FISHERY DATA SERIES NO. 96-1

SITUK RIVER STEELHEAD TROUT STUDIES, 1994

by

Robert E. Johnson

February 1996

Alaska Department of Fish and Game

Division of Sport fish

Symbols and Abbreviations

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Weights and measures (metric)

centimeter	cm
deciliter	dL
gram	g
hectare	ha
kilogram	kg
kilometer	km
liter	L
meter	m
metric ton	mt
milliliter	ml
millimeter	mm

Weights and measures (English)

cubic feet per second	ft^3/s
foot	ft
gallon	gal
inch	in
mile	mi
ounce	oz
pound	lb
quart	qt
yard	yd

Spell out acre and ton.

Time and temperature

day	d
degrees Celsius	°C
degrees Fahrenheit	°F
hour (spell out for 24-hour clock)	h
minute	min
second	s

Spell out year, month, and week.

Physics and chemistry

all atomic symbols	
alternating current	AC
ampere	A
calorie	cal
direct current	DC
hertz	Hz
horsepower	hp
hydrogen ion activity	pH
parts per million	ppm
parts per thousand	ppt, ‰
volts	V
watts	W

General

All commonly accepted abbreviations.	e.g., Mr., Mrs., a.m., p.m., etc.
All commonly accepted professional titles.	e.g., Dr., Ph.D., R.N., etc.
and	&
at	@
Compass directions:	
east	E
north	N
south	S
west	W
Copyright	©
Corporate suffixes:	
Company	Co.
Corporation	Corp.
Incorporated	Inc.
Limited	Ltd.
et alii (and other people)	et al.
et cetera (and so forth)	etc.
exempli gratia (for example)	e.g.,
id est (that is)	i.e.,
latitude or longitude	lat. or long.
monetary symbols (U.S.)	$, ¢
months (tables and figures): first three letters	Jan,...,Dec
number (before a number)	# (e.g., #10)
pounds (after a number)	# (e.g., 10#)
registered trademark	®
trademark	™
United States (adjective)	U.S.
United States of America (noun)	USA
U.S. state and District of Columbia abbreviations	use two-letter abbreviations (e.g., AK, DC)

Mathematics, statistics, fisheries

alternate hypothesis	H_A
base of natural logarithm	e
catch per unit effort	CPUE
coefficient of variation	CV
common test statistics	F, t, χ^2, etc.
confidence interval	C.I.
correlation coefficient	R (multiple)
correlation coefficient	r (simple)
covariance	cov
degree (angular or temperature)	°
degrees of freedom	df
divided by	÷ or / (in equations)
equals	=
expected value	E
fork length	FL
greater than	>
greater than or equal to	≥
harvest per unit effort	HPUE
less than	<
less than or equal to	≤
logarithm (natural)	ln
logarithm (base 10)	log
logarithm (specify base)	log_2, etc.
mideye-to-fork	MEF
minute (angular)	'
multiplied by	x
not significant	NS
null hypothesis	H_O
percent	%
probability	P
probability of a type I error (rejection of the null hypothesis when true)	α
probability of a type II error (acceptance of the null hypothesis when false)	β
second (angular)	"
standard deviation	SD
standard error	SE
standard length	SL
total length	TL
variance	Var

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ABSTRACT

The Situk River produces the largest run of steelhead *Oncorhynchus mykis* in Southeast Alaska. Steelhead were counted and sampled at a weir as they emigrated from the river and counted above the weir by boat. Counts of spawning steelhead obtained with float surveys were compared to counts of steelhead obtained at the weir. In another study, we measured the time it took emigrating steelhead to transit the Situk/Ahrnklin River estuary - information useful in reducing the incidental harvest of steelhead in commercial setnet salmon fisheries.

Between May 21 and July 20, 1994, 7,854 steelhead were counted at a weir as they emigrated from the Situk River and 907 were captured and sampled for age and length.. Seventy four percent of the fish were from the 1987 and 1988 parent years and 51% were repeat spawners. Of the sampled fish, 5.8% were $\geq$ 36 inches total length and by expansion, 459 (SE=58) fish (based on the emigrant count) were available for harvest under current regulations. Eleven float surveys were conducted to count steelhead and a maximum count of 4,702 steelhead was obtained on May 21. This count was 60% of the number of fish subsequently counted at the Situk River weir.

In separate trials in 1992 and 1994, a total of nineteen steelhead implanted with sonic transmitters were tracked as they transited the Situk/Arhnklin River estuary, the site of a commercial set net fishery. Twelve of the 19 steelhead exited the estuary within twelve hours of passing downstream through the Situk River weir. These fish took an average of 13.7 hrs. (SE = 3.1, range = 2.75 to 53.75 hours) to pass from the weir through the estuary. All fish tracked or automatically recorded, emigrated from the estuary during an ebb tide, with 74% leaving within 3 hours following the onset of an ebb tide between midnight and 0600 hours.

When high rates of steelhead emigration coincide with commercial fishery set net openings, incidental harvest of emigrating steelhead can be significantly reduced. According to findings on estuarine transit times, detaining steelhead above the weir and/or curtailing the set net fishery during the first three hours of the ebb tides between midnight and 0600 hours would be effective in reducing incidental harvest of steelhead.

Key words: Situk River, steelhead, *Oncorhynchus mykis,* emigration timing, abundance, age, sex, length, abundance indices, sonic transmitters, commercial setnet, incidental harvest.

INTRODUCTION

Situk River flows into the Gulf of Alaska southeast of Yakutat, Alaska, is 35.2 km long, and has two lakes with a combined surface area of about 397 hectares. Both the Situk River and the adjacent Ahrnklin River flow into a common estuary, which then flows into the Gulf of Alaska (Figure 1). Situk River supports the largest population of wild steelhead, *Oncorhynchus mykis* in Southeast Alaska with runs of nearly 8,000 fish. Because the river supports both fall and spring-run steelhead, and because both runs spawn and emigrate during the same time period, assessments have focused on counting post spawning emigrants (kelts) as both runs exit the river. Indices of escapement have also been made from counts made during float surveys of the river (Seifert and Elliott, in prep). Low escapements in 1991 and 1992 prompted conservation concerns and regulations to reduce harvests; the bag limit was reduced to one steelhead $\geq$36 total length per day, and two per year. The use of bait is prohibited.

Stock assessment programs for steelhead in the Situk River have been problematic (Seifert and Elliott in prep). A weir installed to count sockeye salmon *Oncorhynchus nerka*, has provided only partial emigrant steelhead counts because it is installed after the kelt immigration is already in progress, and spring freshets washed out the weir during two of the four years that it was installed specifically to count steelhead. The effectiveness of sonar to count immigrants was tested in 1989 and 1990 (Johnson 1990, 1991); this method produced counts that varied with environmental conditions and were very labor intensive. Because of these difficulties, Alaska Department of Fish and Game, Division of Sport Fish continued a long-standing program to index steelhead abundance through counts obtained during float surveys of the river. Evaluations

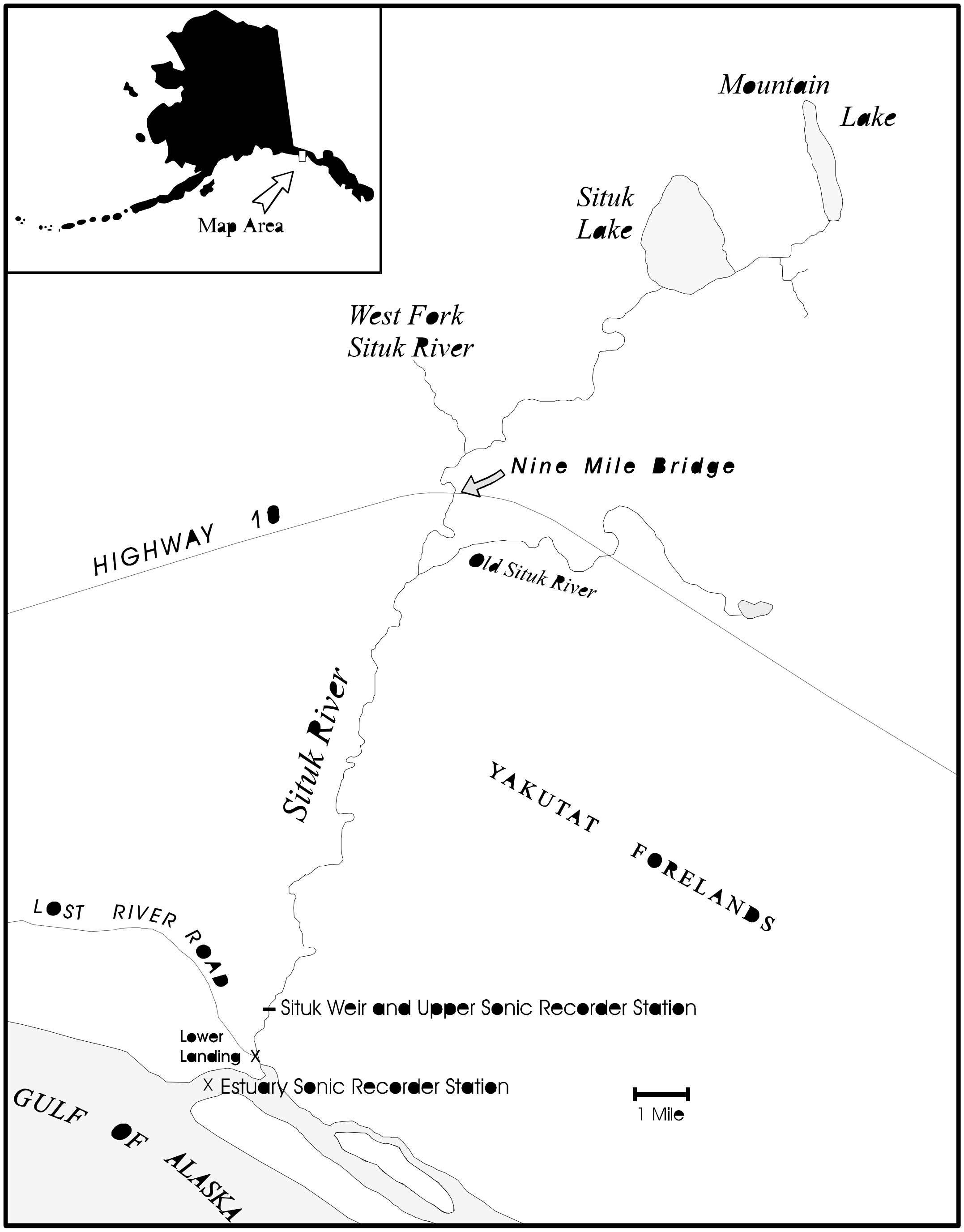

Figure 1.-Situk River drainage and location of weir and automated sonic tag recorder stations.

to validate the accuracy of this technique have not been attempted, however, and the float surveys lacked procedural consistencies (i.e., different or inexperienced observers, changes in the number of observers, failure to document or measure conditions that affected survey results such as water/weather conditions, number and timing of surveys, etc.). Also, counts from the upper Situk River and counts from the lower Situk River made on different dates were sometimes added together with the potential of counting some fish twice

In 1994, we installed a standard bipod/picket weir on the Situk and implemented a newly designed float survey. The survey adopted a set of standardized methods, will estimate the variation in abundance indices, and compare indices with total counts of emigrant steelhead obtained at the weir. These data, collected over a number of years, will be used to estimate expansions for estimating steelhead abundance from float counts in years when weir counts of the total run are unavailable or incomplete.

Infrequently, steelhead kelt emigration timing coincides with the commercial set net fishery at the mouth of the Situk/Ahrnklin River. Anecdotal evidence indicates that during those seasons incidental harvest of emigrating steelhead kelts can be high. Since about 80% of Situk River steelhead repeat spawners are female (Jones, 1983), improving the survival rate of females traversing this fishery would be beneficial.

Consequently, we estimated the transit time of both sexes in 1992 and of females only in 1994, information that could be used to regulate the timing of commercial fishery openings or to regulate when emigrant steelhead are allowed to pass through the weir in order to reduce incidental harvest.

In 1994, our study had five objectives: 1) to count steelhead in weekly float surveys using standardized procedures; 2) count steelhead emigrating past a weir; 3) estimate the proportion of emigrant steelhead that were ≥36 inches total length; 4) estimate the age and length of emigrant steelhead; and 5) estimate the mean time that female steelhead take to travel from the Situk weir through the Situk River lagoon.

METHODS

COUNTS OF EMIGRANT STEELHEAD

Emigrating steelhead kelts were counted as they passed downstream through a bipod and picket weir located 1.2 miles above the Lower Landing on the Situk River (Figure 1). Early in the emigration and during above-normal water levels, a seven-foot-wide opening was made by removing pickets or by lowering the boat gate. This was sufficient to pass several hundred steelhead during a one hour period. Later in the emigration, when water levels were lower and fewer steelhead were present, as many as four adjacent seven-foot sections were opened to entice fish to pass downstream.

Since the peak rate of emigration usually occurred between 22:00 and 03:00 hours, artificial light was needed to see the fish. This was provided by three 300 watt electric lights hung from a cable spanning the river, approximately 20 feet above normal water level. The lights illuminated the entire width of the river in a band about twenty feet wide.

AGE, SEX, AND LENGTH COMPOSITION

A trap on the downstream side of the weir was constructed to catch emigrating steelhead for sampling (Figure 2). The trap was 16 feet wide where it attached to the downstream face of the weir, 35 feet long, and 8 feet wide at the downstream end. The sides were made of 1/2 inch plastic mesh on a frame four feet tall and the downstream end was made of conventional aluminum channel and metal pickets. Emigrants entered the trap from upstream via a 20-inch-wide opening in the weir and through an 8-ft-long chute, a feature that was effective in retaining fish that entered the trap.

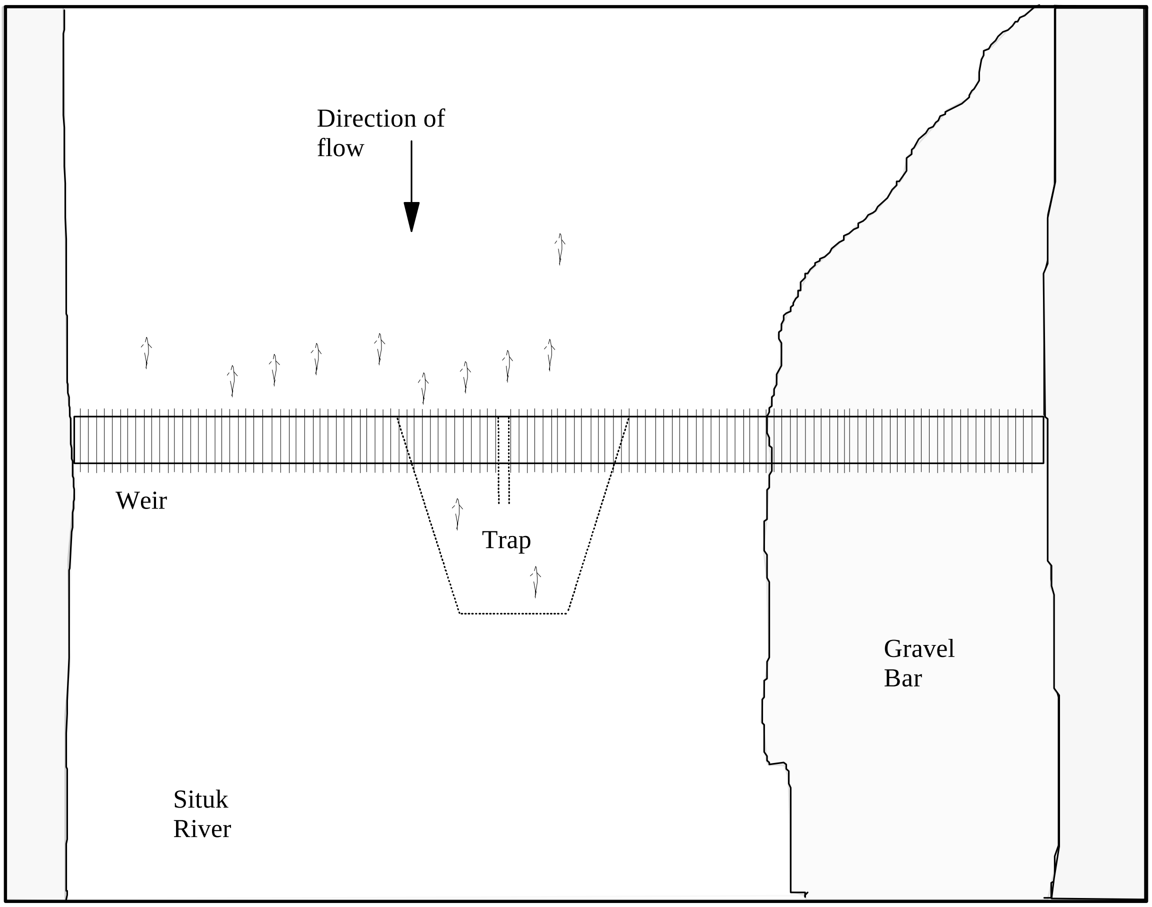

Figure 2.-Situk River weir with downstream trap for catching emigrant steelhead.

Sampled steelhead were dipped from the trap with a dip net and placed in a padded cradle suspended in a water filled box.. Fish were sexed, measured to the nearest 1 cm snout to fork of tail, nearest 1 cm total length, and had scales extracted for age analysis. Age classes used in this study are from Narver and Withler (1977). Crews attempted to sample 1 of every 7 fish passing downstream for length and scales (age) by estimating the number of steelhead above the weir each night and attempting to trap at least 1/7th of that number for sampling. This method of proportional sampling did not work, so the season was stratified into K daily strata (h=1,2,...,K). Age compositions for the season were estimated using weighting factors W_h derived from the daily emigration totals N_h and the total seasonal emigration $N = \sum N_h$:

$$p_{a,h} = \frac{n_{a,h}}{n_h} \quad (4)$$

$$p_a = \frac{1}{N} \sum_h N_h p_{a,h} \quad (5)$$

$$v(p_a) = \sum_h W_h^2 s_h^2 (1 - f_h) \tag{6}$$

where a is age, n_h is daily sample size, $W_h = N_h/N$, f_h is n_h/N_h, and $s_h^2 = p_a(1 - p_a)/(n - 1)$. This formula is an approximation that assumes 1/N is very small.

Data was recorded on customized "Rite in the Rain" forms and included: the date, time of passage through weir, scale sample number, sex, length from tip of snout to fork of tail, and total length (nearest cm), and comments (e.g., incidence of gear-marked or scarred fish, etc.).

STEELHEAD ABUNDANCE INDICES

Float surveys of the Situk River from Situk Lake to the Lower Landing were planned twice weekly from May 5 through May 25, depending on weather and water conditions. This survey timing was based on peak steelhead counts performed since 1987, years of multiple and fairly consistent float surveys (Appendix A1). Surveys were to be completed in one or two consecutive days, with the upper river survey on the day prior to the lower river survey.

The river was divided into 22 sections (Appendix A2). The beginning and ends of each section were based on prominent features along the Situk River, many of which have been used in these surveys since their inception. The length (miles) of each section was measured from aerial photos and length of section was used to calculate the number of steelhead per mile.

Each float survey was conducted by two ADF&G employees. One surveyor was always a trained observer experienced with counting steelhead on the Situk River. Polarized sun-glasses and a wide brimmed hat were worn while counting fish to reduce surface glare. The survey's were conducted by motoring slowly downstream in an outboard powered boat. We used a 14 foot long flat bottomed boat powered by a 50 horsepower outboard motor fitted with a jet pump. This craft provided a stable and high observation platform relative to the water surface, and allowed operation in shallow water at idling speeds without dirtying the water. The speed of the boat was generally just fast enough to allow steerage. Both the motor operator and an observer counted steelhead as a team during the survey. Each observer was responsible for counting fish on one side of the boat. The motor operator maneuvered the boat so that the greatest number of steelhead passed on the side that the front observer was responsible for counting. Steelhead were counted only after they passed the boat. The number of steelhead seen by each observer was recorded on a hand-counter (tallywacker) controlled by the boat operator. When passing through high concentrations of steelhead, each observer mentally kept track of the number of steelhead on their side of the boat before recording the number on the hand counter. Great care was taken to get an accurate count during the first pass through an area because the chances of dirtying the water and obscuring visibility, and interfering with anglers increased with more than one pass. Particular attention was given to spotting steelhead along wide, brushy-edged sections where they commonly seek shelter. In these situations, the boat was steered so that both sides of the river could be observed at all times. The observer in the front of the boat was responsible for counting the middle as well as one side of the river. Steelhead tend to remain in the pools or sections where they are encountered, generally schooling towards the downstream-end of a pool bounded by a riffle. This is advantageous because the fish can be effectively "herded" to the downstream-end of a short section of stream, and counted as they return upstream. The boat was steered close to deep, brushy banks, hoping to force steelhead holding in these areas into the shallows where they can be counted. Snorkel surveys in the

Situk River have shown that steelhead tend not to hide beneath log jams but hold directly downstream of such structures. Therefore, special attention was given to these areas. Surveys were halted temporarily when rain, wind, or turbidity (boat traffic, etc.), caused water visibility to become temporarily obscured. The cumulative count of steelhead on the tallywacker was recorded on the survey form at the end of each stream section.

The amount of surface and subsurface illumination (-1 meter) was measured with a Sekonic model L-188 photographic incident light meter in a waterproof housing. Light measurements were taken with the meter set at ISO 100, and recorded as exposure values (E.V.). The meter was inserted in a meter holder (Figure 3) and aimed 180^o from the direction of the sun. The meter was not obscured by shadow during either reading. Subsurface light transmission readings were taken by submerging the light meter attached to the holder, one meter below the surface of the water. The meter was calibrated by noting that the battery test needle moved to the test position when depressed.

Temperature (°C), weather conditions (presence/absence of precipitation, cloud cover, and wind), and surface and subsurface illumination ,was recorded both at the beginning of the float, and 11 km downstream from the Nine Mile Bridge (Appendix A2). Water level was recorded at Nine Mile Bridge prior to the survey as the distance (nearest 1 cm) from a fixed point on the concrete bridge support (the seam where the molds join the blocks of concrete) to the surface of the water.

TRANSIT TIME OF EMIGRATING STEELHEAD

Studies to estimate the length of time used by kelts to emigrate from the Situk River weir to the mouth of the estuary were conducted in 1992, and 1994. Steelhead were fitted with a sonic transmitter that was audible in both freshwater and saltwater. Fish were tracked with a hand-held hydrophone, and their exit from the lagoon was detected by an automatic data recording logger moored at the lagoon mouth (Figure 1).

In 1992, we attempted to apply transmitters to both fall and spring-run fish in rough proportion to their estimated in-river abundance in 1990. Thus, five steelhead were captured using sport gear and a seine net, above the Nine Mile Bridge (Figure 1) between April 22 and 24, 1992. These fish were assumed to be fall-run because of their dark coloration and upstream location during this time period. The remainder (24 steelhead assumed to be spring-run) were implanted with a transmitter at the weir (17 fish), located approximately 1.5 miles upstream from the river mouth (Figure 1) using seine, rod and reel, dip net, and rotary screw trap between the Nine Mile Bridge and the weir from April 25 to June 4, 1992.

Each captured steelhead was measured for length (snout to fork of tail), scale sampled, and sexed. Individually coded high power sonic transmitters (Sonotronics CHP-87S transmitters), 100 mm long, 18 mm wide, and weighing 32g, were surgically implanted into the abdominal cavity of each fish not bearing obvious wounds or lesions. Transmitters produced a unique combination of frequency, pulse interval, and aural code. Each fish implanted with a transmitter was released as soon as it could swim unassisted. Sonotronics USR-90 scan receivers and DH-2 directional hydrophones were installed at the weir and near the mouth of the estuary. Tandy 102 portable computers were connected to the receivers to record the passage of any fish carrying a transmitter. Unfortunately, river and tidal noise created up to 60 random (false) readings per day at each station. These false readings could not be distinguished from true readings because of the variability of individual tag frequencies. When we discovered this problem, we listened for fish with transmitters while passing fish down through the weir using a Sonotronics USR-4D standard receiver and DH-3

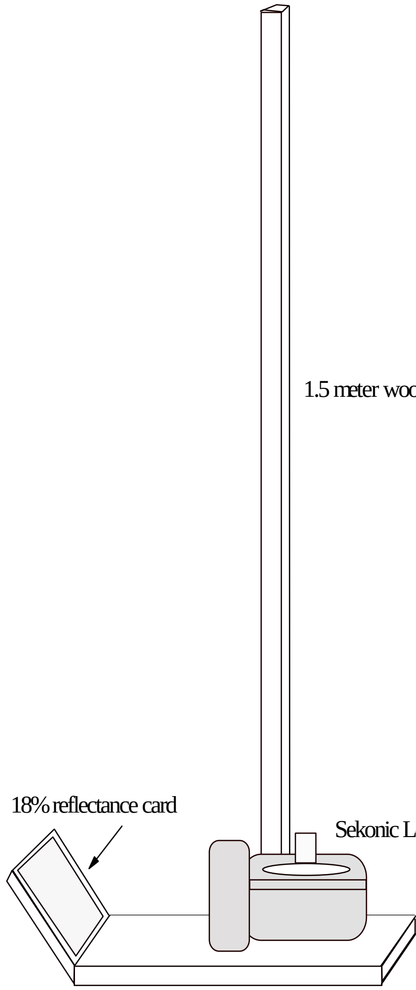

Figure 3.-Device used to hold light meter during surface and subsurface light measurements, 1994.

omni-directional hydrophone. Once a fish with a transmitter passed through the weir, a second crew tracked the fish down river and through the estuary by boat, using a standard receiver and directional hydrophone. The location of each fish was recorded periodically during the transit. A fish was assumed to have left the lagoon if the transmitter was not "heard" after a thorough sweep through the lagoon.

Because so few fish were tracked from the estuary, a second study was planned for 1993. In this study, we planned to tag out-migrating steelhead during the latter part of the emigration (between June 7 and 27, 1992). These fish would be emigrating at or near the time of the first set gill net openings, i.e., would be the segment of the population most vulnerable to capture in the commercial and subsistence fisheries. This second study was aborted early in the season since float counts indicated that emigration occurred earlier than expected, and that about 95% of the steelhead had left the river by June 7 (Brian Glynn, personal communication, ADF&G, Division of Sport Fish, Douglas).

As a result of the prior difficulties, we applied transmitters to the instream population in 1994 so that all migratory "types" would be represented. If systematic differences in transit times among early- and late-emigrating fish occurred, we hoped to observe this trend. By tagging the population at large, we expected to estimate an "average" transit speed representative of the entire population. Twenty one steelhead were given Vemco V3-5H pinger transmitters near the time of the expected peak of abundance, about May 18. The V3-5H sonic transmitters are 90 mm long, 16 mm wide, and weigh 35 g. The transmitters were implanted in the stomachs of steelhead with a minimum weight of 1,750 g (equivalent to 609 mm fork length), a recommendation by Advanced Telemetry Systems that the weight of a tag not exceed 2% of a fishes body weight. Fish to be implanted with transmitters were planned to be captured in proportion to the number of fish distributed in the river according to the May 21 survey count.

Each captured female >609 mm FL was placed in a tagging cradle, measured to the nearest 5 mm FL and total length (TL) and sampled for scales. The sonar transmitters (each visually identified by a unique serial number) were inserted through the fishes' mouth and into the stomach with a plastic wand. Each tag produced a signal with a unique combination of frequency and pulse width, allowing sonic identification of individual fish. Steelhead with inserted transmitters were released as soon as the fish regained swimming control.

Automated hydrophone monitoring stations (each consisting of a Vemco submersible VR20-MON-PNG-UWCASE receiver with an attached hydrophone), were placed near the weir and at the lower limit of the Situk/Ahrnklin River estuary and tested by towing sonic transmitters near their locations. As a further test, the first few transmitter implanted fish released at the weir were tracked manually to verify that the detectors recorded the sonic transmitters. The detectors continuously scanned for frequencies of transmitters and when a signal was detected, the receiver scanned the pulse widths corresponding to released transmitters and identified the individual tag (fish) and recorded the information. The tag serial number, date, and time of detection were stored in the receiver's memory. The length of time it took for a fish to travel from the weir through the lagoon was the difference between the last time the tag was detected at the weir and the last time the tag was detected at the mouth of the lagoon.

RESULTS

COUNTS OF EMIGRANT STEELHEAD

The weir was installed and "fish tight" on the evening of May 21, 1994. Between May 21 and July 20, 7,854 steelhead were counted as they emigrated from the Situk River (Appendix A3). Daily weir counts, cumulative counts and proportions, water level, and water temperature are presented in Figure 4. The rate of emigration was highest on June 2, when 862 steelhead were counted during 24 hours (Figure 4).

AGE, SEX, AND LENGTH COMPOSITION

Sampling of emigrants was not proportional to their abundance. The first 1,900 emigrants, about 25% of the population, was not sampled because a trap to effectively capture emigrants was not completed until May 23. Secondly, the proportion of fish sampled in each day varied (Figure 5). If emigrants had been completely mixed with homogeneous age, sex, and length, etc. characteristics over time, then non-proportional sampling would be permissible. However, as Figure 6

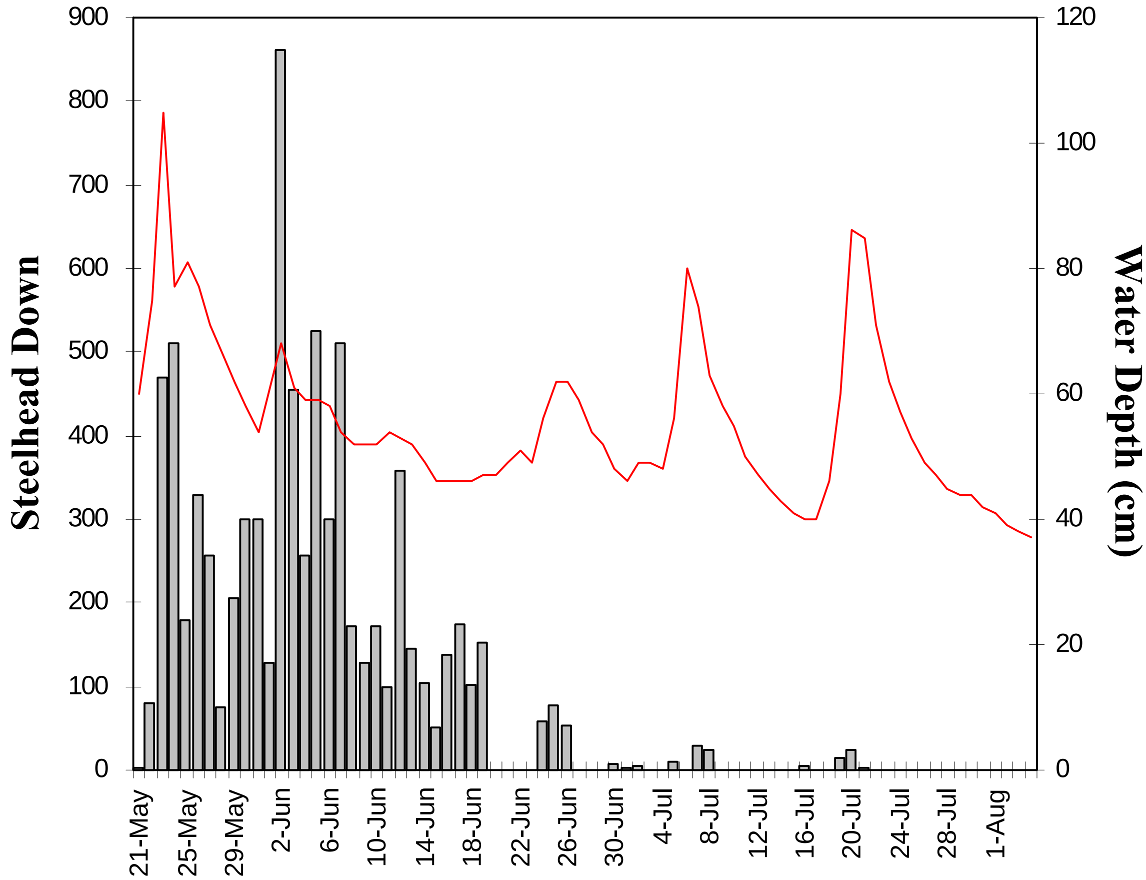

Figure 4.-Daily counts of emigrant steelhead kelts (bars) and water level (line), Situk River weir, 1994.

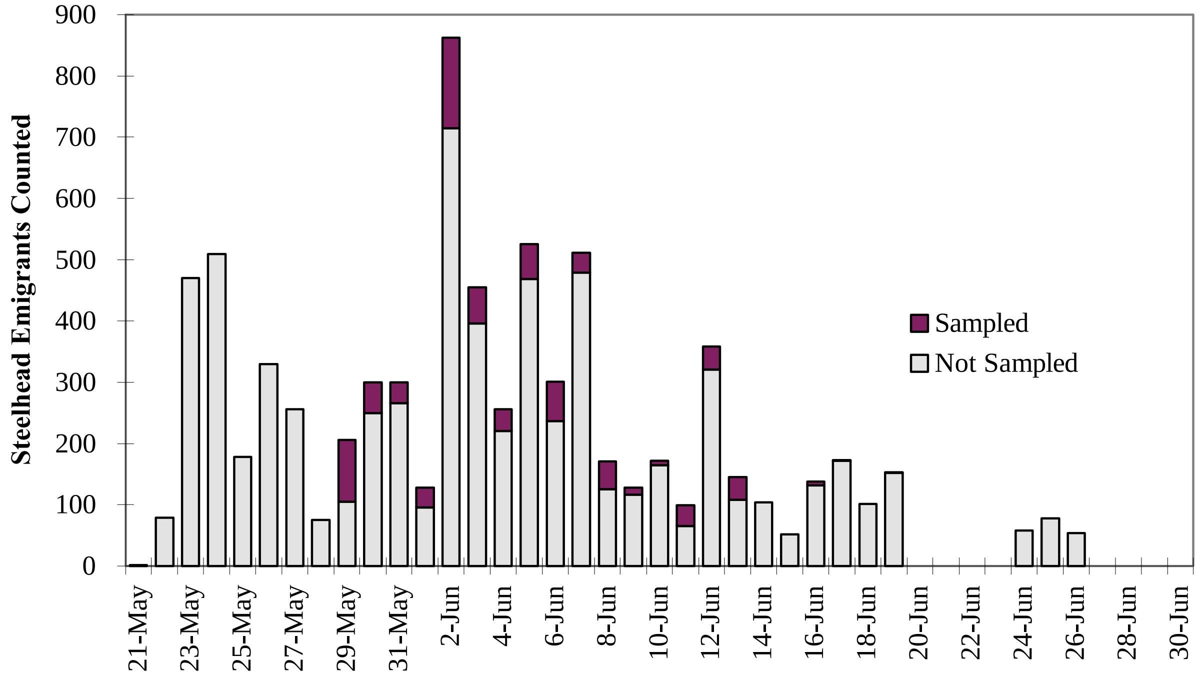

Figure 5.-Number of steelhead sampled for length, sex, and age at the Situk River weir, 1994.

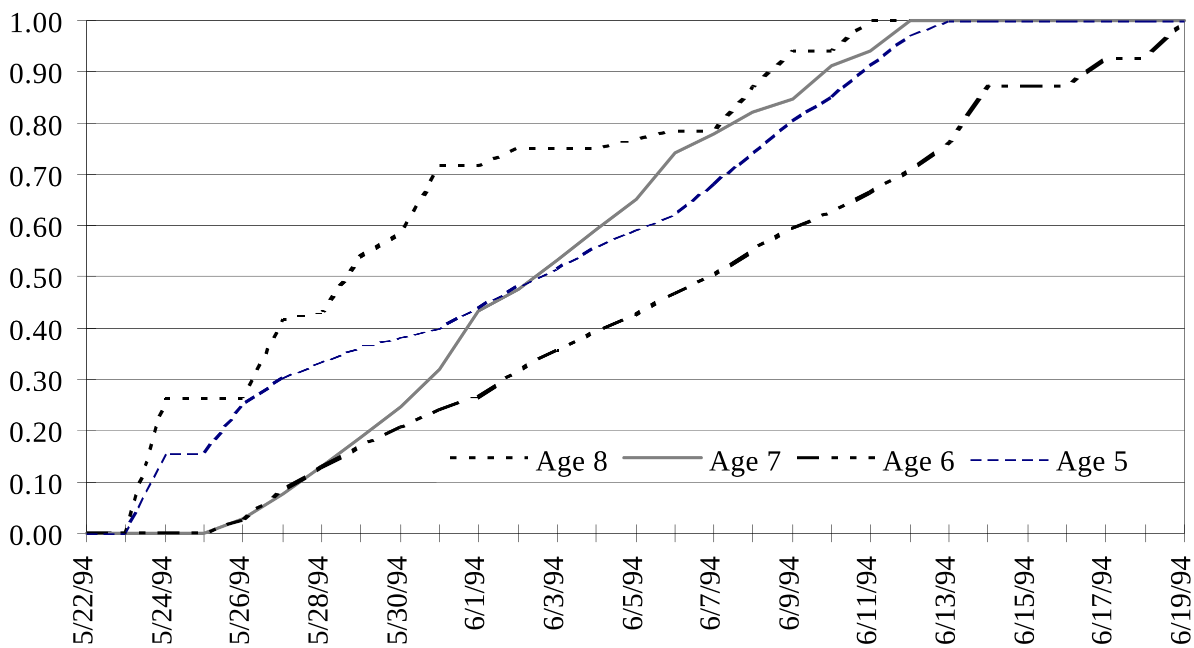

Figure 6.-Cumulative emigration rates of four age classes of steelhead at the Situk River weir, 1994.

demonstrates, ages (and perhaps other characteristics) vary over time justifying the need for a weighting method for estimating age composition. However, estimates of mean lengths for age categories were not weighted and are preliminary.

Nine hundred and seven steelhead were sampled between May 24 and June 12 for sex and length. A total of 875 scale samples were collected but only 681 were usable for age determination. The remaining 194 (39% were from males and 61% from females) and were unreadable due to annulus resorbtion or scale damage. All estimates of length, age, and sex composition are based on the sample of 681 fish (Table 1). Forty nine percent of the sample were females and 51% were males; repeat spawners comprised 59% of the sample. Fish from six parent years were represented with the 1988 (53%), 1987 (20%), and 1989 (21%) parent years dominant. Twenty-two distinct age classes were represented, but 90% of the fish fell into six age categories: 3.2 S1 (27%), 3.2 (21%), 3.3 (17%), 4.2 S1 (11%), 4.2 (9%), and 4.3 (5%).

Of 907 steelhead measured for length, 53 or 5.8% (SE = 0.7%) were ≥ 36 inches total length. Based on this sample and the number of emigrants counted at the Situk River weir, an estimated of 459 steelhead (=.058*7,854; SE=58) were eligible for harvest in 1994 under current regulations. However, 49 of the fish were males and 4 were females, indicating a sample heavily biased toward males. Reasons for this bias are unknown. Thirty eight of the sampled fish were aged; data on sex and age composition is in

.

STEELHEAD ABUNDANCE INDICES

Four surveys of the Situk River from Situk Lake to Nine Mile Bridge (upper river), and seven surveys of the Situk River section from Nine Mile Bridge to the Situk River Lower Landing (lower river) were performed from April 23 through May 29, 1994 (Table 3). The highest count of 4,702 steelhead (4,383 upper river, 319 lower river) was made on May 21. On this date, conditions were excellent on the upper river and fair on the lower river.

Counts of steelhead indicated a similar, fairly even, distribution throughout sections of the river on May 4 & 7, and although counting conditions were not excellent, the same was true on May 13. On May 16 & 17 and on May 21, steelhead numbers per mile decreased above river mile 13.1 (Nine Mile Bridge) and numbers of fish per mile increased between mile 2.5 and mile 8.8 (Figure 7). Between the May 21 survey and May 26, over 1,500 steelhead passed down through the weir, indicating that these were actual concentrations of fish and many were emigrating from the system; not entirely a result of improved fish visibility conditions during surveys. Counts by section from each survey are presented in Appendix A4. Density of steelhead declines in a downstream trend (Figure 8). Steelhead density above Nine Mile Bridge steadily declines from 30% of the observed population on May 7, to 9% by May 21. Overwintering fall steelhead emigrate from Situk Lake to spawn during this period, then continue downstream, though some spring steelhead migrate to and spawn in this area also. Although survey conditions were variable on the upper Situk River surveys during this series, counts will be less affected because this river section is relatively shallow, clear, and absent of deep pools. Overall, 21% (SE=5.0) of the steelhead were distributed from Situk Lake to Nine Mile Bridge, 45% (SE=3.6) from Nine Mile Bridge to river mile 5.2, and 34% (SE=5.5) from river mile 5.2 to the Lower Landing. Conditions were generally fair to excellent during most surveys (Table 4).

Table 1.-Age class, total age, count and length (snout to fork) by sex, and weighted age composition by age class, Situk River steelhead, 1994.

			Female			Male					
Age Class	Total Age	Parent Year	No.	Mean Length	SE	No.	Mean Length	SE	Total	Age Comp. %	SE
4.3s1s1	9	1985	1	900	0.0	0	-	-	1	0.09	0.08
5.3s1	9	1985	0	-	-	1	880	0.0	1	0.18	0.18
Subtotal	9	1985								0.27	0.19
5.3	8	1986	0	-	-	1	805	0.0	1	0.16	0.16
3.3s1s1	8	1986	2	862	81.3	0	-	-	2	0.19	0.13
4.2s1s1	8	1986	1	770	0.0	10	835	23.7	11	3.50	2.62
4.3s1	8	1986	2	745	21.2	0	-	-	2	0.27	0.18
5.2s1	8	1986	1	765	0.0	5	817	28.6	6	0.65	0.29
4.1s2s1	8	1986	1	855	0.0	0	-	-	1	0.02	0.01
Subtotal	8	1986								4.79	2.65
4.3	7	1987	21	740	8.1	14	805	12.9	35	4.87	0.92
5.2	7	1987	1	670	0.0	1	675	0.0	2	0.20	0.17
2.3 s1s1	7	1987	1	690	0.0	0	-	-	1	0.12	0.11
3.2 s1s1	7	1987	16	778	11.4	12	866	24.0	28	3.07	0.59
3.3s1	7	1987	7	795	13.0	6	830	26.2	13	1.62	0.44
4.2s1	7	1987	49	740	7.1	44	802	9.6	93	10.57	1.43
Subtotal	7	1987								20.45	1.86
3.3	6	1988	73	749	4.4	33	801	12.1	106	16.71	1.61
4.2	6	1988	37	675	8.2	38	700	12.1	75	8.80	1.04
3.2 s1	6	1988	90	745	4.9	93	806	7.9	183	27.13	1.91
4.1s1	6	1988	0	-	-	1	655	0.0	1	0.17	0.16
Subtotal	6	1988								52.81	2.71
3.2	5	1989	44	654	7.5	71	670	7.8	115	21.28	3.18
4.1	5	1989	0	-	-	1	595	-	1	0.04	0.03
3.1s1	5	1989	1	630	0.0	0	-	-	1	0.16	0.16
Subtotal	5	1989								21.48	3.18
2.2	4	1990	0	-	-	2	645	5.0	2	0.19	0.16
Subtotal	4	1990								0.19	0.16
Total aged fish			348			333			681		

Table 2.-Brood year, age, and sex of steelhead ≥ 36 inches, Situk River, 1994.

Parent Year	Total Age	Sex: Female	Sex: Male	Total	Age Composition
1989	5	0	5	5	13%
1988	6	2	16	18	47%
1987	7	1	12	13	34%
1986	8	0	2	2	5%
Total		3	35	38	

Table 3.-Number of steelhead counted during float surveys of the Situk River, 1994.

Survey Date	Steelhead Count	River Section	Observers	Comments
23-Apr-94	2,850	Lower River	R. Johnson, G. Woods	Excellent visibility
30-Apr-94	1,612	Lower River	G. Woods, M. Gaede	Poor visibility
4-May-94	2,437	Lower River	G. Woods, B. Glynn	Fair visibility
7-May-94	1,024	Upper River	G. Woods, B. Glynn	Fair visibility
13-May-94	2,235	Lower River	R. Johnson, M. Gaede	Fair conditions, deeper water than usual
13-May-94	705	Upper River	G. Woods, B. Glynn	Fair conditions, deeper water than usual
16-May-94	653	Upper River	G. Woods, M. Gaede	Excellent visibility.
17-May-94	3,908	Lower River	G. Woods, M. Gaede	Excellent visibility., except fair last 2 miles due to wind
21-May-94	4,383	Lower River	R. Johnson, B. Glynn	Fair conditions, wind on lower half, much spawning
21-May-94	319	Upper River	G. Woods, M. Gaede	Excellent visibility.
29-May-94	3,134	Lower River	G. Woods, B. Glynn	Fair visibility.

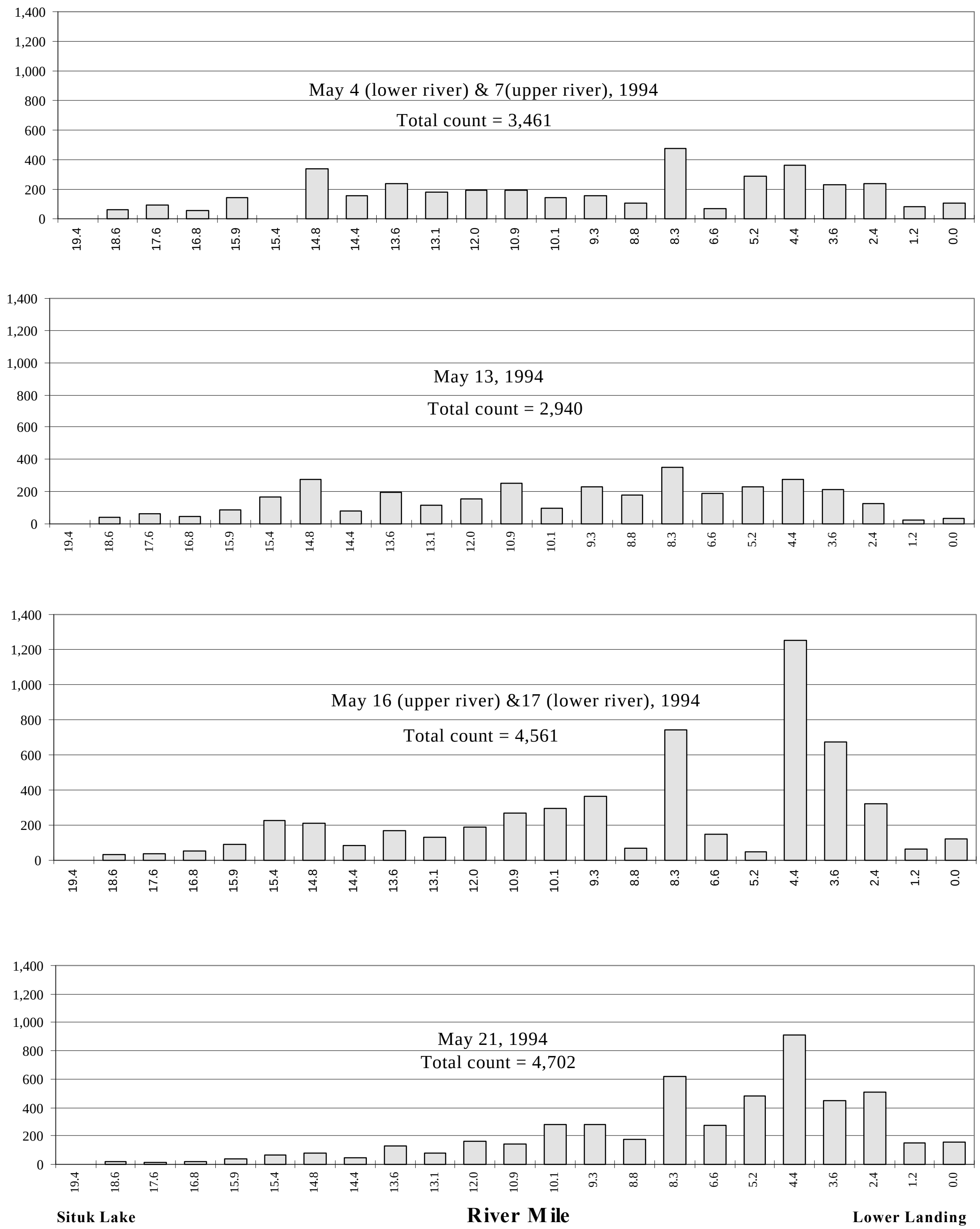

Figure 7.-**Steelhead density per mile in the Situk River, 1995.**

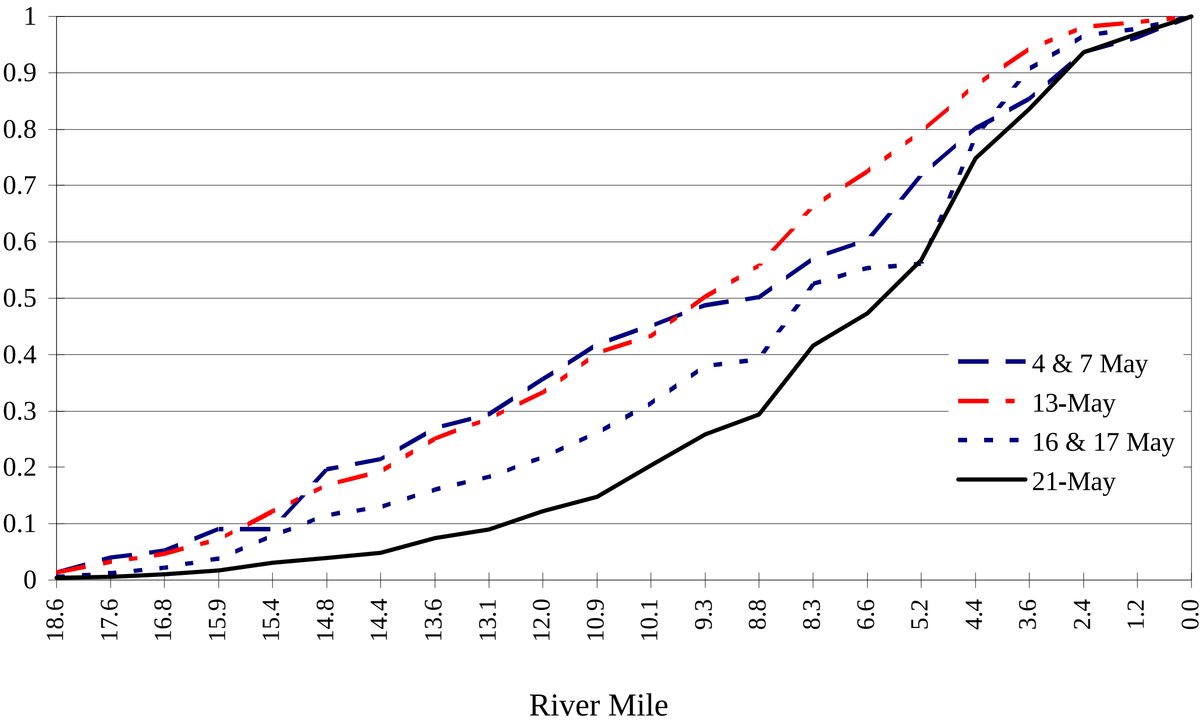

Figure 8.-Cumulative proportions of steelhead counted during complete Situk River float surveys, 1994.

Table 4.-Environmental conditions during steelhead float surveys, 1994.

Situk River Float Survey Conditions, 1994					Luminosity [c]		Cloud Cover				Wind				Precipitation				Turbidity/Color				Overall Conditions Could not see well into -			
Date	Section [a]	Time	Water Height [b]	Water Temp. (°C)	Air	Water	Complete Overcast	Mostly Overcast	Partly Overcast	No Clouds	Constant	Frequent	Occaisional	None	Constant	Frequent	Occaisional	None	Very Heavy	Heavy	Slight	None	Average Pools	Deep Pools	Deepest Pools	No reduction in Vis.
23-Apr	2	1134	43.25	6°	14.50	12.90				X				X				X			X					X
23-Apr	3	1500		8°	14.50	12.80				X			X					X			X				X	
30-Apr	2	1125	37.00	8°	14.50	12.50		X					X				X				X		X			
30-Apr	3	1345		7°	14.50	12.00		X				X					X				X		X			
4-May	2	1110	40.00	7°	15.50	12.00		X					X					X			X			X		
4-May	3	1345		7°	13.50	12.00	X						X				X				X			X		
7-May	1	1145	34.00	7°	16.00	12.50	X						X				X				X			X		
13-May	1	1200	28.50	8°	15.75	12.50			X					X				X			X				X	
13-May	2	1000	28.50	6°	15.75	12.50				X				X				X		X				X		
13-May	3	1300		6°	15.60	12.60				X			X					X		X			X			
16-May	1	1150	37.50	12°	15.80	12.50				X				X				X				X				X
17-May	2	945	38.00	10°	15.90	13.60			X			X						X			X				X	
17-May	3	-		10°	15.40	13.40			X			X						X			X				X	
21-May	1	1145	40.25	10°	15.50	11.90	X						X					X				X			X	
21-May	2	1115	40.25	9°	15.50	11.90	X					X					X				X				X	
21-May	3	1415		9°	13.90	11.25	X					X				X					X			X		
29-May	2	1240	39.00	10°	16.00	14.60			X				X					X			X				X	
29-May	3	1510		10°	16.70	15.00			X			X						X				X			X	

[a] section 1 is the area from Situk Lake downstream to Nine Mile Bridge,
section 2 is the area from Nine Mile Bridge downstream to river mile/km 5.2/8.4,
section 3 is the area downstream from section 2 to the Lower Landing

[b] measured from the Nine Mile Bridge support concrete seam, down to the water surface, in inches

[c] ISO 100, see text

TRANSIT TIME OF EMIGRATING STEELHEAD

Twenty-nine (29) steelhead captured between the weir and four miles below Situk Lake were implanted with sonic transmitters during the spring of 1992. Sonic signals from twelve of these transmitters were received and tracked as they passed down through the weir. The balance of the transmitters were never recorded past the weir (too much "noise" during a flood, too many transmitters in the area at one time, fish lost to mortality, etc.). We attempted to track the fish manually from the weir through the estuary. More often than not, the sonic signal was lost before reaching the breakers. If we could not receive the sonic signal in the estuary, it was assumed to have left the estuary. These estuary exit times were recorded as the time that the transmitter was last received at the location nearest the estuary mouth. Thus, emigration times for these fish was calculated with some uncertainty. Ten of the 12 fish tracked during 1992 were considered to have exited the estuary in eight hours time (Figure 9). The average transit time for sonic transmitter implanted steelhead during 1992 was 8.7 hours (SE = 2.5; range = 2 hrs. 45 min. - 27 hrs. 30 min.) between the weir and the mouth of the estuary (Table 5).

During 1994, sonic transmitters were esophogeally implanted in the stomachs of 22 female steelhead and released back into the Situk River between May 22 and June 8 (Table 4). Eighteen of these fish triggered the automatic logging device just below the weir. Four of the sonic transmitters were not detected at the weir monitor. Of these eighteen fish, seven triggered the logging device in the Situk River estuary and exhibited highly skewed transit times (Figure 9). Only four of the seven fish had been logged out of the estuary 21 hours after passing the weir, Steelhead took an average 22.2 hours (SE =6.3; range = 6 hrs. 08 min. - 53 hrs. 49 min.) to travel between the weir and the mouth of the estuary (Table 5).

Two steelhead were tracked continuously from the weir to the estuary during 1994. One fish traveled directly to the estuary. After about a 9 hour delay it was recorded by the estuary recording station (Figure 10). The second fish also traveled directly to the estuary where the signal was lost after several hours. This sonic transmitter was not recorded by the estuary monitor (Figure 11).

When data for both years are combined, a total of nineteen steelhead implanted with sonic transmitters were tracked as they transited the Situk/Ahrnklin river estuary. Twelve of the 19 steelhead had exited the estuary within twelve hours of passing down through the weir (Figure 9). Combined, fish took an average of 13.7 hrs. (SE = 3.1, range = 2.75 to 53.75 hrs.) to travel from the weir through the estuary. Notably, all fish emigrated from the estuary during ebb tide, with about 80% leaving within 4 hours following the onset of an ebb tide between midnight and 0600 hours (Figure 12). Common to both years were single fish that emigrated to the estuary only to return and pass upstream through the weir, not to be recorded again.

DISCUSSION

COUNTS OF EMIGRANT STEELHEAD AND STEELHEAD ABUNDANCE INDICES

The ratio of steelhead observed during float index surveys to the number eventually emigrating through the Situk River weir ranged from .31 to .60 during the four years in which there are complete counts of steelhead at the Situk River weir (Table 6). Post spawning steelhead mortality should not influence index counts in the Situk River, as observation of more than one or two steelhead carcasses during an entire survey is rare. It is common though for steelhead that will probably soon perish to maintain swimming ability, even when covered with fungus and near death.

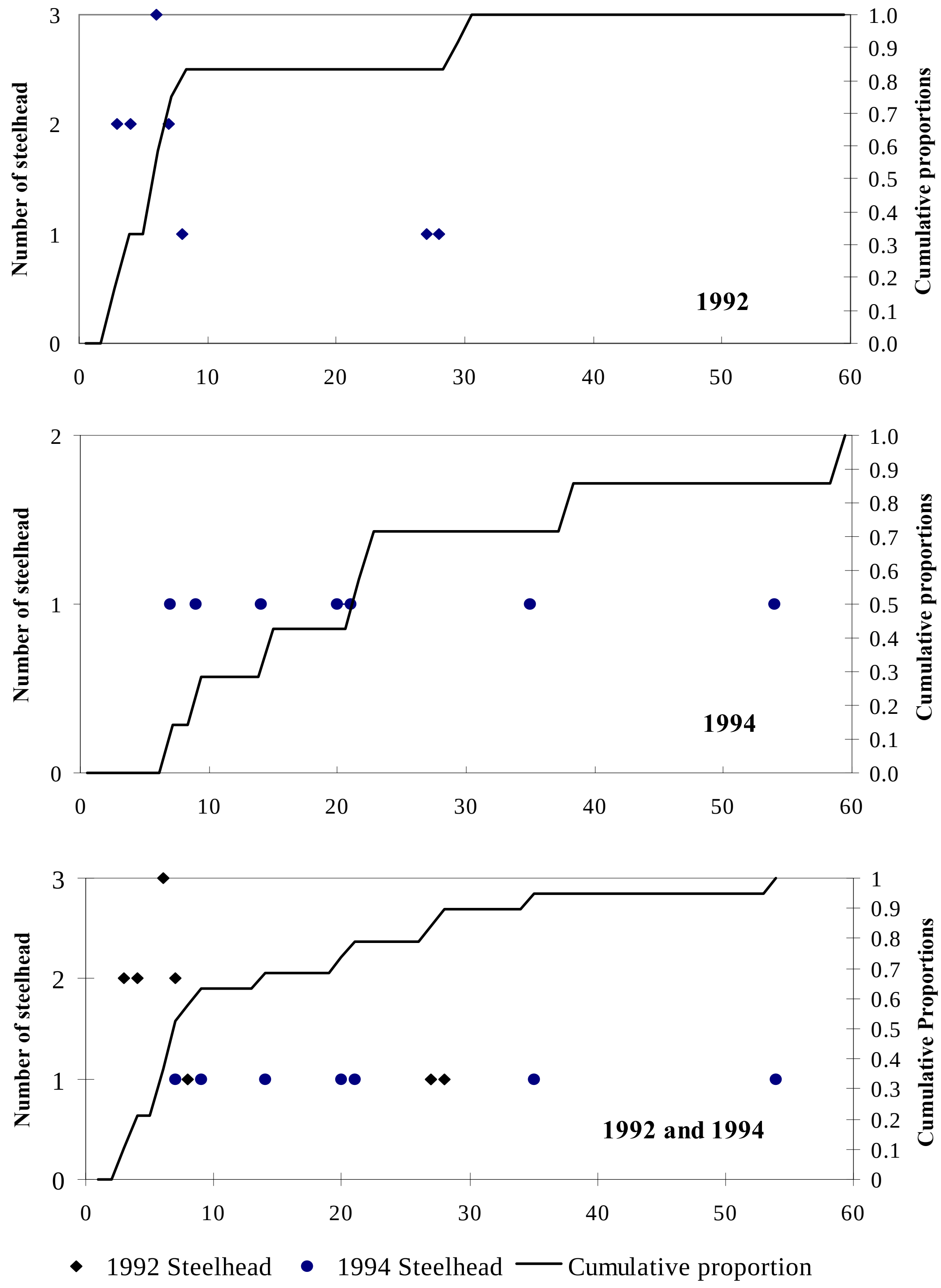

Figure 9.-**Transit time of sonic transmitter implanted steelhead between the Situk River weir and the Situk/Ahrnklin River estuary during 1992 and 1994.**

Table 5.-Date and location of tagging, passage times through the weir and estuary, transit times, length, and sex of steelhead implanted with sonic transmitters and tracked in 1992 and 1994, Situk River.

Tag num	Tagging date	River mile tagged	Days free above weir	Date/time logged down past weir		Date/time estimated out of estuary		Transit time	Hours/ minutes past high tide [a]	Fish length	Sex
258	23-Apr-92	17.0	41	6/3/92	23:30	6/4/92	5:30	6:00	2:20	780	M
88	1-May-92	1.5	50	6/17/92	23:15	6/18/92	7:15	8:00	6:12	650	F
97	1-May-92	1.5	29	5/30/92	23:20	5/31/92	5:00	5:40	4:50	760	F
465	1-May-92	1.5	30	5/31/92	0:12	5/31/92	3:00	2:48	2:50	680	F
447	11-May-92	13.5	29	6/9/92	0:15	6/9/92	3:00	2:45	0:09	720	F
357	16-May-92	7.0	13	5/29/92	23:00	5/30/92	5:30	6:30	6:02	620	F
2444	21-May-92	13.5	9	5/30/92	0:55	5/31/92	3:00	26:05	2:50	820	F
2336	21-May-92	1.5	8	5/29/92	23:30	5/31/92	3:00	27:30	2:50	800	F
366	21-May-92	1.5	9	5/30/92	23:45	5/31/92	3:00	3:15	2:50	820	F
2435	21-May-92	1.5	19	6/9/92	0:30	6/9/92	4:00	3:30	1:09	680	M
2363	22-May-92	1.5	7	5/29/92	23:00	5/30/92	5:30	6:30	6:02	710	F
2453	22-May-92	1.5	12	6/3/92	23:30	6/4/92	5:30	6:00	2:20	630	M
9239	27-May-94	1.2	6	6/2/94	1:28	6/3/94	11:53	34:25	2:07	740	F
9230	22-May-94	10.1	11	6/2/94	19:07	6/5/94	0:56	53:49	2:24	660	F
9247	7-Jun-94	1.2	5	6/12/94	9:37	6/13/94	5:48	20:11	2:19	740	F
9233	24-May-94	5.2	23	6/16/94	12:57	6/16/94	21:21	8:24	2:10	690	F
9250	8-Jun-94	1.2	8	6/16/94	16:10	6/17/94	11:43	19:33	4:13	750	F
9244	5-Jun-94	1.2	14	6/19/94	10:40	6/19/94	23:53	13:13	1:55	820	F
9245	6-Jun-94	1.2	18	6/24/94	10:42	6/24/94	16:50	6:08	2:02	815	F

[a] Time elapsed since previous high tide when transmitter was estimated out or logged out of the estuary

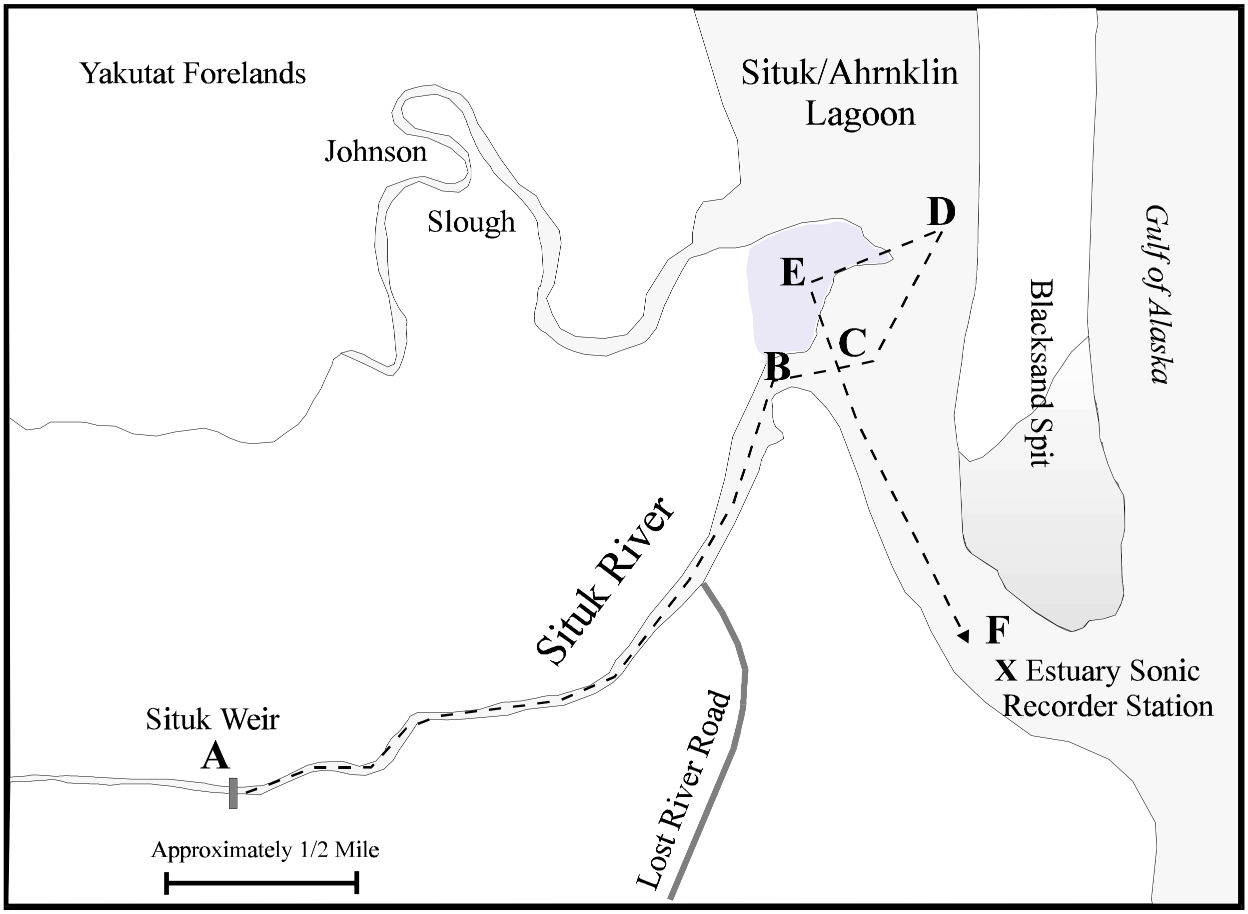

Figure 10.-Manual tracking record of sonic transmitter implanted steelhead 9239 through the Situk/Ahrnklin river estuary, June 2, 1994. Date: June 2, 1994, Tides: High 0844 hours, Low 0259 hours. Weather: rain, 10-15 kt. wind. A, 0129 hrs. - fish passes down through weir, B, 0245 hrs. - fish passed out of river mouth, C, 0320 hrs.D, 0445 hrs., E, 0630 hrs. - fish held in this position, then signal lost, F, 1153 hrs. -fish is recorded by the estuary sonic recording station

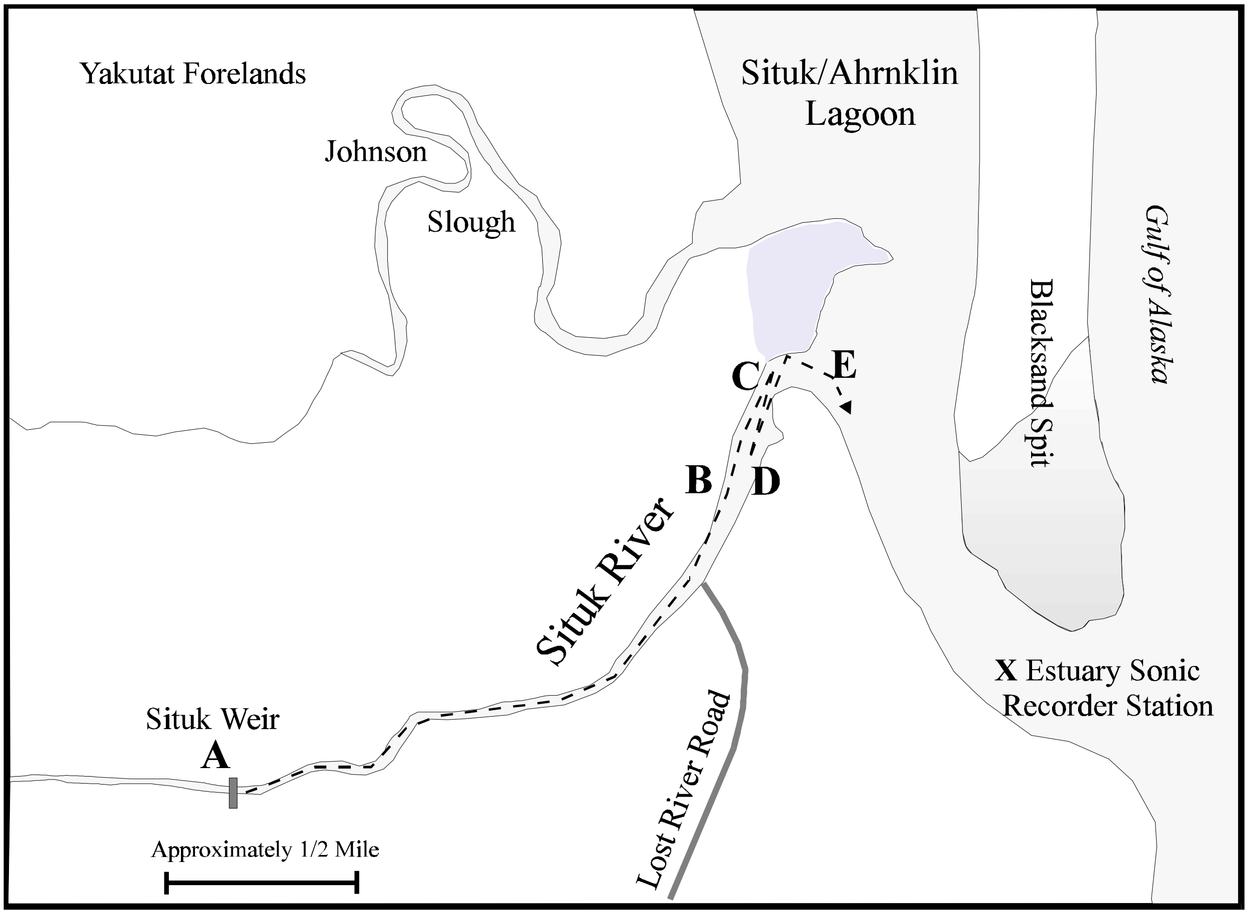

Figure 11.-Manual tracking record of sonic transmitter implanted steelhead 9234 through the Situk/Ahrnklin river estuary, June 2, 1994. Date: June 5, 1994, Tides: high 2246 hrs.low: 0542 hrs.Weather: partly cloudy, slight breeze. A, fish passes downstream through weir; B, caught up with fish and followed it to the mouth of the river; C, fish stayed at this position for some time, other steelhead seen breaking the surface; D, fish moved quickly upstream, reversed and returned downstream; E, fish continued downstream, moving quickly, lost radio signal soon - other steelhead seen jumping along the shoreline - tide ebbing strong - went down to recording station, sonic signal not audible - fish was not recorded by the estuary recording station.

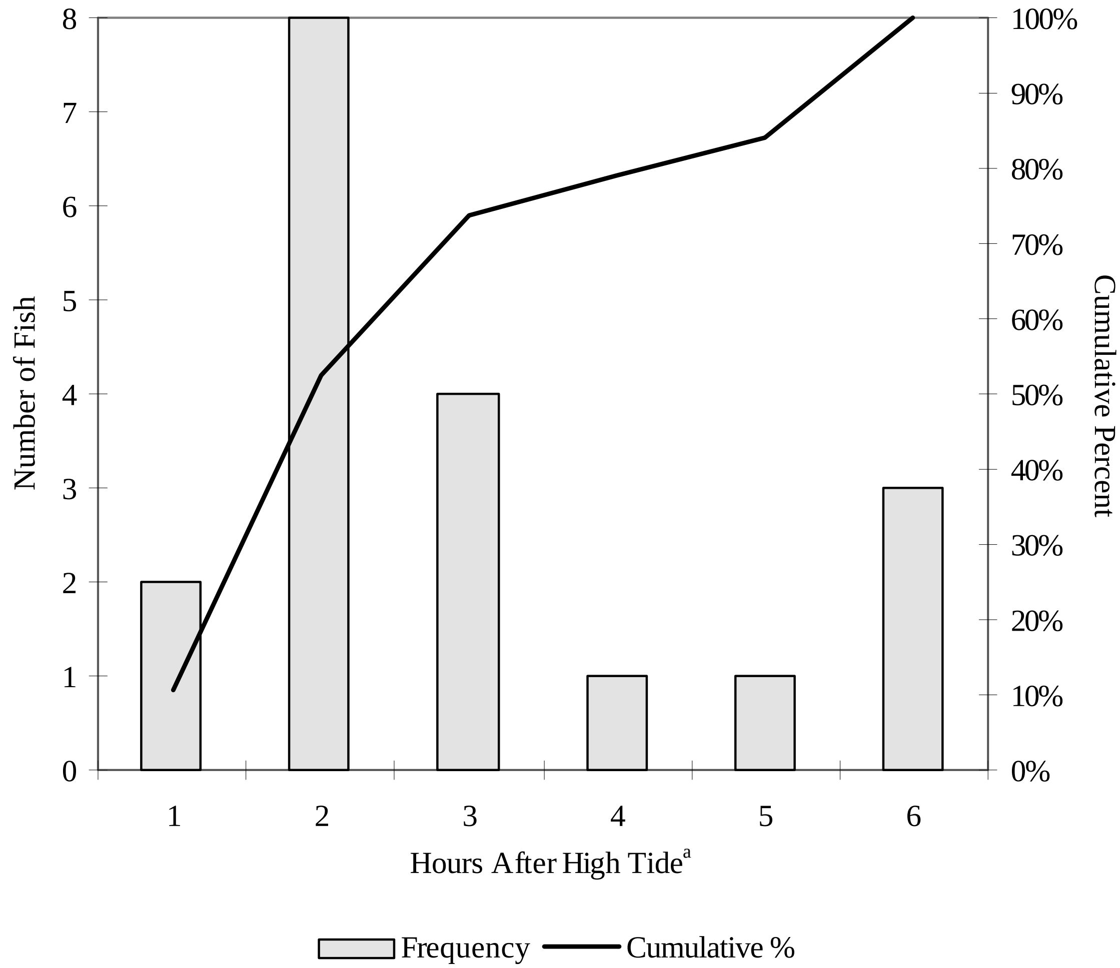

Figure 12.-Exit timing of steelhead with radio transmitters out of the Situk/Ahrnklin estuary relative to the previous high tide, 1992 and 1994. [a] Actual high slack tide in the Situk/Ahrnklin River estuary.

Table 6.-Weir count, peak float count, percent of total steelhead observed, and survey conditions during four years of both weir operation and float survey data.

Year	Peak Float count	Weir count	Proportion observed	Survey Conditions Upper section[a]	Lower section[b]
1989	2,251	5,867	.38	excellent	excellent upper 3/4, poor last 1/4
1990	1,640	3,639	.45	excellent	fair
1992	883	2,976	.30	poor	fair
1994	4,702	7,854	.60	excellent	fair, much spawning

[a] from Situk Lake to Nine Mile Bridge
[b] from Nine Mile Bridge to Lower Landing

These fish are generally swept by the current down to the weir and are included in the downstream count. Viewing conditions varied during these surveys so counts would be expected to be biased low when weather/water conditions were unfavorable, as during the April 30 lower river float. Environmental and viewing conditions encountered during each float during the period of peak steelhead abundance will be ranked and scored after several years of float data are available. These scores will then be used to correlate the number of steelhead observed under varying conditions to the number of steelhead that are eventually counted down through the weir.

Eight percent of the samples of emigrants ≥ 36 in total length were females and 92% were males. However, females comprised 51% and males 49% of all sizes of emigrants during 1994. At Peterson Creek sex ratios of fish ≥ 36 in. total length were 18/16 females to male (Harding and Jones 1990; 1991; 1992) and at Sitkoh Creek sex ratios of fish ≥ 36 in. total length were 54/35 females to male (Jones, Harding, and Schmidt 1991; Harding and Jones, 1994). These differences suggest that our sample of fish over 36 in. total length in the Situk River was biased. Though anecdotal information suggests that females leave Situk River early, there is no data indicating that these fish contain a preponderance of fish ≥ 36 in. total length. More likely are sampling procedures that selected for large males. Consequently, sampling procedures need to be examined and modified if necessary.

TRANSIT TIME OF EMIGRATING STEELHEAD

Technical problems prevented the level of precision desired for determining the timing of steelhead emigrant steelhead through the Situk/Ahrnklin River estuary during both 1992 and 1994, but provided information regarding tidal related emigration patterns. Manual tracking of individual steelhead proved to be time consuming and frustrating both years for the crew, as fish tended to wander around the estuary sometimes for days. Also, equipment limitations usually prevented individual fish from being tracked with certainty as several sonic transmitters shared the same frequency. Differences in selection criteria for tracked fish in 1992 and 1994, and fish “lost” during tracking in 1992 being considered “gone” might have influenced recorded differences in emigration timing between the two years.

High background noise levels created areas in the channel where reception of passing sonic transmitters at the estuary recording station was not possible when tidal currents exceeded about

1M/sec., which occurred during each tidal period. During 1994, it would have been better to deploy several estuary monitors in streamlined cases, on either third of the estuary channel, with another recorder positioned where the Situk River empties into the estuary.

Steelhead behavior observed during manual sonic tag tracking suggest that fish not recorded leaving the estuary by the automatic recording stations may have emigrated during the same tidal cycle that they arrived in the estuary, but during the peak tidal ebb. Since some steelhead remain (presumably in the estuary) for several days, it is curious why more steelhead are not captured in the commercial set net fishery. Although there have been instances to the contrary, a low percentage of steelhead are generally caught in this net fishery. Information gathered during this project might explain why. Set nets are least effective during ebb tide, generally being tied-up to avoid gathering large amounts of algae and debris during the peak tidal outflow. Nets are generally removed from the river altogether during large ebb tides. All steelhead successfully tracked in this study emigrated through the commercial fishing area during ebb tide, generally during the late night and early morning when nets are more unlikely to be attended closely and thereby fish less efficiently. Also, the area where steelhead tended to hold upon entering the estuary was in shallow water close to, but above the commercial fishery area river boundary, which placed them outside of the commercial fishery. Transects conducted with a recording fathometer indicate that the bottom of the estuary is made up of extensive sand ridges approximately 2 to 4 feet high, extending the length and width of the estuary. If remaining emigrant steelhead hold near the estuary bottom during daylight hours (typical behavior observed while in the clear water of the river) until they emigrate, then they would be less likely to be captured by set net gear.

Allowing steelhead unimpeded emigration back into the Gulf of Alaska is a goal of Situk River steelhead management. During infrequent occurrences when early fishing periods coincide with an abundance of steelhead staging near the weir, especially during small tidal periods when nets are more efficient during the ebb tide, emigrant steelhead could be held above the weir for a day prior to a commercial fishery, and released downstream following the closure during short (24 hr.) fishery openings. During more lengthy commercial fishery openings, fish could be released through the weir late at night coinciding with high tides at, or near, midnight to minimize negative effects caused by either delayed emigration from the river, or by being captured in nets. If an extreme situation occurred i.e., an abundance of emigrant steelhead that are pressing the weir, then requiring nets to be tied up or removed during the first three hours of late night/early morning ebb tides would probably be an effective management action.

ACKNOWLEDGMENTS

Randy Ericksen collected radio telemetry data during 1992 and 1993 as project supervisor. His work enabled us to get a quick start during the 1994 portion of the project. Many thanks to Gordon Woods, Brian Glynn, Mike Gaede, and Nick and Molly Kemp who spent much time with the float surveys, emigrant steelhead weir, and sonic tracking, respectively. Dione Cuadra, Vince Jacobsen, and Bill Blackburn, likewise worked hard to accomplish project goals. Bob Marshall, Doug Jones, and Steve Elliott assisted with planning, and analytical and editorial support.

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APPENDIX A

Appendix A1.-Dates of peak Situk River steelhead counts during years with multiple counts (Seifert and Elliott, in prep).

Year	Upper River	Date	Lower River	Date	Total	Total Weir	Percent Counted [a]
1987	1,123	5/11	2,083	5/12	3,206		
1988	430	5/15	2,165	5/25	2,595		
1989	1,016	5/20	1,235	5/21	2,251	5,867	0.38
1990	502	5/16	1,138	5/17	1,640	3,639	0.45
1991	386	5/14	593	5/12	979		
1992	220	5/16	663	5/16	883	2,976	0.30
1993	369	5/19	3,130	5/18	3,499		
1994	319	5/21	4,383	5/21	4,702	7,854	0.60

[a] Survey frequency and methods were not standardized prior to 1994

Appendix A2.-Location descriptions of stream section boundaries used during index float counts, Situk River, 1994.

Location	River Mile	Description of landmarks beginning stream section
Situk Lake	19.4	
Island	18.6	The first prominent island below the lake. Island is grassy with small clump of alder, river makes a sharp left turn over a riffle at the downstream end of the island. 30 foot high bank on left side below island.
Loop	17.6	Long, sweeping right hand curve. Deadfall on left bank, right bank is flat and grassy throughout this area.
Chute	16.8	Middle of the longest straight section on the upper river. Count is recorded at small grassy island in the middle of the stream. Considerable deadfall just above island, while below, the river becomes choppy with a steep gradient.
Pool	15.9	Located at the bottom of a long narrow chute, a large pool with an overhanging tree. One of the most prominent holes on the upper river.
Split	15.4	A single narrow channel with good flow level exits the main channel on the right bank. The small channel is virtually at a right angle to the main channel, and flows through an area of high grass.
End of Flats	14.8	The Flats are a long, fairly straight section of river characterized by step riffles. They end in a sharp right turn that then quickly bends back to the left. Just below the bend is a cut log on the right bank. Count is recorded before the log is reached.
Below log jam	14.4	Main channel is completely blocked by log jam, boat passage through it is not possible. Boat passage is made via smaller channel along right bank. Count is recorded where small channel rejoins main river.
West Fork	13.6	Main tributary of the upper river, the West Fork flows into the river from the right bank. Located about half way through the last straight section above Nine Mile Bridge. Water entering from the West Fork is often darker in color than the main stream.
Nine Mile Bridge	13.1	The shore of the river at the end of the launch ramp directly downstream and adjacent to the Situk River Bridge.
Eagle nest	12.0	The downstream or second occurrence of a large cottonwood containing an eagle nest. This is the bottom loop of an oxbow.
Old Situk	10.9	The *downstream* boundary of the confluence pool where the Old Situk River joins the Situk River. The count should be recorded at the beginning of the riffle.
Airstrip	10.1	The count is recorded at the point where the river flows past the end of the Middle Situk Airstrip.
Cathedral	9.3	This is the first major oxbow pool encountered below the Middle Situk Cabin. Named from the statement "it's so deep that you could sink a Cathedral in it." Many sunken logs and associated log jam. The count is added when the log jam is encountered.
Camp	8.8	to accurately count concentrations of steelhead here. Both sides of the boat need to be observed here. Add the count at the camp site located in the trees visible on the left shore facing downstream.
Finger	8.3	This is a deep hole with an associated slough entering from the left facing downstream. The river swings hard to the right into overhanging willows along a deep run. A very difficult spot to count steelhead. It is best to purposefully run slowly (under control) into the brushy left side of this run to force holding steelhead out onto the downstream shallows. Be careful not to count large Dolly Varden as steelhead here. Add the count where the pool turns into a riffle.
Danny's (ADFG)	6.6	This site is an oxbow bend with a broad gravel beach. Add the count at the beginning of the downstream riffle.
#2 Observation	5.2	Another oxbow bend, the outside of which is a high bank topped by old growth. Stop on the inside or, facing downstream right, side and repeat the observations listed on the survey form. Add counts here also.
	4.4	A logjam plugged oxbow pool. Add the count below the pool where the riffle begins.
Chainsaw		
Colorado Road	3.6	There is a grassy marsh meadow on the downstream left, and old bridge supports on the right bank. Also, there is at least one submerged barrel in the center of the river here. It is just before a hard right turn. An oil exploration road crossed here once, Colorado Oil and Gas Co. Add the count at the bottom of the pool.
Clay bank	2.4	The river turns left along an exposed clay bank on the right facing downstream. The clay seam continues into the river. There is a blowdown spruce at the downstream edge, this pool has filled much recently. Add the counts upon reaching the spruce.
Weir	1.2	Add the count at the upstream face of the weir.
Lower Landing	0.0	Add the count at the junction of the road and the river. Record the stage of the tide.

Appendix A3.-Number of steelhead counted moving downstream and upstream at the Situk River Weir, 1994.

Date	No. Down	Cum. Down.	No. Up	Temp. (C)	H20 Level
21-May	2	2	16	8.5	60
22-May	79	81	31	8.0	75
23-May	470	551	41	8.0	105
24-May	510	1061	10	8.5	77
25-May	178	1239	22	8.0	81
26-May	330	1569	28	9.0	77
27-May	256	1825	14	9.0	71
28-May	75	1900	0	9.0	66
29-May	206	2106	11	9.0	62
30-May	300	2406	27	10.0	58
31-May	300	2706	17	8.5	54
1-Jun	128	2834	7	11.0	61
2-Jun	862	3696	21	9.0	68
3-Jun	455	4151	15	9.5	61
4-Jun	256	4407	7	9.5	59
5-Jun	526	4933	12	10.0	59
6-Jun	301	5234	5	10.0	58
7-Jun	511	5745	14	9.8	54
8-Jun	171	5916	11	10.1	52
9-Jun	128	6044	3	10.5	52
10-Jun	172	6216	1	11.5	52
11-Jun	99	6315	0	12.0	54
12-Jun	358	6673	4	12.0	53
13-Jun	145	6818	2	11.0	52
14-Jun	104	6922	0	12.0	49
15-Jun	52	6974	6	14.0	46
16-Jun	138	7112	0	13.5	46
17-Jun	173	7285	9	11.0	46
18-Jun	101	7386	0	11.0	46
19-Jun	153	7539	0	11.0	47
20-Jun	0	7539	3	11.0	47
21-Jun	0	7539	4	11.0	49
22-Jun	0	7539	0	12.0	51
23-Jun	0	7539	0	12.0	49
24-Jun	58	7597	0	13.0	56
25-Jun	78	7675	0	12.0	62
26-Jun	54	7729	0	12.0	62
27-Jun	0	7729	0	11.0	59
28-Jun	0	7729	0	11.0	54
29-Jun	0	7729	0	12.0	52
30-Jun	8	7737	0	12.0	48

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Date	No. Down	Cum. Down.	No. Up	Temp. (C)	H20 Level
1-Jul	2	7739	0	12.0	46
2-Jul	6	7745	0	14.0	49
3-Jul	0	7745	0	12.0	49
4-Jul	0	7745	0	12.0	48
5-Jul	9	7754	0	12.0	56
6-Jul	0	7754	0	11.0	80
7-Jul	29	7783	0	11.0	74
8-Jul	24	7807	0	13.0	63
9-Jul	0	7807	0	13.0	58
10-Jul	0	7807	0	12.0	55
11-Jul	0	7807	0	11.0	50
12-Jul	0	7807	0	12.0	47
13-Jul	0	7807	0	12.0	45
14-Jul	0	7807	0	14.0	43
15-Jul	0	7807	0	13.0	41
16-Jul	5	7812	0	12.0	40
17-Jul	0	7812	0	12.0	40
18-Jul	1	7813	0	12.0	46
19-Jul	15	7828	0	11.5	60
20-Jul	23	7851	0	11.0	86
21-Jul	2	7853	0	11.0	85
22-Jul	0	7853	0	11.0	71
23-Jul	0	7853	0	11.0	62
24-Jul	0	7853	0	12.0	57
25-Jul	0	7853	0	12.0	53
26-Jul	0	7853	0	12.0	49
27-Jul	0	7853	0	12.0	47
28-Jul	0	7853	0	13.0	45
29-Jul	1	7854	0	13.0	44
30-Jul	0	7854	0	12.0	44
31-Jul	0	7854	0	12.0	42
1-Aug	0	7854	0	13.0	41
2-Aug	0	7854	0	12.0	39
3-Aug	0	7854	0	11.0	38
4-Aug	0	7854	0	12.0	37

Appendix A4.-Situk River steelhead index float surveys, 1994.

		Length of Area		Number of steelhead caught								
River Location	Mile	km	mi	April 23	April 30	May 4	May 7	May 13	May 16	May 17	May 21	May 29
Situk Lake		-	-	-	-	-	-	-	-	-	-	-
	19.4											
	18.6	1.30	0.80	-	-	-	48	34	25	-	15	-
	17.6	1.60	1.00	-	-	-	91	65	38	-	12	-
	16.8	1.30	0.80	-	-	-	43	38	43	-	16	-
	15.9	1.40	0.90	-	-	-	131	75	79	-	34	-
	15.4	0.80	0.50	-	-	-	-	82	112	-	34	-
	14.8	1.80	1.10	-	-	-	370	166	125	-	48	-
	14.4	0.70	0.40	-	-	-	62	33	33	-	19	-
West Fork	13.6	1.20	0.80	-	-	-	189	154	133	-	102	-
9 Mile Bridge	13.1	0.80	0.50	-	595	-	90	58	65	-	39	-
	12.0	1.70	1.10	214	132	204	-	170	-	209	182	41
Old Situk	10.9	1.90	1.20	232	32	213	-	275	-	297	155	67
Airstrip	10.1	1.30	0.80	126	32	117	-	80	-	235	226	98
	9.3	1.30	0.80	130	39	124	-	185	-	292	223	98
	8.8	0.80	0.50	73	27	52	-	90	-	35	89	38
	8.3	0.80	0.50	199	22	237	-	175	-	372	309	178
	6.6	2.60	1.60	295	103	112	-	325	-	247	463	112
	5.2	2.30	1.40	429	-	400	-	323	-	64	671	465
	4.4	1.30	0.80	193	424	288	-	220	-	1,003	729	367
	3.6	1.30	0.80	186	126	185	-	170	-	541	357	327
	2.4	2.00	1.20	624	72	282	-	150	-	387	609	579
Weir	1.2	1.80	1.10	87	27	95	-	30	-	78	182	704
Lower Landing	0.0	2.00	1.20	62	13	128	-	42	-	148	188	60
Total		31.20	9.30	2,850	1,612	2,437	1,024	2,940	653	3,908	4,702	3,134

Appendix A5.-Computer data files concerning Situk River steelhead studies, 1994.

File Name	Description
94SH.xls	Spreadsheet of steelhead sampled by day, age, length, and sex, plus Situk River water levels and weir counts by day, 1994.
floats94.xls	Spreadsheet of Situk River index float counts and viewing conditions, 1994.
94sonic.xls	Spreadsheet of Situk River steelhead sonic tagging and tracking data, 1992 and 1994.
94Situks.doc	WORD 6.0 (Windows) file of this FDS report