habitats above RM 98.6 then about 18,000 of the 21,000 chum salmon which migrated to Curry Station included fish which were milling and later spawned below RM 98.6, and fish which entered and spawned in Susitna River main channel and stream habitats above RM 98.6.

3.2.4.2.2.3.3 Egg Retention

In 1983, a total of 229 female chum salmon carcasses were sampled for egg retention in 12 sloughs and one main channel spawning habitat between RM 98.6 and 161.0 (Table 2-3-45). The average egg retention from a composite of these samples was 114.1 eggs per female. The median retention was 5.0 eggs which indicates nearly all the females sampled had completely spawned. Less than four percent of the females sampled died retaining more than 1,000 eggs each (Figure 2-3-33).

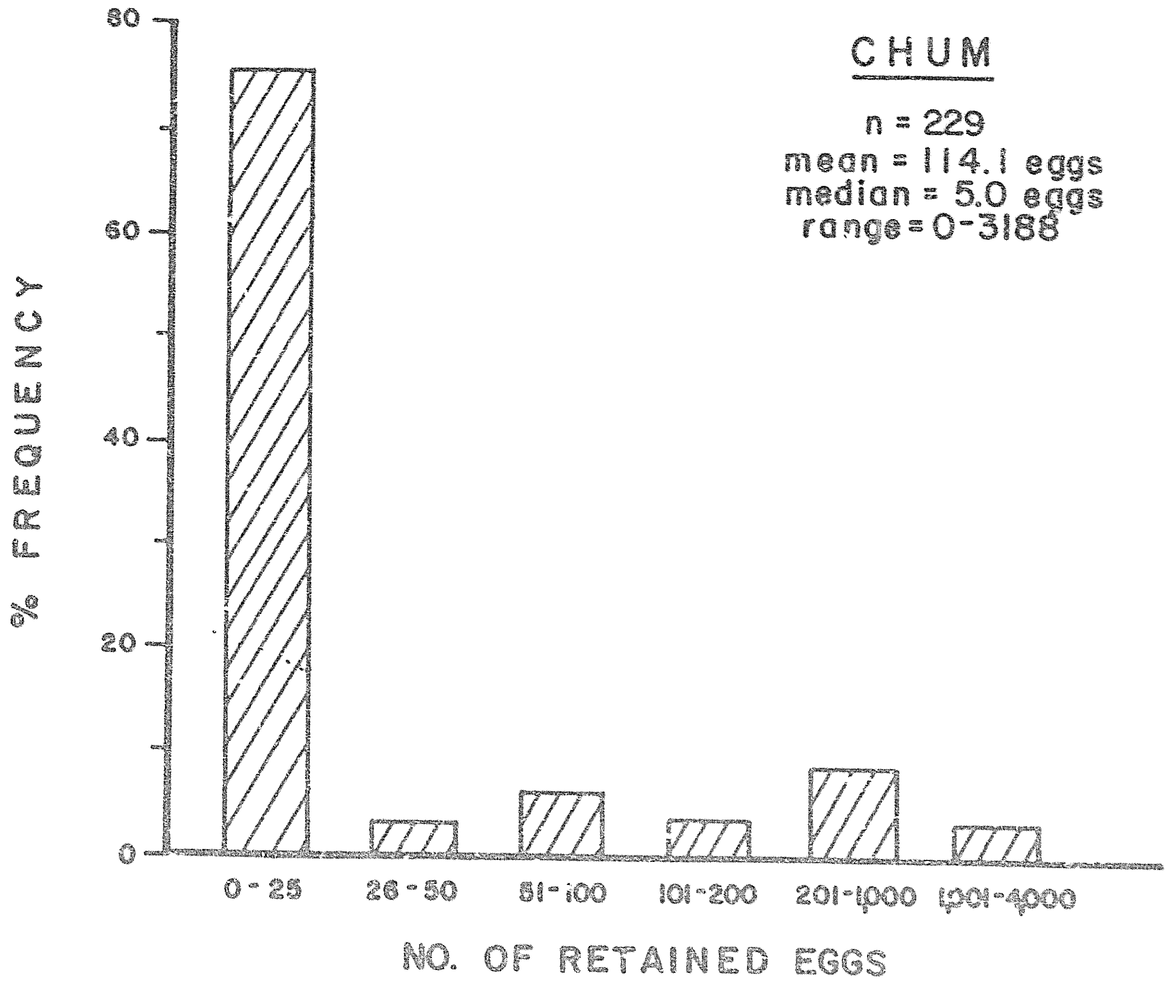


Figure 2-3-33. Percent frequency of egg numbers retained by female chum salmon sampled in slough habitats above RM 98.6 in 1983, Adult Anadromous Investigations, Su Hydro Studies, 1983.

Table 2-3-45. Egg retention of chum salmon at selected spawning habitats between RM 98.6 and 161, Adult Anadromous Investigations, Su Hydro Studies, 1983.

Spawning Habitat with RM [1/]	Sample Size	Egg Retention		
		Mean	Median	Range
Slough 2 RM 100.2	1	335.0	-	-
Moose Slough RM 123.5	7	386.4	5.0	0-1719
Slough A' RM 124.6	17	56.1	5.0	0-754
Slough 8A RM 125.1	2	4.0	4.0	1-7
Slough 9 RM 128.3	51	101.4	9.0	0-1765
Slough 9A RM 133.8	1	21.0	-	-
Main Channel RM 135.2	13	125.0	16.0	0-539
Slough 11 RM 135.3	53	150.0	2.0	0-3188
Slough 17 RM 138.9	4	39.3	27.0	3-102
Slough 19 RM 139.7	2	87.0	87.0	2-172
Slough 20 RM 140.0	12	146.3	4.0	0-1674
Slough 21 RM 141.1	64	82.5	3.5	0-1074
Slough 22 RM 144.5	2	0	-	0
Composite of all sloughs sampled	229	114.1	5.0	0-3188

1/ RM = River Mile

3.2.5 Coho Salmon

3.2.5.1 Intertidal to Talkeetna

3.2.5.1.1 Main Channel Escapement Monitoring

The 1983 escapement of coho salmon into the Yentna River (RM 28) was monitored by SSS counters located at Yentna Station (TRM 04). The escapement was approximated to be 8,850 fish (Table 2-3-22). Daily coho salmon passage rates are presented in Appendix Table 2-C-3 and Appendix Figure 2-C-1.

At Sunshine Station (RM 80) the coho salmon escapement was estimated to be 15,250 fish in 1983 (Table 2-3-46). This value was derived using tag/recapture estimation techniques and had an associated 95 percent confidence interval of 13,450 to 17,600 fish (Table 2-3-46).

Table 2-3-46. Petersen population estimates with associated 95% confidence intervals of coho salmon migration to Sunshine, Talkeetna and Curry stations, Adult Anadromous Investigations, Su Hydro Studies, 1983.

Parameter [1/]	Population Estimate Location		
	Sunshine Station	Talkeetna Station	Curry Station
m	2,24[illegible]	364	70
c	1,243	275	117
r	183	41	10
$\hat{N}$	15,235	2,441	819
95% C.I.	13,437-17,589	1,904-3,402	514-2,011

1/ m = Number of fish marked (adjusted).
c = Total number of fish examined for marks during sampling census.
r = Total number of marked fish observed during sampling census.
$\hat{N}$ = Population estimate. C.I. = Confidence interval around $\hat{N}$.

In 1983, 574 coho salmon were intercepted by the two fishwheels operated at Yentna Station (TRM 04) and defined a 59 day migrational period (Table 2-3-11). Based on these fishwheel catches the migration began on July 7, reached a midpoint on July 27 and extended through the last operational day, September 4. The migration peak occurred on approximately July 23 (Appendix Table 2-D-3, Also based on fishwheel captures, it was determined that coho salmon were more abundant along the south bank where 63 percent of the fishwheel catch at this station was recorded (Figure 2-3-34).

By interpretation of fishwheel catch statistics it was found that the coho salmon migration to Sunshine Station (RM 80) in 1983 began on July 23, reached a midpoint on August 5 and was essentially complete by August 25. The migration reached a peak on August 4 (Appendix Table 2-D-6). From 2,254 fishwheel captures it was determined that coho salmon migrated primarily along the east bank where 82 percent of the interceptions at this station occurred (Table 2-3-11 and Figure 2-3-34).

The distribution of fishwheel catch per hour as a function of time is illustrated in Figure 2-3-34 and reveals a distinct bimodal pattern in the coho salmon catch curve for fishwheels located on both banks of the river at Yentna (TRM 04) and Sunshine (RM 80) stations. This pattern is also apparent for the fishwheels located at Talkeetna (RM 103) and Curry (RM 120) stations (Figure 2-3-35). Three possible explanations may serve to explain this distribution. They are: 1) delayed response to coho salmon catches in the Cook Inlet commercial fishery, 2) stock differences in migrational timing of coho salmon and 3) alteration in migrational movements in response to a variation in seasonal Susitna River discharges. In reviewing the fishwheel

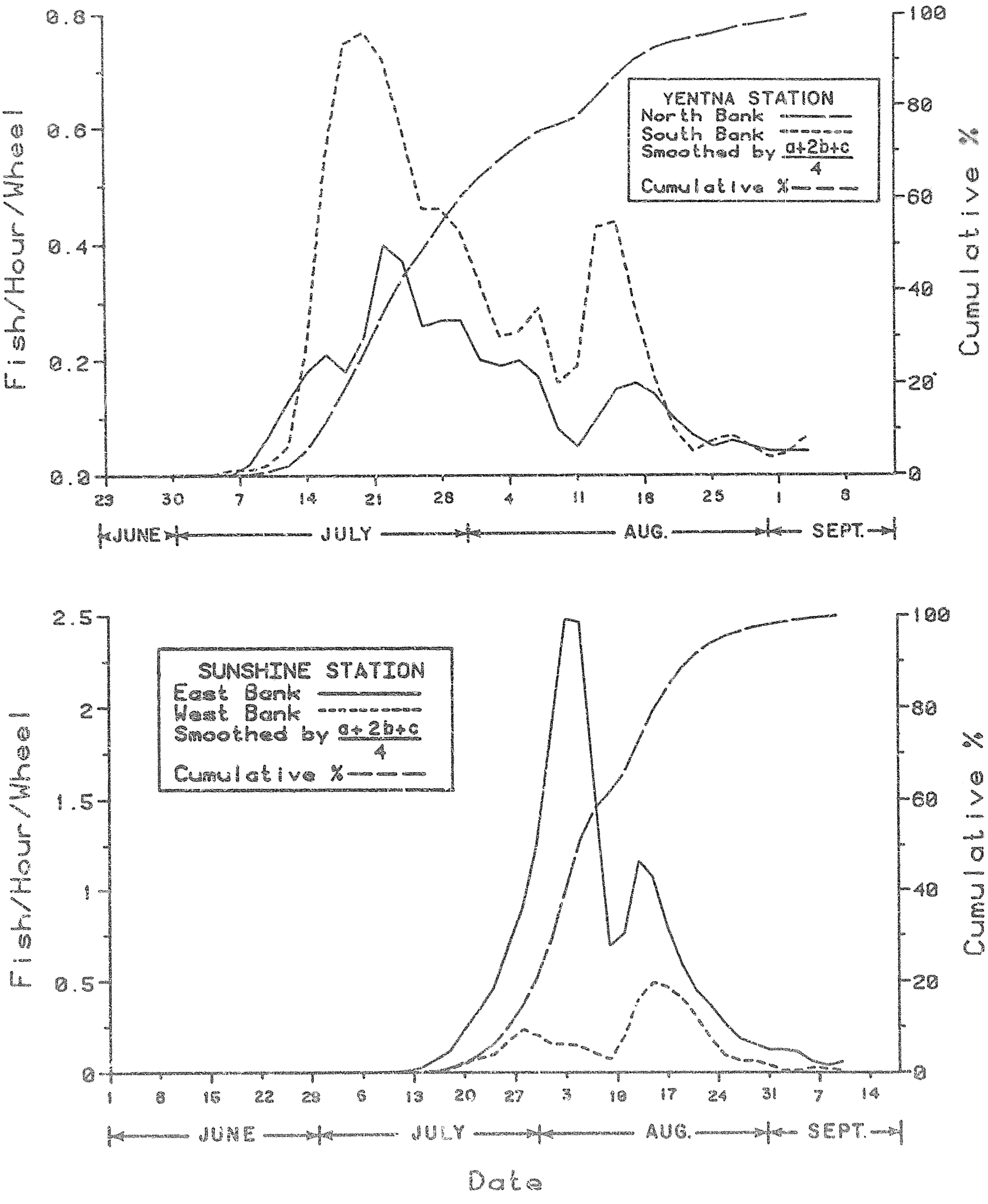


Figure 2-3-34. Mean hourly and cumulative percent fishwheel catch of coho salmon by two day periods at Yentna and Sunshine stations, Adult Anadromous Investigations, Su Hydro Studies. 1983.

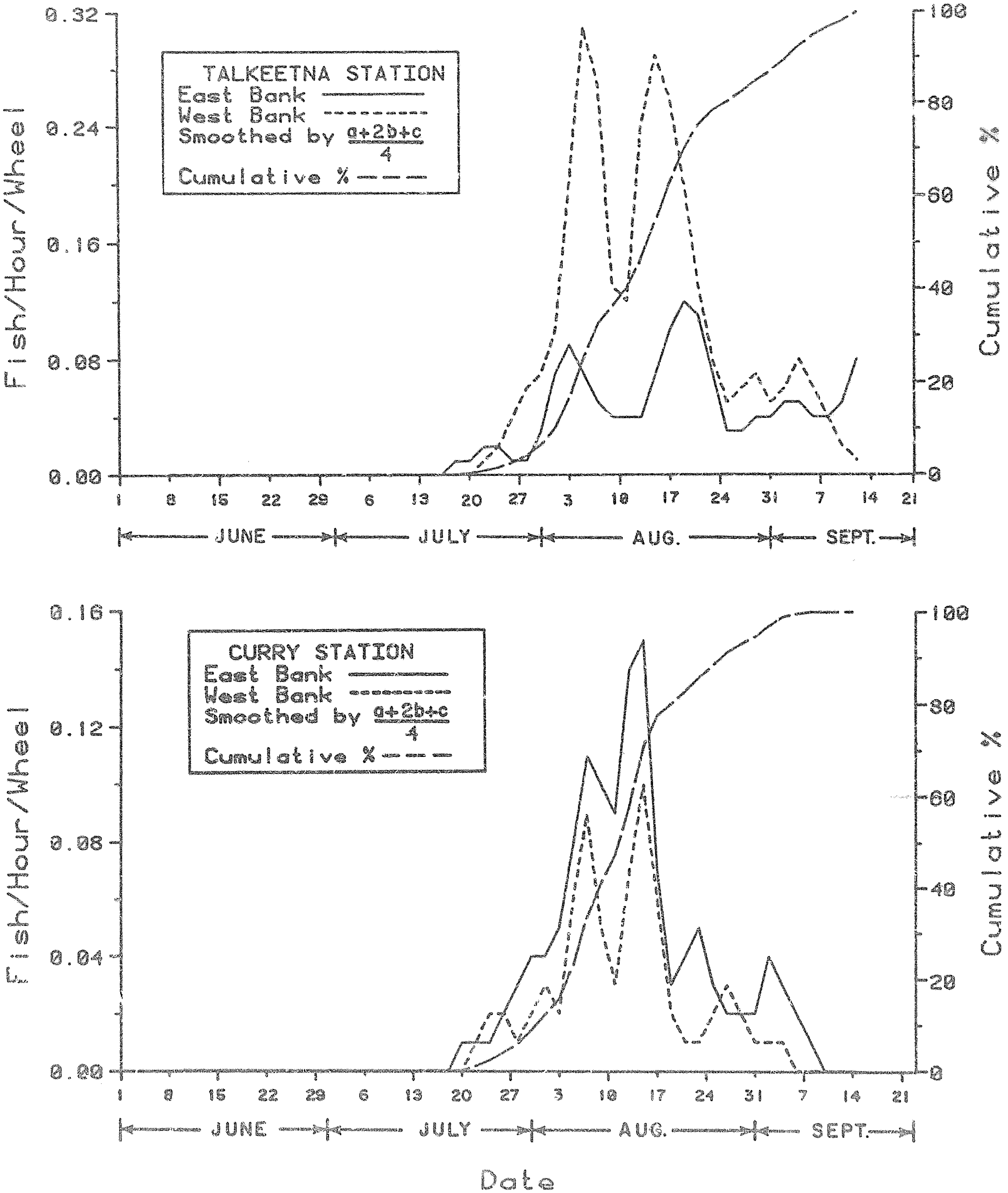


Figure 2-3-35. Mean hourly and cumulative percent fishwheel catch of coho salmon by two day periods at Talkeetna and Curry stations, Adult Anadromous Investigations, Su Hydro Studies, 1983.

catch figures it can be seen that the low catches occur an approximately the same days, August 9 and 10 at all four sampling stations. Differential migrational rates for individual stocks and low catches as a result of the commercial fishery would result in low points in the fishwheel catch distribution at time intervals corresponding to coho salmon migrational rates between stations. This however, is not the case and by examining 1983 USGS provisional Susitna and Yentna rivers discharge data it can be found that peak flows (flooding conditions) occurred on approximately August 10 and 11 in both rivers (Figure 2-3-25). These peak flows correspond exactly to the low points in the fishwheel catch per hour curve and would seem to be the most plausible explanation to the bimodal catch distribution at these stations.

A portion of the 1983 coho salmon escapement passing Yentna (TRM 04) and Sunshine (RM 80) stations were sampled to identify population age composition. Results are summarized in Figure 2-3-36 and Table 2-3-47. Coho salmon migrating to Yentna Station were comprised of 80.4 percent four year old fish, 16.1 percent three year old fish and 3.5 percent five year old fish. All coho salmon sampled here spent at least one winter rearing in freshwater and 80.7 percent migrated to sea in their third year of life. Interestingly, 2.6 percent of the sample did not overwinter in the ocean environment instead returned in the fall of the same year they migrated to sea. At Sunshine Station 516 coho salmon scales were collected from the escapement (Table 2-3-47). Of these scales 63.3, 35.9 and 0.8 percents represented four, three and five year old fish, respectively. The majority of the coho salmon sampled, 63.1 percent, outmigrated in their third year of life.

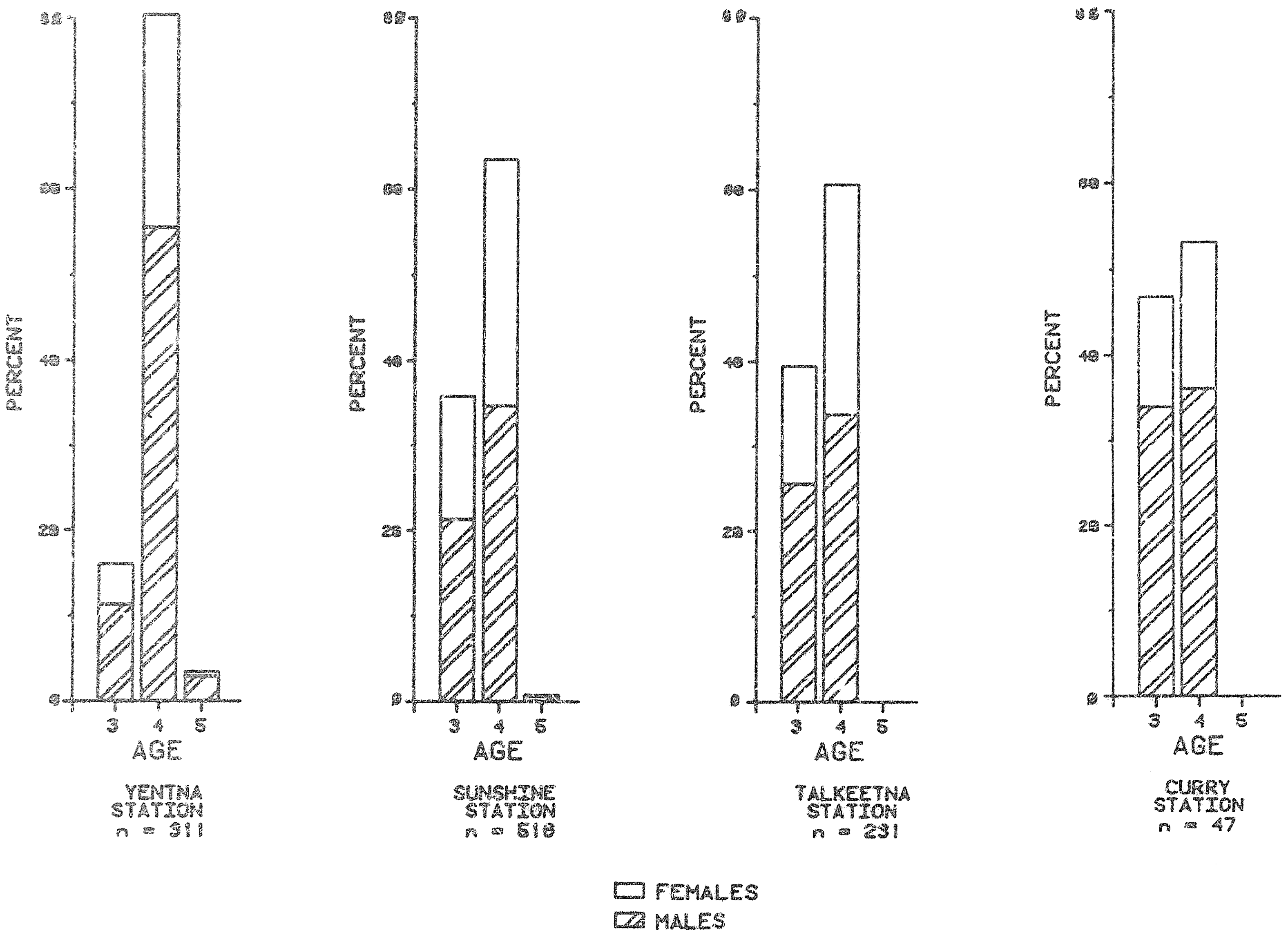


Figure 2-3-36. Age composition of fishwheel intercepted coho salmon at Yentna, Sunshine, Talkeetna and Curry stations, Adult Anadromous Investigations, Su Hydro Studies, 1983.

Length (FL) and related age information was also collected from a subsample of the coho salmon escapement at Yentna (TRM 04) and Sunshine (RM 80) stations in 1983 and the results are summarized in Table 2-3-48. The mean length of all coho salmon measured at Yentna Station was 528 mm. The composite mean length of all coho salmon measured at Sunshine Station was 523 mm. Sex composition relative to age for coho salmon collected at Yentna and

Table 2-3-47. Analysis of coho salmon age data by percent from escapement samples collected at Yentna, Sunshine, Talkeetna and Curry stations, Adult Anadromous Investigations, Su Hydro Studies, 1983.

Collection Site	n	Age Class 1/					
		3_2	3_3	4_2	4_3	4_4	5_4
Yentna Station	311	14.5	1.6	0.3	79.1	1.0	3.5
Sunshine Station	516	35.9	-	0.2	63.1	-	0.8
Talkeetna Station	231	39.4	-	0.4	60.2	-	-
Curry Station	47	46.8	-	-	53.2	-	-

1/ Gilbert-Rich Notation

Sunshine stations in 1983 indicate that males were consistently more abundant than females for all ages at both sites, with overall sex ratios of 2.3:1 and 1.2:1 in the above station order (Table 2-3-49).

3.2.5.2 Talkeetna to Upper Devil Canyon

3.2.5.2.1 Main Channel Escapement Monitoring

The coho salmon escapement to Talkeetna Station (RM 103) was approximately 2,450 fish in 1983 (Table 2-3-46). At Curry Station (RM 120) the escapement was estimated to be 820 coho salmon (Table 2-3-46). Both estimates include

Table 2-3-48. Analysis of coho salmon lengths, in millimeters, by age class from escapement samples collected at Yentna, Sunshine, Talkeetna and Curry stations, Adult Anadromous Investigations, Su Hydro Studies, 1983.

Collection Site	Age Class	n		Range Limits		Mean		95% Conf. Interval [3/]		Median	
		M [1/]	F [2/]	M	F	M	F	M	F	M	F
Yentna Station	3_2	30	15	405-598	395-571	492	492	472-511	464-521	481	505
	3_3	5	-	240-330	-	293	-	-	-	286	-
	4_2	-	1	-	531	-	531	-	-	-	531
	4_3	170	76	320-655	387-609	543	538	534-551	528-549	556	552
	4_4	3	-	300-331	-	315	-	-	-	315	-
	5_4	9	2	552-625	542-597	596	570	-	-	592	570
	ALL [4/]	349	149	240-679	348-613	527	530	519-535	522-539	548	542
		498		240-679		528		522-534		544	
Sunshine Station	3_2	110	75	385-625	400-585	487	491	478-496	480-502	488	500
	4_2	-	1	-	475	-	475	-	-	-	475
	4_3	179	147	395-630	410-640	539	540	531-547	534-547	545	540
	5_4	3	1	600-645	570	625	570	-	-	630	570
	ALL [4/]	438	356	385-665	400-640	523	524	517-528	519-530	520	530
		794		385-665		523		520-527		525	
Talkeetna Station	3_2	59	32	380-595	395-590	482	499	468-496	481-517	470	510
	4_2	1	-	450	-	450	-	-	-	450	-
	4_3	77	62	430-640	450-680	542	552	530-553	542-561	550	555
	ALL [4/]	226	135	340-690	395-700	522	538	514-530	530-546	530	540
		361		340-700		528		522-534		540	
Curry Station	3_2	16	6	430-530	354-555	477	480	461-493	-	470	500
	4_3	17	8	480-610	500-590	554	553	534-575	-	555	560
	ALL [4/]	48	24	420-610	354-600	518	530	503-534	-	515	543
		72		354-610		522		509-535		530	

1/ Males. 2/ Females. 3/ Confidence Interval of the Mean. 4/ Composite of all aged and non-aged samples.

an unknown number of milling fish which returned downstream to spawn below the respective stations.

As depicted in Appendix Table 2-D-9 and Figure 2-3-35 fishwheel catches indicate the 1983 coho salmon migration at Talkeetna Station (RM 103) began on July 30, reached a median on August 14 and was essentially complete by

Table 2-3-49. Sex ratios of male and female coho salmon by age from escapement samples collected at Yentna, Sunshine, Talkeetna and Curry stations, Adult Anadromous Investigations, Su Hydro Studies, 1983.

Collection Site	Age	Sample Size	Number		Sex Ratio (M:F)
			Males	Females	
Yentna Station	3	50	35	15	2.3:1
	4	250	173	77	2.2:1
	5	11	9	2	4.5:1
	All 1/	498	349	149	2.3:1
Sunshine Station	3	185	110	75	1.5:1
	4	327	179	148	1.2:1
	5	4	3	1	3.0:1
	All 1/	794	438	356	1.2:1
Talkeetna Station	3	91	59	32	1.8:1
	4	140	78	62	1.3:1
	All 1/	361	226	135	1.7:1
Curry Station	3	22	16	6	2.7:1
	4	25	17	8	2.1:1
	All 1/	72	48	24	2.0:1

1/ Includes all aged and non-aged samples.

September 7. The migration peak was on August 16. From the illustration of fishwheel catch rates portrayed in Figure 2-3-35 coho salmon were more abundant along the west bank, where 69 percent of the fishwheel catch at this station was recorded.

At Curry Station (RM 120), the 1983 coho salmon fishwheel migration started on July 28, was mid-way through on August 12 and virtually complete by September 2 (Appendix Table 2-D-12 and Figure 2-3-35). The peak of migration occurred on August 15. From the 93 fishwheel captures it is apparent that coho salmon were more prevalent along the east bank, where 63 percent of the fishwheel catch at this station occurred (Figure 2-3-35).

Recaptures of coho salmon tagged at Sunshine (RM 80) and Talkeetna (RM 103) stations in 1983 provide the basis for the migrational timing information which is portrayed in Figure 2-3-37. As illustrated, coho salmon required an average of 17 days or 1.4 mpd to navigate the distance of 23 miles between Sunshine and Talkeetna stations. Between Sunshine and Curry (RM 120) stations, a 40 mile distance, the average travel time was 21 days or 2.0 mpd. The 17 miles between Talkeetna and Curry stations were travelled by coho salmon in an average of three days for a rate of 5.7 mpd.

Two hundred thirty-one and 47 coho salmon intercepted by fishwheels located at Talkeetna (RM 103) and Curry (RM 120) stations were sampled for age in 1983. Results are summarized in Table 2-3-47 and Figure 2-3-36. The sample collected at Talkeetna Station segregated to 60.6 percent four year old fish and 39.4 percent three year old fish. The majority of the coho salmon, 60.2 percent, migrated to sea in their third year of life. Those sampled at Curry

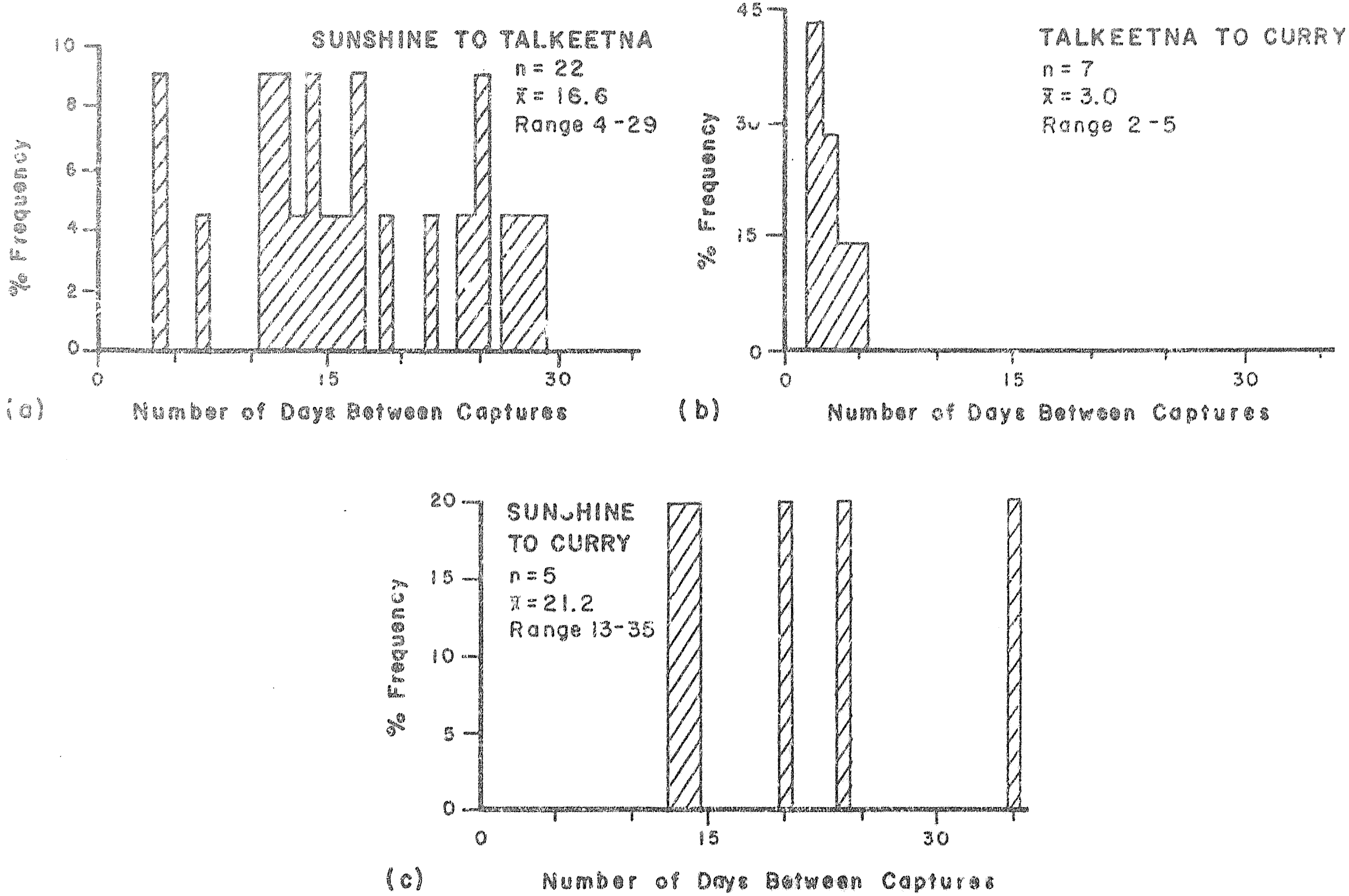


Figure 2-3-37. Migrational rates of coho salmon between (a) Sunshine and Talkeetna stations, (b) Talkeetna and Curry stations and (c) Sunshine and Curry stations, Adult Anadromous Investigations, Su Hydro Studies, 1983.

Station were comprised of 53.2 and 46.8 percent four and three year old fish, respectively. Again, the largest portion, 53.2 percent, migrated to sea in their third year of life.

Length (FL) and associated age data were also collected from a subsample of the coho salmon intercepted at Talkeetna (RM 103) and Curry (RM 120) stations in 1983. The results of these measurements are presented in Table 2-3-48 and Appendix 2-E. Coho salmon sampled at Talkeetna Station averaged 528 mm for all samples and at Curry Station the mean length was 522 mm for all samples. The number of males was consistently greater than the number of females for all ages at both Talkeetna and Curry stations and as shown in Table 2-3-49 male to female sex ratios for all fish sampled were 1.7:1 and 2.0:1, respectively.

3.2.5.2.2 Spawning Ground Surveys

3.2.5.2.2.1 Main Channel

There was no operational Susitna River main channel spawning survey program in 1983. However, while conducting slough and stream surveys one main channel coho salmon spawning site was located at RM 131.1. As illustrated in Appendix Figure 2-G-8 this site was approximately 150 yards upstream from the confluence of 4th of July Creek. Two coho salmon were observed near redd sites here on October 1 (Appendix Table 2-G-1).

3.2.5.2.2.2 Sloughs and Streams

All known Susitna River sloughs between RM 98.6 and 161.0 were repetitively surveyed for coho salmon presence in 1983. These surveys were conducted between July 26 and October 8 with the results listed in Appendix Table 2-G-2.

Coho salmon were observed in three of the sloughs surveyed in 1983 although this presence was not considered to represent spawning but rather only milling activity (Appendix Table 2-G-2).

redundant

Streams tributary to the Susitna River above RM 98.6 and below 161.0 were also surveyed regularly for coho salmon in 1983 (Appendix Table 2-G-3). Ten streams were found to have coho salmon and were, as shown in Table 2-3-50, ranked in order of importance by percent contribution of peak survey counts. Whiskers Creek (RM 101.4) and Indian River (RM 138.6) supported approximately 72 percent of the coho salmon spawning, based on peak survey counts. These counts do not represent total escapements into tributaries but were index counts used to establish relative abundance.

Survey observations indicate coho salmon spawning activity in streams reached a peak between the first week of September and the first week of October in 1983. At Whiskers Creek (RM 101.4) peak spawning occurred during the last two weeks of September (Appendix Table 2-G-3).

From ground and helicopter surveys of Indian River, illustrated in Figure 2-3-38, it was determined that peak spawning occurred here during the second week of September, approximately. Also, as shown in this figure the time difference in peak survey counts between foot and helicopter surveys indicate that the coho salmon observed initially during foot surveys of the first mile continue to move upstream and presumably spawn in the middle and upper reaches of Indian River.

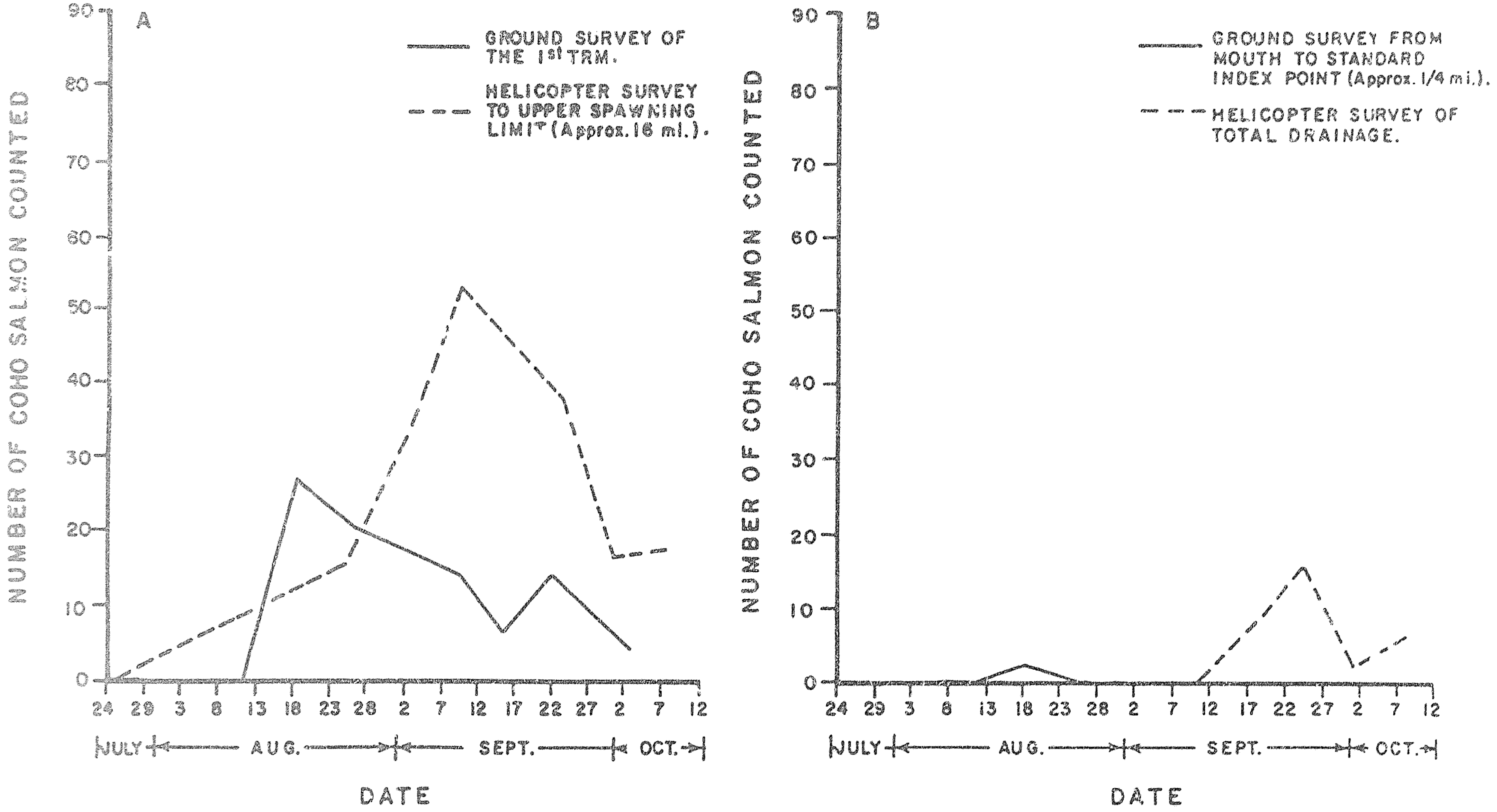


Figure 2-3-38. Peak coho salmon ground and helicopter survey counts of (a) Indian River and (b) Portage Creek, Adult Anadromous Investigations, Su Hydro Studies, 1983.

Table 2-3-50. Coho salmon peak escapement counts for stream habitats above RM 98.6 in order of contribution, Adult Anadromous Investigations, Su Hydro Studies, 1983.

Stream	River Mile	Date	Survey Method	Number Counted Live	Dead	Total	Percent Contribution
Whiskers Creek	101.4	9/24	Hel.	110	5	115	49.1
Indian River	138.6	9/10	Hel.	53	0	53	22.6
Gash Creek	111.6	9/19	Foot	18	1	19	8.1
L. McKenzie Creek	116.2	10/1	Foot	18	0	18	7.7
Portage Creek	148.9	9/25	Hel.	15	0	15	6.4
Chase Creek	106.9	10/1	Hel.	5	1	6	2.6
4th of July Creek	131.0	9/18	Foot	2	1	3	1.3
Slash Creek	111.2	10/2	Foot	2	0	2	0.9
Lane Creek	113.6	9/19	Foot	2	0	2	0.9
Jack Long Creek	144.5	10/1	Hel.	1	0	1	0.4
		TOTAL		226	8	234	100.0

3.3 Bering Cisco

3.3.1 Intertidal to Talkeetna

3.3.1.1 Main Channel Escapement Monitoring

No provision was made to estimate Bering cisco escapements or ascertain their migrational timing characteristics in 1983. However, incidental to adult salmon studies, fishwheel catches of Bering cisco were recorded at both Yentna (TRM 04) and Sunshine (RM 80) stations (Table 2-3-51).

Table 2-3-51. Summary of 1983 Bering cisco interceptions by location and gear type, Adult Anadromous Investigations, Su Hydro Studies, 1983.

Sampling Location	River Mile	Gear Type	Date		Number Caught
			First Capture	Last Capture	
Yentna Station	04	Fishwheel	8/20	9/4	24
Sunshine Station	80	Fishwheel	8/28	9/10	29
Talkeetna Station	103	Fishwheel	8/30	9/10	5
Main Channel	101.0-131.1	Gillnet and Electroshocker	9/15	10/6	9

At Yentna Station (TRM 04) fishwheels intercepted 24 Bering cisco in 1983. The first capture was recorded on August 20 and the last capture on September 4, the last day of fishwheel operation at this station (Appendix Table 2-D-3). There is insufficient information available to define any migrational timing characteristics. Most Bering cisco were found to migrate along the south bank where 67.7 percent of the stations fishwheel captures of Bering cisco occurred.

Sunshine Station (RM 80) fishwheels, operational from June 3 until September 11, intercepted 29 Bering cisco in 1983 (Appendix Table 2-D-6). The first recorded fishwheel catch was on August 28 with catches continuing through September 10 (Table 2-3-51). Bering cisco exhibited an affinity for migration along the east bank at this station as evidenced by 86.2 percent of the fishwheel catch occurring in east bank fishwheels.

3.3.2 Talkeetna to Upper Devil Canyon

3.3.2.1 Main Channel Escapement Monitoring

There was no program designed specifically to monitor Bering cisco abundance, migrational characteristics or spawning activities in 1983. All information pertaining to Bering cisco was gathered incidental to adult salmon and resident and juvenile studies.

Talkeetna Station (RM 103) fishwheels, operating from June 7 through September 12, intercepted five Bering cisco in 1983 (Table 2-3-51). The first fishwheel capture was recorded on August 30 and the last on September 10 (Appendix Table 2-D-9). Sixty percent (3) of these captures occurred in east bank fishwheels and 40 percent (2) in west bank fishwheels. No age, length or sex data were collected from the Bering cisco intercepted at this station.

Curry Station (RM 120) fishwheels were operational from June 9 through September 14 in 1983. There were no recorded captures of Bering cisco in this time period at this station (Appendix Table 2-D-12).

While conducting related resident and juvenile studies, Su Hydro biologists captured or observed nine Bering cisco between September 16 and October 6, 1983. Eight Bering cisco were electroshocked or gillnetted in main channel sites between RM 101.0 and 102.2. The ninth was electroshocked near the confluence of Fourth of July Creek (RM 131.1) on October 6. None of the nine Bering cisco captured in the main channel were in spawning condition at the time of capture.

4.0 SUMMARY

All references to 1981 and 1982 adult anadromous data mentioned in this summary are from the ADF&G, Phase I (1981) and Phase II (1982) Adult Anadromous Fisheries reports.

4.1 Eulachon

In 1983, two migrations of eulachon entered the Susitna River. The first migration was intercepted in the intertidal reach between May 10 and 17 and the second migration from May 19 to June 6.

The upper limit of eulachon migration in the Susitna River for the (1983) first migration was approximately RM 28.5 and for the second migration, RM 50.5. The largest eulachon concentrations during both migrations occurred downstream of the Yentna River confluence (RM 28).

The first eulachon migration in 1983 spawned in the Susitna River main channel between May 15 and 22. Second migration fish also spawned in main channel river habitat between May 23 and June 5. Fish of both migration used similar spawning habitats. The most common spawning areas were near eroding banks where bottom substrates included unconsolidated silty sand and gravel deposits. No eulachon spawning was found to have occurred in any clear water tributary or slough habitats.

In 1983, the first and second eulachon migrations into the Susitna River were comprised of two, three and four year old fish. Three year olds comprised about 90 percent of both migrations.

Eulachon in the first migration (1983) averaged larger length and weight than eulachon in the second migration. Significant difference in length occurred at the 99 percent confidence level between first and second migration eulachon.

Sex composition samples (1983) from RM 4.5 to 60.0 established that the first migration was comprised of more male eulachon than female eulachon by a ratio of 1.2:1. The second migration supported more females than males by a ratio of 0.6:1.

In 1983 male eulachons in both migrations ripened earlier and remained in spawning condition longer than female eulachons. The longer male spawning life was apparent in sex ratio samples collected of spawning and post spawning eulachon where males were more numerous than females by ratios ranging from 3.4:1 to 18.9:1.

Stress associated mortality was observed among second migration (1983) female eulachon in the area of RM 17 at a time when 'high' spawning densities were noted upstream.

Sport fishing effort for eulachon on the Susitna River was minimal in 1983. The estimated (1983) harvest was in the range of 500 to 2,000 fish.

The first migration of eulachon into the Susitna River in 1983 amounted to somewhere in the range of several hundred thousand fish. The second migration was notably larger in magnitude in the range of several million fish.

4.2 Adult Salmon

The first year of the ADF&G Su Hydro Aquatic Studies Program, Adult Anadromous Investigations was in 1981. In that year, second run sockeye, pink, chum and coho salmon were monitored to determine the escapement returns to Susitna (RM 26), Yentna (TRM 04), Sunshine (RM 80), Talkeetna (RM 103) and Curry (RM 120) stations. The escapements were monitored with SSS counters at Susitna, Yentna, Sunshine and Talkeetna stations and additionally by tag/recapture methods at Sunshine, Talkeetna and Curry stations. In 1982, the second year of operations, chinook and first run sockeye salmon escapements were additionally monitored at Sunshine, Talkeetna and Curry stations using the tag/recapture method. Other procedures used to quantify adult salmon escapements at the five sampling stations in 1982 were the same as those followed in 1981.

In 1983, the third year of operation, Susitna Station (RM 26) was deleted from program for reasons defined in the Phase II, Adult Anadromous Fisheries report, 1982. The SSS counters at Sunshine and Talkeetna stations were also deleted as a method for estimating escapement because of the duplication of effort and problems with SSS counter use in the Susitna River. (ADF&G, 1982; Thompson and Barrett, 1983).

The following subsections provide a summary of our 1983 adult salmon investigations in the Susitna and Yentna rivers and provides a comparison of these results with those obtained in 1981 and 1982.

4.2.1 Chinook Salmon

4.2.1.1 Intertidal to Talkeetna

In 1983, the chinook salmon escapement to the Susitna River at Sunshine Station (RM 80) was monitored. The (1983) escapement to the Yentna River (RM 28) was only partially monitored due to a scheduled late start up date of June 30 at Yentna Station (TRM 04).

An estimated 91,200 chinook salmon escaped to the Susitna River at Sunshine Station (RM 80) in 1983 (Table 2-4-1). The escapement to this station in 1982 was about 42 percent lower at 52,900 fish (Figure 2-4-1). The 1981 escapement was only partially monitored and no estimate of the total escapement was made for that year.

At Sunshine Station (RM 80) chinook salmon migrated over a longer period of time in 1983 than in 1982 (Figure 2-4-2). The migration in 1983 began on June 9, reach a midpoint on June 18 and ended on July 9. In 1982, the respective dates were June 18, 30 and July 9.

Chinook salmon age samples were collected in 1983 at Yentna (TRM 04) and Sunshine (RM 80) stations. An insufficient sample was obtained at Yentna Station to define specific results. At Sunshine Station of 1,300 fish sampled, six year old fish were dominate (45%). At this station in 1981, four year old fish were the most abundant (32%), and in 1982 again it was six year old fish (37%). In all three years at Sunshine Station, fish three through seven years old were sampled and nearly all were fish that had gone to sea in their second year of life.

Table 2-4-1. Escapement by species and sampling location for 1981, 1982 and 1983, Adult Anadromous Investigations, Su Hydro Studies, 1983.

Sampling Location	Year	Escapement 1/					
		Chinook	Sockeye 2/	Pink	Chum	Coho	Total
Yentna Station	1981	3/	139,400	36,100	19,800	17,000	212,300
	1982		113,800	447,300	27,800	34,100	623,000
	1983		104,400	60,700	10,800	8,900	184,800
Sunshine Station	1981	4/	133,500	49,500	262,900	19,800	465,700
	1982	52,900	151,500	443,200	430,400	45,700	1,123,700
	1983	91,200	71,700	40,600	266,000	15,200	480,800
Talkeetna Station	1981	4/	4,800	2,300	20,800	3,300	31,200
	1982	10,900	3,100	73,000	49,100	5,100	141,200
	1983	14,500	4,200	9,500	50,400	2,400	78,300
Accounted for		8500	1060	2556	5700	450	
Curry Station	1981	4/	2,800	1,000	13,100	1,100	18,000
	1982	11,300	1,300	58,800	29,400	2,400	103,200
	1983	10,000	1,900	5,500	21,100	800	38,800
							18,266

72,000

1/ Escapement estimates were derived from tag/recapture population estimates except Yentna Station escapements which were obtained using side scan sonar.

2/ Second run sockeye salmon escapement estimates.

3/ Yentna Station side scan sonar equipment was not operational on the dates required to estimate the total Yentna River chinook salmon escapement.

4/ Chinook salmon were not monitored for escapement in 1981.

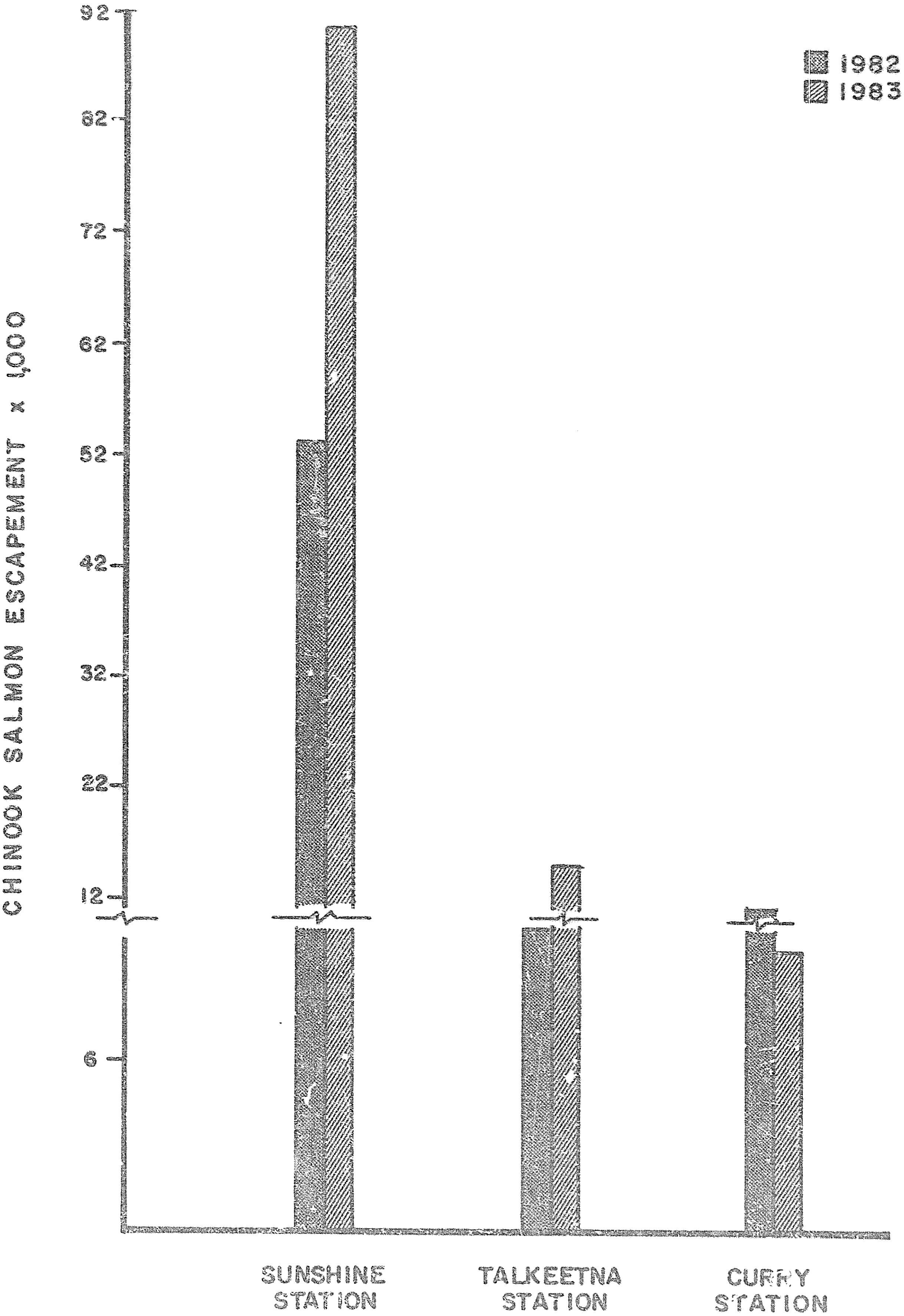


Figure 2-4-1. Minimum Susitna River chinook salmon escapements for 1982 and 1983, Adult Anadromous Investigations, Su Hydro Studies, 1983.

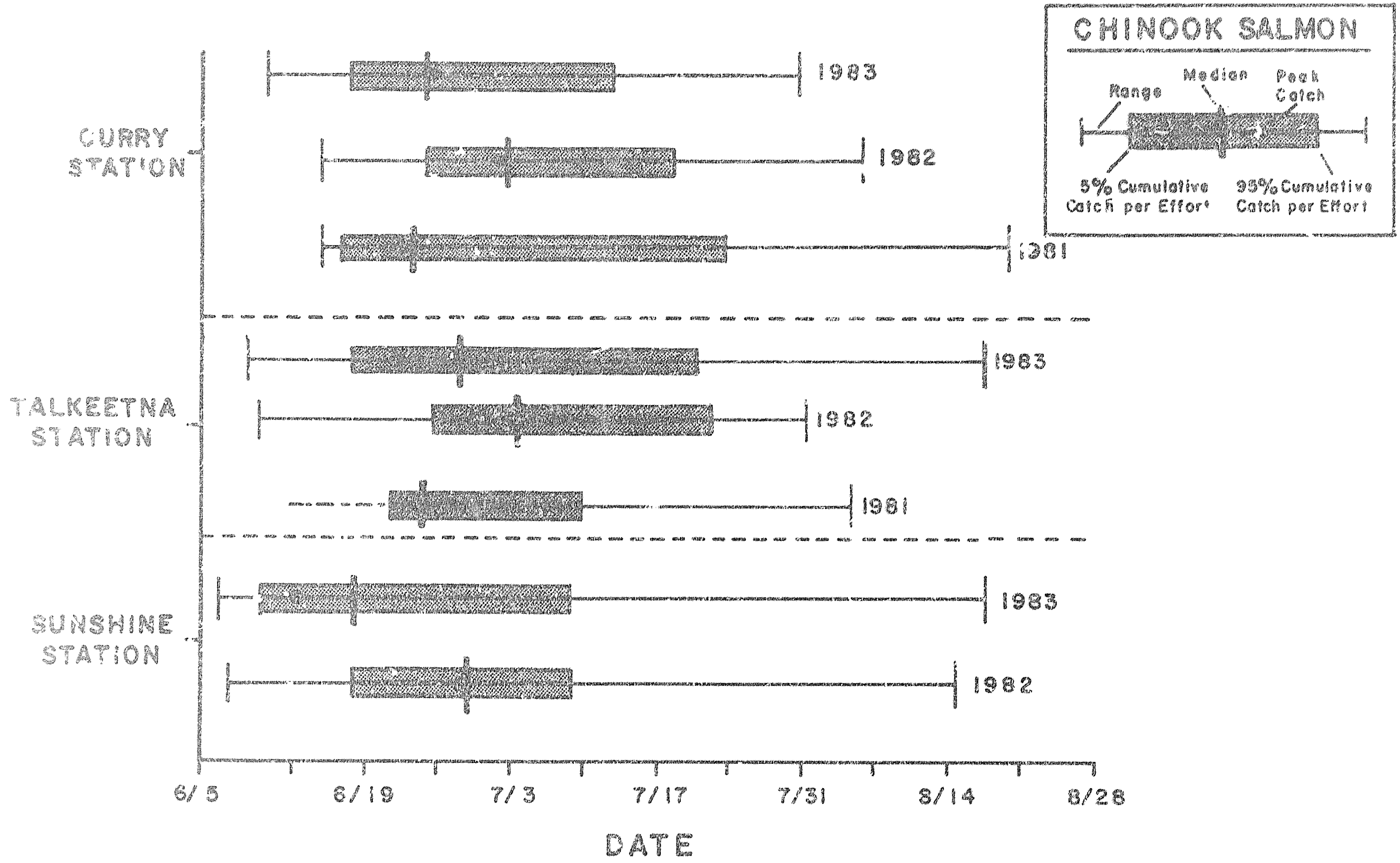


Figure 2-4-2. Migrational timing of chinook salmon based on fishwheel catches at selected locations on the Susitna River in 1981, 1982 and 1983, Adult Anadromous Investigations, Su Hydro Studies, 1983.

Chinook salmon measured for lengths at Yentna Station (TRM 04) averaged a longer length at 594 mm in 1983 than at 513 mm in 1982. At Sunshine Station (RM 80) chinook salmon averaged longer lengths in 1983 than in 1982. Average lengths were 707 mm and 761 mm in 1982 and 1983 respectively.

In 1983 at Yentna (TRM 04) and Sunshine (RM 80) stations both, more male chinook salmon were caught in the fishwheels than females. Respective male to female ratios were 2.3:1 and 1.2:1. Males were also more numerous than females in 1982 at both stations by ratios of 6.4:1 and 1.2:1, respectively.

4.2.1.2 Talkeetna to Upper Devil Canyon

In 1983, chinook salmon escapements were monitored in the Susitna River main channel at Talkeetna (RM 103) and Curry (RM 120) stations (Table 2-4-1). Approximately 14,500 fish reached Talkeetna Station in 1983, about 35 percent higher than the 1982 escapement level of 10,900 fish (Figure 2-4-1). At Curry Station the 1983 escapement was an estimated 10,000 fish. The 1982 escapement to this station was higher at approximately 11,300 fish.

The 1983 chinook salmon migration at Talkeetna (RM 103) and Curry (RM 120) stations occurred between the second week of June and the third week of July (Figure 2-4-2). The midpoint of the migration at Talkeetna Station was reached on June 28. In 1981 and 1982 the midpoint dates were June 25 and July 4, respectively. Upstream at Curry Station the chinook salmon migration in 1983 reached a midpoint in the fourth week of June on the 25th. In 1981 the midpoint was reach one day earlier on June 24, and in 1982 eight days later on July 3.

Of chinook salmon sampled for age at Talkeetna Station (RM 103) in 1983 five year old fish were the most numerous comprising 34 percent of the sample. In contrast during 1981, four (30%) and six (30%) year old fish were equally abundant and out ranked all other ages. In 1982, four year old fish were the most numerous (36%). Almost all chinook salmon sampled for age in 1981, 1982 and 1983 at Talkeetna Station had migrated to sea in their second year of life.

At Curry Station five year old fish out ranked all other ages sampled at 34 percent. In 1981, four year fish were the most numerous, comprising 34 percent of the sample. In 1982 it was the six year old fish at 31 percent. Nearly all the fish sampled in all three years at this station had traveled to sea in their second year of life.

Chinook salmon sampled for lengths at Talkeetna Station (RM 103) in 1983 averaged 626 mm compared to 710 mm and 642 mm in 1981 and 1982 respectively. Upstream 17 miles at Curry Station (RM 120) chinook salmon averaged longer lengths in 1983 than in 1981 or 1982. The average length measured was 668 mm, 725 mm and 743 mm in 1981, 1982 and 1983 respectively.

In 1983, males were more numerous than females among the chinook sampled at Talkeetna (RM 103) and Curry (RM 120) stations. This also occurred in 1981 and 1982 at these stations. Respective male to female ratios at Talkeetna Station were: 2.6:1 (1981), 2.3:1 (1982) and 2.1:1 (1983). At Curry Station these ratios were: 1.9:1 (1981), 2.3:1 (1982) and 1.4:1 (1983).

In 1983 and also in 1981 or 1982 no chinook salmon spawning habitats were found in the Susitna River main channel above RM 98.6. Also there were no slough habitats above RM 98.6 used by chinook salmon for spawning in 1981, 1982 or 1983. Chinook salmon spawning above RM 96.6 occurred in stream habitats in all three years. In 1983, 20 streams were surveyed and 11 supported chinook salmon. In 1981, three streams were surveyed for chinook salmon and all three served as spawning habitats. A total of 19 were surveyed in 1982 and 11 were found to have chinook salmon.

The two most utilized chinook salmon spawning areas above RM 98.6 in 1983 were Indian River (RM 138.6) and Portage Creek (RM 148.9). These were also the two most utilized chinook salmon spawning streams in 1981 and 1982. The peak numbers of fish recorded in Indian River were 422, 1,053 and 1,193 fish respectively for years 1981, 1982 and 1983. At Portage Creek, the respective peak counts for these years totaled 659, 1,253 and 3,140 fish. As indicated the chinook salmon escapements to Indian River and Portage Creek were higher in 1983 than in 1981 or 1982.

4.2.1.3 Escapement Index Surveys

In 1983, chinook salmon escapement surveys were conducted at 19 designated index streams scattered throughout the Susitna River drainage. Escapement counts averaged about six percent higher in 1983 than the previous seven year (1976-82) average and 50 percent higher than in 1982. The largest percent increases were recorded in the Chulitna River drainage (RM 98.5) and upper Susitna River reach above RM 98.6. Several chinook salmon spawning areas in 1983 supported higher escapements than in any year between 1976 and 1982.

4.2.2 Sockeye Salmon

4.2.2.1 First Run

In 1983, an estimated 3,300 first run sockeye salmon migrated past Sunshine Station (RM 80) which is 43 percent less than the 1982 escapement of 5,800 fish. From station fishwheel catches, the 1983 migration was determined to have begun on June 9, reached a midpoint on June 13 and ended on June 21. These dates are all three days later than the respective dates for 1982. Based on fishwheel catches essentially the entire 1983 first run escapement migrated past Sunshine Station (RM 80) along the east bank of the Susitna River at this location (RM 80). In 1982, the same pattern was evident with 99.9 percent of the total station catch being made by the two east bank fishwheels.

In 1983, the first run escapement intercepted at Sunshine Station (RM 80) was comprised of 71 percent five year old fish and 27 percent four year old fish. In 1982, the return was approximately 90 percent five year old fish and six percent four year old fish. First run sockeye salmon sampled at Sunshine Station in 1983 averaged 23 mm smaller in length at 515 mm than in 1982. Sex composition samples from the 1983 escapement indicated there were more males than females by a ratio of 1.3:1. In 1982, females were more numerous by a male to female ratio of 0.6:1.

In 1983 first run of sockeye salmon migrating past Sunshine Station (RM 80) spawned as in 1982 in the Talkeetna River drainage (RM 97.1), specifically in the inlet stream of Papa Bear Lake. Peak spawning in 1983 occurred in this stream between the second and fourth weeks of July. In 1982, the peak occurred sometime between the third week of July and the first week of August. No other areas above RM 80 were found to have supported first run sockeye salmon spawning in 1982 or 1983.

Based on fishwheel catches a number of first run fish migrating past Sunshine Station (RM 80) extended upstream to Talkeetna Station (RM 103) in 1982 and 1983. These fish were not documented any further upstream in the Susitna River than RM 103. The first run fish which reached Talkeetna Station in 1982 and 1983 were considered milling fish that later descended and spawned in Papa Bear Lake inlet stream.

4.2.2.2 Second Run

In 1983 the minimum (second run) sockeye salmon escapement return to the Susitna River drainage was 176,000 fish (Table 2-4-2). Comparative escapements in 1981 and 1982 were 273,000 and 265,000 fish respectively. Escapement returns to Susitna River tributaries below RM 80 excluding the Yentna River (RM 28) were not monitored in 1981, 1982 or 1983 and therefore these fish were not included in the above estimates.

4.2.2.2.1 Intertidal to Talkeetna

In 1983 and for the two previous years (second run) sockeye salmon escapements were monitored in the Yentna River (RM 28) at Yentna Station (TRM 04) and Susitna River at Sunshine Station (RM 80). The 1983 escapement to Yentna River was an estimated 104,400 fish and at Sunshine Station, 71,700 fish (Table 2-4-1). These escapements were the lowest recorded since monitoring began in 1981. The 1983 return was approximately 25 percent and 8 percent less than the escapement levels registered in 1981 of 139,400 fish and 1982 of 113,800 respectively (Figure 2-4-3).

Table 2-4-2. Minimum Susitna River salmon escapements for sockeye, pink, chum and coho salmon in 1981, 1982 and 1983, Adult Anadromous Investigations, Su Hydro Studies, 1983.

Year	Escapement Estimates 1/				
	Sockeye 2/	Pink	Chum	Coho	Total
1981	272,500	85,600	282,700	36,800	677,600
1982	265,200	890,500	458,200	79,800	1,693,700
1983	176,200	101,300	276,800	24,100	578,400

1/ Defined as the summation of the Yentna River escapement obtained by side scan sonar at Yentna Station and the Susitna River escapement obtained by tag/recapture population estimates at Sunshine Station. These estimates do not include escapements to Susitna River tributaries above RM 6 and below RM 77 excluding the Yentna River (RM 28).

2/ Sockeye salmon escapement estimates do not include first run sockeye salmon.

The migration timings of the 1983 second year sockeye salmon escapements to Yentna (TRM 04) and Sunshine (RM 80) stations have been compared with those for years 1981 and 1982 in Figure 2-4-4. The 1983 escapement returns to both stations reached midpoints in the fourth week of July. In 1981 and 1982 the migration midpoints at these stations were reached in the same week except at Yentna Station in 1981 when it occurred in the third week of July.

Based on fishwheel catches, the majority of the (second run) 1983 sockeye salmon escapement migrated past Yentna Station (TRM 04) off the north bank

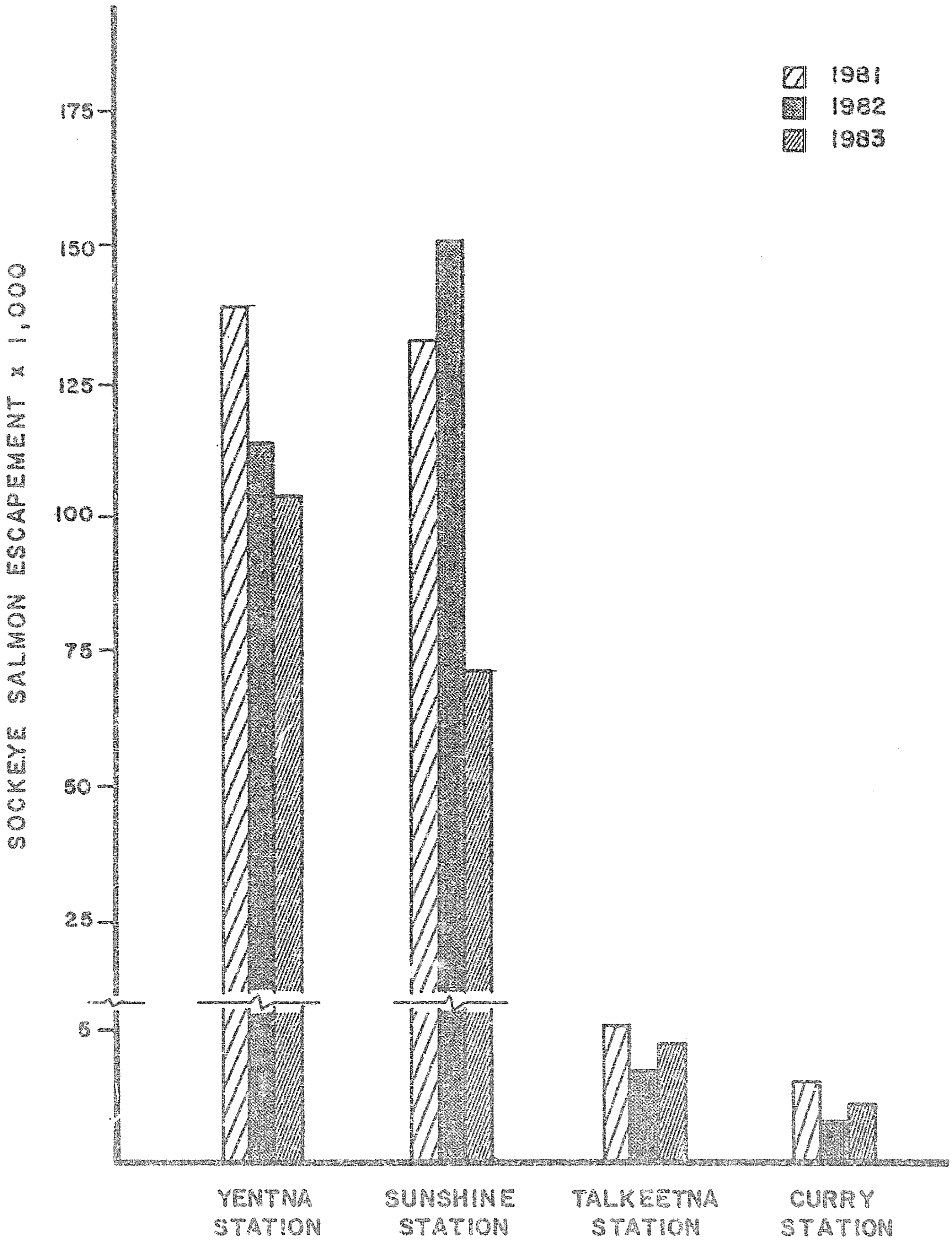


Figure 2-4-3. Minimum Susitna River sockeye salmon escapements for 1981, 1982 and 1983, Adult Anadromous Investigations, Su Hydro Studies, 1983.

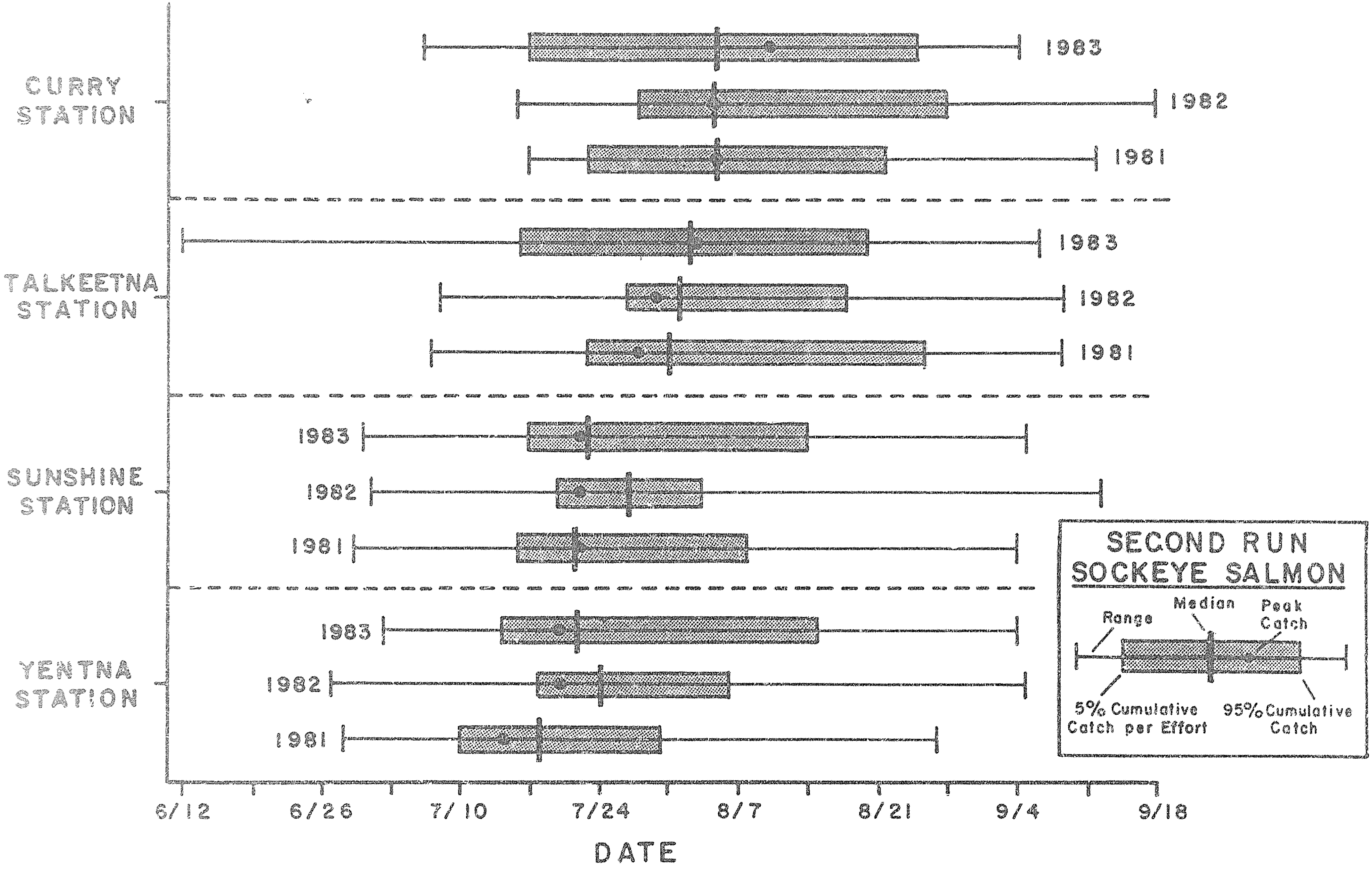


Figure 2-4-4. Migrational timing of sockeye salmon based on fishwheel catches at selected locations on the Susitna River in 1981, 1982 and 1983, Adult Anadromous Investigations, Su Hydro Studies, 1983.

and at Sunshine Station (RM 80) off the east bank. In 1981 and 1982, the same migration pattern was observed.

In 1983 (second run) sockeye salmon escapements reaching Yentna (TRM 04) and Sunshine (RM 80) stations were mainly (64-68 %) four year old fish. In 1981 and 1983, the majority (57-84 %) of the returns were five years old. Nearly all the sockeye salmon adults sampled at Yentna and Sunshine stations in 1981 through 1983 had smolted in their second year of life.

In 1983, the male to female sex ratio of second run sockeye salmon sampled at Yentna Station (TRM 04) was 1.5:1 and at Sunshine Station (RM 80) 1.3:1. These ratios in 1981 and 1982 were 1.2:1 and 2.1:1, and 1.0:1 and 0.9:1 respectively by the same station order.

In 1983 a study was initiated to evaluate Susitna River sockeye salmon fecundities. From 25 samples collected at Sunshine Station (RM 80) it was determined that fecundities ranged from 2,950 to 4,790 eggs and averaged 3,450 eggs. It was also found that length and weight relationships to fecundity were 'good' as determined by correlation coefficients (r) of 0.73 and 0.78, respectively.

4.2.2.2.2 Talkeetna to Upper Devil Canyon

In 1983, escapements of second run sockeye salmon were monitored in the Susitna River at Talkeetna (RM 103) and Curry (RM 120) stations. The 1983 escapement to Talkeetna Station was an estimated 4,200 fish and to Curry Station, 17 miles further upstream, 1,900 fish (Table 2-4-1). These escapements were lower than in 1981 but higher than the 1982 estimates (Figure 2-4-3). In 1981 and 1982, Talkeetna Station received 4,800 and 3,100 fish escapements respectively. At Curry Station the escapements were 2,800 and 1,300 fish, respectively.

In 1983, the (second run) sockeye salmon escapement to Talkeetna (RM 103) and Curry (RM 120) stations began earlier than in 1981 or 1982 (Figure 2-4-4). In all three years the migration midpoints at these stations occurred between the fourth week of July and the first week of August.

In 1983 the second run escapement migrating past Talkeetna Station (RM 103) showed no particular preference to movement along the east or west banks at this location. In 1981 and 1982, similar results were recorded with east and west bank fishwheel catches in each year being about equal. Upstream at Curry Station (RM 120) the migration preference in 1983 was toward the east bank as in 1981 and 1982.

The 1983 escapements of second run fish to Talkeetna (RM 103) and Curry (RM 120) stations were fish three, four, five and six years old. The majority (56-72 %) of the fish sampled at these stations was four year olds. In 1981 and 1982 the majority (32-71%) was five years olds. In all three years, 90 percent or more of the second run sockeye salmon sampled at Talkeetna and Curry stations were fish which had migrated to sea in their second year of life.

Second run sockeye salmon sampled for length in 1983 at Talkeetna (RM 103) and Curry (RM 120) station averaged 510 mm and 430 mm respectively. In 1981 and

1982, sockeye salmon lengths at these stations averaged about 50 mm longer due mainly to higher percentages of five year old fish than in 1983.

In 1983, sockeye salmon second run males were more abundant than females at Talkeetna (RM 103) and Curry (RM 120) stations. The respective ratios were 1.6:1 and 1.6:1. In 1981 females were more numerous than males and in 1982, males were more numerous at these stations. The male to female ratios at Talkeetna Station in 1981 was 0.6:1 and in 1982, 1.3:1. At Curry Station the respective ratios were 0.8:1 and 2.1:1.

Main channel spawning by second run sockeye salmon occurred in 1983 at a single location along the Susitna River west bank between RM 138.6 and 138.9. A total of 11 sockeye salmon were observed spawning at this location on September 15. No other spawning sites were found in 1983. Spawning was not documented in the Susitna River main channel in 1981 or 1982.

In 1983, stream habitats above RM 98.6 were not occupied by spawning sockeye salmon. The same occurred in 1981 and 1982.

Sockeye salmon in 1983 were monitored for observation life at three slough habitats above RM 98.6. The results indicate male and female sockeye salmon averaged 11.8 days of observation time. Generally less observation time was recorded in sloughs where visibility was restricted. A number of the sockeye salmon monitored did not spawn in the slough of first recorded entry. Some spawned elsewhere including other slough habitats and others died from bear predation or stranding.

Second run sockeye salmon occupied 11 slough habitats above RM 98.6 in 1983. They spawned in eight of these sloughs. In 1981, 12 sloughs were occupied and 9 of these were spawning areas. In 1982 the respective numbers where 10 and 8. Peak sockeye salmon counts in slough habitats in 1983 totaled 558 fish which was lower than the peak counts of 1,241 fish in 1981 and 607 fish in 1982. In all three years the majority of these fish were counted at Slough 11 (RM 135.3).

The total 1983 sockeye salmon escapement to slough habitats (above RM 98.6) was estimated at 1,600 fish using same year observation life and survey count data. The 1981 and 1982 respective escapements were 2,178 fish and 1,488 fish subject to the assumption that sockeye salmon averaged the same observation life in 1981 and 1982 as in 1983 (Appendix Tables 2-G-9 and 2-G-10).

4.2.3 Pink Salmon

The minimum pink salmon escapement to the Susitna River in 1983 was estimated to be approximately 101,000 fish. This minimum escapement represents the low escapement year in a two year cycle, typical of pink salmon, and can be compared to escapements in 1982 and 1981 of 891,000 and 86,000, respectively (Table 2-4-2). Escapements are reported as minimum values because they are derived by the summation of Yentna (TRM 04) and Sunshine (RM 80) stations escapements and do not include returns to systems between RM 0 and RM 80 with the exception of the Yentna River (RM 28).

4.2.3.1 Intertidal to Talkeetna

The Yentna River (RM 28) escapement of pink salmon as defined by SSS located at Yentna Station (TRM 04) was 60,700 fish in 1983. This is approximately 1.7 times greater than the escapement of 36,100 fish in 1981. In 1982, the dominant year of the two year cycle, the escapement was 447,300 pink salmon. Sunshine Station (RM 120) recorded a escapement of approximately 40,600 pink salmon in 1983. This was less than the 1981 escapement of 49,500 fish in 1981 (Figure 2-4-5). The 1982 escapement was 443,200 pink salmon (Table 2-4-1).

The midpoint of the pink salmon migration at Yentna Station (TRM 04) was July 26 in 1983 Figure 2-4-6. This compares to dates of July 23 and July 10 in 1982 and 1981, respectively. At Sunshine Station (RM 80) the midpoint of migration was reached on July 30 in 1983 and shows little variance by comparison to August 3 and August 1 migration midpoints in 1982 and 1981, respectively. As illustrated in Figure 2-4-6 the dominant year run of pink salmon in 1982, has much tighter migration timing constraints than either 1983 or 1981 at both Yentna and Sunshine stations.

Based on fishwheel captures, pink salmon were more abundant along the north bank (59.4 percent) at Yentna Station (TRM 04) in 1983. This is contrary to 1982 and 1981 where 63.2 and 54.5 percent of the interceptions occurred in the south bank fishwheel at this station. At Sunshine Station (RM 80) over 90 percent of the pink salmon fishwheel catch was recorded in the two east bank fishwheels for each of the three years the escapement was monitored.

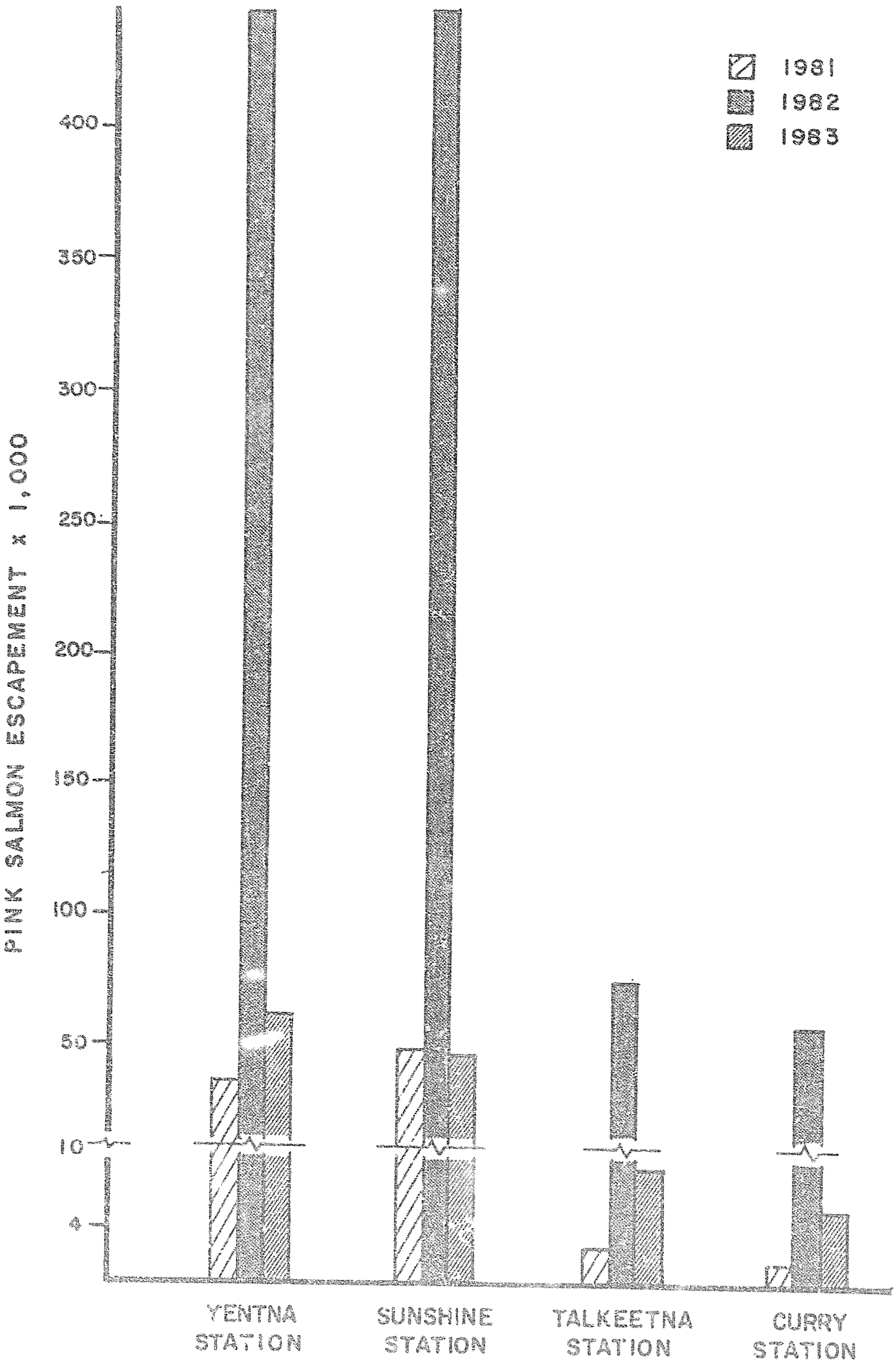


Figure 2-4-5. Minimum Susitna River pink salmon escapements for 1981, 1982 and 1983, Adult Anadromous Investigations, Su Hydro Studies, 1983.

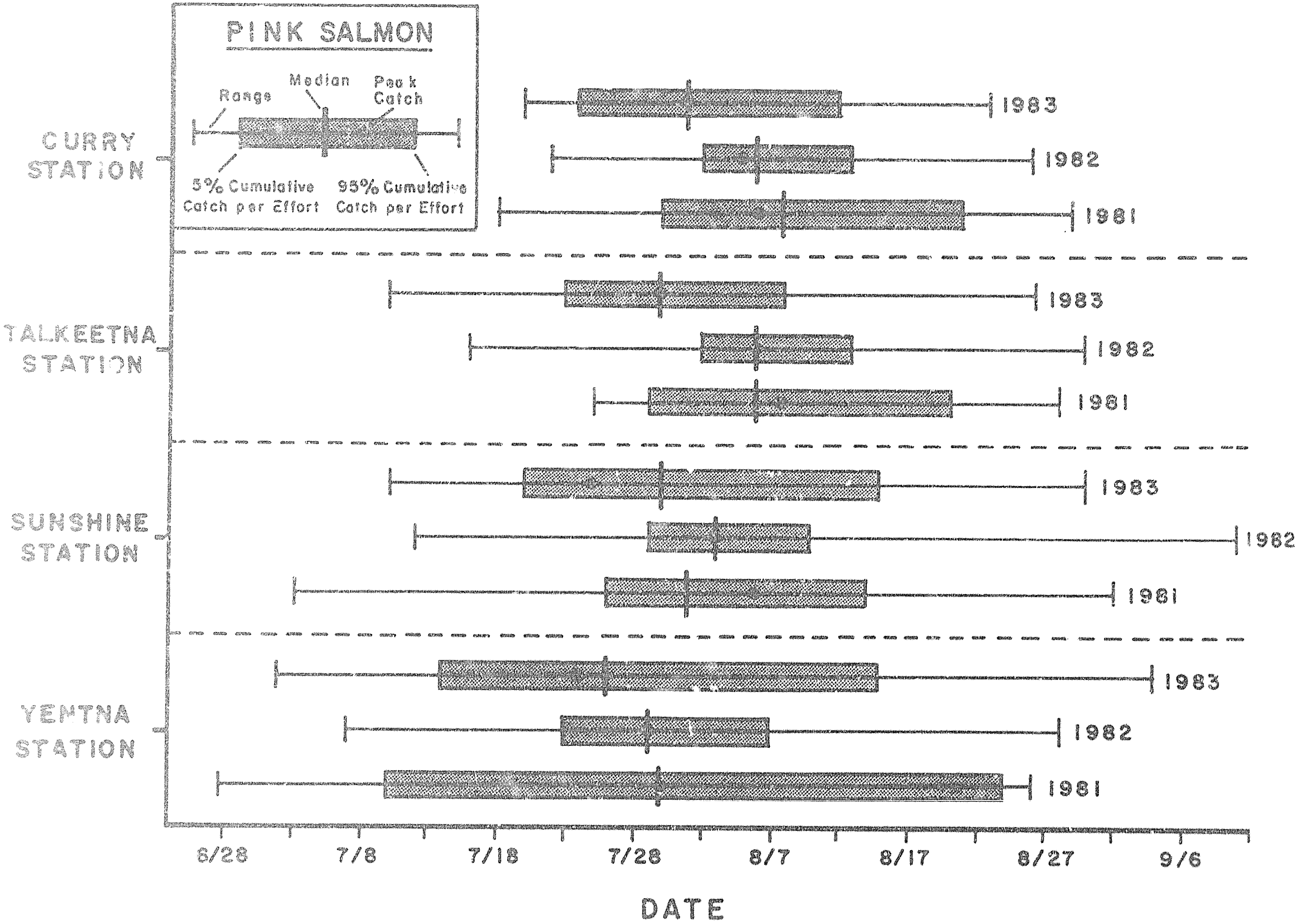


Figure 2-4-6. Migrational timing f pink salmon based on fishwheel catches at selected locations on the Susitna River in 1981, 1982 and 1983, Adult Anadromous Investigations, Su Hydro Studies, 1983.

Length (FL) measurements taken from pink salmon at Yentna Station in 1983 had mean values of 432 mm for males and 421 mm for females. These lengths were noticeably smaller than the those recorded in 1981. In 1981 average lengths for males and females were 478 mm and 471 mm, respectively. At Sunshine Station (RM 80) males and females averaged 435 mm and 423 mm, respectively in 1983. These average lengths are similar to those recorded in 1982, 441 mm and 423 mm for males and females and smaller than 1981 fish which recorded average lengths of 445 mm and 449 mm for males and females, respectively.

The male to female sex ratio of pink salmon sampled at Yentna Station (TRM 04) in 1983 was 0.9:1. This is similar to the values recorded in 1982 and 1981 which were 0.8:1 and 1.0:1, respectively. For pink salmon sampled at Sunshine Station (RM 80) the male to female sex ratio was 1.0:1, 1.8:1 and 0.8:1 in 1983, 1982 and 1981, respectively.

Fecundity studies were conducted in 1983 only. From the 22 samples collected at Sunshine Station (RM 80) it was determined that pink salmon fecundities ranged from 1,125 to 1,975 and averaged 1,475 eggs per female. It was also concluded that the correlation between length and fecundity and weight and fecundity was excellent as indicated by correlation coefficients (r) of 0.97 and 0.87, respectively.

4.2.3.2 Talkeetna to Upper Devil Canyon

The 1983 pink salmon escapement to Talkeetna Station (RM 103) was approximately 9,500 fish. In 1981 and 1982 the escapements were approximated to be 2,300 and 73,000 pink salmon, respectively. The escapement of pink salmon to Curry Station (RM 120) was estimated to be 5,500 fish in 1983. This compares to values of 1,000 and 58,800 in 1981 and 1982 (Table 2-4-1 and Figure 2-4-5).

The pink salmon migrational midpoint in 1983 as determined from fishwheel catches occurred on July 30 at Talkeetna Station (RM 103). This is approximately one week earlier than the midpoint of August 6 recorded in both 1981 and 1982. This pattern is repeated at Curry Station (RM 120) where the 1983 pink salmon migration midpoint of August 1 is approximately one week earlier than the midpoints recorded in 1981 and 1982 (Figure 2-4-6).

In 1983, based on tag recapture information, pink salmon required an average of 3.9 days to travel the 23 mile distance between Sunshine (RM 80) and Talkeetna (RM 103) stations. This compares to average times of 2.6 days and 7.4 days recorded in 1981 and 1982, respectively. The distance of 17 miles between Talkeetna and Curry (RM 120) stations was travelled in an average of 7.1 days in 1983, 10.0 days in 1982 and 6.0 days in 1981. The longer time required to migrate between Sunshine and Talkeetna stations and Talkeetna and Curry stations in 1982 may be attributed to between year differences in water temperature or water velocity or a combination of both.

Pink salmon measured for length (FL) at Talkeetna (RM 103) and Curry (RM 120) stations in 1983 averaged 427 mm and 425 mm, respectively. These are similar to pink salmon lengths collected in 1981 and 1982. Mean lengths for males and females were within eight mm of each other for the pink salmon sample measured in 1981, 1982 and 1983.

The male to female ratio of pink salmon sampled at Talkeetna Station (RM 103) was 0.8:1 in 1983. In 1981 and 1982 however, males were equally or more abundant than females as evidenced by ratios of 1.2:1 and 1.0:1, respectively. At Curry Station (RM 120), the male pink salmon were as equally abundant as females in 1983 with a male to female sex ratio of 1.0:1. Comparatively, in 1981, males were less abundant than females by a ratio of 0.8:1 and in 1982 males were more numerous than females by a ratio of 2.5:1.

In 1983, 14 pink salmon were observed in slough habitats. All of these were considered milling not spawning fish. In 1982 however, an estimated 297 pink salmon spawned in slough habitats. The majority of these spawned in slough 11 (RM 135.3) (57.2 percent) and Slough 20 (RM 140.0) (25.2 percent). In 1981 an estimated 38 pink salmon spawned in Slough 8 (RM 113.7). This represents the entire pink salmon escapement to slough habitats in 1981 (Appendix Table 2-G-11).

Streams tributary to the Susitna River between RM 98.6 and 161.0 supported the majority of the pink salmon spawning in this river reach in 1983 and also in 1981 and 1982. For comparative purposes the peak pink salmon survey counts for all streams were totalled and a streams relative importance was ranked by the percent contribution to this total. In 1983 this total was 1,329 pink salmon and the majority (88.1 percent) of these fish were observed in Indian River (RM 138.6) and Portage Creek (RM 1[illegible].9). Comparatively, in 1982 this total was considerably larger at 2,855 pink salmon. A total of 378 pink salmon were observed during peak surveys in 1981 and only Chase Creek (RM 106.9) and Lane Creek comprised more than ten percent of the total years peak survey counts. Three streams provided more than ten percent of this total in 1982 and they were: 1) Indian River (25.9 %), 2) Fourth of July Creek (RM 131.1) (24.6 %) and 3) Lane Creek (RM 113.6) (22.4 %).

Peak of pink salmon spawning in streams based on survey counts occurred from the first to the third week of August in 1983, third to fourth week of August in 1981 and from the second to third week of August in 1982.

4.2.4 Chum Salmon

In 1983, chum salmon escapement to the Susitna River drainage was a minimum 277,000 fish (Table 2-3-2). Not included in this estimation were escapements to Susitna River tributaries below RM 80 with exception of the Yentna River (RM 28). Compared to 1981 and 1982 escapements of 283,000 and 458,000 fish respectively, the 1983 escapement was the lowest of the last three years.

4.2.4.1 Intertidal to Talkeetna

Chum salmon escapement estimates for 1983 were obtained for the Yentna River (RM 28) at Yentna Station (TRM 04) and Susitna River at Sunshine Station (RM 80). The (1983) escapement returns to Yentna and Sunshine stations were an estimated 10,800 and 266,000 fish respectively (Table 2-4-1). As indicated by these numbers the Yentna River supported about four percent of the combined estimated escapement to the two stations.

The Yentna River (RM 28) received a substantially smaller return of chum salmon in 1983 than in the two previous years. The Yentna Station estimate in 1983 about 45 percent less than the 1981 escapement of 19,800 fish and 60 percent less than the 1982 escapement of 27,800 fish. The Susitna River at Sunshine Station (RM 80) supported a 1983 escapement nearly identical to the 1981 escapement of 262,900 fish and about 60 percent of the 1982 escapement level of 430,400 fish (Figure 2-4-7).

The 1981 through 1983 timings of the chum salmon migrations into the Yentna River (RM 28) at Yentna Station (TRM 04) and Susitna River at Sunshine Station (RM 80) are illustrated in Figure 2-4-8. The chum escapement returns to Yentna and Sunshine stations generally peaked earlier in 1983 than in 1981 or 1982 as determined from fishwheel catches.

In 1983 a bimodal chum salmon migration was recorded at both Yentna (TRM 04) and Sunshine (RM 80) stations. Two factors attributed to this event. The first was additional fishing time in the Cook Inlet drift net fishery which resulted in seasonally 'high' catches. The second was 'high' flow events in the Yentna (RM 28) and Susitna rivers which caused a temporary migration delay.

The chum salmon escapement to Yentna Station (TRM 04) in 1983 exhibited no particular preference to migration along the north or south bank as indicated by station fishwheel catches. In 1981 and 1982 the majority of the escapement migrated off the north bank based on the catches.

In 1983 five year old fish were dominate (51 - 58%) followed by four, three and six year old fish of the chum salmon returns to Yentna (TRM 04) and Sunshine (RM 80) stations. In 1981 and 1982 four year fish were dominate (84-91%) at these stations followed by five and three year old fish.

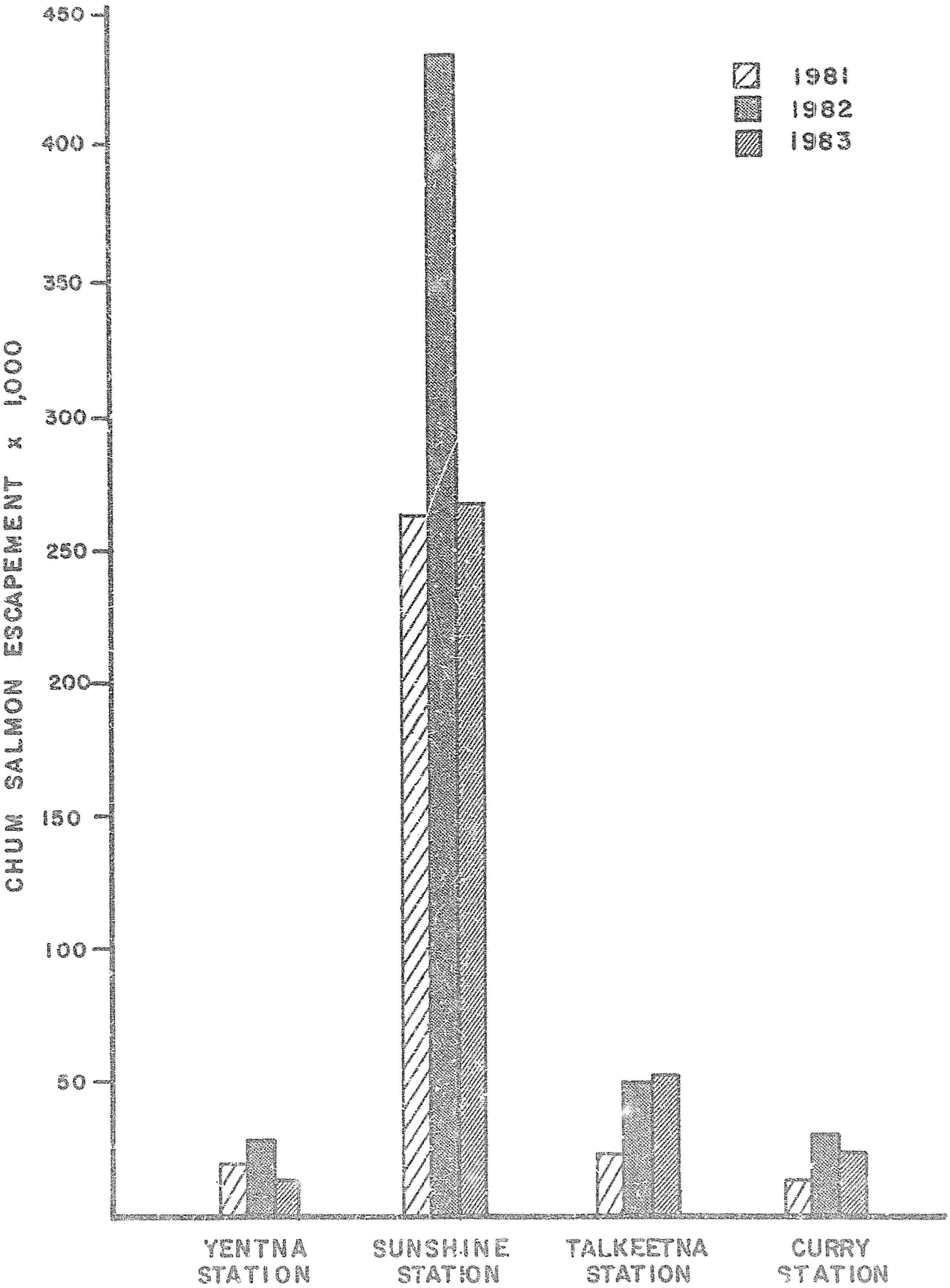


Figure 2-4-7. Minimum Susitna River chum salmon escapements for 1981, 1982 and 1983, Adult Anadromous Investigations, Su Hydro Studies, 1983.

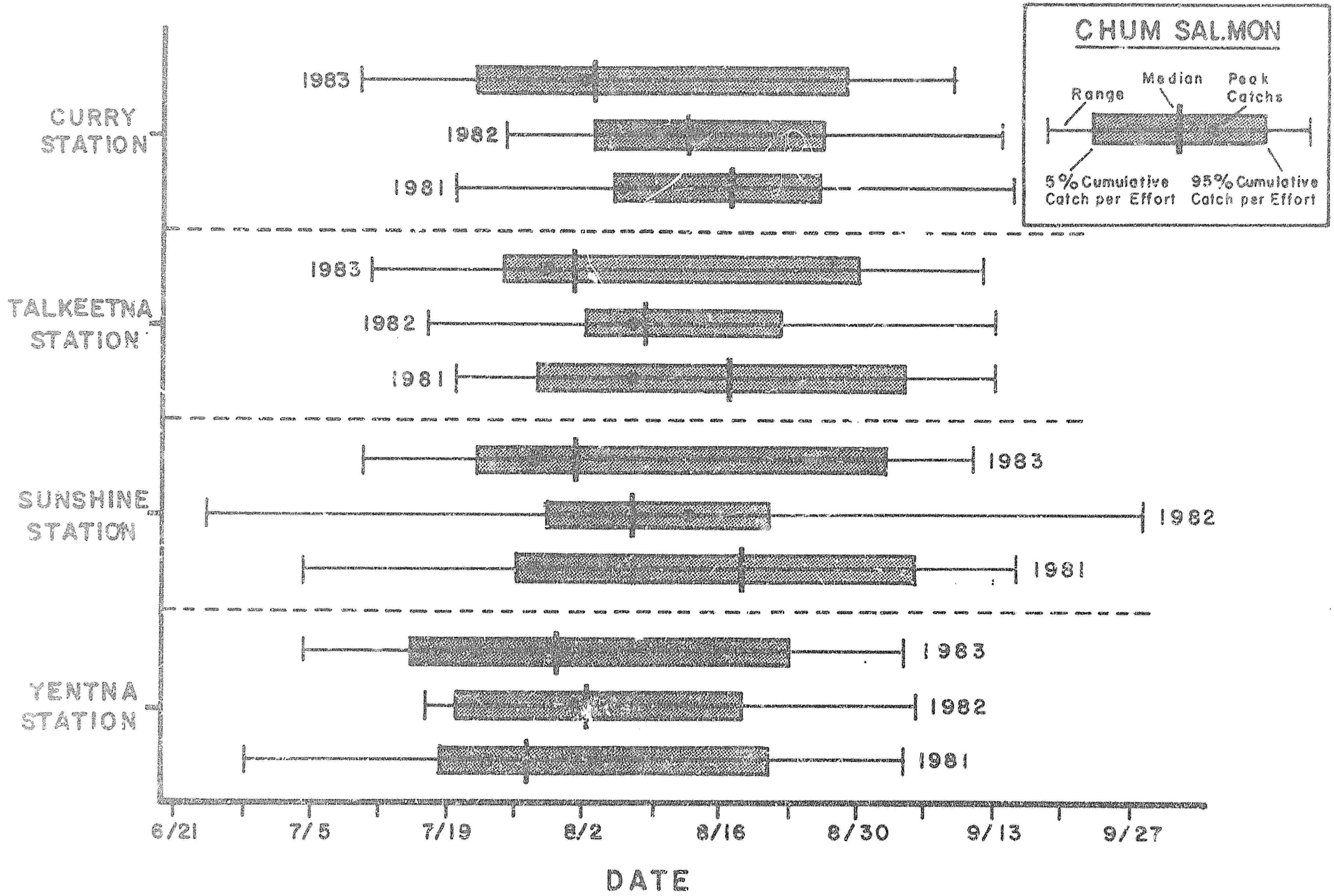


Figure 2-4-8. Migrational timing of chum salmon based on fishwheel catches at selected locations on the Susitna River in 1981, 1982 and 1983, Adult Anadromous Investigations, Su Hydro Studies, 1983.

Sex composition sampling of the 1983 chum salmon escapement at Yentna (TRM 04) and Sunshine (RM 80) stations provided male to female ratios of 1.3:1 and 1.0:1 respectively. In 1982 the sex ratios were identical to those recorded in 1983 at these stations. In 1981, the respective ratios were 1.0:1 and 0.8:1 at Yentna and Sunshine stations.

Specific information regarding Susitna River chum salmon fecundities were collected in 1983 only. The data collected from 2[illegible] chum salmon samples at Sunshine Station (RM 80) provided the following information: 1) the average female chum salmon contained approximately 3,200 eggs, 2) fecundities ranged from 2,475 to 4,075 eggs and 3) length and weight were both 'highly' correlated to fecundity.

4.2.4.2 Talkeetna to Upper Devil Canyon

Escapement returns of chum salmon in 1981, 1982 and 1983 were monitored at Susitna River main channel locations Talkeetna (RM 103) and Curry (RM 120) stations (Table 2-4-1). The 1983 escapement to Talkeetna Station was approximately 50,400 fish and to Curry Station, 21,100 fish. Talkeetna Station sustained approximately a three percent higher escapement return in 1983 than in 1982 of 49,100 fish and a 140 percent higher return than in 1981 of 20,800 fish. Upstream at Curry Station the 1983 escapement was about 30 percent lower than the 1982 return of 29,400 fish and 60 percent higher than the 1981 return of 13,100 fish (Figure 2-4-7).

In 1983 the chum salmon migration began earlier at Talkeetna (RM 103) and Curry (RM 120) stations than in 1981 or 1982 (Figure 2-4-8). Chum salmon were generally abundant at both main channel stations in 1981, 1982 and 1983 during the month of August.

Based on fishwheel catches chum salmon migrated in higher numbers along the west side of the Susitna River at Talkeetna Station (RM 103) than along the east side in 1983. At Curry Station (RM 120) most of the escapement migrated along the east side of river at this location than off the west side. The same trend occurred in 1981 and 1982 at both stations.

In 1983 the escapement returns of chum salmon to Talkeetna (RM 103) and Curry (RM 120) stations were mainly five year old fish (69-72%) compared in 1981 and 1982 to four year old fish (84-87%).

Chum salmon were measured for length at Talkeetna (RM 103) and Curry (RM 120) stations in 1981, 1982 and 1983. The lengths, generally averaged around 600 mm at the two stations in all three years.

In 1983 chum salmon males were more numerous than females at Talkeetna (RM 103) and Curry (RM 120) stations. The same was found in 1981 and 1982 at both stations. The male to female sex ratios at Talkeetna station were 1.3:1, 1.9:1 and 1.5:1 in 1981, 1982 and 1983 respectively. At Curry Station the respective ratios were 1.1:1, 1.1:1 and 1.9:1.

Main channel spawning by chum salmon was found in six areas of the Susitna River in 1983. The locations were distributed between RM 115.0 and 138.9. In 1981, there were four areas identified between RM 129.2 and 135.2, and in

1982 nine locations were found between RM 114.4 and 148.2. Main channel spawning occurred in the month of September in all three years.

Chum salmon spawned in seven stream habitats above RM 98.6 in 1983. The highest numbers of fish were recorded at Indian River (RM 138.6). In 1981 and 1982 both, eight stream habitats served as chum salmon spawning habitats. The highest escapement counts were again recorded at Indian River in 1981 and 1982. The peak chum salmon escapement count for all stream habitats in 1981, 1982 and 1983 was 245, 1,748 and 1,411 fish respectively.

Peak of chum salmon spawning occurred in stream habitats above RM 98.6 during the third and fourth weeks of August in 1983. In 1981 the peak occurred between the second week of August to the second week of September and in 1982, during the last week of August and the first week of September.

In 1983 chum salmon were monitored for observation life at five slough habitats above RM 98.6. The mean average observation life of chum salmon occupying these slough habitats was 6.9 days. Less observation time per fish was recorded in the study sloughs where visibility was poorest. The restricted visibility periods were directly related to 'high' flows in the Susitna River. Not all of the chum monitored for observation life in 1983 spawned in the slough of first recorded entry. For example a number of chum salmon which entered Moose Slough (RM 123.5) were later found spawning in other slough habitats.

Upstream of RM 98.6 chum salmon mainly used slough habitats for spawning in 1983. Twenty three sloughs were occupied by chum salmon in 1983 and 18 of these were used for spawning. In 1981, 20 sloughs were occupied by chum salmon and in 1982, 17 sloughs were entered. The larged numbers of chum salmon spawners were recorded at sloughs 11 (RM 135.3) and 21 (RM 144.1) in 1983. In 1981 these sloughs were 8A (RM 125.1) and 11, and for 1982 sloughs 21 and 11. The peak salmon escapement count for all sloughs habitats surveyed above RM 98.6 in 1983 was 1,467 fish. This compares to 2,596 fish in 1981 and 2,244 fish in 1982.

The 1983 chum salmon escapement to slough habitats (above RM 98.6) was an estimated 3,000 fish calculated from same year observation life and survey count data. The 1981 escapement to slough habitats was about 4,500 fish and for 1982, approximately 5,100 fish based on the assumption that chum salmon had the same average observation life in those years as recorded in 1983. (Appendix Tables 2-G-12 and 2-G-13).

4.2.5 Coho Salmon

The minimum coho salmon escapement into the Susitna River basin was 24,000 fish in 1983. In 1981 and 1982 the minimum escapements were 37,000 and 80,000 coho salmon, respectively. These escapements are considered minimum values because they do not include returns to systems between RM 0 and 80 with the exception of the Yentna River (RM 28) (Table 2-4-2).

4.2.5.1 Intertidal to Talkeetna

The 1983 escapement to Yentna Station (TRM 04) was 8,900 coho salmon the smallest for the three year data base. The 1981 coho salmon escapement of

17,000 was one half of the 34,000 coho salmon escapement recorded in 1982. The number of coho salmon migrating to Sunshine Station (RM 80) was estimated to be 15,200 fish in 1983 again, the smallest escapement compared to 1981 and 1982 values of 19,800 and 45,700 fish, respectively (Table 2-4-1 and Figure 2-4-9).

The coho salmon migration in 1983 reached a midpoint on July 27 at Yentna Station (TRM 04) based on fishwheel catches. This is four days earlier than the July 31 migration midpoint in 1981 and 6 days earlier than the 1982 migration midpoint of August 2. At Sunshine Station (RM 80) the August 5 coho salmon migrational midpoint in 1983 was also the earliest recorded for the three year period. In 1981 this date was August 12 and in 1982 August 20 (Figure 2-4-10).

The majority of the 1983 coho salmon escapement sampled at Yentna Station (TRM 04), 79.1 percent, were age class 4_3 fish. This was also true in 1981 and 1982 when 82.9 and 66.8 percent of the sample, respectively were age class 4_3 fish. Age class 3_2 coho salmon accounted for all but a few percent of the remaining coho salmon sampled for age 1983 and also in 1981 and 1982. Coho salmon sampled for age at Sunshine Station (RM 80) were also predominantly (63.1%) age class 4_3 in 1983. Again, this is also the case in 1981 and 1982 when 65.1 and 50.1 percent of the sample were age class 4_3 fish.

Lengths of age class 4_3 coho salmon, the predominant age class, collected at Yentna Station (TRM 04) in 1983 averaged 543 mm for males and 538 mm for females. In 1981, male coho salmon sampled at this station were smaller

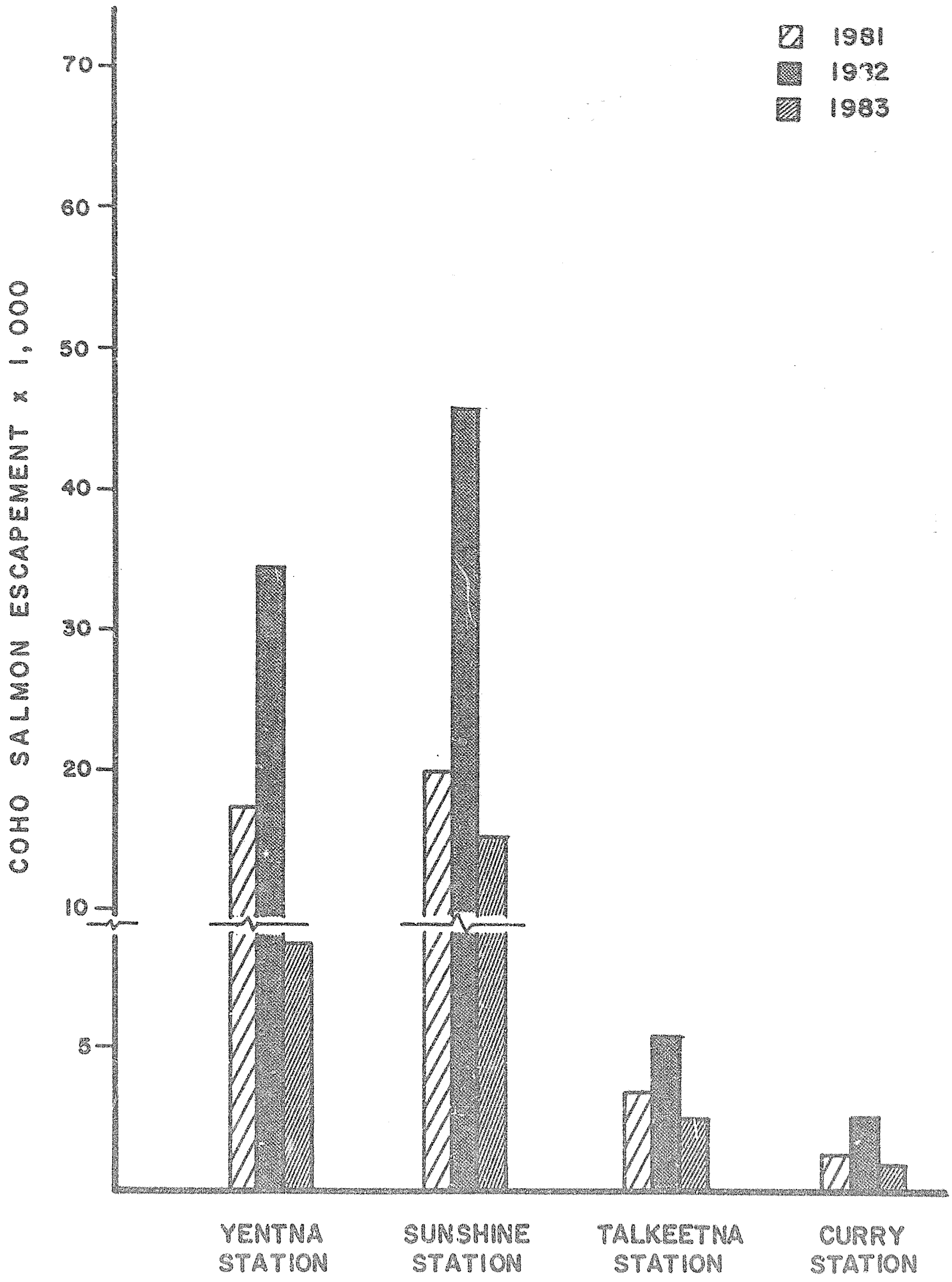


Figure 2-4-9. Minimum Susitna River coho salmon escapements for 1981, 1982 and 1983, Adult Anadromous Investigations, Su Hydro Studies, 1983.

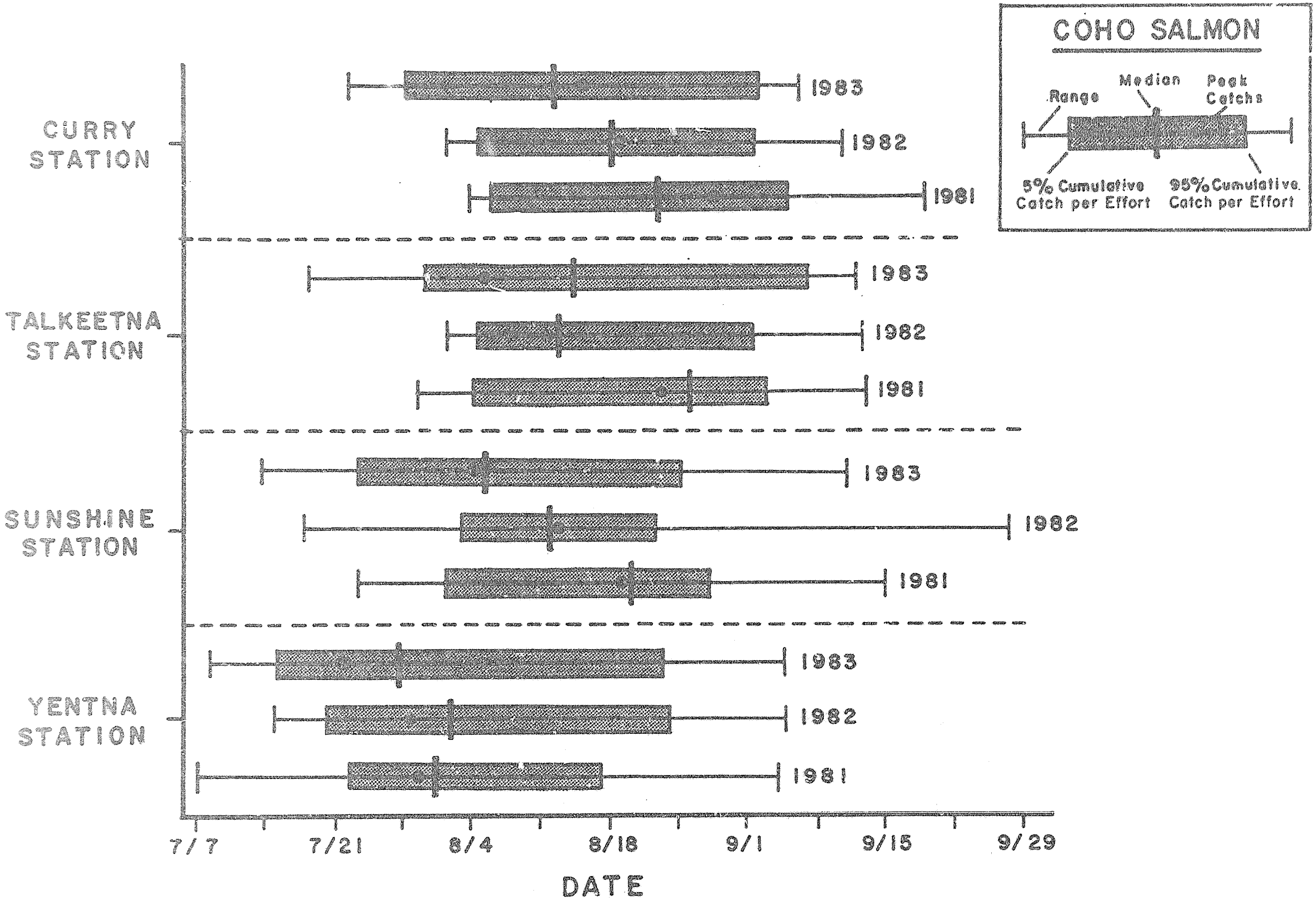


Figure 2-4-10. Migrational timing of coho salmon based on fishwheel catches at selected locations on the Susitna River in 1981, 1982 and 1983, Adult Anadromous Investigations, Su Hydro Studies, 1983.

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averaging 541 mm and females were larger averaging 540 mm in length. Those fish sampled in 1983 were smaller than the coho salmon measured in 1982 when the average size for males and females was 549 mm and 544 mm, respectively. At Sunshine Station (RM 80) age class 4_3 coho salmon averaged 539 mm and 540 mm for males and females, respectively. The 1983 coho salmon sampled for length were smaller than those sampled in both 1981 and 1982 when males and females averaged 541 mm and 542 mm and 564 and 551 mm in length respectively.

The overall male to female sex ratio was 2.3:1 at Yentna Station (TRM 04) in 1983. There was fewer males present in 1981 when the sex ratio was 0.9:1 and males were more numerous in 1982 by a sex ratio of 2.3:1. Males were more abundant than females at Sunshine Station (RM 80) in 1983 by an overall sex ratio of 1.2:1. This was also the pattern exhibited in 1981 and 1982 when the sex ratios were 1.2:1 and 1.4:1, respectively.

4.2.5.2 Talkeetna to Upper Devil Canyon

The coho salmon escapement to Talkeetna Station (RM 103) in 1983 was estimated to be 2,400 fish. This was the lowest escapement recorded for the three year period the escapement was monitored. The escapement in 1981 was 3,300 coho salmon and in 1982 approximately 5,100 fish. The 1983 escapement of coho salmon to Curry Station (RM 120) was approximately 800 fish. This compares to 1981 and 1982 escapements of 1,100 and 2,400, respectively (Table 2-4-1 and Figure 2-4-9).

The coho salmon migration at Talkeetna Station (RM 103) began on July 30 in 1983. This is one week earlier than the approximate August 5 beginning date in both 1981 and 1982. The migration reached a median approximately the same time, August 12 in both 1983 and 1982. In 1981 this point was reached about two weeks later, August 26. At Curry Station (RM 120) the coho salmon migration began and reached a midpoint earlier in each successive year as depicted in Figure 2-4-10.

Coho salmon migrational rates were slower in 1983 than 1981 and 1982. The rate of travel between Sunshine (RM 80) and Talkeetna (RM 103) was 1.4 mpd in 1983 compared to rates of 4.0 and 5.3 mpd in 1981 and 1982, respectively. This was also true for the coho salmon migrational rate between Talkeetna and Curry (RM 120) stations. In 1983 this distance was travelled at a rate of 5.7 mpd. In 1981 and 1982 the rates were 11.3 and 10.0 mpd, respectively.

From a sample of the escapement passing Talkeetna Station (RM 103) in 1983 it was determined that age class 4_3 fish represented the largest portion of those fish sampled, 60.2 percent. This compares with 84.8 percent age 4_3 fish in 1981 and 41.0 percent in 1982. Age class 3_2 coho salmon were the dominant age class in 1982 when they totalled 59.0 percent of the sample. The Curry Station (RM 120) escapement of coho salmon generally were similar in age class composition to those sampled at Talkeetna Station. In 1983, age class 4_3 fish comprised 53.2 percent of the sample compared to 68.8 and 46.0 percents in 1981 and 1982, respectively. Again, age class 3_2 coho salmon were the dominant age class in 1982 representing 54.0 percent of those fish sampled.

In 1983, coho salmon sampled at Talkeetna (RM 103) and Curry (RM 120) stations averaged 528 mm and 522 mm for all fish sampled, respectively. From the samples collected at these stations in 1981 and 1982 and compared to 1983 information the most noticeable deviation occurs in 1982 when age class 3_2 coho salmon ranged from 30 to 50 mm larger than the age class 3_2 fish sampled in 1983 and 1981.

The overall coho salmon male to female sex ratio at Talkeetna Station (RM 103) in 1983 was 1.7:1. This compares to ratios of 1.5:1 and 1.5:1 in 1981 and 1982, respectively. At Curry Station (RM 120) the overall male to female sex ratio in 1983 was 2.0:1 and compares to ratios of 2.0:1 and 1.3:1 in 1981 and 1982, respectively. Generally, males were more abundant than females at these sampling sites for the three years the escapement was sampled.

One main channel coho salmon spawning site was located in 1983. This site was found at RM 131.1 approximately 150 yards above the confluence of Fourth of July Creek. No main channel spawning sites were located in 1982 while in 1981 a single spawning site was identified at RM 129.2.

There was no coho salmon spawning activity reported in slough habitats in 1983 or 1981. The only documented coho salmon spawning slough habitats occurred in 1982 when spawning activity was observed in Slough 8A (RM 125.1).

Coho salmon migrating to the Upper Susitna River (RM 98.7-161.0) are primarily stream spawners. Peak stream survey counts represent only a portion of the escapement for that stream and are used as a index of relative abundance and not an indication of total stream escapement.

For comparative purposes peak stream survey counts were totalled for all streams and the percent contribution of each stream to this total was used to rank that streams relative importance for each year surveys were conducted. From this in 1983, a low escapement year, only two streams contributed more than ten percent to the total peak stream survey counts. These tributaries were Whiskers Creek (RM 101.4) and Indian River (RM 138.6). This compares to 1981 and 1982 peak stream survey counts where five streams in each of the two years comprised more than ten percent of the total peak survey counts.

Peak coho salmon spawning in streams, based on survey counts, occurred from the first week of September to the first week of October in 1983 and comparatively, during the second and third week of September in 1981 and from the second week of September to the first week of October in 1982.

4.3 Bering Cisco

Bering cisco were not specifically sampled in 1983, although information obtained incidental to other fishery studies were recorded. Bering cisco were initially documented to occur in the Susitna River during August of 1981. The escapement was monitored for migrational timing, relative abundance and population meristic information at Susitna (RM 26), Yentna (TRM 04), Sunshine (RM 80) and Talkeetna (RM 103) in 1981 and 1982. Bering cisco were not known to occur above RM 103, approximately in either of these years.

In 1981, concurrent to main channel sampling Bering cisco were tagged. The tagging program was suspended in 1982 although main channel spawning studies were continued.

Probable successive year spawning in Susitna River Bering cisco stocks was reported in the Phase II, ADF&G/Su Hydro Adult Anadromous Report, 1982 (ADF&G, 1982). This probability is further supported by the recapture of a Bering cisco in Lower Cook Inlet in August of 1983 which had been initially tagged at RM 77.0 on October 5, 1981. This individual was caught in August of 1983. A necropsy of the specimen revealed that it was a gravid female. Scale analysis indicated the age of this individual was 5_1. The possibility exists that this female Bering cisco spawned as many as two times and was prepared to spawn again in 1983.

The known distribution of Bering cisco in the Susitna River was also extended in 1983. A single Bering cisco was captured at 4th of July Creek (RM 131.0) on October 6 redefining the upper limit of this species in the Susitna River. The previous known upper limit of the Bering cisco range was RM 101.9 based on a single capture here in 1982.

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