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and
Marianna Alexandersdottir

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ABSTRACT

The widespread practice of hook-and-release fishing for chinook salmon *Oncorhynchus tshawytscha* in the Kenai River prompted the Alaska Department of Fish and Game to initiate a multi-year investigation of mortality associated with this fishing technique. Preliminary findings from two hook-and-release experiments, conducted during 1990, are presented in this report.

Short-term (1-5 day) hooking mortality for chinook salmon that were caught and released in the Kenai River recreational fishery was assessed using radio telemetry. Biological and fishery variables were recorded for each of 125 early-run and 120 late-run fish that were tagged during 1990. Mortality estimates were 8.8 percent and 5.9 percent for early- and late-run salmon respectively. Most mortality took place within 72 hours of release. The distribution of fishery variables differed among runs, largely due to management regulations, but no relationship was found associating these variables with the fates of radio-tagged fish. Hooking location was the only factor that significantly affected mortality. Chinook salmon that were injured in the gills had a significantly reduced chance of surviving; however, the frequency of gilled fish was small in both experiments.

Initial movements of radio-tagged fish occurred in both upstream and downstream directions. Movement occurred most frequently during the second half of the day. Upstream movements to spawning destinations were variable, and frequently punctuated by milling behavior. An average of 32 days elapsed between tagging and spawning. Most (72 percent) early-run fish spawned in tributary streams with peak spawning occurring in mid-July; while most late-run fish spawned in the mainstem with peak activity in mid-August. Spawner destinations within each run were independent of weekly entry times.

KEY WORDS: Kenai River, chinook salmon, *Oncorhynchus tshawytscha*, radio telemetry, transmitters, mortality, hook-and-release, angling variables.

INTRODUCTION

The Kenai River (Figure 1) is a glacial stream located in Southcentral Alaska on the Kenai Peninsula. The river and its associated tributaries drain an area of approximately 5,700 square kilometers. The Kenai River supports the largest recreational fishery for chinook salmon *Oncorhynchus tshawytscha* in Alaska. The world record all-tackle chinook salmon (42.6 kg, 94 lb) was taken from the Kenai River during 1985 and fish in excess of 31.8 kg (70 lb) are not uncommon. Thus, the Kenai River enjoys a wide reputation for abundant catches of large chinook salmon. The estimated annual harvest of Kenai River chinook salmon from 1986 through 1990 has ranged from 7,982 to 30,259 fish and averaged 19,341 fish (Nelson 1990). Harvest and effort in this fishery have grown dramatically since first estimated in 1974.

Angling for chinook salmon is restricted to the lower 80 km (50 miles) of mainstem river and is conducted primarily out of small outboard-powered boats by both guided and non-guided anglers. The fishery begins in early May and continues for 6 days each week until the season ends on 31 July. The return of adult chinook salmon (and the harvest) occurs in two distinct components, an early run and a late run. Fish caught prior to 1 July comprise the early run, while those caught after that date make up the late run. Early-run fish account for about 30% of the harvest and late-run fish make up the remaining 70%. Recent harvests have been taken in equal proportions by guided and non-guided anglers. The state has implemented restrictive regulations to manage the harvest in this fishery including minimum escapement goals, a daily bag and possession limit of one fish, and a yearly bag and possession limit of two fish.

The voluntary practice of hook-and-release fishing for chinook salmon in the Kenai River has increased in recent years due to abundant returns, restrictive bag and possession limits, and selective harvesting for "trophy" sized fish. During 1986 to 1990, an estimated 44,213 chinook salmon (31% of the catch) were released by anglers (Table 1). In the early-run component of the 1988 fishing season, approximately 90% of the total chinook salmon return to the river was caught. The released component of that catch (5,946 fish) represented 73% of the estimated escapement. The ultimate fate of these hooked-and-released fish was unknown. Also in 1988, the Alaska Board of Fisheries directed the Alaska Department of Fish and Game (ADFG) to manage the recreational fishery to achieve escapement goals of 9,000 early-run and 22,300 late-run chinook salmon. If these goals can not be projected during the season, harvest is reduced by restricting the time or area of the fishery, or reducing the bag limit to zero by requiring hook-and-release fishing only. Weak returns of adult chinook salmon in both the early and late runs prompted ADFG to implement mandatory hook-and-release fishing, for the first time, as a regulatory mechanism during the 1990 fishing season.

This study resulted from increased concern over the fate of hooked-and-released fish, the growth of this practice in the recreational fishery, and the need to evaluate the biological costs of hook-and-release fishing when used as a management tool. The goal of this multi-year study is to estimate the short-term (5 day) mortality associated with hook-and-release fishing for chinook salmon in the Kenai River and the effects of selected biological and fishing variables on mortality.

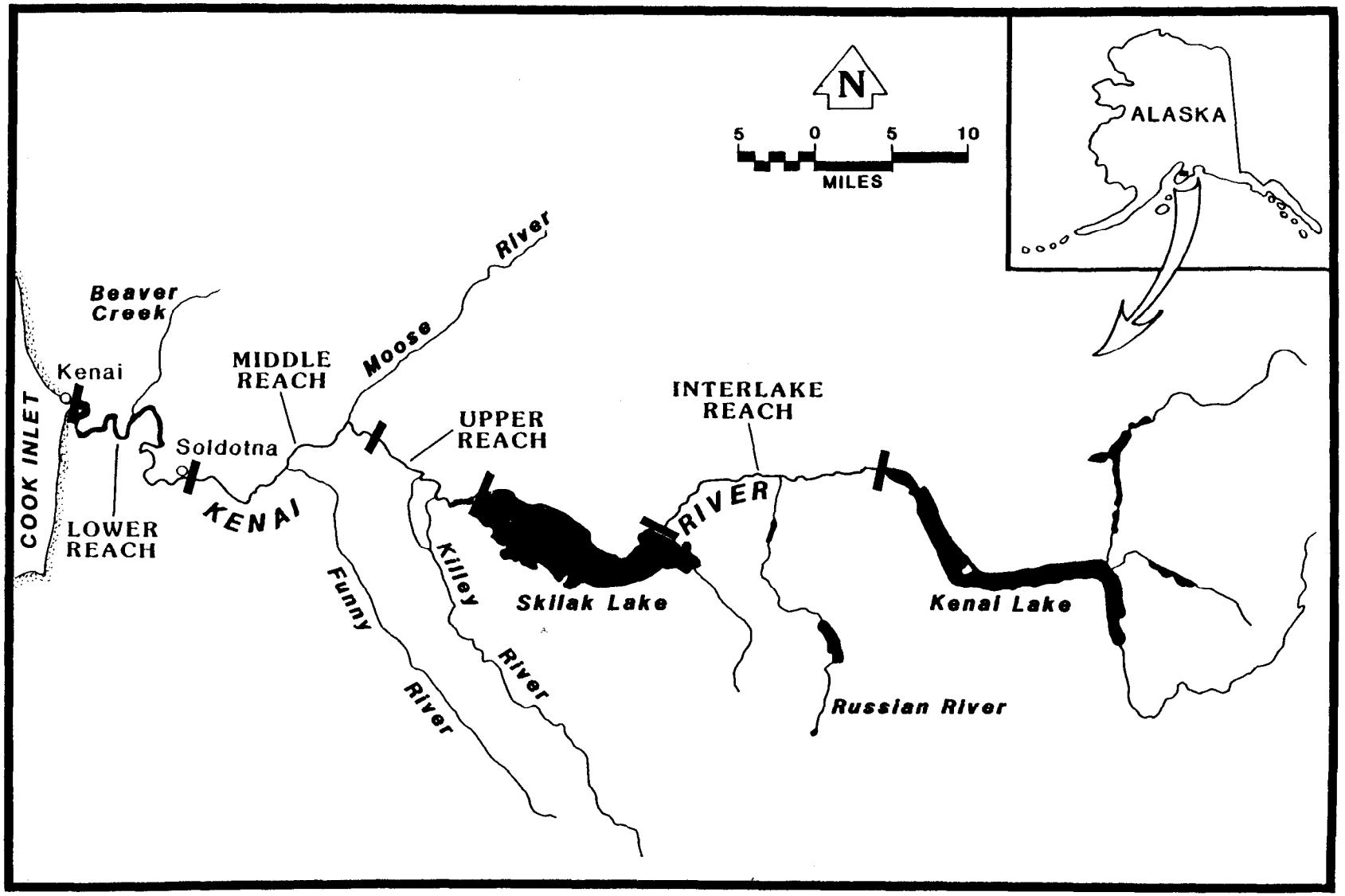

Figure 1. Map of the Kenai Peninsula showing the Kenai River basin.

Table 1. Estimated escapements and numbers of chinook salmon that were caught, released, and retained in the Kenai River recreational fishery during 1986 through 1990.

Year	Run Component	Numbers of Chinook Salmon			Percent Released	Estimated Escapement[a]
		Caught	Retained	Released		
1986	Early	12,117	7,561	4,556	38	19,519
	Late	15,331	9,004	6,327	41	48,559
	Both	27,448	16,565	10,883	40	68,078
1987	Early	19,119	13,281	5,838	31	12,362
	Late	16,701	12,237	4,464	27	52,787
	Both	35,820	25,518	10,302	29	65,149
1988	Early	18,693	12,747	5,946	32	8,133
	Late	23,238	17,512	5,726	25	34,496
	Both	41,931	30,259	11,672	28	42,629
1989	Early	9,901	7,256	2,645	27	10,736
	Late	12,210	9,127	3,083	25	19,908
	Both	22,111	16,383	5,728	26	30,644
1990	Early[b]	4,973	1,735	3,238	65	8,656
	Late[b]	8,637	6,247	2,390	28	25,770
	Both	13,610	7,982	5,628	41	34,426
All	Early	64,803	42,580	22,223	34	59,406
	Late	76,117	54,127	21,990	29	181,520
	Both	140,920	96,707	44,213	31	240,926

[a] Inriver return minus the sport harvest.

[b] Release of catch mandatory for all or part of run.

Our study used radio telemetry to monitor the daily locations and estimate fates of chinook salmon that were caught and released in the recreational fishery. This report presents findings from the 1990 fishing season in which 125 early-run and 120 late-run chinook salmon were caught, tagged, and released. An additional 100 chinook salmon were tagged and released during the 1989 field season (Bendock and Alexandersdottir 1990). Biological and fishery variables were measured for each fish, and fates were established using a matrix of criteria based on telemetry signals and movement behavior. Specific objectives for this study were to:

1. test the hypothesis that short term hook-and-release mortality for chinook salmon is not greater than 0.20;

2. estimate hook-and-release mortality;

3. estimate the effects that biological and fishery variables have on mortality rates;

4. estimate the duration of time tagged chinook salmon are vulnerable to harvest in the lower Kenai River; and,

5. determine if chinook salmon destined for various spawning locations in the Kenai River drainage exhibit temporal differences in migratory timing through the lower river fishery.

METHODS

Data Collection and Procedures

Experimental Design and Assumptions:

The Kenai River presents several unique obstacles to conducting a hook-and-release study. The turbidity of the mainstem and tributaries prevents visual observations of study animals. The size and discharge of the mainstem precludes the operation of a weir for capturing or recovering fish and ADFG personnel have failed to find suitable alternatives to gill net or hook-and-line sampling for capturing chinook salmon with minimum injury. The size of chinook salmon (often in excess of 23 kg) makes them difficult to handle and susceptible to injury when removed from the water. Due to these limitations, we chose to use radio telemetry to monitor the fates of individual fish. Thus, the mortality we estimate is a maximum value that includes the effects of handling and tagging.

There is some evidence that hooking mortality is higher among salmon that are still feeding and in salt water than those that have entered fresh water to spawn (Parker et al. 1959). Consequently, we limited our tagging area to a 4.8 km (3 mi) reach of the lower Kenai River (Figure 2) and assumed that all chinook salmon captured within this reach responded similarly to angling and tagging. Since radio transmitters do not propagate a signal in salt water, our tagging reach was located far enough upstream to allow for a 5 to 6 km buffer area in which to identify tagged fish that moved downstream.

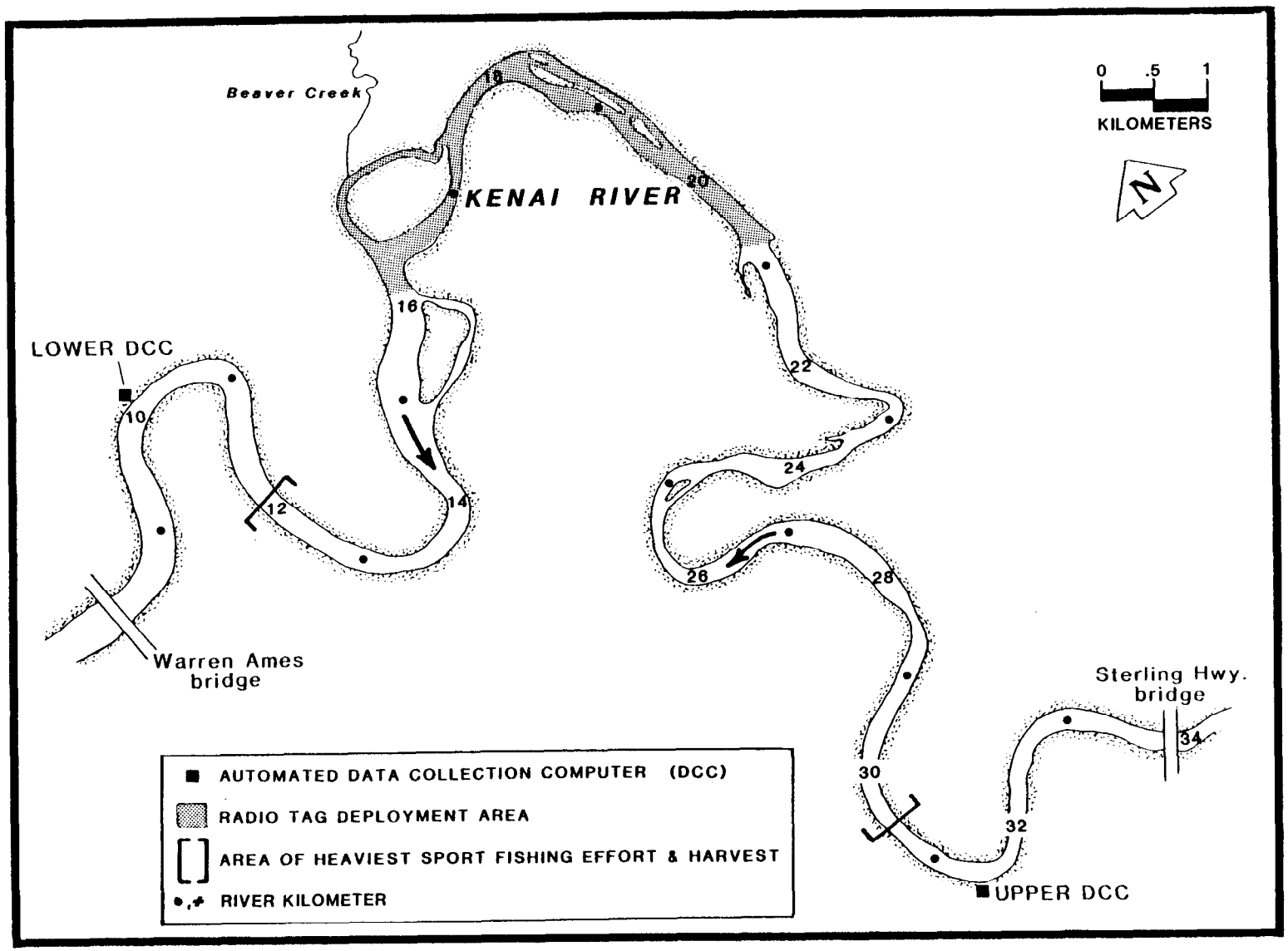

Figure 2. Map of the lower Kenai River delineating the area of greatest sport fishing harvest and effort, the boundaries of the tagging area and locations of the automated data collection computers.

A total of 125 early-run chinook salmon and 120 late-run salmon were angled, equipped with externally mounted radio transmitters, and released in the lower Kenai River. The fate of each radio-tagged fish was monitored daily for 5 consecutive days using aerial and ground tracking methods to test the hypothesis that short-term hook-and-release mortality is not greater than 0.20 (Objective 1). A minimum sample size of 100 was chosen prior to the 1989 season in order to achieve a desired precision for Objective 2 ($p < 0.05$, 80% of the time) using the binomial model (Cochran 1977). However, results in 1989 indicated that male and female chinook salmon differed in their fates after release. Sample size goals were increased to a minimum of 120 in order to allow for stratification by sex in the experiment. The 80% upper confidence interval for an estimated mortality of 0.20 would be 0.27 at this sampling level.

To estimate the duration that each radio-tagged fish was vulnerable to harvest in the lower river recreational fishery, the number of days that each tagged fish spent between the time of release and passing an automated data logger (DCC) at rkm 30.4 was calculated (Objective 4). Fish that were alive following 5 days at-large and that survived the recreational fishery were located daily until spawning was indicated by the cessation of movement near the maximum distance penetrated upstream and radio transmitter signal modes. The duration at-large, rates of movement, and estimated location of spawning were used to describe temporal differences in migratory timing of spawners (Objective 5).

Assumptions of this study were:

1. there was no tagging or natural mortality;

2. there was no tag loss; and

3. tags that were removed by various fisheries or that we failed to locate were a random subset of the total sample and did not bias the study results.

Telemetry Equipment:

Radio telemetry equipment used in this study was manufactured by Advanced Telemetry Systems, Inc., Isanti, Minnesota. Transmitters were encapsulated in electrical resin and measured approximately 20 mm X 70 mm with a 350 mm whip antenna. Each transmitter operated on a unique frequency between 48.000 MHz and 49.999 MHz separated by a minimum of 10 KHz. The minimum transmitter battery life was 85 days. Transmitters were equipped with mortality and activity options that altered their normal pulse rate of approximately one pulse per second. The mortality circuit, which doubled the pulse rate to 2 pulses per second, was triggered following 3 to 4 motionless hours. Subsequent movement reset the transmitter to the normal mode. Elevated levels of activity were indicated by a built in mercury switch that inserted additional pulses when the transmitter was moved vigorously. Thus, radio signals were transmitted in either normal, active, or mortality modes.

Programmable scanning receivers and directional loop antennas were used to monitor radio transmissions. Daily flights in a PA-18 Supercub with an

antenna mounted to the left wing jury struts were undertaken to locate tagged salmon. Flying was conducted at approximately 70 mph and 800 to 1,000 ft above the water column. A programmable receiver scanned available radio transmitter frequencies at 2 second intervals and the river mile location of each fish was estimated to coincide with the point of maximum acoustic signal strength.

Two stationary automated data collection computers (DCC's) were positioned along the banks of the lower Kenai River at rkm 10.5 and 30.6 (rm 6.5 and 19) (Figure 2). These DCC locations delineate boundaries of the reach in which approximately 84% of the effort and 90% of the harvest occurs in the chinook salmon recreational fishery (Hammarstrom 1989). Lead-acid batteries supplied field power to the DCC's and associated receivers which scanned each available frequency for 5 second intervals on a continuous basis. The frequencies, Julian date, time, and pulse rates of radios transmitting within range of the DCC's (usually less than 1.6 km) were stored electronically. These data were transferred to a microcomputer database file on a weekly basis via an RS-232 interface. DCC's were subject to extrinsic electronic interference, thus, aircraft location data were given priority when resolving discrepancies of location between the two data bases.

Capture and Tagging:

Recreational fishermen targeting chinook salmon were observed by a two-person crew working out of an outboard powered river boat in the lower Kenai River. The crew started a stopwatch when a fish strike was observed or an angler was seen setting a hook. The angler was subsequently asked if the fish was intended to be released and if we could place a radio transmitter on it. Fish that were volunteered in this manner were played to the anglers boat and placed in a landing net. The leader was cut and the fish and net were passed to the tagging boat without being removed from the water. The tagging crew started a second stopwatch, removed the tackle, noted the locations of injuries, and transferred the fish to a tagging cradle using a tail restraining loop. The cradle and loop, which immobilize the fish and keep it under water during processing, are described by Hammarstrom et al. (1985). Thus, none of the fish were removed from the water during their capture, transfer, or handling.

Radio transmitters were mounted on the right side of each fish beneath the anterior half of the dorsal fin. Each tag was securely fastened through the fish using two 7.6 cm (3 in) nickle pins that were epoxied to the tags on one end and tied against 2.5 cm (1 in) diameter plastic Petersen disks on the other end (Figure 3). Stainless hypodermic needles measuring 16 gauge by 100 mm (4 in) were used to shield the nickle pins and provide a sharp cutting surface for penetrating the skin of the salmon. The needles were removed from the pins after penetrating through the skin and were re-used numerous times. When processing was complete, the tail loop was removed, and the fish was supported until it swam away under its own initiative.

Biological and Fishery Variables:

Biological and fishery variables were recorded for each angling event. The biological variables were the mid-eye to fork-length (in millimeters) and sex

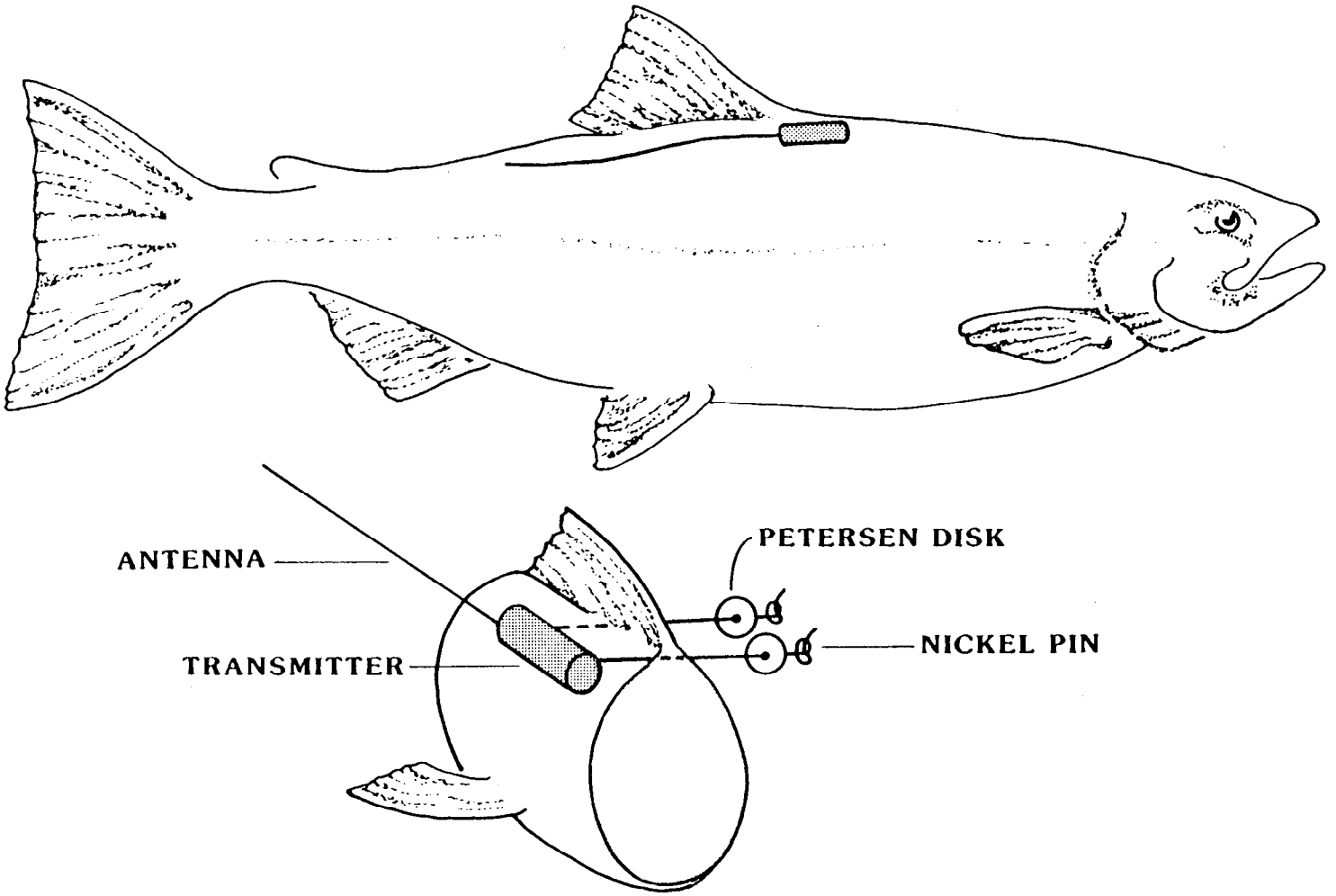

Figure 3. Schematic diagram of a salmon showing the attachment of a radio transmitter.

of the fish, while the fishery variables defined the environmental conditions, fishing methods, and condition of fish at release (Table 2). Date, time, water temperature, catch and release locations, angler's name, and angling and tagging durations were recorded for each fish. Each event was assigned one of three fishing method classifications: back-bouncing, back-trolling, or drifting; and one of three terminal gears: artificial lure, bait, or lure/bait combination. The number and type of hooks and the presence of bleeding was noted. Classifications of anatomical hooking sites (Figure 4) adapted from Mongillo (1984) were recorded. The mid-eye to fork-of-tail length (measured to the nearest 10 mm) and sex (estimated from external characteristics) of tagged fish were recorded. The presence of sea lice *Lepeophtheirus salmonis*, gill net marks, fungus, other wounds, and fishing tackle were noted. Each fish was subjectively judged to be either vigorous or lethargic upon release.

Dispositions of Tagged Fish

Observed frequencies of dead and alive radio-tagged fish, during the 5 day interval from release, were used to estimate hook-and-release mortality. Classifications for both 5-day and ultimate fates were used to describe the dispositions of all tagged fish. Tag recoveries from sport, commercial, and subsistence fisheries, interpretations of daily movement histories, and radio transmission modes were used to estimate fates. The following nine classifications defined 5-day fates:

1. survivor: a fish that sustained upstream movement, transmitted radio signals in either normal or active modes, or was harvested after 5 days at-large;

2. mortality: a fish that failed to move upstream from the intertidal area (rkm 19.3, rm 12), transmitted radio signals in the mortality mode, or a tagged carcass recovered within 5 days of release (see discussion below);

3. sport harvest: fish tagged with transmitter that was recovered in the recreational fishery;

4. set net harvest: fish tagged with transmitter that was recovered in the east side Cook Inlet commercial set net fishery or fish processing plants;

5. tag net harvest: fish tagged with transmitter that was recovered in ADFG gill net studies conducted in the Kenai River;

6. education net harvest: fish tagged with transmitter that was recovered in the inriver Kenaitze tribal education fishery;

7. drop-out: fish that returned to Cook Inlet and was not subsequently relocated.

8. uplost: fish that moved upstream but subsequently stopped transmitting a signal,

9. unknown: tagged fish that we failed to relocate.

Table 2. Biological, environmental, and fishing variables recorded for each chinook salmon angling event during 1989 and 1990.

Variable	Explanation
SEX	Estimation based on external characteristics.
LENGTH	Measurement (millimeter) from mid-eye to the fork of tail.
DATE	Recorded as mm/dd/yy.
TIME	Hour and minute of hook-up.
LOCATION	River mile location of hook-up.
WATER TEMPERATURE	Measured daily and recorded in degrees Celsius.
ANGLING METHOD	1. Back-Bouncing 2. Back-Trolling 3. Drifting
TERMINAL GEAR	1. Artificial Lure 2. Bait 3. Bait/Lure Combination
HOOK PLACEMENT	One of 12 anatomical locations, see Figure 4.
NUMBER OF HOOKS	Number of hooks (shanks) used in the terminal gear.
TYPE OF HOOKS	Recorded as either single or treble and determined by the number of points on each hook.
HOOKS REMOVED	Yes if hooks removed, and no if hooks left in fish.
TIME PLAYED	Angling time in minutes and seconds from the initial strike until the fish is landed in a net.
TIME TAGGED	Handling time in minutes and seconds from placement in the net until tagged and released.
BLEEDING	Yes if fish is bleeding, and no if fish is not bleeding.
LOCATION RELEASED	River mile location that fish is released.
CONDITION	Subjective judgement as to the condition of each fish upon release, and recorded as either vigorous or lethargic.

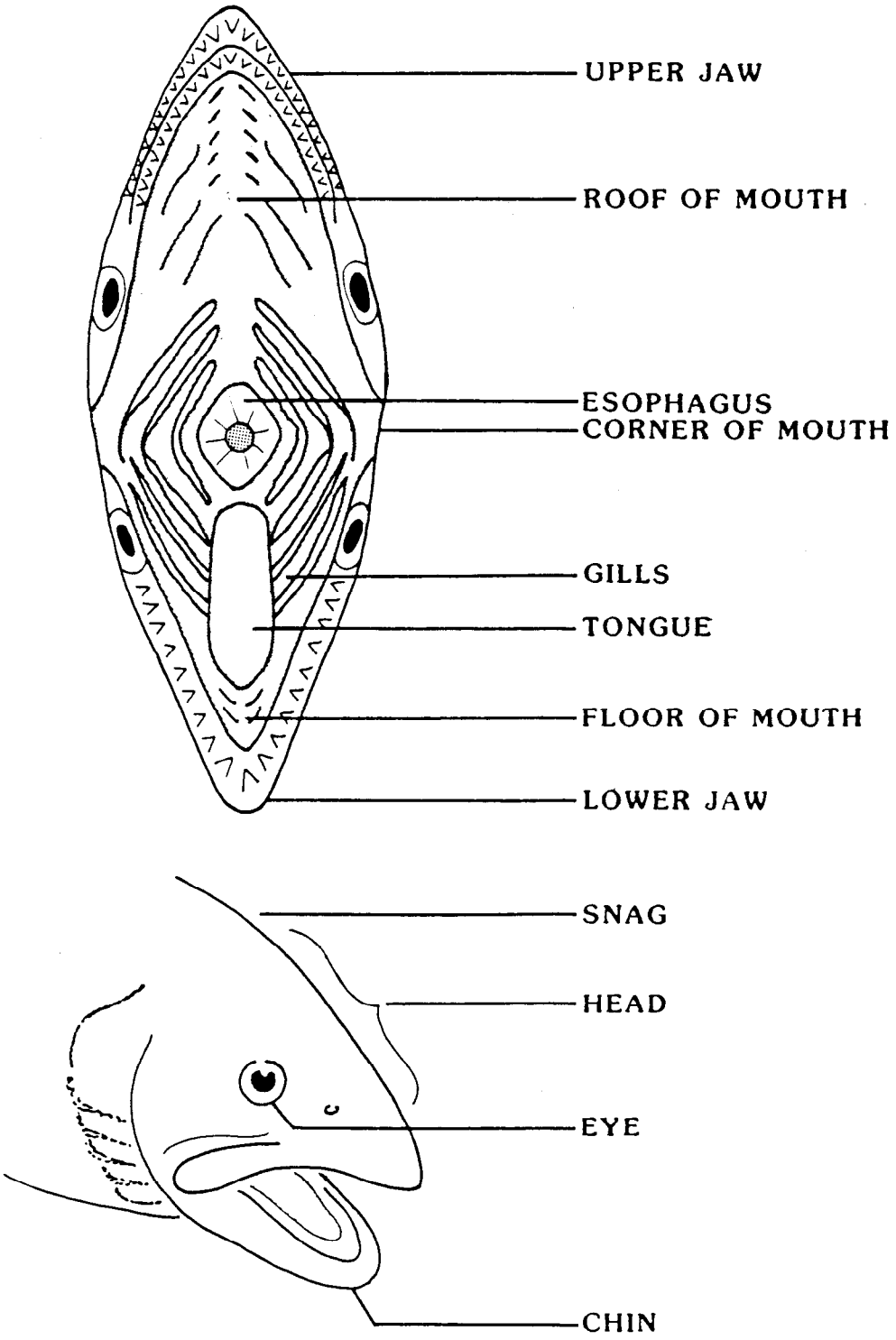

Figure 4. Diagrammatic view of a salmonid head illustrating hook injury locations adapted from Mongillo (1984).

The last seven fates represent fish that were removed from the study due to factors other than hook-and-release mortality.

Dispositions of tagged fish that survived more than 5 days or the ultimate-fates of the fish were as above with the exception of the first category (survivor), which becomes:

1. spawner: fish that held at destinations above the intertidal reach and transmitted signals in either normal or active modes.

The 5-day fates defined in this experiment fall into three groupings. Within the first 5 days the radio-tagged fish either survived, suffered hook-and-release mortality, or were removed from the experiment by a fishery or other unknown causes. Chinook salmon removed from the experiment within the first 5 days by some means other than hook-and-release mortality were classified as censored fish.

Ultimate fates were assigned to the salmon at the end of the season, and included spawners, hook-and-release mortalities or mortalities classified after 5 days, fish harvested in one of the fisheries, and those whose signal was lost, i.e. drop-outs, uplost fish.

Mortalities:

The most difficult process in the determination of fate was that of estimating whether a fish had suffered hook-and-release mortality within 5 days of release. During the course of the study in 1989, it became apparent that the tag signals were not providing unambiguous evidence of this mortality. Therefore, we developed the following series of decision rules to allocate fates to the radio-tagged fish:

1. fish that are taken in the recreational or other fisheries are allocated to the appropriate fate;

2. if a carcass is recovered within 5 days, the fish is allocated to hook-and-release mortality;

3. if a fish consistently moves upstream at any time during and after the first 5 days, it is considered a survivor (irrespective of signal mode);

4. if a fish remains immobile, transmits a mortality signal within 5 days, and continues to transmit in the mortality mode thereafter, then the fish is allocated to hook-and-release mortality (irrespective of river mile location);

5. if a fish remains immobile within or below the tagging area (below rkm 19.3) within 5 days from release and during the remainder of the experiment, the fish is considered a hook-and-release mortality (irrespective of signal mode);

6. if a tag is not relocated after the fish has been sited below the lower DCC (rkm 10.5), the fish is a drop-out;

7. if the tag is not relocated after several days of upstream movement, the fish is up-lost; and

8. if the tag is never relocated, the fate is unknown.

The first three rules were considered unambiguous. Relocation of a tag further and further upstream was considered proof of active movement. If a tag was collected from a fishery the fate was clearly defined. A carcass observed within 5 days of release was clearly categorized as a hook-and-release mortality, but in most cases where mortality was assigned we found that the fish were categorized according to the fourth and fifth rules.

These rules (numbers 4 and 5) were necessary as the radio-tag mortality signals did not provide a clear indication of mortality. A tag could be transmitting mortality signals even while the fish was consistently relocated further and further upstream. A fish could transmit several days of mortality signals while remaining immobile, then suddenly move upstream with a normal signal. A stationary fish would transmit a mixture of mortality and normal signals. Therefore, the assumptions that were made in rules 4 and 5 were:

1. fish that disappear from the Kenai River are alive, a dead fish cannot float out to sea;

2. there is no spawning below rkm 19.3 and fish observed to be stationary, or slowly moving downstream, in this area are dead irrespective of signal; and

3. fish that were observed to be immobile above rkm 19.3 and had normal signals were considered survivors (in potential spawning areas).

Thus, location became crucial in our decision process. The most important assumption is that there is little spawning below rkm 19.3 (Burger et al. 1983) and a fish that does not migrate upstream of this point is assumed to be a mortality. Signal mode was of secondary importance for a fish relocated in this river reach. Above river rkm 19.3, spawning could occur and a stationary fish could be on its spawning grounds. In this case, signal mode becomes the primary decision tool and only a consistent mortality signal will result in the fish being categorized as a dead fish.

Since this process leaves room for doubt, we divided the hook-and-release mortalities into "best-case" and "worst-case" categories. Only those fish defined as mortalities by rule 2 were considered "best-case" mortalities since we were certain of the fates for these fish, while those classified using rules 4 and 5 were "worst-case" mortalities.

In several cases, 5-day fates were not established until the end of the experiment. This was due to the stop-and-go behavior of many fish in the experiment.

Data Analysis

The assumption that censorship, i.e. removal from the experiment by factors other than hook-and-release mortality, is independent of biological and

fishery variables was tested. The size distributions of tagged fish removed by the sport, tag, and set net fisheries were compared to the distribution of the total released sample using the non-parametric Kolmogorov-Smirnov statistic (Conover 1980). The hypothesis of no association among the categorical fishery variables, biological variables, and fate were tested using chi-square statistics (Snedecor and Cochran 1967). The null hypotheses tested were:

1. there is no association between sex, length, and fate, where fate included the categories survivor, censored, or mortality;

2. there is no association between sex and length and the fishery variables;

3. there is no association between the fishery variables and fate; and,

4. there was no size selectivity in the various fisheries or censoring processes on the tagged population.

The first three null hypotheses were tested separately as sample sizes were not large enough to combine all of the categorical variables in one contingency table.

For this analysis, the day of release was defined as day 1 of the experiment and the date of release was assumed not to have an effect. In order to test the assumption that there was no change in censoring rates or mortality rates by actual date of release, a test of independence was carried out for fates by week of release. The null hypothesis that spawning destination does not differ by weekly interval of tagging was tested using chi-square contingency table analyses.

All statistical tests were conducted at the 90% ($\alpha = 0.10$) significance level unless otherwise noted.

Estimating Hook-and-Release Mortality:

The methods of survival analysis were used to estimate hook-and-release mortality (Cox and Oates 1984). For this analysis, we define hook-and-release mortality as a failure event and the time to that event the failure time. In this experiment, censored individuals are those removed by a fate other than hook-and-release mortality e.g. the sport fishery. All fish still surviving 5 days after release are automatically censored, or removed from the experiment. This method computes the percent dying on each day of the experiment from all fish available on that day. Fish available on any day are those available the previous day minus those dying and those censored the previous day.

The non-parametric Kaplan-Meier estimator was used to estimate the survivor function F(t), which is the probability of surviving to time t, and is estimated by (Cox and Oates 1984),

$$\hat{F}(t) = \sum_{j<t} (1-\hat{\lambda}_j) \qquad (1)$$

where $\hat{\lambda}_j$ is the hazard function or the probability of dying at time j, and is estimated by,

$$\hat{\lambda}_j = \frac{d_j}{r_j} \tag{2}$$

and,

d_j = number of individuals dying at time j,

r_j = number available or alive just before time j.

The number alive just before time j, r_j, includes those individuals censored at time j. The variance for the survivor function is estimated using Greenwood's formula (Cox and Oates 1984),

$$\text{var}(\hat{F}(t)) = \hat{F}(t)^2 \sum_{j<t} \frac{d_j}{r_j(r_j-d_j)}. \tag{3}$$

The Kaplan-Meier estimator can be stratified and an estimate of total mortality (M_t) due to hook-and-release was estimated as follows:

$$M_t = \sum_{i=1}^{s} n_i \, m_i \tag{4}$$

where,

n_i = number of fish released in stratum i, i=1,..s

m_i = estimate of total mortality in stratum i and

$$m_i = (1-\hat{F}_i) \tag{5}$$

where,

$\hat{F}_i$ = final estimate of survivor function, i.e. after 5 days.

The variance of M_t is estimated by,

$$V(M_t) = \sum_{i=1}^{s} n_i^2 \, V(m_i) \tag{6}$$

and the variance of the stratum mortality, $V(m_i)$, is equal to the variance of the survivor function, F_i.

A chi-square statistic computed using the log-rank method is used to test the hypothesis that the survivor functions do not differ among strata (Kalbfleisch and Prentice 1980).

Explanatory Variables:

The influence of explanatory variables on hook-and-release mortality can be estimated using Cox's proportional hazards regression model which is described by (Cox and Oates 1984),

$$\lambda(t,z) = w(z;b)\ \lambda_o(t) \tag{7}$$

where $\lambda_o(t)$ is a baseline hazard function, in this case the Kaplan-Meier function. The function $w(z;b)$ is a parametric shift function of the vector of covariates, z, and the parametric vector b. The shift function will adjust the baseline hazard function dependent on the effect of the covariates included in the model. Typically, $w(z;b)$ is an exponential function (Steinberg and Colla 1988) and the hazard at time t is described by,

$$\lambda(t,z) = \lambda_o(t)\ e^{(z;b)}. \tag{8}$$

The survivor function for this model is defined by,

$$F(t;z) = \exp[\ -\int_0^t \lambda_o(u)\ e^{(z;b)}\ du]. \tag{9}$$

In other words, any decrease (or increase) due to a covariate value will be constant or proportional. This assumption can be tested by an investigation of plots of the $\log(-\log(F(t;z)))$ for each covariate value. These curves should be parallel for the assumption of proportional hazards to be met (Kalbfleisch and Prentice 1980). If they are not parallel, that explanatory variable should be used to define strata rather than be included in the model as a covariate.

The survival analysis was carried out using the SURVIVAL module of SYSTAT (Steinberg and Colla 1988).

Comparison of Experiments:

Three hook-and-release experiments have been conducted; for the late run in 1989 and the early and late runs in 1990. A comparison of these three experiments was made using the Kaplan-Meier non-parametric model and the log-rank chi-square statistic (Kalbfleisch and Prentice 1980). The experiments were entered into the models as strata in order to test for significant differences among the experiments. The effect of fishery and biological variables was estimated for the combined experiments using Cox's proportional hazard model.

RESULTS

In 1990, two hook-and-release experiments were conducted: the first was during the early run, from 15 May to 30 June, and the second for the late run,

from 1 July-30 July. During the early run, 125 radio-tagged chinook salmon were tagged and released and during the late run 120 chinook salmon were tagged and released. The variables recorded for each tagged fish are presented in Appendix A1 and are summarized in Table 3. The number of fish tagged per day ranged from 0 to 20. All fish were caught between rkm 16 and 23.2 (rm 10 to 14.5) and released between rkm 14.5 and 23.2 (rm 9 to 14.5). Water temperature, recorded each fishing day, ranged from 5.6° C to 12.8° C and averaged 10.6° C.

During the early run, 125 radio-tagged fish ranged in length from 500-1,210 mm, averaging 918 mm (SE = 14 mm). Sixty-nine (69) males were tagged during the early run averaging 904 mm in length (SE = 23 mm) and 56 females averaging 936 mm (SE = 12 mm). During the late run, 120 tagged fish ranged from 405 mm to 1,200 mm averaging 774 mm (SE = 16 mm). Eighty-nine (89) males averaging 710 mm (SE = 16 mm) were tagged and 31 females averaging 957 mm (SE = 16 mm).

The length frequencies of radio-tagged fish differed between runs and sexes (Figure 5). During both the early and late runs, the length distribution of released females was unimodal and all females released but one were over 750 mm. The lengths for males released during both runs ranged from 500 to 1,200 mm, but during the early run, the length distribution was skewed to the left while during the late run it was skewed to the right (Figure 5). The length frequencies for males and females were significantly different for the early ($p = 0.08$) and the late run ($p = 0.001$). Males were significantly smaller than females for both runs.

Five-day and Ultimate Fates

During the early run there were 112 (89.6%) hook-and-release survivors of 125 released, 11 (8.8%) mortalities, and two fish were censored (1.6%). Within the first 5 days, one fish was harvested in the recreational fishery and one was taken in the tag net fishery (Table 4). Over the remainder of the experiment, 9 (7.2%) fish were harvested in the sport fishery, 2 (1.6%) fish were caught in the tag net fishery, and 4 (3.2%) additional fish were classified as mortalities due to unknown causes. In addition, two fish had dropped out of the river without returning and the radio signal was lost for two fish (Table 4). With 20 salmon removed and 11 suffering mortality, a total of 94 or 75% of the early-run release were estimated to have survived to spawn.

During the late run, there were 106 survivors (88.3%) of 120 released at the end of the 5-day experiment, 7 (5.8%) mortalities and 6 (5%) censored fish (Table 4). Within the first 5 days, 3 fish were taken in the recreational sport fishery, 1 in the tag net fishery, 1 in the set net fishery, and 1 chinook salmon had left the river without returning. Over the duration of the experiment, 71 (59.2%) fish survived to spawning. The number of mortalities did not change after 5 days, but other removals did increase substantially. Twenty-five (20.8%) fish were removed in the fisheries; 12 (10%) in the sport fishery, 7 (5.8%) in the tag net fishery, and 6 (5%) in the commercial set net fishery. In addition, 10 fish (8.3%) dropped out of the river and seven fish (5.8%) were considered "uplost", i.e. their signals were lost in the upper reaches of the river (Table 4).

Table 3. Summary values for selected biological and fishery variables, 1989-1990.

Variable	1989 Late-Run (n=101)	1990 Early-Run (n=125)	1990 Late-Run (n=120)	All (n=346)
SEX				
Male	57	69	89	215
Female	44	56	31	131
MEAN LENGTH (millimeters)				
Male	854	904	704	808
Female	1003	936	957	963
GUIDED ANGLER				
Yes	n/a	96	66	162
No	n/a	29	54	83
ANGLING METHOD				
Back Troll	8	125	26	159
Drift	93	0	91	184
Back Bounce	0	0	3	3
TERMINAL GEAR				
Bait	0	0	0	0
Artificial Lure	15	125	23	163
Bait/Lure Combo.	86	0	97	183
HOOK TYPE				
Single	95	122	106	323
Treble	6	3	14	23
NO. HOOKS				
One	1	119	9	129
Two	100	6	111	217
HOOK REMOVED				
Yes	97	112	112	321
No	3	13	8	24
BLEEDING				
Yes	11	26	15	52
No	90	99	105	294
SEA LICE				
Yes	79	93	101	273
No	22	32	19	73
CONDITION				
Vigorous	92	120	116	328
Lethargic	9	5	4	18
MEAN HANDLING TIME (minutes) = TIME PLAYED + TIME TAGGED				
All Samples	17	14.8	14.8	15.5

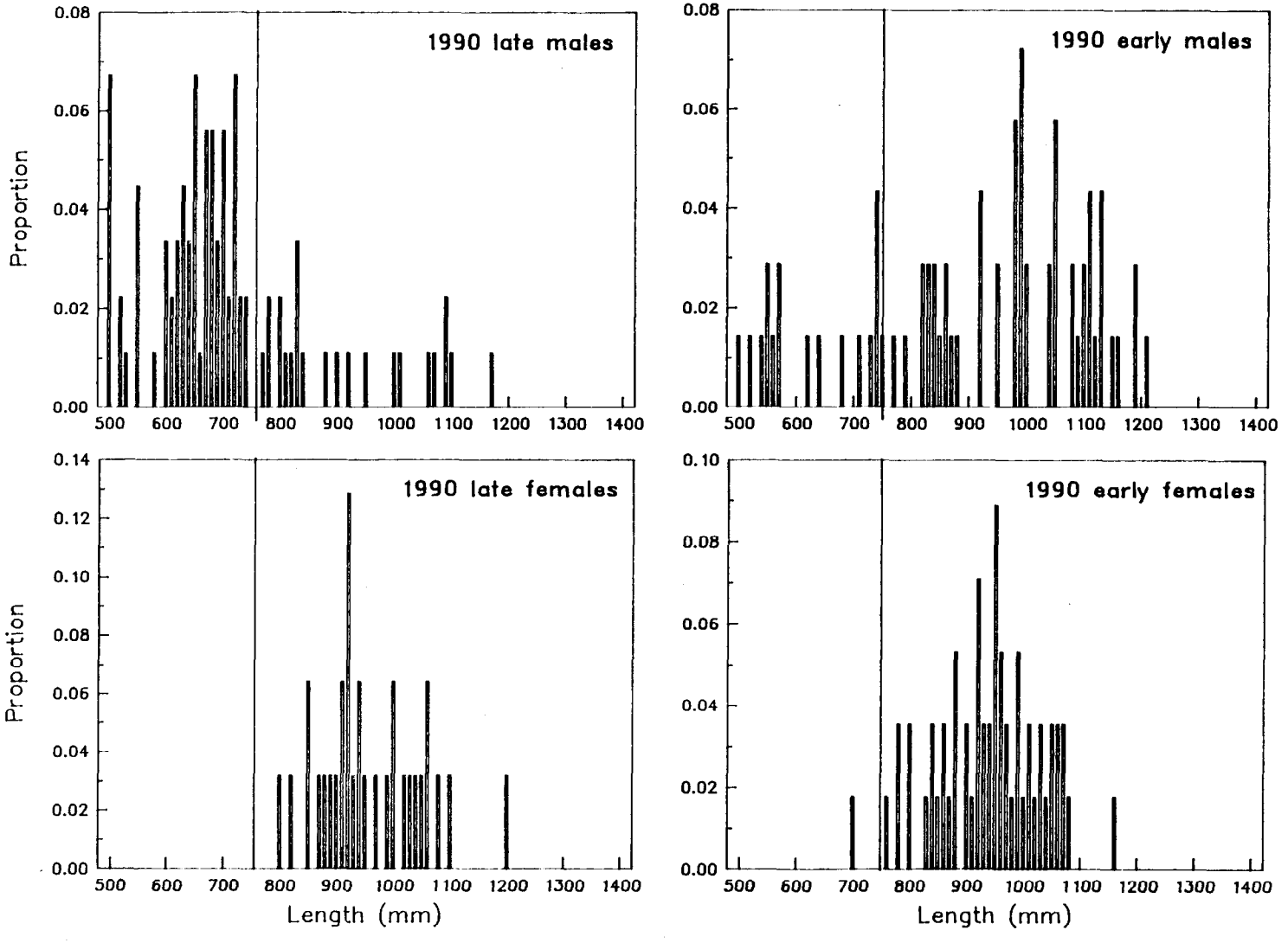

Figure 5. Length frequency for chinook salmon radio-tagged and released during 1990 Kenai River hook-and-release experiments.

Table 4. Distribution of fates by run and sex for Kenai River chinook salmon, 1990.

	Females		Males		Total	
	Number	Percent	Number	Percent	Number	Percent
Early Run						
Five-day Fates:						
Harvest	1.00	0.80	.	.	1.00	0.80
Mortality	6.00	4.80	5.00	4.00	11.00	8.80
Survivors	49.00	39.20	63.00	50.40	112.00	89.60
Tag net	.	.	1.00	0.80	1.00	0.80
Total	56.00	44.80	69.00	55.20	125.00	100.00
Ultimate Fates:						
Dropouts	1.00	0.80	2.00	1.60	3.00	2.40
Harvest	6.00	4.80	3.00	2.40	9.00	7.20
Mortality	9.00	7.20	6.00	4.80	15.00	12.00
Spawner	39.00	31.20	55.00	44.00	94.00	75.20
Tag net	.	.	2.00	1.60	2.00	1.60
Uplost	1.00	0.80	1.00	0.80	2.00	1.60
Total	56.00	44.80	69.00	55.20	125.00	100.00
Late Run						
Five-day Fates						
Dropout	.	.	2.00	1.67	2.00	1.67
Harvest	1.00	0.83	2.00	1.67	3.00	2.50
Mortality	1.00	0.83	6.00	5.00	7.00	5.83
Survivor	28.00	23.33	78.00	65.00	106.00	88.33
Set net	.	.	1.00	0.83	1.00	0.83
Tag net	.	.	1.00	0.83	1.00	0.83
Total	30.00	25.00	90.00	75.00	120.00	100.00
Ultimate Fates:						
Dropout	1.00	0.83	9.00	7.50	10.00	8.33
Harvest	3.00	2.50	9.00	7.50	12.00	10.00
Mortality	1.00	0.83	6.00	5.00	7.00	5.83
Set net	.	.	6.00	5.00	6.00	5.00
Spawner	22.00	18.33	49.00	40.83	71.00	59.17
Tag net	1.00	0.83	6.00	5.00	7.00	5.83
Uplost	2.00	1.67	5.00	4.17	7.00	5.83
Total	30.00	25.00	90.00	75.00	120.00	100.00

Associations Between Fate and Biological Characteristics

Chi-square statistics were used to test the null hypothesis of independence between size and sex groups and fates. Three groups were defined, small males, large males, and females. The sample for males was divided into two groups, smaller and larger than 750 mm, based on length frequencies for the 1989 (Bendock and Alexandersdottir 1990) and 1990 experiments (Figure 5).

Early Run:

A total of 125 chinook salmon were tagged and released; 69 were males and 55 females (Table 5). Virtually all of the females fell into the larger than 750 mm length group. Of the 11 mortalities, 7 were females (12.7% of 55) and 5 were males (7.3% of 69). Of the five males, three or 17.6% were smaller than 750 mm. No significant differences were found among the three size-sex groups in the distribution of fates, either for 5-day ($\chi^2 = 3.5$, df = 4, p = 0.32) or ultimate fates ($\chi^2 = 6.95$, df = 4, p = 0.138). Censoring rates were low within the first 5 days after release, only two fish (1.6%) were removed from the experiment. Over the duration of the experiment, a total of 20 (16%) were removed.

Comparisons of the length frequencies of salmon that were censored, or removed from the experiment during the first 5 days, and of salmon that were classified as mortalities to all salmon released during the early run, were not significant. Significant differences were found in some cases for the ultimate fates (Figure 6). Female chinook salmon that were removed from the radio-tagged population before spawning either as mortalities (D = 0.45, p = 0.09) or due to other causes (D = 0.46, p = 0.10) were significantly larger than the total release of females in the early run.

Late Run:

A total of 120 late-run chinook salmon were tagged and released including 30 females and 90 males. Only one (3.3%) female and no large males died within 5 days after release, compared to six (9.2%) small males. Male chinook salmon accounted for the bulk of the fish removed from the experiment, from hook-and-release mortality and from other causes. Of a total of 90 males tagged and released, 6 died and 35 were otherwise removed, leaving only 49 or 54% surviving to spawn (Table 5). In comparison, of a total 30 females released, 1 suffered hook-and-release mortality, 7 were otherwise removed, and 22 or 73% survived to spawn (Table 5). However, chi-square tests comparing the distribution across fates for the three size-sex groups were not significant for the late run either for the 5-day ($\chi^2 = 3.8$, df = 4, p = 0.43) or ultimate fate ($\chi^2 = 6.2$, df = 4, p = 0.19).

None of the comparisons of the length distributions of censored fish or hook-and-release mortalities to the total release gave significant results for the late run.

Associations Between Size, Sex, and Fishery Variables

The distribution of fishery variables was found to be independent of the size and sex groups for most variables. The length of time handled was significant

Table 5. Distribution of fates by size and sex class for Kenai River chinook salmon, 1990.

	Five-day Survivors		Spawners[a]		Mortalities		Censored	
	No.	Percent	No.	Percent	No.	Percent	No.	Percent
Early run:								
Small Males[b]	14	82.3	12	70.0	3	17.6	0	0
Large Males	49	94.2	43	83.0	2	3.8	1	1.9
Females	49	87.5	39	70.0	6	10.7	1	1.8
Total	112	89.6	94	75.2	11	8.8	2	1.6
Late run:								
Small Males	55	84.6	34	52.0	6	9.2	4	6.1
Large Males	23	92.0	15	60.0	0	0	2	8.0
Females	28	93.3	22	73.0	1	3.3	1	3.3
Total	106	88.3	71	59.2	7	5.8	7	5.8

[a] Number of 5-day survivors that ultimately spawned.

[b] Small males < 750 mm.

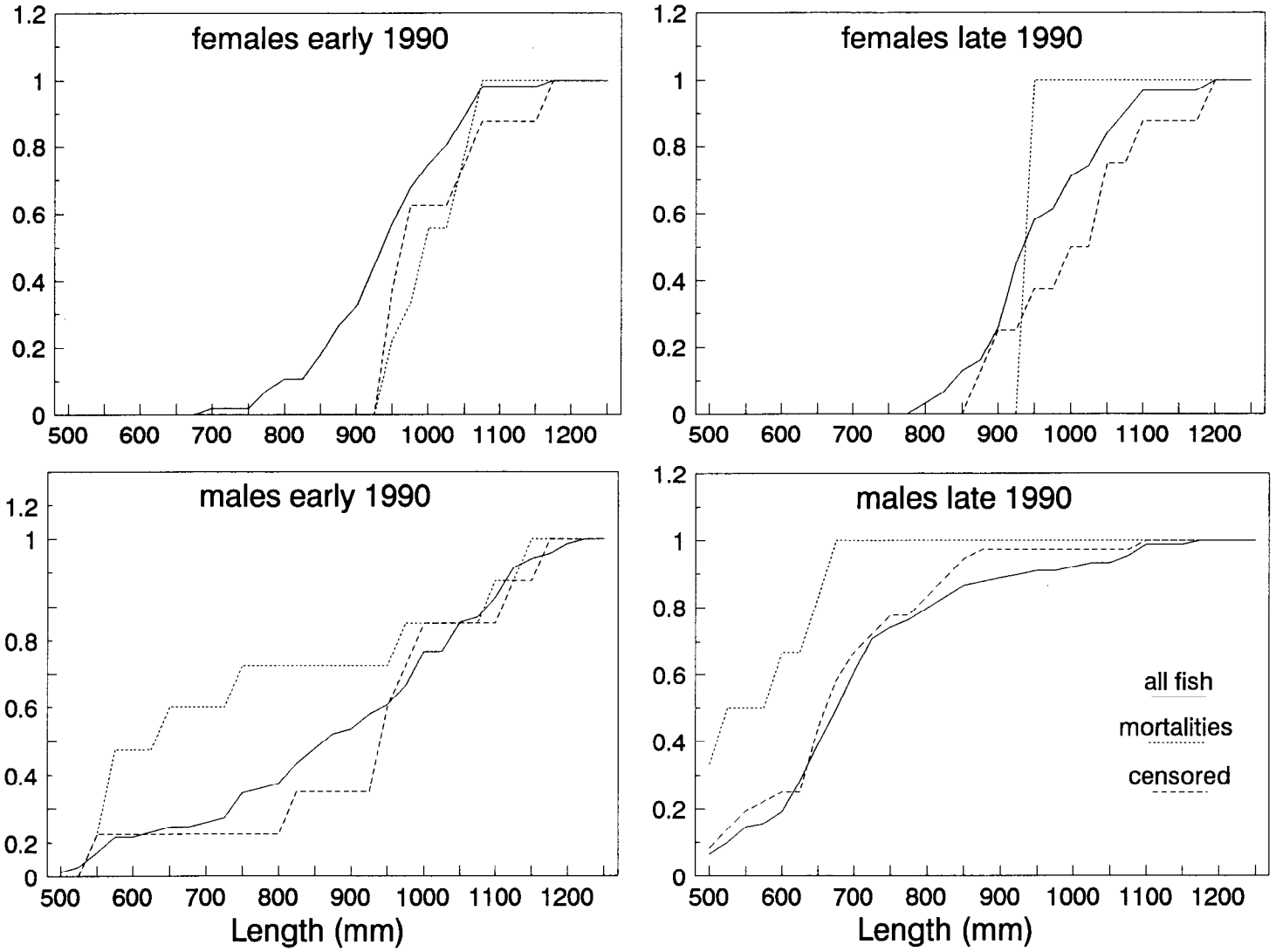

Figure 6. Cumulative length distributions for chinook salmon release, mortalities and censored in 1990 hook-and-release experiments.

for both the early (χ^2 = 6.45, df = 2, p = 0.04) and late runs (χ^2 = 30.1, df = 2, p = 0.001). Fewer small males than would be expected under the hypothesis of independence required over 10 minutes to play and tag (Table 6). The percent of fish tagged and released by week differed between sexes for the early (χ^2 = 30.1, df = 2, p = 0.001) and the late (χ^2 = 30.9, df = 2, p = 0.001) runs. Over the 6 weeks of the early run, 66% of the females were tagged and released in the first 4 weeks compared to 50% of the males (Table 6). The experiment for the late run lasted for 4 weeks, during which 69% of the small males and 50% of the large males were released in the first half, but only 17% of the females (Table 6).

Associations Between Fishery Variables and Fate

The hypothesis that there was no association between the fate of the tagged chinook salmon and the fishery variables was tested using a series of chi-square tests. Sample sizes were not large enough in either experiment to test for interactions between fishery variables and fates.

Early Run:

The tests resulted in rejection of the null hypothesis for hooking location (χ^2 = 24.9, df = 6, p < 0.001), condition at release (χ^2 = 17.0, df = 2, p < 0.001), and whether or not the hook was removed (χ^2 = 8.87, df = 2, p < 0.01). Four fish were gilled and three or 75% of these died, while overall 11 or 9% died (Table 7). Five fish were lethargic at release and three of these or 60% died compared to 7% of the fish classified as vigorous at release (Table 7). The hook was not removed from 13 fish and 4 or 31% of these died compared to the overall mortality rate of 9% (Table 7). No changes in the distribution of the fishery variables occurred over the remainder of the experiment.

Late Run:

Results from tests in the late run differed from early-run results. Hook location was significantly associated with fate (χ^2 = 18.9, df = 6, p = 0.09), but only one fish was gilled and died, and it had the largest contribution to the chi-square statistic. Condition at release was also significant (χ^2 = 5.9, df = 2, p = 0.05), but only four fish were lethargic at release of which one died. The small sample sizes make it difficult to interpret these results, but they do follow the same trend as for the early run in 1990. Whether or not fish were bleeding was found to be significantly associated with fate for late-run fish (χ^2 = 14.2, df = 2, p = 0.001), 15 fish were bleeding at release and of these, four or 25% died compared to the overall mortality rate of 6%.

Survival Analysis

The estimated survival of hooked-and-released chinook salmon 5 days after release was 91.2% (n = 125, SE = 2.5%) for the early run and 94.1% (n = 120, SE = 2.2%) for the late run (Figure 7, Table 8). In 1990, few fish were removed from the experiment within the first 5 days after release, except as hook-and-release mortalities. During the early run, two fish were censored compared to four fish during the late run (Table 8). Most of the mortalities

Table 6. Distribution by run and sex of fishery variables significantly associated with size and sex for Kenai River chinook salmon, 1990.

Handling Time:

	Early Run		Late Run	
	< 10 min	> 10 min	< 10 min	> 10 min
Small males	13 (76%)	4 (24%)	62 (95%)	3 (5%)
Large males	25 (48%)	27 (52%)	12 (48%)	13 (52%)
Females	38 (68%)	18 (32%)	17 (57%)	13 (43%)
Total	76 (61%)	49 (39%)	91 (76%)	29 (24%)

Week Released:

	Early Run		Late Run	
	Weeks 1-4	Weeks 5-6	Weeks 1-2	Weeks 3-4
Small males	10 (59%)	7 (41%)	45 (69%)	20 (31%)
Large males	26 (50%)	26 (50%)	12 (48%)	13 (52%)
Females	37 (66%)	19 (34%)	5 (17%)	25 (83%)
Total	73 (57%)	55 (43%)	62 (52%)	58 (48%)

Table 7. Distribution across 5-day fates of fishery variables significantly associated with fate for Kenai River chinook salmon, 1990.

	Censored	Mortalities	Survivors	Total
Early Run				
Hook Location:				
Gilled	0 (0%)	3 (75%)	1 (25%)	4
Not gilled	2 (2%)	8 (7%)	111 (92%)	121
Total	2 (2%)	11 (9%)	112 (90%)	121
Condition at Release:				
Lethargic	0 (0%)	3 (60%)	2 (40%)	5
Vigorous	2 (2%)	8 (7%)	110 (92%)	120
Total	2 (2%)	11 (9%)	112 (90%)	121
Hook Removed:				
No	0 (0%)	4 (31%)	9 (69%)	13
Yes	2 (2%)	7 (6%)	103 (92%)	112
Total	2 (2%)	11 (9%)	112 (90%)	121
Late Run				
Hook Location:				
Gilled	0 (0%)	1(100%)	0 (0%)	1
Not gilled	7 (6%)	6 (5%)	106 (89%)	119
Total	7 (6%)	7 (6%)	106 (88%)	120
Condition at Release:				
Lethargic	1 (25%)	1 (25%)	2 (50%)	4
Vigorous	6 (5%)	6 (5%)	104 (90%)	116
Total	7 (6%)	7 (6%)	106 (88%)	120
Bleeding:				
No	7 (7%)	3 (3%)	95 (90%)	105
Yes	0 (0%)	4 (27%)	11 (73%)	15
Total	7 (6%)	7 (6%)	106 (88%)	120

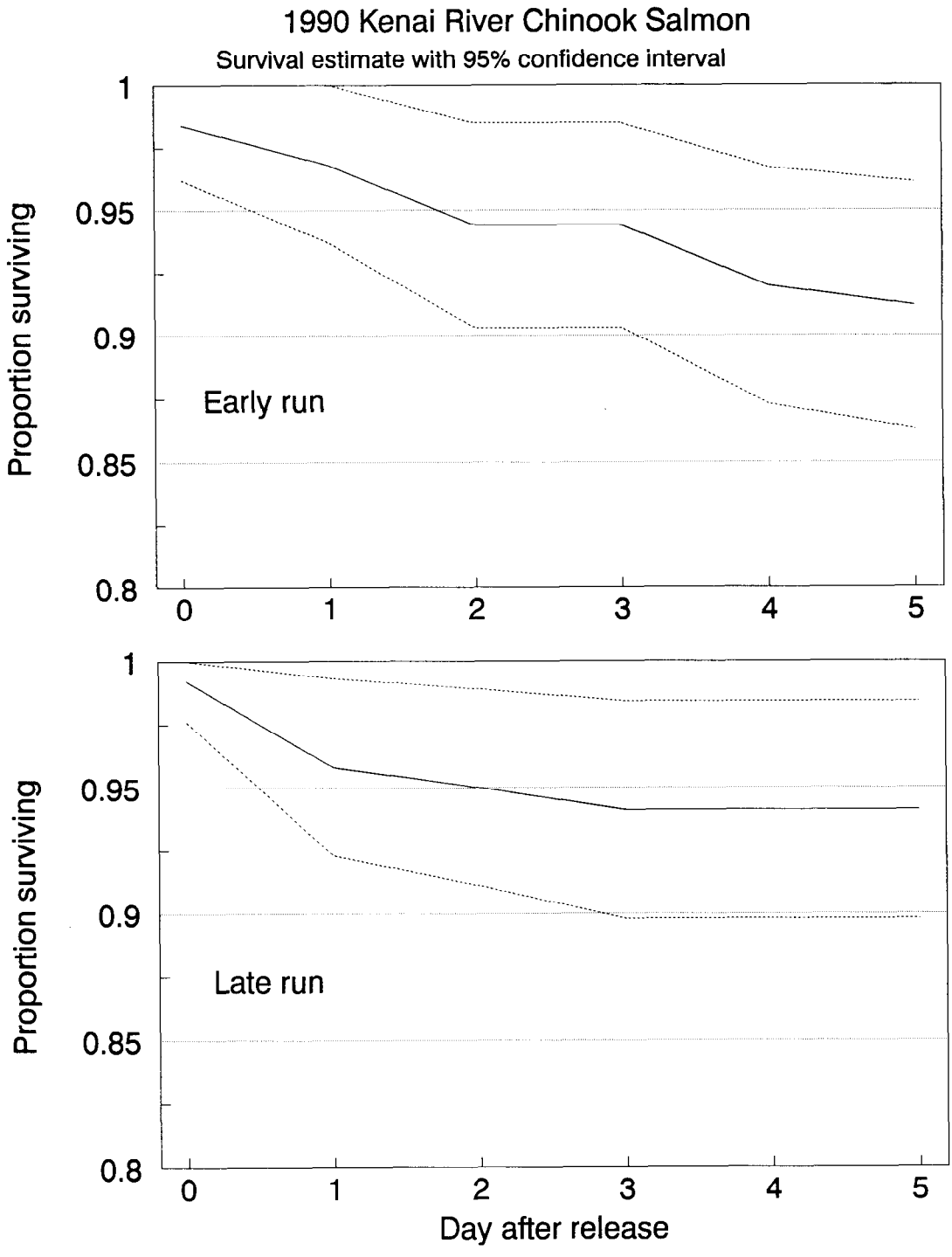

Figure 7. Daily estimate of probability of surviving for chinook salmon during early and late runs in Kenai River 1990.

Table 8. Number released, dying and censored chinook salmon and estimated survival in hook-and-release mortality study in Kenai River, 1990.

Time After Release (j)	Number At Risk (r_j)	Number Dying (d_j)	Number Censored	Estimated Probability Of surviving (F(t))	Standard Error
Early Run					
0	125	2	0	0.984	0.011
1	123	2	0	0.968	0.016
2	121	3	1	0.944	0.021
3	117	0	0	0.944	0.021
4	117	3	1	0.920	0.024
5	113	1		0.912	0.025
Total		11	2		
Late Run					
0	120	1	1	0.992	0.008
1	118	4	1	0.958	0.018
2	113	1	2	0.950	0.020
3	110	1	0	0.941	0.022
4	109	0	0	0.941	0.022
5	109	0		0.941	0.022
Total		7	4		

had occurred within 3 days, including all 7 of the early-run hook-and-release mortalities and 7 of the 11 late-run mortalities (Table 8).

During the early run (Table 9), estimated percent survival for small males was 82.4%, 96.1% for large males, and 89.3% for females. During the late run, survival for small males was estimated at 90.9%, 96.7% for females, and 100% for large males (Table 9). Comparisons of the survival among the three size-sex groups were not significant either for the early ($\chi^2 = 3.44$, df = 2, p = 0.179) or the late ($\chi^2 = 3.0$, df = 2, $p > 0.2$) runs. Therefore, the overall estimates of survival for the two experiments were 91.2% (95% CI: 86.3%-91.2%) for the early run and 94.1% (95% CI: 89.8%-98.4%) for the late run. A log-rank test comparing the early and late runs in 1990 was not significant ($\chi^2 = 0.38$, df = 1, p = 0.54) and the overall estimate of survival for the combined data is 93% (95% CI: 89.9%-96.1%).

Explanatory Variables:

Cox's proportional hazard model was used to investigate the effect of the fishery variables on survival. Hook location was a significant explanatory variable for the early run (Table 10), due to the highly lethal effect of gilling. The expected survival of a gilled fish was estimated at 74.9% compared to 94.1% for a salmon not hooked in the gills. During the late run, of the 120 chinook salmon released, only one fish had been hooked in the gills, and hooking location was not a significant effect for this experiment. But in fact, during the late and early run, all but one fish that were gilled were classified as mortalities.

Bleeding was found to be a significant factor for the late run in 1990 (Table 10). A fish which was bleeding at release was estimated to have a 75.2% chance of surviving compared to 97.1% for a fish that was not bleeding. This factor was not significant for the early-run experiment. All fish that were gilled in 1990, however, were also bleeding, and an interaction effect might be expected. However, sample sizes were too small to test for interaction among the various factors.

Comparison of Experiments 1989-1990

The hook-and-release project has included three experiments to this time, 2 in 1990 and 1 in 1989 (Bendock and Alexandersdottir 1990). In 1989, an estimated survival of 89.4% for released chinook salmon is similar to 91.2% and 94.1% for the early and late runs, respectively, in 1990 (Figure 8, Table 11). The stratified Kaplan-Meier estimates of survival for these three experiments were not significantly different ($\chi^2 = 1.3$, df = 2, p = 0.52). However, censoring patterns were significantly different in 1989 between males and females (Bendock and Alexandersdottir 1990) as females were removed at a faster rate than males in the recreational fishery within 5 days of release; and the rate of censoring was significantly higher in 1989 compared to 1990 ($\chi^2 = 1.3$, df = 2, p = 0.52). Therefore, the three experiments were separated as strata for analysis of the combined data.

Cox's proportional hazard model was applied to the combined data with experiment as strata. The proportional hazards model assumes that the ratio of the hazard functions remains constant for covariates, i.e. that the proportional

Table 9. Estimates of probability of survival by size and sex strata for Kenai River chinook salmon, 1990.

Stratum	n	Estimated Probability Of Survival	Standard Error
Early Run			
Small Males	17	0.824	0.092
Large Males	50	0.961	0.027
Females	56	0.893	0.038
Ho: There is no difference in survival among sex-size groups for early run 1990.			
$v^2 = 3.44$ df = 2 p = 0.179[a]			
Late Run			
Small Males	66	0.909	0.036
Large Males	23	1.000	0.000
Females	31	0.967	0.033
Ho: There is no difference in survival among sex-size groups for late run 1990.			
$v^2 = 3.00$ df = 2 p = 0.223[a]			
Combined Size and Sex Groups			
Early Run	120	0.912	0.025
Late Run	125	0.941	0.022
Ho: There is no difference in survival between the early and late runs 1990.			
$v^2 = 0.38$ df = 1 p = 0.540[a]			
1990 Combined	245	0.930	0.016

[a] Null hypothesis rejected at $p < 0.10$.

Table 10. Results of Cox's proportional hazard analysis for early and late Kenai River chinook salmon, 1990.

	Early Run	Late Run
Explanatory variable entering model as covariate.	Hooking location[a]	Bleeding[b]
Coefficient estimate	1.554	-2.270
Standard error	0.347	0.764
p-value	<0.001	<0.001
Expected survival		
Covariate = 1	0.749	0.752
Number observed	4	15
Covariate = 2	0.941	0.971
Number observed	121	95
KM survival[c]	0.912	0.941

[a] Covariate = 1 hooked in gills;
Covariate = 2 not hooked in gills.

[b] Covariate = 1 fish bleeding;
Covariate = 2 fish not bleeding.

[c] Survival estimated using Kaplan-Meier method.

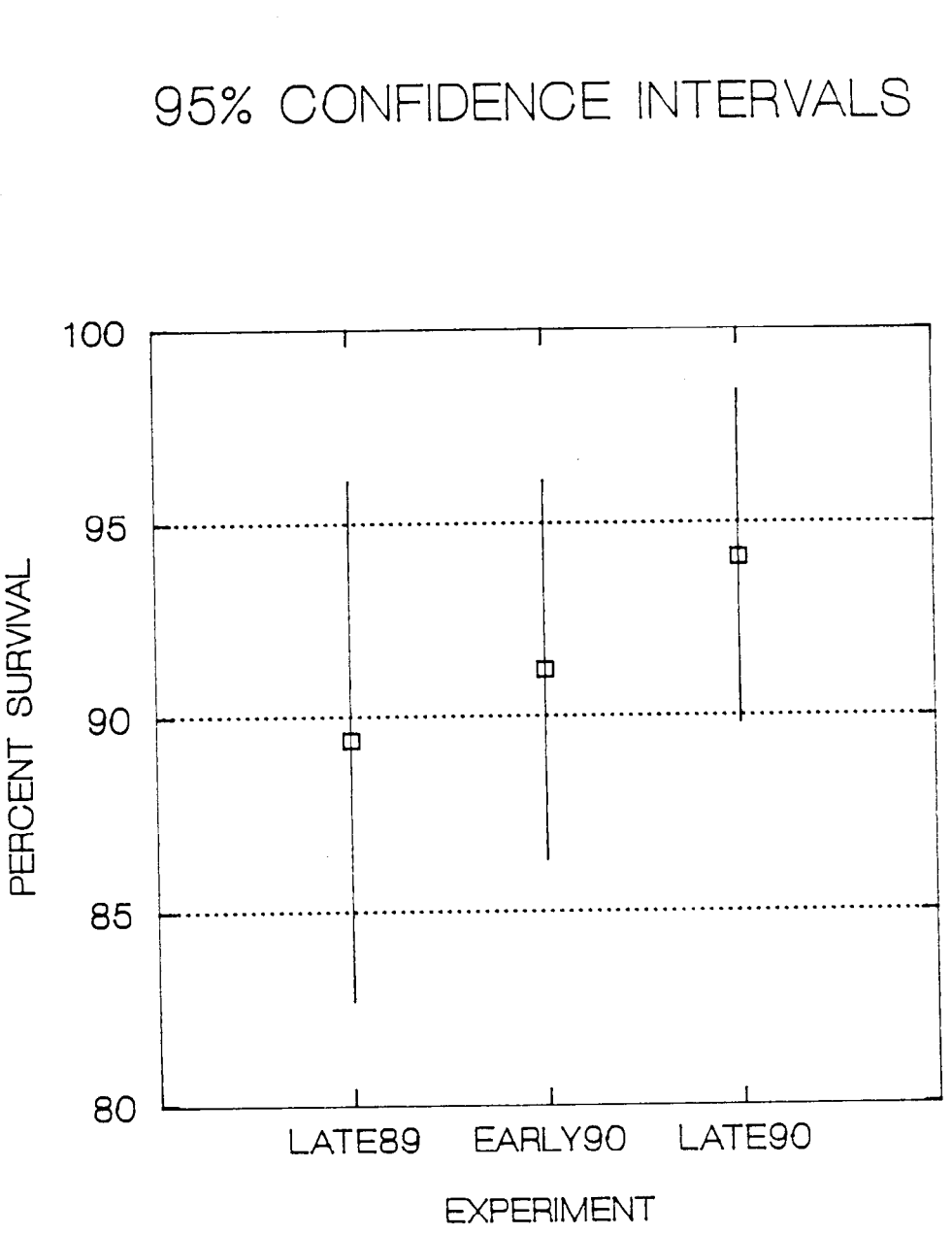

Figure 8. Estimate of survival with 95% confidence intervals for hook-and-release experiments for Kenai River chinook salmon in 1989 and 1990.

Table 11. Estimates of probability of survival for 1989 and 1990 Kenai River chinook salmon using Cox's proportional hazard model.[a]

	Late 1989	Early 1990	Late 1990
KM - survival[b]	0.894	0.912	0.941
Standard error	0.034	0.025	0.022
Model estimates:			
Fish gilled	0.734	0.749	0.782
Fish not gilled	0.936	0.940	0.949

[a] Model hazard rate: $\chi(t,z) = \chi_0(0)\ e^{zb}$ where b is the estimated coefficient for the covariate hooking location, and z is the value of the covariate.

[b] Estimate of survival from Kaplan-Meier estimator.

decrease or increase (depending on the value of the covariate) in survival is constant over the life of the experiment (Kalbfleisch and Prentice 1980). The plots of the log(-log(F(t;z))) where the three experiments were covariates (Figure 9) do not appear to be parallel, but cross in several places, further reinforcing the decision to maintain experiments as strata. While the estimates of survival across the three experiments were not functionally different, the rates at which tagged fish were censored by sex were functionally different across years. It is this reason that the proportional hazard model predicted stratification across experiments.

Explanatory Variables:

Hook location was found to be the only significant explanatory variable ($p < 0.001$) in the model with all data combined. Expected survival decreased to 73%-78% when a fish was gilled, compared to expected survivals ranging in the 90 percentages for fish that were not gilled (Table 11). Log-log plots were also made with hooking location as a covariate, and these did appear to be parallel, allowing hooking location to remain as a covariate in the final model.

Movement Behavior of Tagged Fish

Initial Direction of Movement:

Initially, chinook salmon moved both upstream and downstream after being tagged and released. A total of 228 fish were located within 48 hr of release. During this period, 46 fish (20%) were relocated within 0.8 km of their point of release, while 84 fish (37%) moved downstream and 98 fish (43%) moved upstream. Fish moving upstream traveled a mean distance of 4.8 km (3.0 mi) during the initial relocation period and downstream fish averaged 5.4 km (3.4 mi). The maximum distance traveled by a radio-tagged fish during this initial period was 21 and 19 km for downstream and upstream swimmers respectively.

The initial direction of movement upon release was independent of sex ($\chi^2 = 0.242$, df = 2, $p > 0.10$) and total handling time ($\chi^2 = 3.671$, df = 2, $p > 0.10$). The null hypothesis that initial direction of movement is independent of run timing was rejected ($\chi^2 = 13.732$, df = 2, $p < 0.005$). Forty-three percent of the early-run fish moved downstream initially while only 30% of the late-run fish moved downstream. A significantly higher proportion of tagged-and-released fish moved downstream initially during the first half of the early run ($\chi^2 = 6.048$, df = 2, $p < 0.05$); however, a temporal difference in direction of travel was not observed during the late run ($\chi^2 = 1.404$, df = 2, $p > 0.10$).

Returns to Cook Inlet:

A total of 34 fish returned to Cook Inlet after being tagged and released. The subsequent return of these fish to fresh water was dependant upon run timing with significantly more early-run fish returning than late run fish ($\chi^2 = 14.448$, df = 1, $p < 0.005$).

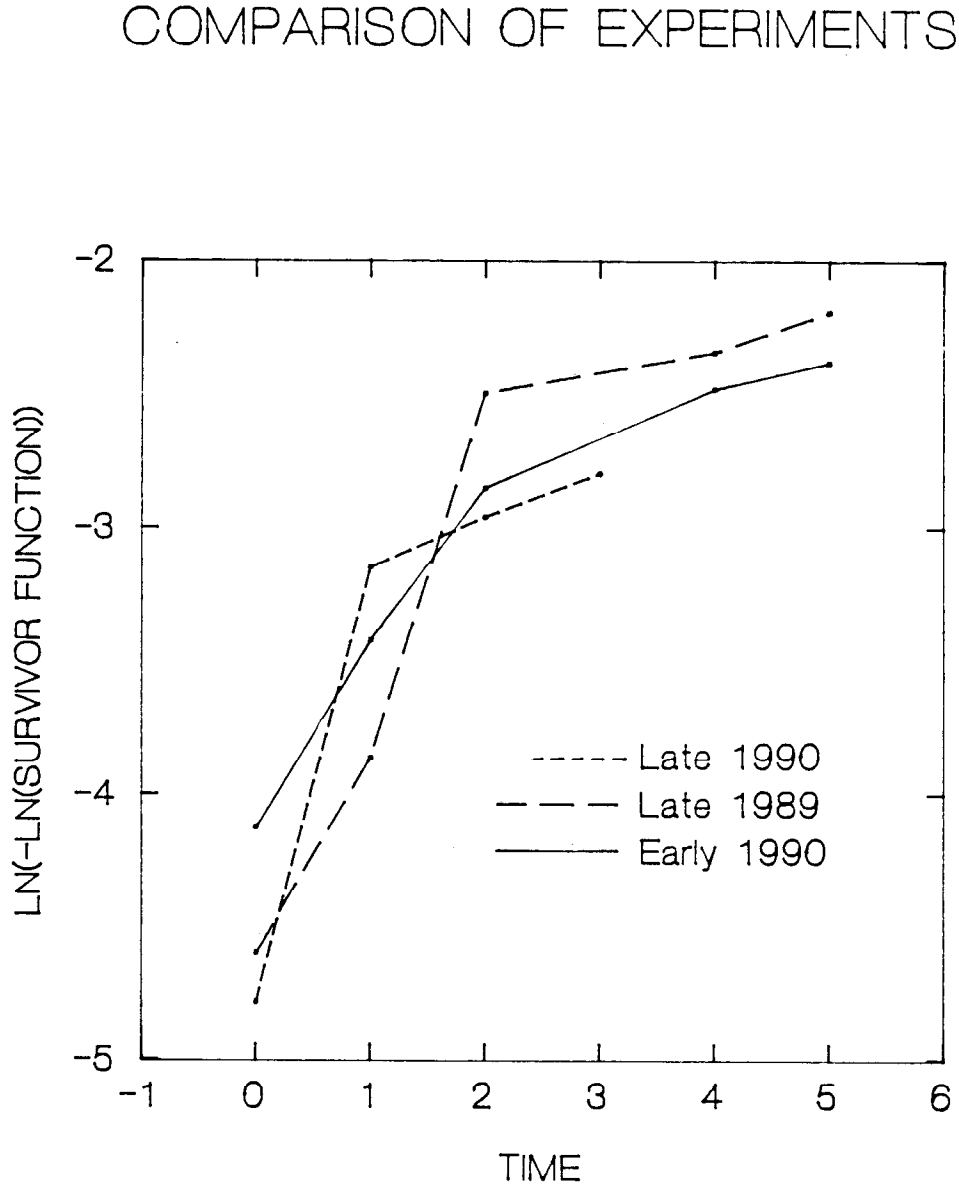

Figure 9. Plots of log(-log(Survivor function)) for three Kenai River hook-and-release experiments 1989 and 1990.

Eighteen (14%) of the early-run fish returned to Cook Inlet after remaining in the river from 1 to 28 days and penetrated upstream from 18 to 78 rkm. Fourteen (78%) of these fish returned to fresh water where 13 were later classified as spawners and one was caught in the tag net. The remaining three fish were not subsequently located (drop outs). Fish number 95 was located approximately 8 km up the Killey River (78 km above Cook Inlet) 28 days after tagging but was found dead 4 days later on a Cook Inlet beach 48 km south of the Kenai River mouth. A subsequent examination indicated that this fish (a female) did not spawn.

Sixteen (13%) late-run fish returned to salt water after remaining in the river from 1-37 days and penetrated from 16 to 35 km upstream. Only two (13%) of these returned to later spawn in fresh water. Seven (44%) were not subsequently located, 5 (31%) were harvested in the commercial set gill net fishery, and 2 (13%) were classified as spawners before re-entering salt water.

Movements Through the Lower River Sport Fishery:

The number of days from release until the first record at the upper DCC (rkm 30.6) was calculated for each tagged fish to describe movement rates through the lower river sport fishery. Data were available for 80 early-run and 33 late-run fish during the 1990 experiment. The mean upstream distance traveled for all tagged fish between the point of release and the DCC was 11.6 km. The duration of time required to travel this distance ranged from 0.9 days to 27.1 days with a median of 6.3 and an average of 8.1 days. Seventy-five percent of these fish transited the lower river within 11 days of release (Figure 10). The mean rate of movement for early-run fish (1.4 km/d) was lower than that for late-run fish (1.6 km/d). Movement of tagged fish past the upper DCC occurred predominantly during the second half of the day. Sixty-five percent of the tagged fish passed the upper DCC between 1200 and 2400 hours (Figure 11).

Management objectives for the chinook salmon fishery change on 1 July as late-run fish begin to enter the river. To escape the inriver recreational fishery, early-run chinook salmon must either enter tributary drainages or continue moving upstream beyond rkm 80 in the mainstem. Twenty-two percent of the radio-tagged early-run fish never exited the area open to sport fishing. On 2 July, 70% of the tagged early-run fish that were ultimately judged to be spawners remained available to harvest in the lower 80 km of mainstem and 33% were still vulnerable to harvest on 14 July. Thus, early-run salmon remain vulnerable to harvest throughout much of the late run.

Spawning Destinations

The date and river mile location of spawning for each fish was estimated using daily movement histories and radio signal modes. We assumed that spawning took place at the maximum upstream distance penetrated by each fish where holding behavior was noted and that completion of spawning coincided with the onset of consecutive radio signals in the mortality mode. A total of 165 fish (94 early run and 71 late run) were classified as spawners. Early-run spawners distributed primarily to tributary destinations, while late-run spawners remained in the mainstem ($\chi^2 = 80.041$, $df = 1$, $p < 0.001$) (Figure 12).

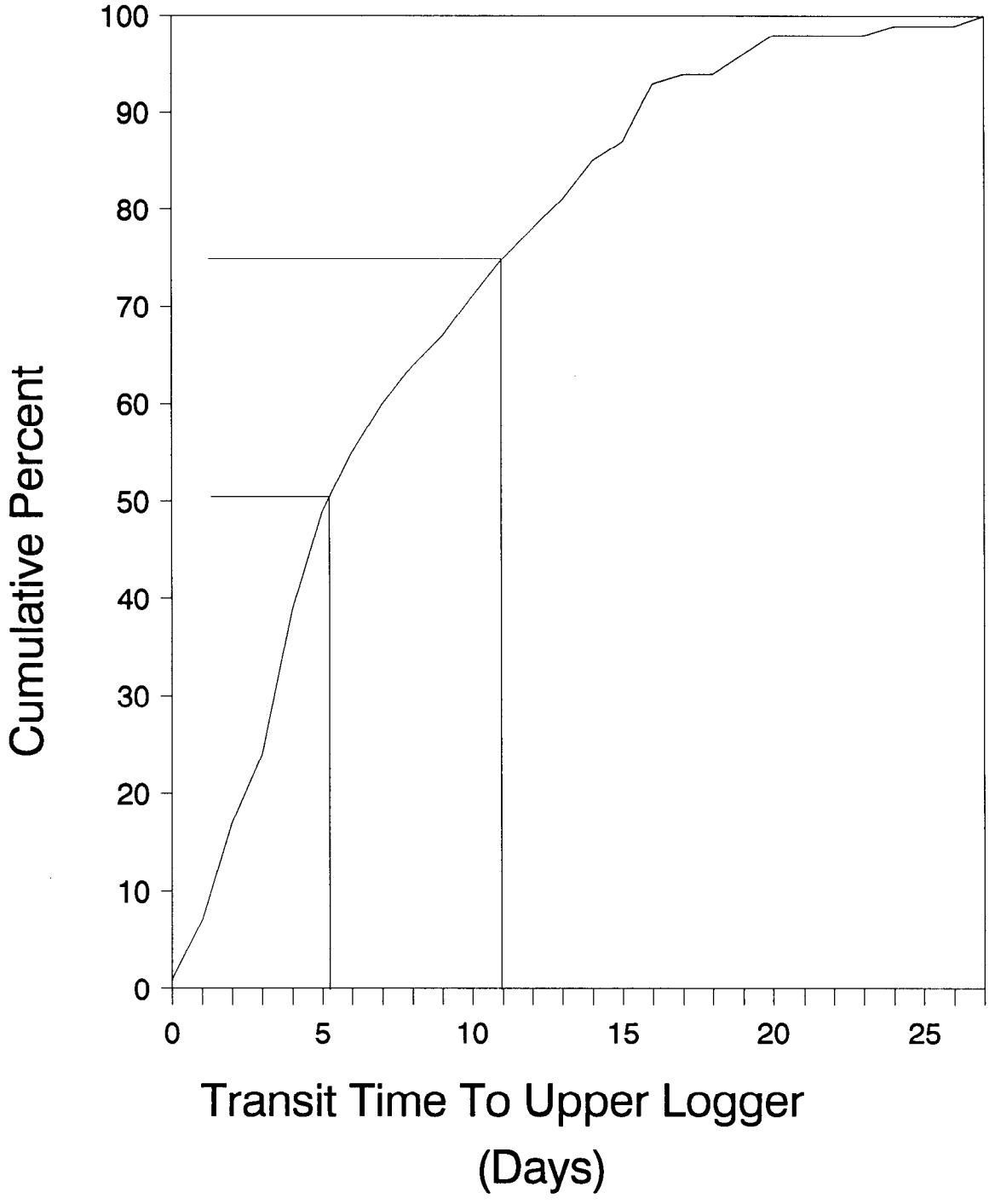

Figure 10. Duration of time for radio-tagged chinook salmon to exit the sport fishery from point of release to the upper Data Collection Computer located at river kilometer 30.6 (river mile 19).

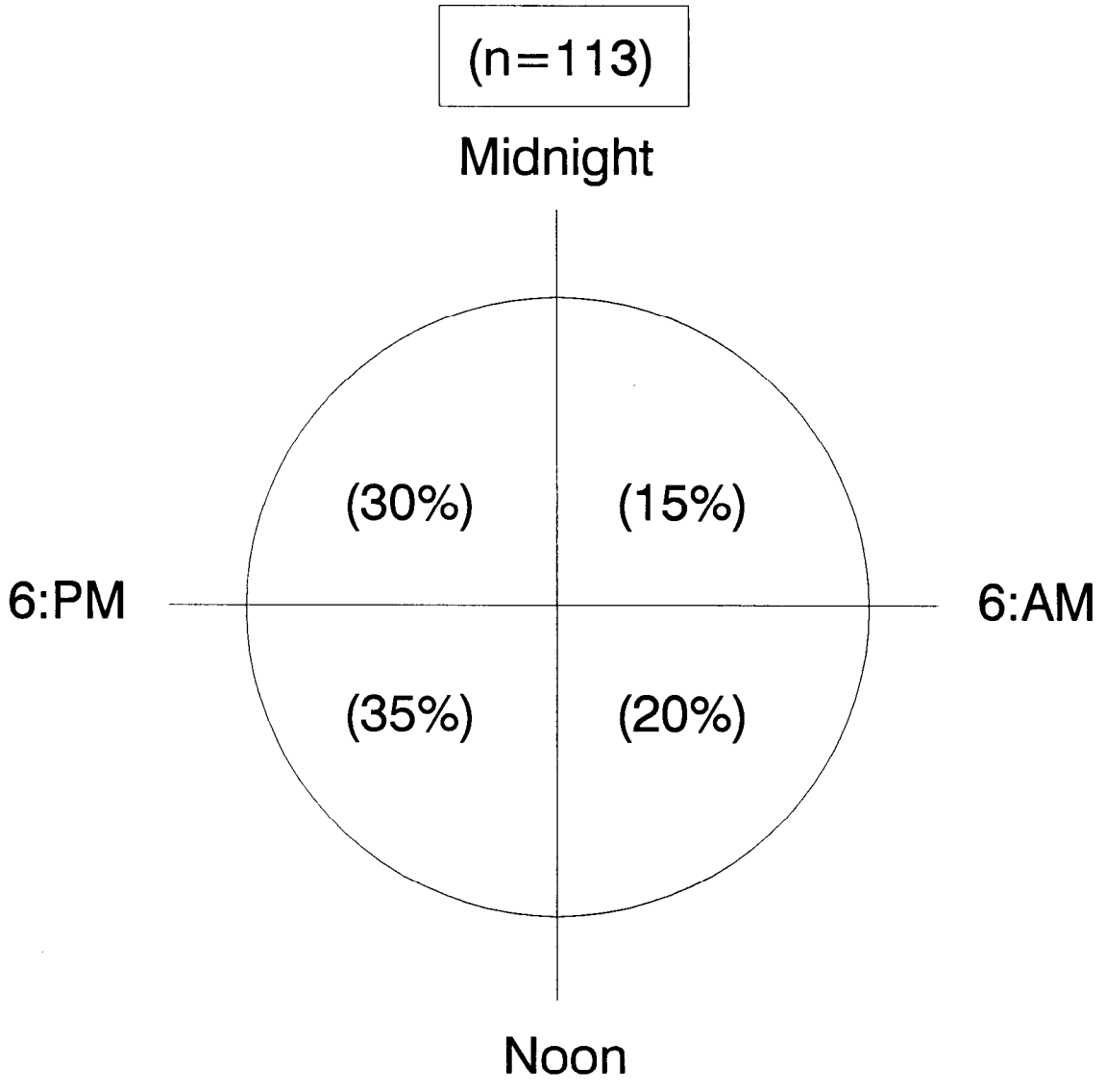

Figure 11. Proportions of radio-tagged chinook salmon moving during quarter-day intervals based on the times of initial contact at the upper Data Collection Computer.

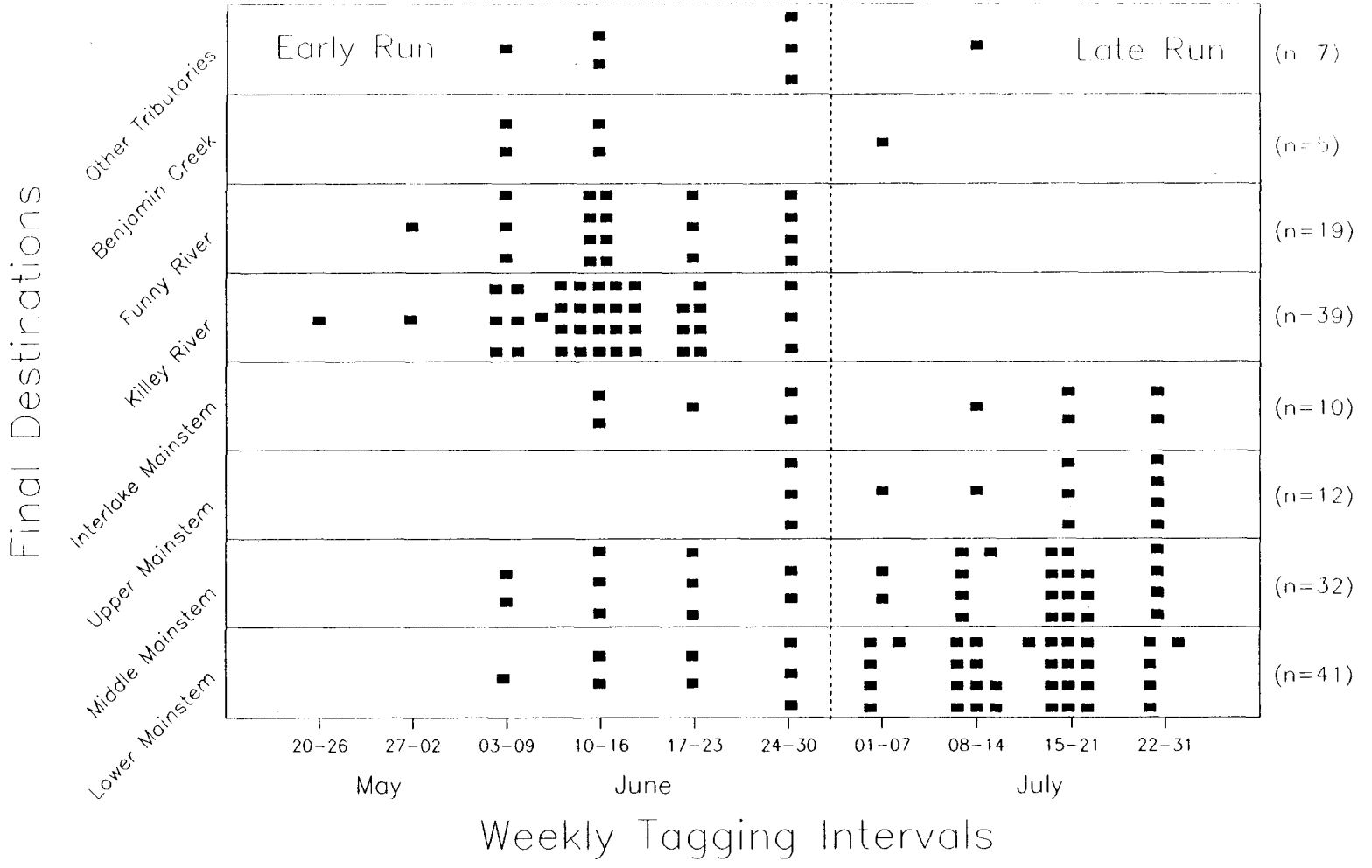

Figure 12. Final destinations of 165 spawning chinook salmon by weekly intervals of capture and release, 1990.

Early Run:

Early-run spawners distributed to both tributary (72%) and mainstem (28%) final destinations (Figure 13). Destinations were independent of weekly entry times for early-run fish (χ^2 = 12.932, df = 9, p > 0.10). The Killey (42%) and Funny rivers (20%) were the most extensively used tributary destinations, while the middle section (11%) was the most extensively used mainstem river reach. Completion of early-run spawning activity, evidenced by consecutive mortality signals or downstream movement from maximum upper locations, occurred from 23 June through 22 August with peak spawning in mid-July. Median spawning dates were 13, 18, and 19 July for Funny River, Killey River, and mainstem spawners, respectively.

Late Run:

Mainstem destinations were selected for spawning by 69 (97%) out of 71 tagged fish. The remaining two fish (3%) spawned in Benjamin and Juneau creeks. Thirty-three fish (46%) spawned in the lower mainstem river reach, followed by 22 (31%) in the middle reach, 9 (13%) in the upper reach, and 5 (7%) in the interlake reach (Figure 13). Distributions of spawners among the four mainstem river reach classifications were independent of weekly entry times (χ^2 = 12.932, df = 9, p < 0.10). Completion of late-run spawning activity, evidenced by consecutive mortality signals or downstream movement from maximum upper locations, occurred from 23 July through 10 September with a median spawning date of 15 August.

Stream Life of Tagged Fish:

The duration of time between tagging and death (stream life) was calculated for 165 fish that were judged to have spawned (Table 12). Mean stream life was 32 days (SE = 0.837) and ranged from 8 to 67 days. Stream life for tributary spawners (mean = 33.7 days, SE = 1.391) and mainstem spawners (mean = 30.3 days, SE = 1.076) was not significantly different.

Tagged fish that migrated to small tributaries spent a larger proportion of their stream life in the mainstem than fish utilizing the Funny and Killey rivers (χ^2 = 5.526, df = 2, 0.05 < p <0.010). Tagged fish utilizing small tributaries expended 79% of their stream life in the mainstem, while Killey and Funny River fish expended 54% and 55%, respectively.

DISCUSSION

Hook-and-Release Mortality

Hook-and-release mortality was found to be significantly smaller than the tolerance level of 20% established at the outset of this study. The hook-and-release mortality estimated in this study should be considered an overestimate, as the effect of additional handling during the tagging cannot be subtracted. For the three experiments, the survival after 5 days was estimated at 89.4%, 91.2%, and 94.1% for the late 1989 run, the early 1990, and the late 1990 runs. The 95% confidence intervals for these three estimates were well above the 80% tolerance level that we had established

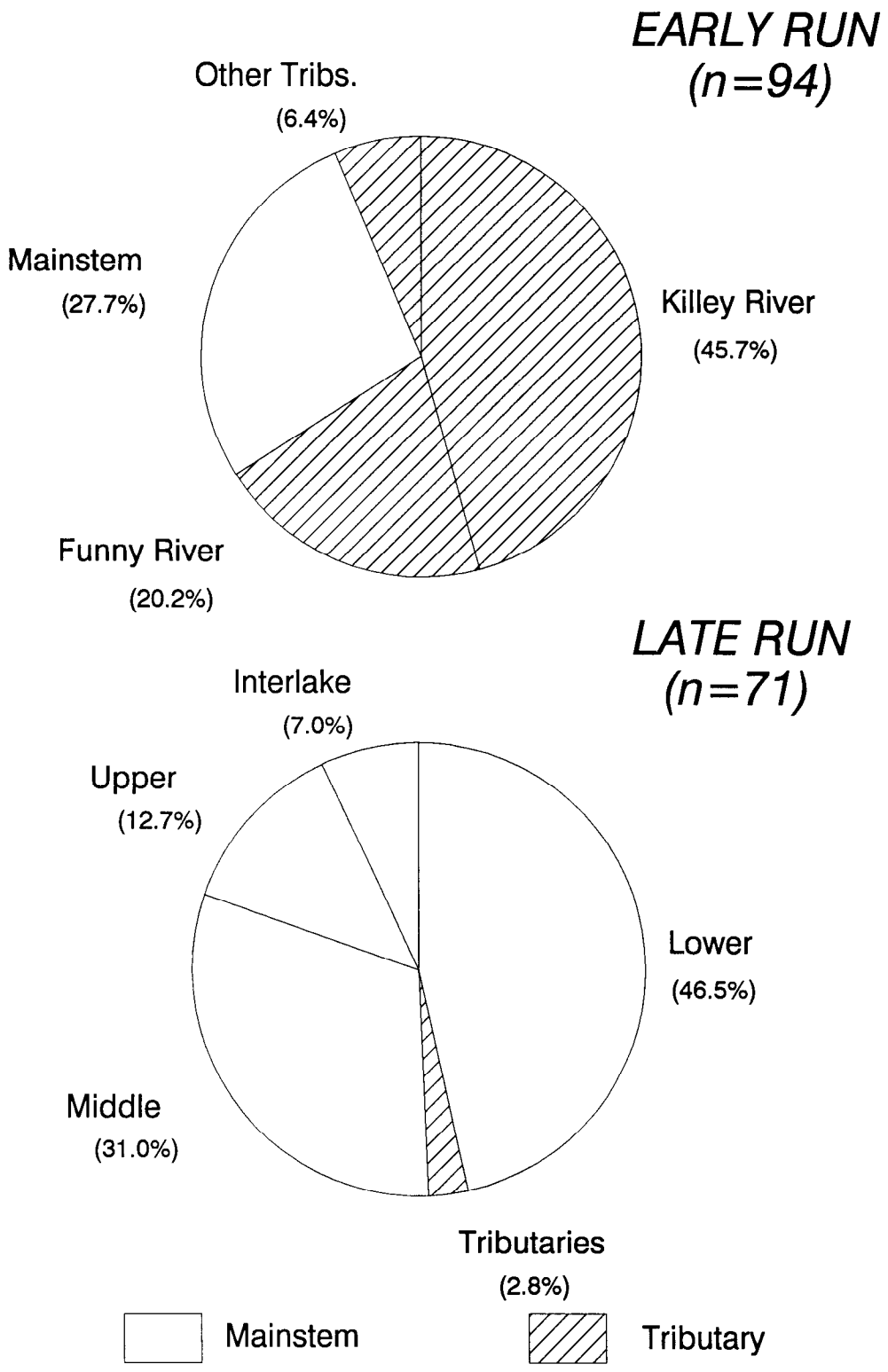

Figure 13. Spawning destinations by location or river reach for early- and late-run chinook salmon that were hooked and released during 1990.

Table 12. Estimated stream life of chinook salmon for four Kenai River spawner destinations, 1990.

Destination	n	Stream Life (days) Min.	Max.	Mean	S. E.
Mainstem	95	8	60	30.3	1.076
Killey River	44	20	56	35.1	1.279
Funny River	19	17	67	30.9	2.723
Other Tribs.	7	18	41	32.6	3.062
ALL	165	8	67	31.8	0.837

(Figure 8). None of the confidence intervals varied by more than ± 7% absolute value.

Although the three experiments did differ in several aspects, including size and sex distributions, the rate and pattern of censoring, and the distribution of fishery variables, the final conclusion regarding the effect of being hooked-and-released on the survival of a chinook salmon in the Kenai River was the same for all three experiments. The mortality is well below 20% and the only factor which significantly affected mortality was hooking location. A chinook salmon that was gilled had a significantly reduced chance of surviving compared to a salmon that was not gilled. However, the frequency of chinook salmon that were hooked in the gills was small in all three experiments (Table 7), and the overall effect of this factor was minimal.

There were differences between the experiments. In 1989, females were retained in the recreational fishery at a faster rate than males and the overall level of censoring was higher in this experiment than in the two 1990 experiments (Bendock and Alexandersdottir 1990). The reason for this difference cannot be determined, and although it does affect analysis of the data, it did not lead to significantly different results among the experiments. During the late run, a larger number of salmon backed out of the Kenai River after release without subsequently returning as compared to the early run. Some of these fish were taken in the set net commercial fishery while others were never relocated (dropouts). However, few of these removals occurred within 5 days of release (Table 3). In 1990, all three early-run dropouts were still in the river and were classified survivors 5 days after release, while during the late run only three out of 16 such removals occurred within 5 days of release. Since most of these fish can be classified as survivors with respect to the 5-day hook-and-release experiment, we can assume no effect on the estimate of hook-and-release mortality. There were proportionably more small males caught and released during the late run in 1990 than during the early 1990 run or the late 1989 run, due to the age composition of that run. Small males also represented the largest proportion of the mortalities in all of the experiments, but this difference was not significant. The distribution of fishery variables differed among the runs, largely due to management regulations, but no relationship was found associating these fishery variables with fate.

Chinook Salmon Movements

Radio telemetry has been successfully used to study a variety of fish in fresh water including chinook salmon in the Kenai River, (Burger et al. 1985), Columbia River (Liscom et al. 1978, Gray and Haynes 1979), and Skagit River (Granstrand and Gibson 1980). These studies collected information on movement rates and timing, habitat selection, or distribution. An implicit assumption in these studies is that the behavior of tagged salmon is not significantly altered by the use and attachment of radio transmitters. We found no evidence of a consistent pattern of behavior that could be ascribed to our radio tags or handling procedures. Upon release, some tagged salmon continued upstream movement, while others moved downstream or remained in place. Eight fish were re-caught in the sport fishery and retained on the same day they were tagged and released. Anecdotal evidence from both recreational and commercial fishermen that harvested radio-tagged fish indicated that these salmon were

vigorous when taken, and that there were no apparent injuries associated with the tags. Gray and Haynes (1979) concluded that travel times and numbers of returning fish did not differ significantly between externally radio-tagged salmon and a control group.

The maximum upstream distance (34 km) traveled by a radio-tagged chinook salmon during 24 hr in this study is slightly further than that reported for migrating chinook salmon in other studies using telemetry. Maximum distances reported for 24 hr movements have ranged from 17 km on the Skagit River (Granstrand and Gibson 1980) to 29 km for the Kenai River (Burger et al. 1983). Burger et al. (1983) reported that early-run chinook salmon in the Kenai River migrated at a significantly faster daily rate than late-run fish, however, we found the mean rate of movement for early-run fish that exited the lower Kenai River to be less than that of late-run fish. Our observation that most diel movement of chinook salmon occurs during the second half of the day between 1200 and 2400 hours is supported by the findings of Burger et al. (1983).

Numerous investigations using telemetry to describe movement behavior have shown downstream as well as upstream movements following the release of tagged fish. The majority (57%) of our tagged fish either remained in place or had moved downstream when first relocated compared to 53% reported by Burger et al. (1983) in the initial 48 hr. This behavior may be in response to capture and handling stress, or may result from a weak affinity for upstream movement by fish that are not fully adapted to their freshwater environment. Similar downstream movements for tagged chinook salmon have been reported by Liscom et al. (1978) and Eiler (1989). All of these studies, except Liscom et al. (1978), captured salmon in or near the intertidal reaches of rivers where fish were first entering fresh water. The Alaska Department of Fish and Game (1983) observed in the Susitna River that the farther upstream salmon were radio-tagged, the less likely they were to exhibit downstream movement after tagging. It is possible that the motivation for salmon to maintain upstream positions increases with sexual maturation, as this response increased in the latter half of the 1989 experiment and the 1990 early-run experiments.

Spawning Destinations

Holding or milling behavior of radio-tagged salmon was observed both en route to, and near, spawning destinations. An average duration of approximately 1 month transpired between tagging and spawning, but few fish migrated directly to their respective spawning destinations during this period. Lower river spawners frequently milled for 1 to several weeks in the upper intertidal reach before migrating the remaining few kilometers to a spawning site. Several fish that did not move for up to 10 days in the lower river were subsequently sport harvested and reported to be in excellent condition. Another fish held in the vicinity of rkm 16 for 34 days before moving upstream to spawn near rkm 21. Fish that eventually spawned in the interlake reach commonly held for prolonged periods in the lower, middle, or upper river reaches. Early-run fish often entered tributaries such as Beaver Creek or the Funny River for 1 or more days before continuing up the mainstem to a final destination. Tributaries spawners often milled for extended periods in the

mainstem at or below their destination confluence. This behavior was particularly evident for Funny River spawners which held along the south bank between rkm 45 to 48 (rm 28-30) and Slikok Creek spawners which held in "College Hole" below rkm 25. Thus, movement patterns, without additional knowledge of ultimate upstream destinations, may be poor indicators of spawning locations. Prolonged holding in a localized area before continued upstream movement has been reported by Eiler (1989), Granstrand and Gibson (1980), and Burger et al. (1983). Liscom et al. (1978) reported that tributary spawners in the Columbia River often overshoot their intended target streams then spend from 6 to 38 days milling near their confluence before entering to spawn. Similar behaviors were observed for chinook salmon spawning in tributaries to the Susitna River (ADFG 1983). The variability we observed in movement rates for salmon between the point of release and the upper DCC may be explained, in part, by the tendency of chinook salmon to hold for prolonged periods or temporarily back downstream, and because fish spawning in the vicinity of the DCC spent their entire stream life en route to that location.

The majority (79%) of chinook salmon we tagged had entered the river within a few days of capture based on the presence of sea lice (McLean et al. 1990), yet the average elapsed time that we observed between tagging and spawning (32 days) was considerably shorter than the 52 day interval reported for chinook salmon in the Skagit River (Granstrand and Gibson 1980). Most (72%) early-run fish spawned in tributaries, while most (97%) late-run fish spawned in the mainstem. The selection of spawning destinations, peak spawning periods, and the lower river kilometer limit for spawning that we observed are consistent with the findings of Burger et al. (1983). Based on the findings from three separate investigations using telemetry, early-run fish spawn primarily in the Killey River (54%), followed by the mainstem (20%), Funny River (19%), and other tributaries (7%) (Figure 14). Late-run fish spawn primarily in the lower river (40%), middle river (26%), upper river (19%), interlake reach (14%), and in tributaries (1%). The distribution of spawners among river reaches varied between investigations. Only 2.5% of the early-run fish sampled by Burger et al. (1983) spawned in the mainstem compared to 28% in our study. During the late run, Hammarstrom et al. (1985) observed relatively uniform proportions of use among mainstem reaches, while Burger et al. (1983) observed the highest use in the upper reach during 1979, and the lower reach during 1980 and 1981. We do not know if homing occurs to specific spawning reaches, or if variability in use occurs in response to seasonal environmental conditions or intraspecific factors. However, the disproportionately high sport fishing harvest that occurs in the lower 32 rkm (Hammarstrom 1989) likely targets on lower-river spawners.

Implications for Chinook Salmon Management

The chinook salmon recreational fishery is managed in two distinct components (early and late) with separate management objectives for each run (McBride and Hammarstrom 1990). The Cook Inlet commercial gill net fishery is not prosecuted during the early run, but harvests late-run chinook salmon in salt water. Hydroacoustic assessment (sonar) is used to estimate total inriver return. The sonar facility is located at rkm 13.6 in the intertidal zone of the river.

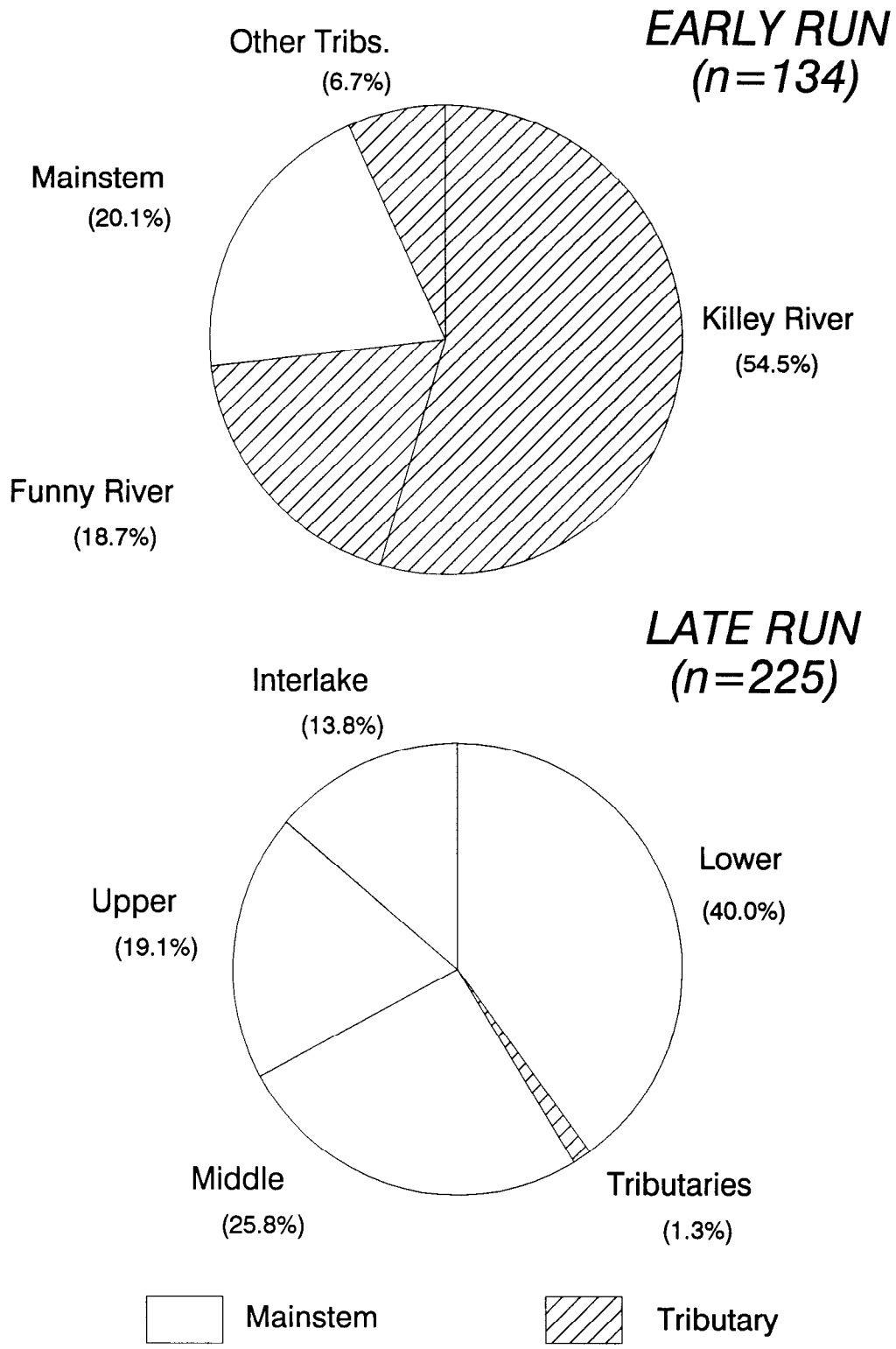

Figure 14. Spawning destinations by location or river reach for 359 radio-tagged chinook salmon released in the Kenai River during 1979 to 1990 (Burger et al. 1983, Hammarstrom et al. 1985, Bendock and Alexandersdottir 1990).

Findings on the movements of radio-tagged chinook salmon that have been caught and released may explain anecdotal reports of salmon with sport tackle occurring in Cook Inlet commercial catches. Caught-and-released fish backed down to Cook Inlet during both the early and late runs; however most of the early-run fish returned to fresh water, while most late-run fish were either caught in set gill nets or disappeared from the study. If salmon return to Cook Inlet in response to hooking events, it is possible that mandatory catch-and-release fishing, during a late-run conservation shortfall, may result in higher gill net mortalities if high catch rates are sustained in the lower river recreational fishery.

Salmon that back downstream and possibly return upstream a second time, or mill in the lower Kenai River, may result in multiple sonar counts which can affect the accuracy of the inriver return estimate. Knowledge of the migratory behavior of fish becomes crucial as the use of sonar to estimate abundance becomes more widespread. To date, multiple sonar counts of individual fish due to downstream migration from hooking events has been of concern for the early run. This is because the number of released fish in the early run has, in some years, been large in comparison to total inriver return. During the late run, the number of released fish has been small in comparison to inriver return.

The slow exodus of early-run fish from the reach of river open to fishing makes them vulnerable to harvest throughout much of the late run. Since early-run fish can not be physically distinguished from late-run fish, additional closures in the fishery may be necessary to protect them from harvest during the late run in years of a conservation shortfall.

All of the chinook salmon used in this study were hooked and released at least once, and 43 of these fish (the sport harvested component) were hooked at least twice. Anglers reported additional hook-and-release events for 14 fish during the 2 years of study; thus, nearly 20% of the fish in this study were hooked multiple times. The proportion of fish in this group that spawned was half of the overall rate, while the proportion of drop outs was three times as high. Additional hooking events and subsequent injuries may explain the abrupt downstream movements we observed in some fish that had penetrated several kilometers upstream. Furthermore, as catch rates increase in the sport fishery, mortality may also increase due to cumulative injury from multiple hooking events.

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computer. We would like to acknowledge funding provided for this project through the Federal Aid in Fish Restoration Act (16 U.S.C. 777-777K).

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APPENDIX A

Appendix A1. Movements during 23 May - 15 June of chinook salmon that were tagged during the early run (22 May - 15 June).

	Date	RM	River Mile Locations By Date																												
No.	Tagged	Tagged	5/23	5/24	5/25	5/26	5/27	5/28	5/29	5/30	5/31	6/01	6/02	6/03	6/04	6/05	6/06	6/07	6/08	6/09	6/10	6/11	6/12	6/13	6/14	6/15					
1	5/22/90	14.5	13.0	11.0	14.5	14.5	14.5	14.5	14.5	14.5	14.5	14.5	14.5	14.5	14.5	[hook and release mortality]															
2	5/23/90	13.0		17.0	20.0	23.0	24.0	26.0	30.0	30.0	32.0	28.0	30.0	35.0	36.0	36.0	36.0	36.0	36.0	36.0	36.0	36.0	36.0	36.0	36.0	36.0					
3	5/30/90	12.5										17.0	19.0	20.0	21.0	24.0	26.0	27.0	31.0	34.0	33.0	33.0	33.0	33.0	33.0	35.0					
4	5/31/90	14.5										19.0	25.0	26.0	26.5	36.0	36.0	36.0	36.0	36.0	36.0	36.0	36.0	36.0	36.0	36.0					
5	6/07/90	14.8																	14.0	14.5	14.5	14.5	12.0	12.0	12.0	12.0					
6	6/07/90	14.8																	14.5	7.0	6.0	9.0	9.0	9.0	10.0	10.0					
7	6/08/90	14.8																		14.5	14.5	14.5	14.5	14.5	14.5	14.5					
8	6/08/90	14.8																		13.0	13.0	13.0	13.0	12.0	13.0	13.0					
9	6/08/90	13.5																		14.5	14.5	14.5	14.5	14.5	14.5	14.5					
10	6/08/90	13.5																		14.5	14.5	14.5	14.5	10.0		3.0					
11	6/09/90	14.8																			15.5	19.0	19.0	20.0	20.0	20.0					
12	6/09/90	14.8																			13.5	14.5	14.0	14.5	14.5	12.0					
13	6/09/90	14.8																			14.5	14.5	14.5	12.0	12.0	12.0					
14	6/09/90	13.5																			13.0	13.0	13.0	11.5	12.0	12.0					
15	6/09/90	13.5																			10.0	out	3.0	out		10.5					
16	6/09/90	13.5																			4.0	4.0	9.5	12.0	11.0	10.0					
17	6/09/90	13.5																			12.0	11.0	11.0	11.0		out					
18	6/09/90	13.5																			11.0	6.0	out	out		8.0					
19	6/09/90	13.5																			12.0	8.0	8.0	6.5		out					
20	6/10/90	13.5																				12.0	10.0	10.0	10.0	14.5					
21	6/09/90	13.5																			14.5	14.5	14.5	14.5	14.5	8.0					
22	6/09/90	13.5																			3.0	out	11.5	10.0		10.0					
23	6/10/90	12.8																				11.0	11.5	14.5	14.5	14.5					
24	6/10/90	14.8																				14.5	14.5	12.0	12.0	11.0					
25	6/10/90	14.8																				14.5	14.5	18.0	23.0	23.0					
26	6/10/90	14.5																				11.0	10.0	11.0	11.0	11.0					
27	6/10/90	14.5																				11.0	10.5	8.0		8.0					
28	6/10/90	14.0																				14.0	14.5	14.5	14.5	13.0					
29	6/10/90	13.5																				14.5	14.5	14.5	14.5	14.5					
30	6/10/90	13.0																				11.0	11.0	10.0	10.0	10.0					
31	6/10/90	13.0																				10.5	6.5	10.0		10.0					
32	6/10/90	13.3																				7.0	out	9.0	10.0	10.0					
33	6/10/90	13.0																				12.0	12.0	4.0		out					
34	6/12/90	13.0																						12.0	13.0	13.0					
35	6/12/90	13.5																						14.5	14.5	15.5					
36	6/12/90	13.0																						14.5	14.5	18.0					
37	6/12/90	13.3																						12.0	13.0	12.0					
38	6/12/90	13.0																						14.5	14.5	14.5					
39	6/12/90	13.5																						14.5	18.0	21.0					
40	6/12/90	14.5																						14.5	14.5	14.5					
41	6/12/90	14.0																						12.0	12.0	12.0					
42	6/12/90	13.0																						12.0	12.0	10.0					
43	6/12/90	13.0																						12.0	13.0	12.0					
44	6/12/90	14.5																						12.0	12.0	10.0					
45	6/12/90	13.5																						6.0		10.0					
46	6/12/90	13.5																						6.0		10.0					
47	6/12/90	13.8																						12.0	12.0	10.0					
48	6/12/90	14.5																						14.5	14.5	14.5					
49	6/12/90	13.5																						10.0	10.0	10.0					

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Appendix A1. (Page 2 of 2).

No.	Date Tagged	RM Tagged	River Mile Locations By Date																												
			5/23	5/24	5/25	5/26	5/27	5/28	5/29	5/30	5/31	6/01	6/02	6/03	6/04	6/05	6/06	6/07	6/08	6/09	6/10	6/11	6/12	6/13	6/14	6/15			
50	6/12/90	13.5																						14.5	14.5	16.0			
51	6/12/90	13.0																						8.0	10.0	6.0			
52	6/12/90	14.8																						14.5	14.5	14.5			
53	6/13/90	13.5																							11.0	11.0			
54	6/13/90	13.5																							12.0	11.0			
55	6/13/90	14.5																							14.5	12.0			
56	6/14/90	13.0																								12.0			
57	6/14/90	13.5																								out			
58	6/14/90	13.0																								12.0			
59	6/14/90	13.0																								out			
60	6/14/90	11.5																								4.0			
61	6/14/90	12.0																								12.0			
62	6/14/90	13.5																								12.0			
63	6/14/90	14.5																								14.5			
64	6/15/90	13.5																											
65	6/15/90	13.0																											
66	6/15/90	11.5																											
67	6/15/90	13.5																											
68	6/15/90	13.8																											

Appendix A2. Movements during 16 June - 6 July of chinook salmon that were tagged during the early run (22 May - 30 June).

No.	Date Tagged	RM Tagged	River Mile Locations By Date																								
			6/16	6/18	6/19	6/20	6/21	6/22	6/23	6/25	6/26	6/27	6/28	6/29	6/30	7/02	7/03	7/04	7/05	7/06							
1	5/22/90	14.5																									
2	5/23/90	13.0	44.0	Kil	Kil	Kil	Kil	Kil	Kil					Kil				Kil									
3	5/30/90	12.5	35.0	46.0	46.0	46.0	Kil	Kil	Kil					Kil				Kil									
4	5/31/90	14.5	36.0	36.0	36.0	36.0	30.0	Fun	Fun					Fun				Fun									
5	6/07/90	14.8	12.0	9.0	9.0	7.0	6.5	out	out	6.5	5.0	5.0	out		out	3.0	3.0			2.0							
6	6/07/90	14.8	12.0	12.0	14.5	19.0	19.0	19.0	19.0	19.0	19.0	19.0	19.0		19.0	19.0	19.0		19.0	19.0							
7	6/08/90	14.8	14.5	14.5	16.0	21.0	30.0	44.0	44.0	44.0	Kil			Kil				Kil									
8	6/08/90	14.8	13.0	12.0	12.0	12.0	12.0	18.0	8.5	22.0	30.0	36.0	36.0		44.0	Kil		Kil									
9	6/08/90	13.5	14.5	14.5	14.5	14.5	15.0	14.5	14.5	16.0	16.0	14.5	16.0		16.0	4.0	4.0	[died from catch and release mi 16 on 7/1/90]									
10	6/08/90	13.5	9.0	12.0	14.5	27.0	27.0	30.0	Fun					Fun				Fun									
11	6/09/90	14.8	22.0	29.0	30.0	31.0	33.0	34.0	35.0	33.0	31.0	31.0	32.0		44.0	Kil		Kil									
12	6/09/90	14.8	14.5	16.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	14.5	14.5		29.0	43.0	44.0	44.0	Kil								
13	6/09/90	14.8	12.0	11.0	11.0	11.0	11.0	10.0	Bev	19.0	21.0	26.0	30.0	44.0	46.0	46.0	46.0	44.0	Kil								
14	6/09/90	13.5	12.0	10.0	10.0	10.0	12.0	23.0	30.0	37.0	Kil			Kil				Kil									
15	6/09/90	13.5	11.0	12.0	14.0	27.0	36.0	36.0	36.0	Kil				Kil				Kil									
16	6/09/90	13.5	11.0	12.0	22.0	22.0	11.0	11.0	11.0	11.0	11.0	[spawner middle river]															
17	6/09/90	13.5	out	out	out	out	out	7.0	out	out	6.0	[tag net mi 7.8 on 6/26/90]															
18	6/09/90	13.5	8.0	12.0	12.0	14.5	14.5	16.0	16.0	16.0	16.0	16.0	16.0		27.0	30.0	30.0	30.0	30.0	Fun							
19	6/09/90	13.5	out	out	out	out	out		4.0	12.0	12.0	12.0	12.0		14.5	26.0	28.0		20.0	19.0							
20	6/10/90	13.5	9.0	10.0	10.0	7.0	7.0	12.0	7.0	10.0	10.0	Bev	10.0		12.0	12.0	13.0		13.0	13.0							
21	6/09/90	13.5	12.0	2.0	out	10.0	10.0	10.0	Bev	Bev	Bev	Bev	Bev		Bev	26.0	29.0	30.0	Fun	[spawner Funny River]							
22	6/09/90	13.5	10.0	12.0	17.5	23.0	29.0																				
23	6/10/90	12.8	12.0	17.0	17.0	26.0	29.0	Fun	Fun					46.0	44.0	Kil		Kil									
24	6/10/90	14.8	10.0	11.0	11.0	10.0	12.0	12.0	Bev	12.0	17.5	22.0	25.0	28.9	29.0	42.0	44.0	44.0	44.0	44.0							
25	6/10/90	14.8	[harvested in sport fishery at mi 23 on 6/15/90]																								
26	6/10/90	14.5	11.0	10.0	10.0	10.0	12.0	18.0	28.0	Fun				Fun				Fun									
27	6/10/90	14.5	10.0	11.0	12.0	11.0	11.0	11.0	17.0	22.0	29.0	36.0	44.0	44.0	44.0	[harvested in sport fishery at mi 45 on 7/1/90]											
28	6/10/90	14.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	14.5	22.0	21.0		42.0	Kil		44.0									
29	6/10/90	13.5	14.5	14.5	14.5	15.0	15.0	14.5	14.5	19.0	19.0	25.0	29.0	42.0	44.0	Kil		Kil									
30	6/10/90	13.0	9.0	12.0	11.0	12.0	11.0	12.0	14.5	19.0	18.0	19.0	22.0		27.0	30.0	33.0	40.0	40.0	40.0							
31	6/10/90	13.0	12.0	14.0	21.0	27.0	29.0	33.0	36.0	36.0	36.0	36.0	36.0		Kil	[spawner Killey River]											
32	6/10/90	13.3	11.0	11.0	10.0	10.0	10.0	10.0	17.0	18.0	26.0	28.0	28.0		36.0	Kil		Kil									
33	6/10/90	13.0	out	out	2.0	3.0	3.0	14.5	18.0	24.0	26.0	30.0	30.0	Fun				Fun									
34	6/12/90	13.0	14.5	24.0	28.0	28.0	28.0	28.0	31.0	32.0	35.0	35.0	36.0	36.0	36.0	36.0	36.0	36.0	36.0	36.0							
35	6/12/90	13.5	14.5	23.0	25.0	28.0	30.0	34.0	34.0	36.0	36.0	44.0	44.0	Kil				Kil									
36	6/12/90	13.0	18.0	29.0	30.0	36.0	36.0	36.0	37.0	44.0	44.0	Kil		Kil				Kil	[spawner Killey River]								
37	6/12/90	13.3	12.0	11.0	11.0	11.5	12.0	10.0	14.5	17.0	20.0	23.0	27.0		43.0	[harvested in sport fishery at mi 45 on 7/1/90]											
38	6/12/90	13.0	14.5	26.0	28.0	28.0	28.0	30.0	30.0	30.0	30.0	Fun		Fun				Fun									
39	6/12/90	13.5	27.0	36.0	44.0	Kil	Kil	Kil	Kil					Kil				Kil									
40	6/12/90	14.5	14.5	14.5	17.0	20.0	20.0	20.0	25.0	27.0	28.0	30.0	34.0		36.0	36.0	36.0	36.0	36.0	36.0							
41	6/12/90	14.0	12.0	10.0	10.0	7.0	8.0	9.0	12.0	12.0	14.5	17.0	19.0		25.0	30.0	36.0	44.0	Kil								
42	6/12/90	13.0	10.0	4.0	4.0	9.0	10.0	11.0	11.0	11.0	12.0	16.0	16.0		22.0	28.0	36.0	36.0	44.0	Kil							
43	6/12/90	13.0	12.0	12.0	17.5	23.0	29.0	36.0	36.0	43.0	Kil			Kil				Kil									
44	6/12/90	14.5	12.0	11.0	11.0	10.0	12.0	18.0	26.0	30.0	40.0	48.0	60.0	60.0		60.0	60.0	60.0									
45	6/12/90	13.5	10.0	26.0	33.0	44.0	44.0	44.0	46.0	46.0	46.0	Kil		46.0	46.0	46.0	46.0	46.0	44.0	46.0							
46	6/12/90	13.5	10.0	26.0	33.0	44.0	44.0	44.0	46.0	46.0	46.0	Kil		46.0	46.0	46.0	46.0	46.0	44.0	46.0							
47	6/12/90	13.8	10.0	12.0	14.5	15.0	15.0	14.5	14.5	21.0	23.0	29.0	29.0	35.0	40.0	44.0	60.0		68.0								
48	6/12/90	14.5	14.5	14.5	14.0	14.0	14.0	14.0	[hook and release mortality]																		
49	6/12/90	13.5	12.0	10.0	11.0	14.5	14.5	18.0	23.0	25.0	25.0	27.0	27.0	29.0	30.0	33.0		28.0	28.0	34.0							

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Appendix A2. (Page 2 of 3).

No.	Date Tagged	RM Tagged	River Mile Locations By Date 6/16	6/18	6/19	6/20	6/21	6/22	6/23	6/25	6/26	6/27	6/28	6/29	6/30	7/02	7/03	7/04	7/05	7/06
50	6/12/90	13.5	18.0	24.0	26.0	29.0	29.0	29.0	Fun					Fun				Fun		
51	6/12/90	13.0	10.0	12.0	10.0	11.0	10.0	10.0	18.0	22.0	28.0	29.0	35.0		43.0	Kil		Kil		
52	6/12/90	14.8	15.0	28.0	28.0	28.0	[uplost after 6/20/90]													
53	6/13/90	13.5	5.0	10.0	14.5	24.0	24.0	22.0	22.0	22.0										
54	6/13/90	13.5	11.0	17.0	22.0	30.0	29.0	30.0	Fun					Fun				Kil		
55	6/13/90	14.5	10.0	6.0	7.0	5.0	7.0	7.0	10.0	10.0	6.5	6.0	[hook-and-release mortality]							
56	6/14/90	13.0	12.0	12.0	20.0	26.0	26.0	Fun	Fun					Fun				Fun		
57	6/14/90	13.5	out	12.0	14.5	16.0	24.0	28.0	28.0	43.0	Kil			Kil				Kil		
58	6/14/90	13.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	Bev	14.5	12.0	12.0		12.0	14.5	14.5		14.5	16.0
59	6/14/90	13.0	3.0	12.0	18.0	29.0	Fun	Fun	Fun					Fun						
60	6/14/90	11.5	out	5.0	12.0	14.5	16.0	17.0	19.0	20.0	20.0	22.0	22.0		22.0	25.0	28.0	30.0	30.0	Fun
61	6/14/90	12.0	18.0	25.0	25.0	25.0	25.0	23.0	23.0	23.0	23.0	[hook-and-release mortality]								
62	6/14/90	13.5	12.0	14.0	15.0	14.5	18.0	22.0	29.0	30.0	Fun			Fun				Fun	[spawner Funny River]	
63	6/14/90	14.5	14.5	14.0	13.0	13.0	13.0	13.0	[hook-and-release mortality]											
64	6/15/90	13.5	12.0	14.5	16.0	19.0	20.0	19.0	20.0	22.0	22.0	22.0	27.0	28.0	30.0	38.0	44.0	44.0	44.0	Kil
65	6/15/90	13.0	6.0	6.5	12.0	22.0	22.0	22.0	22.0	22.0	22.0	22.0	22.0		22.0	22.0	22.0		22.0	22.0
66	6/15/90	11.5	14.5	19.0	20.0	23.0	27.0	27.0	29.0	29.0	Fun	Fun		Fun				Kil		
67	6/15/90	13.5	13.0	12.0	13.0	12.0	12.0	12.0	12.0	12.0	[hook-and-release mortality]									
68	6/15/90	13.8	11.0	11.0	10.0	10.0	10.0	10.0	Bev	18.0	19.0	28.0	30.0	36.0	36.0			73.0		
69	6/16/90	13.5		24.0	29.0	36.0	36.0	36.0	36.0	36.0	36.0	36.0	36.0		45.0	Kil		Kil		
70	6/16/90	13.5		17.0	12.0	9.5	7.0	11.0	12.0	14.0	14.5	14.5	14.5		41.0	Kil		Kil		
71	6/16/90	13.0		12.0	10.0	6.0	12.0	13.0	14.5	17.0	8.0	out	out		out	out	out			out
72	6/16/90	13.5		12.0	12.0	14.5	21.0	25.0	30.0	30.0	30.0	31.0	33.0		44.0	44.0	44.0	44.0	44.0	43.0
73	6/16/90	13.8		14.5	20.0	24.0	28.0	29.0	33.0	36.0	40.0	44.0	44.0	44.0	44.0	Kil		Kil		
74	6/19/90	13.5				10.0	10.0	Bev	Bev	17.0	20.0	21.0	25.0		30.0	30.0	30.0	30.0	30.0	30.0
75	6/19/90	13.0				14.5	12.0	20.0	19.0	17.0	18.0	17.0	14.5		20.0	17.0	17.0		17.0	14.5
76	6/19/90	13.0				10.0	10.0	10.0	13.0	21.0	22.0	27.0	30.0	Fun	30.0	39.0	44.0	44.0	46.0	46.0
77	6/19/90	11.5				12.0	14.5	18.0	21.0	26.0	23.0	23.0	19.0		19.0	19.0	20.0	30.0	30.0	30.0
78	6/19/90	11.5				12.0	10.0	10.0	10.0	19.0	20.0	22.0	26.0		Fun			Kil		
79	6/20/90	13.5					11.0	14.5	20.0	23.0	27.0	29.0	29.0	30.0	30.0	35.0	43.0	44.0	44.0	44.0
80	6/20/90	13.5					14.5	22.0	27.0	27.0	28.0	29.0	36.0		44.0	44.0	46.0	Kil		
81	6/20/90	13.5					11.5	12.0	12.0	[caught by tagging crew at mi 7 on 6/24/90]										
82	6/20/90	12.0					12.0	10.0	10.0	14.5	14.5	18.0	22.0		22.0	Kil		Kil		
83	6/20/90	12.0					12.0	14.5	14.5	17.0	18.0	19.0	19.0		22.0	36.0	24.0	44.0	44.0	Kil
84	6/21/90	13.5						14.5	18.0	28.0	30.0	30.0	30.0	33.0	30.0	30.0	30.0	30.0	30.0	30.0
85	6/21/90	13.0						2.0	out	out	out	8.0	14.5		18.0	Fun		Fun		
86	6/21/90	12.0						9.0	7.0	5.0	4.0	4.0	[hook-and-release mortality]							
87	6/21/90	11.5						12.0	12.0	12.0	12.0	14.5	14.5		14.5	14.5	17.0		14.5	15.0
88	6/21/90	12.3						12.0	14.5	18.0	22.0	22.0	25.0		28.0	29.0	27.0	30.0	30.0	30.0
89	6/22/90	12.0							out	10.0	10.0	Bev	16.0		19.0	22.0	22.0		29.0	35.0
90	6/22/90	11.5							20.0	16.0	19.0	19.0	19.0		19.0	19.0	19.0		19.0	19.0
91	6/22/90	12.3							12.0	8.0	8.0	8.0	8.0		8.0	8.0	[hook-and-release mortality]			
92	6/22/90	13.5							16.0	22.0	27.0	30.0	36.0		44.0	44.0	45.0	44.0	[sport harvested at mi 44 on 7/04/09]	
93	6/22/90	12.3							14.5		20.0	26.0	34.0		33.0	44.0	46.0	46.0	Kil	
94	6/26/90	13.0										12.0	12.0		12.0	12.0	13.0		13.0	12.0
95	6/26/90	13.8										12.0	10.0		10.0	17.0	20.0		28.0	28.0
96	6/26/90	12.8										16.0	19.0		30.0	35.0	36.0	36.0	36.0	36.0
97	6/26/90	14.5										14.5	15.0		18.0	19.0	19.0		26.0	28.0
98	6/26/90	13.0										6.5	4.0			5.0	8.5		19.0	25.0

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	Date	RM	River Mile Locations By Date																									
No.	Tagged	Tagged	6/16	6/18	6/19	6/20	6/21	6/22	6/23	6/25	6/26	6/27	6/28	6/29	6/30	7/02	7/03	7/04	7/05	7/06								
99	6/26/90	12.0								14.5	20.0		29.0	42.0	45.0	46.0	49.0	49.0	50.0	65.0								
100	6/26/90	12.5										12.0	11.0		11.0	17.0	22.0	[harvested in sport fishery at mi 22 on 7/03/90]										
101	6/26/90	13.5										12.0	12.0		12.0	27.0	27.0	29.0	28.0	30.0								
102	6/27/90	13.8											12.0		19.0	22.0	27.0	27.0	28.0	29.0								
103	6/27/90	13.0											14.5		20.0	8.0	22.0	26.0		3.0								
104	6/27/90	12.0											12.0		12.0	22.0	27.0	33.0	33.0	34.0								
105	6/27/90	12.3											12.0		16.0	22.0	24.0	26.0	27.0	27.0								
106	6/27/90	13.8											12.0		12.0	12.0	12.0		12.0	12.0								
107	6/27/90	13.0											11.0		12.0	19.0	25.0	29.0	30.0	30.0								
108	6/27/90	12.3											12.0		12.0	17.0	17.0		22.0	22.0								
109	6/28/90	12.0													10.0	4.0	4.0			2.0								
110	6/28/90	11.8													16.0	23.0	28.0	38.0	44.0	33.0								
111	6/28/90	12.0													12.0	12.0	16.0	[sport harvested at mi 16.5 on 7/04/90]										
112	6/28/90	12.0													12.0	12.0	17.0		14.5	14.5								
113	6/28/90	12.0													14.5	19.0	22.0		26.0	26.0								
114	6/28/90	11.5													16.0	[harvested in sport fishery at mi 18 on 7/01/90]												
115	6/29/90	13.8													12.0	12.0	12.0		19.0	20.0								
116	6/29/90	12.0													16.0	16.0	16.0		16.0	6.5								
117	6/29/90	12.0													12.0	16.0	20.0		20.0	28.0								
118	6/29/90	12.3													14.5	17.0	17.0		17.0	20.0								
119	6/29/90	10.5													16.0	27.0	27.0	36.0	30.0	30.0								
120	6/29/90	11.5													12.0	16.0	22.0		27.0	27.0								
121	6/30/90	12.0														6.0	7.5		11.0	11.0								
122	6/30/90	12.0														[hook-and-release mortality same day as tagged 6/30/90]												
123	6/30/90	11.5														4.0	4.0			4.0								
124	6/30/90	14.5														14.5	17.0		19.0	22.0								
125	6/30/90	14.5														19.0	22.0		24.0	27.0								

Appendix A3. Movements during 7 July - 28 July of chinook salmon that were tagged during the early run (22 May - 30 June).

No.	Date Tagged	RM Tagged	River Mile Locations By Date 7/07	7/09	7/10	7/11	7/12	7/13	7/14	7/16	7/17	7/18	7/19	7/20	7/21	7/23	7/24	7/25	7/26	7/27	7/28
1	5/22/90	14.5																			
2	5/23/90	13.0		Kil				Kil	[spawner Killey River]												
3	5/30/90	12.5		Kil				Kil	[spawner Killey River]												
4	5/31/90	14.5		Fun				Fun	[spawner Funny River]												
5	6/07/90	14.8	2.0		2.0	[spawner lower river]															
6	6/07/90	14.8	19.0		20.0	Sli	Sli	Sli	[spawner Slicok Creek]												
7	6/08/90	14.8		Kil				Kil	[spawner Killey River]												
8	6/08/90	14.8		Kil				Kil				Kil				KIl	[spawner Killey River]				
9	6/08/90	13.5																			
10	6/08/90	13.5		Fun				Fun	[spawner Funny River]												
11	6/09/90	14.8		Kil				Kil	[spawner Killey River]												
12	6/09/90	14.8		Kil				Kil				Kil				Kil	[spawner Killey River]				
13	6/09/90	14.8		Ben				Ben				Ben	[spawner Benjamin Creek]								
14	6/09/90	13.5		Kil				Kil	[spawner Killey River]												
15	6/09/90	13.5		Kil				Kil	[spawner Killey River]												
16	6/09/90	13.5																			
17	6/09/90	13.5																			
18	6/09/90	13.5		Fun				Fun				Fun	[spawner Funny River]								
19	6/09/90	13.5	19.0		19.0	[spawner middle river]															
20	6/10/90	13.5	13.0		12.0	12.0	13.0		13.0	13.0	[spawner lower river]										
21	6/09/90	13.5																			
22	6/09/90	13.5														Ben	[spawner Benjamin Creek]				
23	6/10/90	12.8		Kil				Kil	[spawner Killey River]												
24	6/10/90	14.8	Kil	Kil				Kil				Kil				Kil	[spawner Killey River]				
25	6/10/90	14.8																			
26	6/10/90	14.5		Fun				Fun				Fun	[spawner Funny River]								
27	6/10/90	14.5																			
28	6/10/90	14.0		Kil				Kil				Kil				Kil	[spawner Killey River]				
29	6/10/90	13.5		Kil				Kil				Kil	[spawner Killey River]								
30	6/10/90	13.0	40.0		48.0	47.0		47.0	[found dead at mi 8.6 on 7/20/90 unspawned]												
31	6/10/90	13.0																			
32	6/10/90	13.3		Kil				Kil	[spawner Killey River]												
33	6/10/90	13.0		Fun				Fun	[spawner Funny River]												
34	6/12/90	13.0	36.0	36.0	[spawner middle river]																
35	6/12/90	13.5		Kil				Kil	[spawner Killey River]												
36	6/12/90	13.0																			
37	6/12/90	13.3																			
38	6/12/90	13.0		Fun				Fun	[spawner Funny River]												
39	6/12/90	13.5		Ben				Ben				Ben	[spawner Benjamin Creek]								
40	6/12/90	14.5	36.0	36.0	36.0	40.0	44.0	44.0	46.0	52.0		65.0	46.0		65.0	69.0			69.0		
41	6/12/90	14.0		Kil				Kil				Kil	[spawner Killey River]								
42	6/12/90	13.0		Kil				Kil				Kil	[spawner Killey River]								
43	6/12/90	13.0		Kil				Kil	[spawner Killey River]												
44	6/12/90	14.5		63.0				65.0				65.0	[spawner Skilak Lake]								
45	6/12/90	13.5	Kil	Kil				Kil				Kil				Kil			Kil		
46	6/12/90	13.5	Kil	Kil				Kil				Kil				Kil			Kil		
47	6/12/90	13.8		68.0				Ski				60.0				63.0			64.0		
48	6/12/90	14.5																			
49	6/12/90	13.5	34.0		28.0	42.0	Kil	Kil				Kil				Kil	[spawner Killey River]				

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No.	Date Tagged	RM Tagged	River Mile Locations By Date 7/07	7/09	7/10	7/11	7/12	7/13	7/14	7/16	7/17	7/18	7/19	7/20	7/21	7/23	7/24	7/25	7/26	7/27	7/28
50	6/12/90	13.5		Fun				Fun				Fun				Fun	[spawner Funny River]				
51	6/12/90	13.0		Ben				Ben				Ben	[spawner Benjamin Creek]								
52	6/12/90	14.8																			
53	6/13/90	13.5						22.0	[spawner middle river]												
54	6/13/90	13.5		Kil				Kil				Kil				Kil	[spawner Killey River]				
55	6/13/90	14.5																			
56	6/14/90	13.0		Fun				Fun	[spawner Funny River]												
57	6/14/90	13.5		Kil				Kil				Kil				Kil	[spawner Killey River]				
58	6/14/90	13.0	16.0		14.5	14.5	14.5		14.5	14.5	[spawner lower river]										
59	6/14/90	13.0						18.0	[spawner Funny River]												
60	6/14/90	11.5		Fun	[spawner Funny River]																
61	6/14/90	12.0																			
62	6/14/90	13.5																			
63	6/14/90	14.5																			
64	6/15/90	13.5		Kil				Kil				Kil				Kil			Kil		
65	6/15/90	13.0	22.0		22.0	22.0	22.0		22.0	22.0	22.0	22.0	22.0	22.0	22.0	22.0	22.0	22.0	[spawner middle river]		
66	6/15/90	11.5		Kil				Kil				Kil				Kil	[spawner Killey River]				
67	6/15/90	13.5																			
68	6/15/90	13.8		Qtz				Qtz				Qtz	[spawner Quartz Creek]								
69	6/16/90	13.5		Kil				Kil	[spawner Killey River]												
70	6/16/90	13.5		Kil				Kil				Kil	[spawner Killey River]								
71	6/16/90	13.0	[drop out after 6/26/90]																		
72	6/16/90	13.5	Kil	Kil				Kil				Kil				Kil	[spawner Killey River]				
73	6/16/90	13.8		Kil				Kil				Kil	[spawner Killey River]								
74	6/19/90	13.5	30.0	30.0	[spawner middle river]																
75	6/19/90	13.0	18.0		23.0	21.0	21.0		22.0	21.0	22.0	22.0	25.0		22.0	22.0	23.0	22.0	22.0	22.0	22.0
76	6/19/90	13.0	46.0	46.0	46.0	46.0	Kil	Kil				Kil				Kil	[spawner Killey River]				
77	6/19/90	11.5	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0			31.0		31.0	31.0	29.0	[spawner middle river]			
78	6/19/90	11.5		Kil	[spawner Killey River]																
79	6/20/90	13.5	44.0	Kil				Kil	[spawner Killey River]												
80	6/20/90	13.5		Kil				Kil	[spawner Killey River]												
81	6/20/90	13.5																			
82	6/20/90	12.0		Kil				Kil	[spawner Killey River]												
83	6/20/90	12.0		Kil				Kil				Kil	[spawner Killey River]								
84	6/21/90	13.5	Fun	Fun				Fun	[spawner Funny River]												
85	6/21/90	13.0		Fun				Fun				Fun				Fun	[spawner Funny River]				
86	6/21/90	12.0																			
87	6/21/90	11.5	14.5		15.5	15.0	[spawner lower river]														
88	6/21/90	12.3	30.0	Fun				Fun				Fun				Fun	[spawner Funny River]				
89	6/22/90	12.0	44.0		46.0	48.0	48.0	48.0	48.0	65.0	65.0					65.0			65.0	[spawner interlake reach]	
90	6/22/90	11.5	19.0		19.0	19.0	19.0	[spawner lower river]													
91	6/22/90	12.3																			
92	6/22/90	13.5																			
93	6/22/90	12.3		Kil				Kil	[spawner Killey River]												
94	6/26/90	13.0	12.0		12.0	12.0	11.5		12.0	12.0	12.0	12.0	[spawner lower river]								
95	6/26/90	13.8	19.0		28.0	29.0	34.0	36.0	35.0	36.0		Kil				Kil	[spawner Killey River]				
96	6/26/90	12.8	36.0	36.0	36.0	40.0	44.0	46.0	46.0	46.0		46.0	46.0	[spawner upper river]							
97	6/26/90	14.5	27.0	28.0	28.0	28.0	29.0		30.0	30.0		44.0	49.0		49.0	49.0	48.0		48.0	46.0	
98	6/26/90	13.0	22.0		22.0	30.0	30.0	30.0	30.0	Fun		Fun				Fun	[spawner Funny River]				

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No.	Date Tagged	RM Tagged	River Mile Locations By Date																						
			7/07	7/09	7/10	7/11	7/12	7/13	7/14	7/16	7/17	7/18	7/19	7/20	7/21	7/23	7/24	7/25	7/26	7/27	7/28				
99	6/26/90	12.0				Jun				Jun	[spawner Juneau Creek]														
100	6/26/90	12.5																							
101	6/26/90	13.5	30.0	30.0	28.0	28.0	30.0	30.0	30.0	30.0		Fun				Fun			Fun	[spawner Funny River]					
102	6/27/90	13.8	29.0	30.0	29.0	30.0	30.0	30.0	36.0	44.0	65.0					98.0			Gra						
103	6/27/90	13.0	3.0		6.5	6.0	6.0		6.5	[drop out after 7/15/90]															
104	6/27/90	12.0	37.0	44.0	44.0	44.0	46.0	46.0	Kil			Kil				Kil			Kil	[spawner Killey River]					
105	6/27/90	12.3	28.0	28.0	28.0	28.0	30.0	31.0	42.0	49.0			49.0		65.0	63.0	[spawner Skilak Lake]								
106	6/27/90	13.8	12.0		12.0	14.5	14.5		28.0	30.0		30.0	Fun			Fun	[spawner Funny River]								
107	6/27/90	13.0	Fun	Fun				Fun				Fun	[spawner Funny River]												
108	6/27/90	12.3	26.0	36.0	36.0	36.0	36.0	36.0	36.0	36.0		36.0	[spawner middle river]												
109	6/28/90	12.0	3.0		out	out	out		out	out	[drop out after 7/07/90]														
110	6/28/90	11.8	[uplost after 7/06/90]																						
111	6/28/90	12.0																							
112	6/28/90	12.0	12.0		14.5	12.0	14.5		14.5	14.5	12.0	12.0	12.0	12.0	14.5	12.0	12.0	12.0	14.5	14.5	14.5				
113	6/28/90	12.0	27.0	28.0	28.0	28.0	27.0	27.0	27.0	27.0		13.0	12.0		12.0	12.0	12.0	[spawner middle river]							
114	6/28/90	11.5																							
115	6/29/90	13.8	22.0		22.0	22.0	23.0		23.0	27.0		24.0	44.0		Kil	Kil			Kil						
116	6/29/90	12.0	8.5		9.0	9.0	7.0		7.0	7.0		10.0	8.0		7.0	6.5	7.0	[mortality after 7/14/90]							
117	6/29/90	12.0	28.0	28.0	29.0	29.0	29.0	29.0	28.0	28.0	[harvested in sport fishery at mi 28 on 7/17/90]														
118	6/29/90	12.3	19.0		27.0	28.0	30.0	29.0	29.0	29.0		41.0	44.0		Kil	Kil			Kil						
119	6/29/90	10.5	Fun	Fun								49.0	49.0		49.0	49.0	49.0		49.0	49.0					
120	6/29/90	11.5	26.0	28.0	27.0	27.0	27.0	27.0	27.0	27.0		27.0	28.0		27.0	30.0	30.0		27.0						
121	6/30/90	12.0	6.5		7.0	7.0	7.0		11.0	17.0	22.0	24.0	28.0		28.0	26.0	[spawner middle river]								
122	6/30/90	12.0																							
123	6/30/90	11.5	4.0		4.0	4.0	4.0		4.0	4.0	[hook-and-release mortality]														
124	6/30/90	14.5	22.0		22.0	21.0	24.0	25.0	28.0	31.0	40.0	42.0			43.0	43.0	42.0		42.0	41.0					
125	6/30/90	14.5	27.0		26.0	27.0	27.0	28.0	26.0	28.0		30.0	42.0		46.0	48.0	50.0								

Appendix A4. Movements during 30 July - 12 August of chinook salmon that were tagged during the early run (22 May - 30 June).

No.	Date Tagged	RM Tagged	River Mile Locations By Date 7/30	7/31	8/01	8/02	8/03	8/04	8/05	8/06	8/07	8/08	8/09	8/10	8/11	8/12	[Ultimate Fate]
1	5/22/90	14.5															
2	5/23/90	13.0															
3	5/30/90	12.5															
4	5/31/90	14.5															
5	6/07/90	14.8															
6	6/07/90	14.8															
7	6/08/90	14.8															
8	6/08/90	14.8															
9	6/08/90	13.5															
10	6/08/90	13.5															
11	6/09/90	14.8															
12	6/09/90	14.8															
13	6/09/90	14.8															
14	6/09/90	13.5															
15	6/09/90	13.5															
16	6/09/90	13.5															
17	6/09/90	13.5															
18	6/09/90	13.5															
19	6/09/90	13.5															
20	6/10/90	13.5															
21	6/09/90	13.5															
22	6/09/90	13.5															
23	6/10/90	12.8															
24	6/10/90	14.8															
25	6/10/90	14.8															
26	6/10/90	14.5															
27	6/10/90	14.5															
28	6/10/90	14.0															
29	6/10/90	13.5															
30	6/10/90	13.0															
31	6/10/90	13.0															
32	6/10/90	13.3															
33	6/10/90	13.0															
34	6/12/90	13.0															
35	6/12/90	13.5															
36	6/12/90	13.0															
37	6/12/90	13.3															
38	6/12/90	13.0															
39	6/12/90	13.5															
40	6/12/90	14.5		69.0	[spawner interlake reach]												
41	6/12/90	14.0															
42	6/12/90	13.0															
43	6/12/90	13.0															
44	6/12/90	14.5															
45	6/12/90	13.5		Kil		Kil				Kil	[spawner Killey River]						
46	6/12/90	13.5		Kil		Kil				Kil	[spawner Killey River]						
47	6/12/90	13.8					78.0			78.0				78.0	[spawner interlake reach]		
48	6/12/90	14.5															
49	6/12/90	13.5															

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Appendix A4. (Page 2 of 3).

No.	Date Tagged	RM Tagged	River Mile Locations By Date 7/30	7/31	8/01	8/02	8/03	8/04	8/05	8/06	8/07	8/08	8/09	8/10	8/11	8/12	[Ultimate Fate]
50	6/12/90	13.5															
51	6/12/90	13.0															
52	6/12/90	14.8															
53	6/13/90	13.5															
54	6/13/90	13.5															
55	6/13/90	14.5															
56	6/14/90	13.0															
57	6/14/90	13.5															
58	6/14/90	13.0															
59	6/14/90	13.0															
60	6/14/90	11.5															
61	6/14/90	12.0															
62	6/14/90	13.5															
63	6/14/90	14.5															
64	6/15/90	13.5		Kil	[spawner Killey River]												
65	6/15/90	13.0															
66	6/15/90	11.5															
67	6/15/90	13.5															
68	6/15/90	13.8															
69	6/16/90	13.5															
70	6/16/90	13.5															
71	6/16/90	13.0															
72	6/16/90	13.5															
73	6/16/90	13.8															
74	6/19/90	13.5															
75	6/19/90	13.0	[spawner middle river]														
76	6/19/90	13.0															
77	6/19/90	11.5															
78	6/19/90	11.5															
79	6/20/90	13.5															
80	6/20/90	13.5															
81	6/20/90	13.5															
82	6/20/90	12.0															
83	6/20/90	12.0															
84	6/21/90	13.5															
85	6/21/90	13.0															
86	6/21/90	12.0															
87	6/21/90	11.5															
88	6/21/90	12.3															
89	6/22/90	12.0															
90	6/22/90	11.5															
91	6/22/90	12.3															
92	6/22/90	13.5															
93	6/22/90	12.3															
94	6/26/90	13.0															
95	6/26/90	13.8															
96	6/26/90	12.8															
97	6/26/90	14.5	46.0	46.0	46.0	46.0	46.0			46.0		46.0		46.0	[spawner upper river]		
98	6/26/90	13.0															

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No.	Date Tagged	RM Tagged	River Mile Locations By Date 7/30	7/31	8/01	8/02	8/03	8/04	8/05	8/06	8/07	8/08	8/09	8/10	8/11	8/12	[Ultimate Fate]
99	6/26/90	12.0															
100	6/26/90	12.5															
101	6/26/90	13.5															
102	6/27/90	13.8		Gra			Gra			Gra	[spawner Grant Creek]						
103	6/27/90	13.0															
104	6/27/90	12.0															
105	6/27/90	12.3															
106	6/27/90	13.8															
107	6/27/90	13.0															
108	6/27/90	12.3															
109	6/28/90	12.0															
110	6/28/90	11.8															
111	6/28/90	12.0															
112	6/28/90	12.0	12.0	[spawner lower river]													
113	6/28/90	12.0															
114	6/28/90	11.5															
115	6/29/90	13.8		Kil		Kil				Kil				Kil	[spawner Killey River]		
116	6/29/90	12.0															
117	6/29/90	12.0															
118	6/29/90	12.3		Kil	[spawner Killey River]												
119	6/29/90	10.5	49.0	49.0	49.0	49.0	66.0			65.0				65.0	[spawner interlake reach]		
120	6/29/90	11.5								25.0		22.0	[spawner middle river]				
121	6/30/90	12.0															
122	6/30/90	12.0															
123	6/30/90	11.5															
124	6/30/90	14.5	40.0	41.0	41.0	41.0	41.0			41.0		40.0		40.0	[spawner upper river]		
125	6/30/90	14.5		Jun			75.0			75.0				75.0	[spawner interlake reach]		

Appendix A5. Movements during 5 July - 31 July of chinook salmon that were tagged during the late run (3 July - 31 July).

No.	Date Tagged	RM Tagged	River Mile Locations By Date 7/05	7/06	7/07	7/10	7/11	7/12	7/13	7/14	7/16	7/17	7/18	7/19	7/20	7/21	7/23	7/24	7/25	7/26	7/27	7/28	7/30	7/31
126	7/03/90	14.5	16.0	16.0	17.0	21.0	23.0	20.0		21.0	22.0	19.0	23.0	23.0		22.0	[east side set net on 7/23/90]							
127	7/03/90	12.0	11.0	12.0	11.0	12.0	12.0	10.0		10.0	12.0		14.5	14.5	[harvested in sport fishery at mi 14.5 on 7/20/90]									
128	7/03/90	11.3	16.0	14.5	14.5	13.0	12.0	14.5		16.0	17.0		16.0	16.0	12.0	12.0	12.0	12.0		14.5	19.0	22.0	19.0	20.0
129	7/03/90	12.3		5.0	12.0	19.0	19.0	19.0		19.0	17.0		18.0	18.0	19.0	19.0	19.0	19.0	Sli	Sli	[found dead in Slicok Creek on 7/27/90 unspent]			
130	7/05/90	12.3		14.5	20.0	36.0	36.0	44.0	44.0	44.0	46.0		Kil				Kil			Ben				Ben
131	7/05/90	11.0		6.5	7.0	6.5	6.5	6.5		6.0	5.0	[hook-and-release mortality]												
132	7/05/90	11.3		12.0	12.0	12.0	12.0	11.5		11.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	13.0	12.0	12.0	12.0	12.0
133	7/05/90	11.3		17.0	12.0	4.0	6.5			out	out	[drop out after 7/11/90]												
134	7/05/90	11.5		23.0	25.0	34.0	30.0	28.0	28.0	30.0	30.0	30.0	30.0	38.0		44.0	44.0	44.0		46.0	46.0		49.0	49.0
135	7/05/90	11.3		3.0	4.0	4.0	4.0	4.0		4.0	4.0	5.0	5.0	[hook-and-release mortality]										
136	7/05/90	11.3		12.0	10.0	11.0	11.0	10.0		10.0	11.0	12.0	10.0	11.5	12.0	12.0	2.0	out	[drop out after 7/23/89]					
137	7/05/90	11.3		12.0	12.0	12.0	12.0	12.0		13.0	13.0		18.0	12.0	14.5	14.5	14.5	14.5	18.0	18.0	18.0	18.0	12.0	10.0
138	7/05/90	11.3		16.0	16.0	11.0	11.0	10.0		10.0	11.0		10.0	11.0		11.0	11.0	10.0	[caught by tagging crew at mi 9.2 on 7/24/90]					
139	7/05/90	11.3		12.0	12.0	13.0	13.0	14.5		16.0	14.5	14.5	14.5	14.5	14.5	14.5	25.0	26.0	[harvested in sport fishery at mi 30 on 7/25/90]					
140	7/06/90	11.5			10.0	11.0	11.0	18.0		17.0	3.0		5.0	4.0		10.0	12.0	10.0		12.0	11.0		10.0	9.0
141	7/06/90	11.3			6.5	20.0	23.0	26.0	27.0	27.0	26.0			11.0	[lost signal after 7/19/90]									
142	7/06/90	11.3			12.0	10.0	11.5	11.0		11.0	11.0		12.0	16.0	14.5	14.5	12.0	10.0		11.0	[harvested in sport fishery at mi 13.5 on 7/27/90]				
143	7/06/90	12.3			10.0	10.0	10.0	9.0		11.0	11.0	12.0	11.0	10.0	12.0	12.0	11.0	10.0	12.0	6.5	6.5		6.5	[spawner lower river]
144	7/06/90	10.5			10.0	10.0	8.5	9.0		9.0	[caught by tagging crew at mi 9.3 on 7/14/90]													
145	7/06/90	11.3			12.0	12.0	12.0	11.0		11.0	12.0		2.0	3.0		3.0		out	[drop out after 7/21/90]					
146	7/06/90	11.5			10.0	9.0	8.5	12.0		11.0	12.0	12.0	12.0	12.0	12.0	12.0			12.0	[erratic radio signal, tag failure after 7/25/90]				
147	7/06/90	11.5			12.0	8.5	12.0	12.0		9.0	12.0	12.0	12.0	10.0	12.0	12.0	10.0	11.0	12.0	12.0			0.0	3.0
148	7/06/90	11.5			2.0	[east side set net off Humpy Pt. on 7/09/90]																		
149	7/06/90	11.0			7.0	2.0	[hook-and-release mortality]																	
150	7/07/90	11.8				4.0	4.0	3.0		3.0	[hook-and-release mortality]													
151	7/07/90	11.3				6.5	9.0	11.0		6.0				1.0		1.0	1.0	1.0		out	[drop out after 7/24/90]			
152	7/07/90	11.3				3.0	12.0	16.0		14.5	14.5	14.5	16.0	out		out	[east side set net on 7/21/90]							
153	7/07/90	11.3				12.0	12.0	12.0		12.0	10.0		9.0	10.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	18.0	22.0
154	7/10/90	12.0					12.0	14.5		14.5	14.5	15.0	14.5	14.5	19.0	14.5	27.0	32.0		36.0	36.0		38.0	38.0
155	7/10/90	11.3					13.0	12.0		12.0	14.5	14.5	12.0	14.5		14.5	19.0	19.0		19.0	17.0	17.0	17.0	16.0
156	7/10/90	11.5					12.0	11.0		10.0	12.0	12.0	12.0	12.0	12.0	[east side set net on 7/21/90]								
157	7/10/90	11.0					5.0	4.0		4.0	4.0	[hook-and-release mortality]												
158	7/10/90	12.3					12.0	14.5		18.0	19.0		20.0	22.0	22.0	22.0	14.5	14.5	14.5	14.5	14.5	14.5	15.0	[spawner middle river]
159	7/10/90	13.5					12.0	14.5		15.0	14.5	14.5	14.5	14.5	14.5	14.5	14.5	14.5	14.5	16.0	15.5		16.0	8.5
160	7/11/90	11.3						[harvested in sport fishery at mi 13.5 on 7/12/90]																
161	7/11/90	11.0						11.0		12.0	14.5	[harvested in sport fishery at mi 16.6 on 7/17/90]												
162	7/11/90	10.0						9.0		14.5	14.5		13.0	14.0		14.0	[uplost after 7/21/90]							
163	7/11/90	11.3						12.0		16.0	14.0	14.5	12.0	16.0	16.0	16.0	16.0	19.0	22.0	22.0	22.0	[spawner lower river]		
164	7/11/90	12.0						11.5		12.0	12.0	12.0	4.0	12.0	[uplost after 7/19/90]									
165	7/12/90	11.0								12.0	16.0	14.5	14.5	14.5	14.5	14.5	14.5	14.5	14.5	20.0	10.0		7.0	7.0
166	7/12/90	11.3								4.0	3.0		3.0	[hook-and-release mortality]										
167	7/12/90	10.8								10.0	9.0	out	[drop out after 7/16/90]											
168	7/12/90	10.0								13.0	17.0	19.0	19.0	22.0	[harvested in sport fishery at mi 21 on 7/21/90]									
169	7/12/90	10.0								13.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	[harvested in sport fishery at rm 13.5 on 7/27/90]			
170	7/12/90	11.3								19.0	19.0	[harvested in sport fishery at mi 19 on 7/17/90]												
171	7/12/90	10.0								8.0	14.5		12.0	12.0	12.0	12.0	14.5	14.5	14.5	14.5	14.5	14.5	14.5	14.5
172	7/13/90	11.0								14.5	16.0		20.0	22.0	22.0	22.0	23.0	26.0		25.0	27.0		24.0	24.0
173	7/13/90	11.5								11.0	10.0	12.0	12.0	10.0	12.0	10.0	12.0	0.0	out	[drop out after 7/24/90]				
174	7/13/90	11.5								11.0	14.5		19.0	22.0		27.0	27.0	23.0	14.5	[spawner middle river]				

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No.	Date Tagged	RM Tagged	River Mile Locations By Date																														
			7/05	7/06	7/07	7/10	7/11	7/12	7/13	7/14	7/16	7/17	7/18	7/19	7/20	7/21	7/23	7/24	7/25	7/26	7/27	7/28	7/30	7/31									
175	7/13/90	11.3								12.0	12.0	12.0	12.0	12.0	12.0	12.0	19.0	19.0	19.0	19.0	20.0	20.0	19.0	20.0									
176	7/13/90	11.0								[harvested in sport fishery at mi 17 on 7/14/90]																							
177	7/13/90	11.5								16.0	17.0	19.0	22.0	25.0		30.0	44.0	47.0		60.0				60.0									
178	7/13/90	12.0								10.0	12.0	12.0	12.0	10.0		10.0	12.0	12.0		12.0	12.0	12.0	10.0	10.0									
179	7/13/90	11.5								12.0	14.5	12.0	14.5	16.0	14.5	14.5	16.0	16.0		16.0	12.0	14.5	18.0	20.0									
180	7/13/90	10.0								14.5	22.0	22.0	22.0	22.0	22.0	22.0	22.0	22.0	22.0	22.0	22.0	22.0	26.0	26.0									
181	7/14/90	11.3									11.0		17.0	24.0		26.0	26.0	27.0	[harvested in sport fishery at mi 28 on 7/25/90]														
182	7/14/90	11.3									5.0		4.0	4.0		5.0	8.5	8.5		9.0	10.0	12.0	6.5	7.0									
183	7/14/90	11.0									10.0		10.0	9.0	12.0	9.0	12.0	10.0			12.0	12.0	11.0	10.0									
184	7/14/90	11.3									11.0	12.0	12.0	12.0	12.0	5.0	10.0	12.0	12.0	12.0	12.0	12.0	10.0	12.0									
185	7/14/90	10.5									14.5	14.5	16.0	16.0		18.0	19.0	20.0		20.0	20.0		18.0	20.0									
186	7/14/90	11.3									10.0		14.5	17.0		19.0	18.0	20.0		20.0	19.0	19.0	20.0	19.0									
187	7/14/90	11.5									4.0		4.0	4.0		4.0	10.0	9.0		10.0	10.0		11.0	11.0									
188	7/17/90	11.0											14.5	16.0	14.5	16.0	17.0	14.5	14.5	18.0	14.5	14.5	14.5	17.0									
189	7/17/90	11.0											10.0	9.0	19.0	26.0	26.0	38.0		38.0	38.0		35.0	34.0									
190	7/17/90	10.0											10.0	9.0		9.0	10.0	10.0		12.0	11.0		12.0	12.0									
191	7/17/90	10.0											12.0	17.0	19.0	19.0	19.0	19.0	19.0	19.0	19.0	19.0	19.0	19.0									
192	7/17/90	10.0											12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0									
193	7/17/90	10.0											8.5	8.5		9.0	[caught by tagging crew at mi 6.9 on 7/22/90]																
194	7/17/90	10.0											17.0	25.0		29.0	30.0	30.0		30.0	30.0		30.0	30.0									
195	7/17/90	10.0											11.0	9.0		9.0	12.0	12.0	12.0	10.0	10.0		12.0	12.0									
196	7/17/90	10.0											12.0	12.0	14.5	14.5	14.5	14.5	14.5	14.5	14.5	14.5	14.5	14.5									
197	7/17/90	10.2											6.0	6.5		4.0	7.0	7.0		7.0	9.0		9.0	7.0									
198	7/17/90	10.0											6.0	12.0	12.0	14.5	12.0	9.0		9.0	9.0	12.0	8.0	9.0									
199	7/17/90	10.0											8.0	8.0		8.0	8.5	9.0	12.0	8.5	9.0	12.0	11.0	11.0									
200	7/17/90	10.0											12.0	12.0		18.0	19.0	19.0	19.0	19.0	19.0	22.0	27.0	34.0									
201	7/17/90	10.0											12.0	14.5	14.5	14.5	16.0	14.5	14.5	14.5	16.0	16.0	16.0	16.0									
202	7/17/90	10.0											18.0	24.0		27.0	27.0	27.0		27.0	27.0		28.0	28.0									
203	7/17/90	10.5											14.5	27.0		29.0	32.0	32.0		38.0	40.0		40.0	40.0									
204	7/17/90	10.0											12.0	9.0	12.0	11.0	12.0	10.0	12.0	12.0	12.0	12.0	11.0	11.0									
205	7/17/90	10.0											12.0	14.5	14.5	18.0	20.0	20.0		20.0	20.0	22.0	22.0	19.0									
206	7/17/90	10.0											12.0	14.5	14.5	14.5	14.5	14.5	14.5	14.5	14.5	14.5	14.5	14.5									
207	7/17/90	10.0											14.5	14.5		16.0	20.0	20.0		23.0	25.0		25.0	25.0									
208	7/18/90	13.0												12.0	12.0	14.5	26.0	27.0		27.0	27.0		22.0	28.0									
209	7/18/90	10.0												12.0	12.0	12.0	12.0	12.0	12.0	10.0	10.0		12.0	12.0									
210	7/18/90	10.0												12.0	12.0	14.5	14.5	14.5	14.5	14.5	14.5	14.5	14.5	14.5									
211	7/18/90	10.0												9.0	12.0	12.0	14.5	14.5	14.5	14.5	[uplost after 7/26/90]												
212	7/18/90	10.0												12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0									
213	7/18/90	10.0												6.0			3.0	3.0		out	out	[set net - from processor, no date]										
214	7/18/90	11.3												9.0		9.0	7.0	6.5	5.0	4.0	0.0	[hook-and-release mortality]										
215	7/18/90	11.3												7.0		8.0	17.0	20.0		20.0	20.0	17.0	17.0	17.0									
216	7/19/90	10.8														2.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0									
217	7/19/90	13.3													12.0	10.0	9.0	6.0		12.0	12.0	12.0	12.0	10.0									
218	7/20/90	10.0														5.0	13.0	12.0	12.0	12.0	12.0	12.0	14.5	14.5									
219	7/20/90	10.0														12.0	12.0	12.0	14.5	16.0	16.0	14.5	12.0	12.0									
220	7/20/90	12.3														12.0	20.0	20.0		28.0	28.0		30.0	40.0									
221	7/21/90	10.0															12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0									
222	7/21/90	11.0															12.0	10.0	12.0	10.0	10.0		12.0	11.0									
223	7/21/90	13.5															14.5	14.5	14.5	14.5	14.5		14.5	14.5									

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Appendix A5. (Page 3 of 3).

No.	Date Tagged	RM Tagged	River Mile Locations By Date 7/05	7/06	7/07	7/10	7/11	7/12	7/13	7/14	7/16	7/17	7/18	7/19	7/20	7/21	7/23	7/24	7/25	7/26	7/27	7/28	7/30	7/31
224	7/24/90	12.8																	14.5	14.5	14.5	17.0	26.0	27.0
225	7/24/90	10.8																	(harvested in sport fishery at mi 13 on 7/24/90]					
226	7/24/90	11.8																	12.0	10.0	12.0	out	[drop out after 7/28/90]	
227	7/24/90	10.5																		19.0	14.5	12.0	27.0	27.0
228	7/24/90	11.3																	12.0	12.0	12.0	12.0	12.0	12.0
229	7/25/90	11.3																		10.0	12.0	12.0	12.0	12.0
230	7/25/90	11.3																		12.0	12.0	12.0	12.0	5.0
231	7/25/90	11.3																		14.5	18.0	18.0	12.0	6.0
232	7/25/90	11.3																		14.5	16.0	17.0	19.0	21.0
233	7/25/90	11.0																		13.0	14.5	17.0	27.0	27.0
234	7/25/90	11.0																		12.0	[caught by tagging crew at mi 7.0 on 7/27/90]			
235	7/26/90	11.3																			12.0	12.0	12.0	14.5
236	7/26/90	11.3																			9.0		10.0	12.0
237	7/28/90	13.0																					12.0	19.0
238	7/28/90	11.8																					6.0	out
239	7/31/90	12.0																						
240	7/31/90	10.0																						
241	7/31/90	10.0																						
242	7/31/90	10.0																						
243	7/31/90	11.3																						
244	7/31/90	10.8																						
245	7/31/90	12.3																						

Appendix A6. Movements during 1 August - 4 September of chinook salmon that were tagged during the late run (3 July - 31 July).

	Date	RM	River Mile Locations By Date																	
No.	Tagged	Tagged	8/01	8/02	8/03	8/06	8/07	8/08	8/09	8/10	8/13	8/15	8/17	8/20	8/22	8/24	8/27	8/29	9/04	[Ultimate Fate]
126	7/03/90	14.5																		
127	7/03/90	12.0																		
128	7/03/90	11.3	20.0	20.0	19.0	16.0	14.5	14.5	14.5	13.0	9.0	9.0	9.0	9.0	9.0	[spawner middle river]				
129	7/03/90	12.3																		
130	7/05/90	12.3		Ben		Ben				Ben										
131	7/05/90	11.0																		
132	7/05/90	11.3	12.0	12.0	11.0	7.0	[spawner lower river]													
133	7/05/90	11.3																		
134	7/05/90	11.5	49.0	43.0	43.0	40.0		40.0	[spawner upper river]											
135	7/05/90	11.3																		
136	7/05/90	11.3																		
137	7/05/90	11.3	11.0		11.0	6.5		3.0		3.0	out	3.0	3.0	[spawner lower river]						
138	7/05/90	11.3																		
139	7/05/90	11.3																		
140	7/06/90	11.5	10.0		8.5	8.0	[spawner lower river]													
141	7/06/90	11.3																		
142	7/06/90	11.3																		
143	7/06/90	12.3																		
144	7/06/90	10.5																		
145	7/06/90	11.3																		
146	7/06/90	11.5																		
147	7/06/90	11.5	out	2.0	2.0	[spawner lower river]														
148	7/06/90	11.5																		
149	7/06/90	11.0																		
150	7/07/90	11.8																		
151	7/07/90	11.3																		
152	7/07/90	11.3																		
153	7/07/90	11.3	19.0		14.5	16.0	17.0	17.0	14.5	13.0										
154	7/10/90	12.0	38.0	36.0	36.0	36.0	[spawner middle river]													
155	7/10/90	11.3	[spawner lower river]																	
156	7/10/90	11.5																		
157	7/10/90	11.0																		
158	7/10/90	12.3																		
159	7/10/90	13.5	9.0		8.0	[spawner lower river]														
160	7/11/90	11.3																		
161	7/11/90	11.0																		
162	7/11/90	10.0																		
163	7/11/90	11.3																		
164	7/11/90	12.0																		
165	7/12/90	11.0	4.0		3.0	3.0		3.0		out										
166	7/12/90	11.3																		
167	7/12/90	10.8																		
168	7/12/90	10.0																		
169	7/12/90	10.0																		
170	7/12/90	11.3																		
171	7/12/90	10.0	14.5	14.5	14.5	16.0		16.0	15.0	16.0	17.0	17.0	17.0	17.0	17.0	[spawner lower river]				
172	7/13/90	11.0	24.0		28.0	28.0		41.0		60.0	72.0	73.0	73.0	[spawner interlake reach]						
173	7/13/90	11.5																		
174	7/13/90	11.5																		

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Appendix A6. (Page 2 of 3).

No.	Date Tagged	RM Tagged	River Mile Locations By Date 8/01	8/02	8/03	8/06	8/07	8/08	8/09	8/10	8/13	8/15	8/17	8/20	8/22	8/24	8/27	8/29	9/04	[Ultimate Fate]
175	7/13/90	11.3	20.0	19.0	19.0	15.5	[spawner lower river]													
176	7/13/90	11.0																		
177	7/13/90	11.5			74.0	Jun				Jun	Jun	Jun	69.0	[spawner Juneau Creek]						
178	7/13/90	12.0	12.0	12.0	12.0	11.0		5.0		3.0										
179	7/13/90	11.5	22.0	23.0	22.0	22.0	[spawner middle river]													
180	7/13/90	10.0	27.0		28.0	37.0		32.0		38.0	38.0	43.0	38.0	40.0	38.0		38.0	[spawner middle river]		
181	7/14/90	11.3																		
182	7/14/90	11.3	3.0	4.0	4.0	5.0		5.0		3.0	out	[drop out after 8/10/90]								
183	7/14/90	11.0	[caught by tagging crew at mi 9.2 on 7/31/90]																	
184	7/14/90	11.3	12.0		7.0	7.0	[spawner lower river]													
185	7/14/90	10.5	22.0	22.0	22.0	24.0		40.0		40.0	43.0	43.0	43.0	43.0	43.0	42.0	41.0	[spawner upper river]		
186	7/14/90	11.3	17.0	19.0	22.0	15.5		15.5		15.5	[spawner lower river]									
187	7/14/90	11.5		Bev	Bev	12.0		8.0		7.0	5.0	4.0	4.0	[spawner lower river]						
188	7/17/90	11.0	17.0		14.5	16.0		17.0		17.0	15.5	16.0	[spawner lower river]							
189	7/17/90	11.0	35.0	35.0	34.0	[spawner middle river]														
190	7/17/90	10.0	12.0	12.0	16.0	20.0	20.0	20.0		22.0	28.0	43.0	43.0	43.0	43.0	43.0	43.0	[spawner upper river]		
191	7/17/90	10.0	18.0	19.0	20.0	19.0	19.0			19.0	19.0	19.0		17.0	16.0	[spawner lower river]				
192	7/17/90	10.0	12.0	12.0	11.0	12.0	14.5	14.5	14.5	14.5	16.0	17.0	16.0	16.0	16.0	16.0	16.0	[spawner lower river]		
193	7/17/90	10.0																		
194	7/17/90	10.0	30.0		30.0	31.0		31.0		34.0	47.0	46.0	46.0	46.0	46.0	46.0	46.0	[spawner upper river]		
195	7/17/90	10.0	12.0		11.0	12.0	12.0	12.0	14.5	14.5	16.0	16.0	16.0	15.5	[spawner lower river]					
196	7/17/90	10.0	16.0	18.0	16.0	16.0		16.0	15.0	14.5	8.5	8.5	8.5	8.0	8.5	[spawner lower river]				
197	7/17/90	10.2	7.0		5.0	4.0		out	[drop out after 8/6/90]											
198	7/17/90	10.0	6.0		6.5	7.0		5.0		4.0	4.0	4.0	[spawner lower river]							
199	7/17/90	10.0	12.0		9.0	9.0		9.0		9.0	22.0	22.0	26.0	26.0	26.0	26.0	22.0	[spawner middle river]		
200	7/17/90	10.0	34.0	34.0	34.0	34.0	[spawner middle river]													
201	7/17/90	10.0	16.0		17.0	18.0		18.0		20.0	21.0	19.0	19.0	19.0	19.0	19.0	17.0	[spawner lower river]		
202	7/17/90	10.0	28.0		27.0	28.0		34.0		34.0	34.0	34.0	33.0	32.0	32.0	32.0	34.0	[spawner middle river]		
203	7/17/90	10.5	40.0		26.0	16.0		12.0		26.0	47.0	27.0	27.0	27.0	27.0	[spawner upper river]				
204	7/17/90	10.0	12.0	12.0	14.5	14.5	15.5	14.5	14.5	[spawner lower river]										
205	7/17/90	10.0	19.0	20.0	[spawner lower river]															
206	7/17/90	10.0	14.5	14.5	14.5	14.5	14.5	14.5	14.5	17.0	22.0	23.0	17.0	19.0	20.0	20.0	17.0	17.0	[spawner lower river]	
207	7/17/90	10.0	25.0		27.0	25.0	23.0	23.0	24.0	24.0	30.0	46.0	60.0		72.0	72.0		72.0	72.0	[spawner interlake reach]
208	7/18/90	13.0	28.0		38.0	38.0		37.0		37.0	[spawner middle river]									
209	7/18/90	10.0	12.0	12.0	14.5	28.0		34.0		34.0	34.0	33.0	38.0			11.5	[spawner middle river]			
210	7/18/90	10.0	14.5	14.5	14.5	16.0	17.0	25.0	17.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	[spawner middle river]
211	7/18/90	10.0																		
212	7/18/90	10.0	12.0	12.0	12.0	12.0	12.0	16.0		16.0	26.0	26.0	26.0	26.0	26.0	25.0	[spawner middle river]			
213	7/18/90	10.0																		
214	7/18/90	11.3																		
215	7/18/90	11.3	17.0		18.0	[uplost after 8/3/90]														
216	7/19/90	10.8	12.0	12.0	12.0	14.5	15.0	20.0		32.0	37.0	37.0	33.0	32.0	32.0	27.0	28.0	28.0	[spawner middle river]	
217	7/19/90	13.3	10.0		10.0	10.0		10.0	[caught by tagging crew at mi 9.2 on 8/09/90]											
218	7/20/90	10.0	14.5	14.5	14.5	12.0	12.0	22.0	23.0	28.0	25.0	25.0	25.0	25.0	[spawner middle river]					
219	7/20/90	10.0	12.0	12.0	8.5	7.0		7.0		4.0	4.0	4.0	[spawner lower river]							
220	7/20/90	12.3	45.0		60.0	71.0				71.0	[spawner interlake reach]									
221	7/21/90	10.0	12.0	12.0	12.0	12.0	12.0	22.0	17.0	20.0	27.0	26.0	26.0	27.0	26.0	25.0	21.0	21.0	[spawner middle river]	
222	7/21/90	11.0	11.0	11.0	12.0	13.0	12.0	11.0		11.0	9.0	10.0	10.0	6.5	7.0	7.0	6.5	6.5	7.0	[spawner lower river]
223	7/21/90	13.5	16.0	14.5	14.5	14.5		16.0	17.0	19.0	19.0	19.0	19.0	19.0	[spawner lower river]					

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Appendix A6. (Page 3 of 3).

No.	Date Tagged	RM Tagged	River Mile Locations By Date 8/01	8/02	8/03	8/06	8/07	8/08	8/09	8/10	8/13	8/15	8/17	8/20	8/22	8/24	8/27	8/29	9/04	[Ultimate Fate]
224	7/24/90	12.8	30.0		46.0	[uplost after 8/03/90]														
225	7/24/90	10.8																		
226	7/24/90	11.8																		
227	7/24/90	10.5	32.0	33.0	33.0	34.0	36.0	36.0		36.0	35.0	38.0	41.0	41.0	41.0	41.0	41.0	41.0	[spawner upper river]	
228	7/24/90	11.3	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	14.5	16.0	20.0	19.0	20.0	19.0	17.0	5.0	[spawner lower river]	
229	7/25/90	11.3	12.0	14.5	14.5	14.5	14.5	14.5	14.5	14.5	22.0	6.0	14.5	25.0	[uplost after 8/20/90]					
230	7/25/90	11.3	5.0		6.5	2.0		out	[drop out after 8/06/90]											
231	7/25/90	11.3	6.0		7.0	9.0	12.0	12.0		20.0	31.0	46.0	46.0	46.0	46.0	46.0	46.0	46.0	46.0	[spawner upper river]
232	7/25/90	11.3	22.0	22.0	22.0	24.0	25.0	25.0		27.0	[harvested in sport fishery at mi 31.5 on 8/10/90]									
233	7/25/90	11.0	28.0		29.0	33.0		34.0		37.0	46.0	46.0	46.0	46.0	46.0	46.0	46.0	46.0	46.0	[spawner upper river]
234	7/25/90	11.0																		
235	7/26/90	11.3	14.5	14.5	14.5	14.5	14.5	14.5	14.5	14.5	14.5	16.0	16.0	16.0	16.0	16.0	16.0	16.0	16.0	[spawner lower river]
236	7/26/90	11.3	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	24.0	31.0	32.0	32.0	32.0	32.0	[spawner middle river]
237	7/28/90	13.0	27.0		27.0	27.0		27.0		27.0	46.0	46.0	48.0		66.0	66.0		66.0	[spawner interlake reach]	
238	7/28/90	11.8	out		8.0	12.0	12.0	14.5	14.5	14.5	17.0	17.0	19.0	19.0	19.0	[spawner lower river]				
239	7/31/90	12.0	4.0		out	out		out		out	6.5	19.0	27.0	27.0	27.0	28.0	33.0	33.0	33.0	[spawner middle river]
240	7/31/90	10.0	10.0		9.0	14.5	14.5	14.5	14.5	16.0	19.0	19.0	27.0	31.0	41.0	41.0	43.0	45.0	45.0	[spawner upper river]
241	7/31/90	10.0	7.0	13.0	16.0	16.0		10.0		10.0	10.0	12.0	12.0	13.0	13.0	13.0	13.0	13.0	15.5	[spawner lower river]
242	7/31/90	10.0	12.0	12.0	14.5	46.0		46.0		66.0	69.0	71.0	72.0		72.0	72.0		74.0	74.0	[spawner interlake reach]
243	7/31/90	11.3							12.0	12.0	12.0	15.0	17.0	23.0	28.0	33.0	33.0	33.0	33.0	[spawner middle river]
244	7/31/90	10.8	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	20.0	25.0	28.0	27.0	27.0	24.0	24.0	[spawner middle river]	
245	7/31/90	12.3	12.0	12.0	17.0	16.0	19.0	19.0		19.0	19.0	19.0	19.0	19.0	18.0	18.0	18.0	[spawner middle river]		

APPENDIX B

Appendix B1. Detailed tagging and recapture information for each radio-tagged chinook salmon.[a]

No.	Date Rele.	Water Temp.	River Mile	Time of Day	Seconds Played	Seconds To Tag	Method	Gear	#1 Hook Injury	#2 Hook Injury	Numb Hooks	Type Hook	Hook Removed	Length (mm)	Sex	Bleeding?	Where	Sea Lice	Condition	RM Rele	Guided	5 Day Fate	Final Fate
1	5/22	42	14.5	820	113	526	BT	AL	K		2	T	Y	1150	M	N		N	V	14.5	N	M	M
2	5/23	44	13.0	735	291	255	BT	AL	K		2	T	Y	915	F	N		Y	V	12.5	Y	S	SP
3	5/30	46	12.5	1130	247	245	BT	AL		K	2	S	Y	710	M	N		N	V	12.3	Y	S	SP
4	5/31	47	14.5	700	148	268	BT	AL		K	2	T	Y	735	M	N		Y	V	14.0	N	S	SP
5	6/07	53	14.8	800	300	475	BT	AL	K		1	S	Y	560	M	N		Y	V	14.5	Y	S	SP
6	6/07	53	14.8	1240	300	235	BT	AL	K		1	S	Y	775	F	Y	K	Y	V	14.3	Y	S	SP
7	6/08	53	14.8	1000	1320	270	BT	AL	K		1	S	Y	1050	M	N		Y	V	14.3	Y	S	SP
8	6/08	53	14.8	1030	755	375	BT	AL	K		1	S	Y	1110	M	N		Y	V	14.0	Y	S	SP
9	6/08	53	13.5	1042	350	140	BT	AL	K		1	S	Y	540	M	N		Y	V	13.0	Y	S	M
10	6/08	53	13.5	1055	245	224	BT	AL	K		1	S	Y	875	F	N		Y	V	13.0	Y	S	SP
11	6/09	53	14.8	630	600	309	BT	AL	K		1	S	Y	1100	M	N		Y	L	14.5	Y	S	SP
12	6/09	53	14.8	720	285	299	BT	AL	K		1	S	Y	990	M	N		Y	V	14.5	Y	S	SP
13	6/09	53	14.8	835	300	211	BT	AL	U		1	S	Y	840	M	N		Y	V	14.5	Y	S	SP
14	6/09	53	13.5	900	833	201	BT	AL	U		1	S	Y	1040	M	N		Y	V	12.5	Y	S	SP
15	6/09	53	13.5	930	319	283	BT	AL	K		1	S	Y	680	M	N		Y	V	13.0	Y	S	SP
16	6/09	53	13.5	930	200	248	BT	AL	L		1	S	Y	735	M	N		Y	V	13.0	Y	S	SP
17	6/09	53	13.5	1050	77	235	BT	AL	K		1	S	Y	950	M	N		Y	V	13.3	Y	S	TG
18	6/09	53	13.5	1010	177	257	BT	AL	K		1	S	Y	775	F	N		Y	V	13.0	Y	S	SP
19	6/09	51	13.5	1106	107	411	BT	AL	I	S	2	S	Y	515	M	Y	I	N	V	13.0	N	S	SP
20	6/10	51	13.5	730	320	271	BT	AL	L		1	S	Y	915	F	N		Y	V	13.0	N	S	SP
21	6/09	53	13.5	1050	285	360	BT	AL	C		1	S	Y	795	F	N		Y	V	13.0	Y	S	SP
22	6/09	53	13.5	1105	409	202	BT	AL	H		1	S	Y	855	M	N		Y	V	13.0	Y	S	SP
23	6/10	51	12.8	800	1179	261	BT	AL	L		2	S	Y	1050	M	N		Y	V	12.0	N	S	SP
24	6/10	51	14.8	845	320	186	BT	AL	K		1	S	Y	880	F	N		N	V	14.5	Y	S	SP
25	6/10	51	14.8	850	1212	221	BT	AL	L		1	S	Y	945	F	N		Y	V	14.5	Y	S	H
26	6/10	51	14.5	925	75	172	BT	AL	K		1	S	Y	730	M	N		N	V	14.3	Y	S	SP

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Appendix B1. (Page 2 of 10).

No.	Date Rele.	Water Temp.	River Mile	Time of Day	Seconds Played	Seconds To Tag	Method	Gear	#1 Hook Injury	#2 Hook Injury	Numb Hooks	Type Hook	Hook Removed	Length (mm)	Sex	Bleeding?	Where	Sea Lice	Condition	RM Rele	Guided	5 Day Fate	Final Fate
27	6/10	51	14.5	930	309	172	BT	AL	K		1	S	Y	945	M	N		Y	V	14.0	Y	S	H
28	6/10	51	14.0	940	480	298	BT	AL	K		1	S	Y	785	M	Y	K	Y	V	13.5	Y	S	SP
29	6/10	51	13.5	1005	492	242	BT	AL	L		1	S	Y	1000	M	N		Y	V	13.0	Y	S	SP
30	6/10	51	13.0	1015	262	255	BT	AL	L		1	S	Y	1035	F	N		Y	V	12.5	Y	S	M
31	6/10	51	13.0	1200	270	243	BT	AL	K		1	S	Y	1045	F	N		Y	V	12.5	Y	S	SP
32	6/10	51	13.3	1210	234	198	BT	AL	R		1	S	Y	975	M	Y	R	Y	V	13.0	N	S	SP
33	6/10	51	13.0	1222	290	222	BT	AL	K		1	S	Y	800	F	Y	I	Y	V	12.8	Y	S	SP
34	6/12	50	13.0	635	292	181	BT	AL	K		1	S	Y	990	M	N		N	V	12.5	Y	S	SP
35	6/12	50	13.5	710	318	190	BT	AL	U		1	S	Y	975	M	N		N	V	13.0	N	S	SP
36	6/12	50	13.0	715	160	212	BT	AL	K		1	S	Y	915	F	Y	K	Y	V	12.8	N	S	SP
37	6/12	50	13.3	730	301	217	BT	AL	K		1	S	Y	1030	F	N		Y	V	12.8	N	S	H
38	6/12	50	13.0	735	420	180	BT	AL	R		1	S	Y	820	M	N		Y	V	12.8	N	S	SP
39	6/12	50	13.5	745	190	300	BT	AL	K		1	S	Y	985	F	Y	K	N	V	13.0	N	S	SP
40	6/12	50	14.5	755	1114	250	BT	AL	K		1	S	Y	1125	M	N		N	V	13.0	Y	S	SP
41	6/12	50	14.0	820	290	210	BT	AL	C		1	S	Y	830	F	N		N	V	13.5	N	S	SP
42	6/12	50	13.0	840	165	270	BT	AL	K		1	S	Y	545	M	N		Y	V	12.8	Y	S	SP
43	6/12	50	13.0	840	580	440	BT	AL	K		1	S	Y	1125	M	N		N	V	12.5	N	S	SP
44	6/12	50	14.5	845	1560	215	BT	AL	S		1	S	N	1090	M	N		Y	V	13.3	N	S	SP
45	6/12	50	13.5	858	320	602	BT	AL	G		1	S	N	1050	F	Y	G	Y	L	12.8	Y	M	M
46	6/12	50	13.5	915	480	261	BT	AL	H		1	S	Y	1065	F	Y	H	Y	V	12.5	Y	S	SP
47	6/12	50	13.8	925	600	310	BT	AL	K		1	S	N	875	F	N		Y	V	13.0	Y	S	SP
48	6/12	50	14.5	945	315	203	BT	AL	L		1	S	Y	1000	F	N		Y	V	14.0	Y	M	M
49	6/12	50	13.5	1005	540	205	BT	AL	K		1	S	Y	1030	F	N		N	V	13.3	Y	S	SP
50	6/12	50	13.5	1045	177	276	BT	AL	U		1	S	Y	760	F	N		N	V	13.0	Y	S	SP
51	6/12	50	13.0	1115	136	279	BT	AL	K		1	S	N	850	M	N		Y	V	12.8	N	S	SP
52	6/12	50	14.8	1135	718	281	BT	AL	S		1	S	Y	960	F	N		N	V	14.0	Y	S	UL

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Appendix B1. (Page 3 of 10).

No.	Date Rele.	Water Temp.	River Mile	Time of Day	Seconds Played	Seconds To Tag	Method	Gear	#1 Hook Injury	#2 Hook Injury	Numb Hooks	Type Hook	Hook Removed	Length (mm)	Sex	Bleeding?	Where	Sea Lice	Condition	RM Rele	Guided	5 Day Fate	Final Fate
53	6/13	47	13.5	730	368	182	BT	AL	K		1	S	Y	910	F	N		Y	V	13.3	Y	S	SP
54	6/13	47	13.5	817	602	245	BT	AL	K		1	S	Y	740	M	N		N	V	12.0	Y	S	SP
55	6/13	47	14.5	1000	477	263	BT	AL	T		1	S	N	1055	F	N		Y	V	14.0	Y	M	M
56	6/14	49	13.0	755	440	262	BT	AL	T		1	S	Y	865	F	N		Y	V	12.8	Y	S	SP
57	6/14	49	13.5	925	210	182	BT	AL	K		1	S	Y	860	F	N		Y	V	13.0	Y	S	SP
58	6/14	49	13.0	930	325	262	BT	AL	K		1	S	Y	970	F	N		Y	V	12.5	Y	S	SP
59	6/14	49	13.0	945	300	262	BT	AL	K		1	S	N	835	F	N		Y	V	12.8	Y	S	SP
60	6/14	49	11.5	1110	204	387	BT	AL	K		1	S	N	815	M	N		N	V	11.0	Y	S	SP
61	6/14	49	12.0	1135	135	282	BT	AL	U		1	S	N	935	F	N		Y	V	11.8	Y	M	M
62	6/14	49	13.5	1150	300	227	BT	AL	L		1	S	Y	855	M	N		N	V	13.0	Y	S	SP
63	6/14	49	14.5	1240	194	232	BT	AL	L		1	S	N	1065	F	N		N	V	14.0	N	M	M
64	6/15	47	13.5	635	530	187	BT	AL	K		1	S	Y	960	F	N		Y	V	13.0	Y	S	SP
65	6/15	47	13.0	755	590	174	BT	AL	U		1	S	Y	900	F	N		Y	V	12.8	Y	S	SP
66	6/15	47	11.5	800	370	233	BT	AL	L		1	S	Y	1020	F	N		N	V	11.0	Y	S	SP
67	6/15	47	13.5	902	390	265	BT	AL	L		1	S	Y	975	M	Y	L	N	V	12.8	Y	M	M
68	6/15	47	13.8	1025	255	182	BT	AL	L		1	S	Y	835	M	N		Y	V	13.5	Y	S	SP
69	6/16	46	13.5	655	223	210	BT	AL	K		1	S	Y	895	F	N		Y	V	13.3	Y	S	SP
70	6/16	46	13.5	725	323	228	BT	AL	K		1	S	Y	970	F	Y	K	Y	V	13.0	Y	S	SP
71	6/16	46	13.0	820	890	234	BT	AL	U		1	S	Y	1105	M	N		Y	V	13.0	Y	S	DO
72	6/16	46	13.5	840	285	241	BT	AL	L		1	S	Y	985	F	N		N	V	13.0	Y	S	SP
73	6/16	46	13.8	850	308	207	BT	AL	S		1	S	Y	945	F	N		Y	V	13.0	Y	S	SP
74	6/19	48	13.5	920	135	184	BT	AL	U		1	S	Y	835	F	N		N	V	13.3	Y	S	SP
75	6/19	48	13.0	952	342	228	BT	AL	K		1	S	Y	915	M	N		N	V	12.8	Y	S	SP
76	6/19	48	13.0	1015	490	249	BT	AL	K		1	S	Y	985	M	Y	K	Y	V	12.5	Y	S	SP
77	6/19	48	11.5	1112	337	207	BT	AL	K		1	S	Y	1115	M	Y	K	Y	V	10.8	N	S	SP
78	6/19	48	11.5	1148	220	263	BT	AL	K		1	S	Y	1010	F	Y	K	Y	V	11.0	Y	S	SP

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Appendix B1. (Page 4 of 10).

No.	Date Rele.	Water Temp.	River Mile	Time of Day	Seconds Played	Seconds To Tag	Method	Gear	#1 Hook Injury	#2 Hook Injury	Numb Hooks	Type Hook	Hook Removed	Length (mm)	Sex	Bleeding?	Where	Sea Lice	Condition	RM Rele	Guided	5 Day Fate	Final Fate
79	6/20	48	13.5	632	90	233	BT	AL	K		1	S	Y	500	M	N		Y	V	13.0	Y	S	SP
80	6/20	48	13.5	655	167	198	BT	AL	K		1	S	Y	745	M	N		N	V	13.3	Y	S	SP
81	6/20	48	13.5	718	755	290	BT	AL	K		1	S	Y	985	M	N		N	V	12.3	Y	TN	TN
82	6/20	48	12.0	745	245	262	BT	AL	K		1	S	Y	865	M	Y	K	Y	V	11.8	N	S	SP
83	6/20	48	12.0	805	309	221	BT	AL	S		1	S	Y	920	M	N		Y	V	11.8	N	S	SP
84	6/21	48	13.5	700	221	232	BT	AL	K		1	S	Y	920	M	N		N	V	12.8	N	S	SP
85	6/21	48	13.0	825	272	219	BT	AL	L		1	S	Y	825	M	N		Y	V	12.5	N	S	SP
86	6/21	48	12.0	725	300	394	BT	AL	G		1	S	Y	565	M	Y	G	Y	L	11.3	Y	M	M
87	6/21	48	11.5	735	330	268	BT	AL	K		1	S	Y	1080	M	N		N	V	11.0	Y	S	SP
88	6/21	48	12.3	915	219	227	BT	AL	K		1	S	Y	845	F	N		Y	V	12.0	Y	S	SP
89	6/22	49	12.0	705	297	262	BT	AL	K		1	S	Y	990	M	Y	K	Y	V	11.5	N	S	SP
90	6/22	49	11.5	740	600	227	BT	AL	K		1	S	Y	1100	M	N		N	V	11.3	Y	S	SP
91	6/22	49	12.3	800	210	213	BT	AL	K		1	S	Y	635	M	N		Y	V	11.5	Y	M	M
92	6/22	49	13.5	808	420	210	BT	AL	K		1	S	Y	975	F	N		Y	V	13.3	Y	S	H
93	6/22	49	12.3	855	500	193	BT	AL	K		1	S	Y	880	M	N		Y	V	11.8	Y	S	SP
94	6/26	49	13.0	650	122	234	BT	AL	K		1	S	Y	620	M	Y	I	Y	V	12.8	Y	S	SP
95	6/26	49	13.8	720	190	217	BT	AL	U		1	S	Y	945	F	N		N	V	13.0	Y	S	M
96	6/26	49	12.8	740	900	217	BT	AL	U		1	S	Y	1045	M	N		Y	V	12.5	Y	S	SP
97	6/26	49	14.5	815	390	279	BT	AL	K		1	S	Y	1185	M	N		Y	V	14.0	N	S	SP
98	6/26	49	13.0	830	900	223	BT	AL	K		1	S	Y	860	F	N		Y	V	12.5	Y	S	SP
99	6/26	49	12.0	920	495	211	BT	AL	K		1	S	Y	1105	M	N		Y	V	11.5	Y	S	SP
100	6/26	49	12.5	940	245	164	BT	AL	K		1	S	Y	950	F	Y	K	Y	V	12.0	Y	S	H
101	6/26	49	13.5	953	480	180	BT	AL	K		1	S	Y	1005	F	N		Y	V	12.8	N	S	SP
102	6/27	47	13.8	640	510	329	BT	AL	K		1	S	Y	995	M	N		N	V	13.3	N	S	SP
103	6/27	47	13.0	705	900	303	BT	AL	U		1	S	Y	1155	F	Y	U	Y	V	12.0	N	S	DO
104	6/27	47	12.0	720	300	219	BT	AL	K		1	S	Y	915	F	Y	K	Y	V	11.8	Y	S	SP

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No.	Date Rele.	Water Temp.	River Mile	Time of Day	Seconds Played	Seconds To Tag	Method	Gear	#1 Hook Injury	#2 Hook Injury	Numb Hooks	Type Hook	Hook Removed	Length (mm)	Sex	Bleeding?	Where	Sea Lice	Condition	RM Rele	Guided	5 Day Fate	Final Fate
105	6/27	47	12.3	850	668	282	BT	AL	K		1	S	Y	1185	M	N		Y	V	12.0	Y	S	SP
106	6/27	47	13.8	840	190	230	BT	AL	K		1	S	Y	695	F	N		Y	V	13.3	Y	S	SP
107	6/27	47	13.0	845	246	194	BT	AL	K		1	S	Y	770	M	Y	I	Y	V	12.8	Y	S	SP
108	6/27	47	12.3	1000	169	273	BT	AL	K		1	S	Y	945	F	N		Y	V	11.8	Y	S	SP
109	6/28	51	12.0	810	63	238	BT	AL	K		1	S	Y	545	M	Y	K	N	V	11.8	Y	S	DO
110	6/28	51	11.8	923	330	242	BT	AL	K		1	S	Y	975	M	N		Y	V	11.0	Y	S	UL
111	6/28	51	12.0	840	191	308	BT	AL	G		1	S	N	1160	M	Y	G	Y	L	11.5	Y	S	H
112	6/28	51	12.0	850	510	248	BT	AL	K		1	S	Y	1130	M	N		Y	V	11.5	Y	S	SP
113	6/28	51	12.0	900	1200	248	BT	AL	K		1	S	Y	1210	M	N		Y	V	11.5	Y	S	SP
114	6/28	51	11.5	955	300	208	BT	AL	K		1	S	Y	940	F	N		Y	V	11.0	Y	H	H
115	6/29	53	13.8	745	600	162	BT	AL	K		1	S	Y	925	F	N		Y	V	12.8	Y	S	SP
116	6/29	53	12.0	720	365	189	BT	AL	T		1	S	N	990	F	Y	T	Y	V	11.5	Y	S	M
117	6/29	53	12.0	755	409	234	BT	AL	L		1	S	Y	1075	F	N		Y	V	11.5	Y	S	H
118	6/29	53	12.3	937	400	179	BT	AL	K		1	S	N	1045	M	N		Y	V	11.8	Y	S	SP
119	6/29	53	10.5	1130	237	211	BT	AL	K		1	S	Y	1055	F	N		Y	V	10.3	N	S	SP
120	6/29	53	11.5	1215	380	330	BT	AL	K		1	S	Y	825	M	N		Y	V	11.0	N	S	H
121	6/30	54	12.0	650	221	209	BT	AL	U		1	S	Y	925	F	N		Y	V	11.8	Y	S	SP
122	6/30	54	12.0	810	226	223	BT	AL	G		1	S	Y	955	F	Y	G	Y	L	11.3	Y	M	M
123	6/30	54	11.5	910	150	189	BT	AL	K		1	S	Y	565	M	N		Y	V	11.3	N	M	M
124	6/30	54	14.5	1220	480	216	BT	AL	K		1	S	N	1040	M	N		N	V	14.0	Y	S	SP
125	6/30	54	14.5	1400	900	325	BT	AL	K		1	S	Y	1075	M	N		Y	V	13.0	Y	S	SP
126	7/03	54	14.5	640	300	255	BT	CO		U	2	T	Y	630	M	N		Y	V	14.5	Y	S	SN
127	7/03	54	12.0	700	120	210	DR	CO		S	2	S	Y	695	M	N		N	V	11.8	N	S	H
128	7/03	54	11.3	745	110	296	DR	CO	K	K	2	S	Y	675	M	N		Y	V	11.0	N	S	SP
129	7/03	54	12.3	915	180	229	BT	CO		K	2	S	Y	520	M	Y	T	N	V	12.0	Y	S	M
130	7/03	54	12.3	645	600	225	BT	CO		S	2	S	Y	1000	F	N		Y	V	11.8	N	S	SP

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No.	Date Rele.	Water Temp.	River Mile	Time of Day	Seconds Played	Seconds To Tag	Method	Gear	#1 Hook Injury	#2 Hook Injury	Numb Hooks	Type Hook	Hook Removed	Length (mm)	Sex	Bleeding?	Where	Sea Lice	Condition	RM Rele	Guided	5 Day Fate	Final Fate
131	7/05	54	11.0	655	160	270	DR	CO		G	2	S	Y	500	M	Y	G	N	L	10.5	Y	M	M
132	7/05	54	11.3	710	190	226	DR	CO		K	2	S	Y	725	M	N		Y	V	11.0	Y	S	SP
133	7/05	54	11.3	730	90	324	DR	CO		K	2	S	Y	525	M	N		N	V	10.8	Y	S	DO
134	7/05	54	11.5	745	300	254	BT	CO		K	2	T	Y	920	F	N		N	V	11.0	Y	S	SP
135	7/05	54	11.3	835	90	165	DR	CO		U	2	S	Y	500	M	N		N	V	11.0	N	M	M
136	7/05	54	11.3	930	200	267	DR	CO		K	2	S	Y	675	M	N		Y	V	10.8	N	S	DO
137	7/05	54	11.3	950	250	210	DR	CO	L		2	S	Y	625	M	N		Y	V	11.0	N	S	SP
138	7/05	54	11.3	1005	100	235	DR	CO		L	2	S	Y	795	M	N		Y	V	11.0	N	S	TN
139	7/05	54	11.3	1017	102	185	DR	CO	R	K	2	S	Y	650	M	N		Y	V	11.0	N	S	H
140	7/06	53	11.5	645	110	338	DR	CO	L	L	2	S	Y	595	M	N		Y	V	11.3	Y	S	SP
141	7/06	53	11.3	710	90	302	DR	CO		L	2	S	Y	550	M	N		Y	V	10.8	N	S	UL
142	7/06	53	11.3	815	197	200	DR	CO		S	2	S	N	650	M	Y	L	Y	V	11.0	Y	S	H
143	7/06	53	12.3	835	150	332	DR	CO		K	2	S	N	550	M	N		Y	V	12.0	N	S	SP
144	7/06	53	10.5	1020	120	253	BT	AL		K	2	T	Y	705	M	N		Y	V	10.0	Y	S	TN
145	7/06	53	11.3	1045	120	330	DR	CO	K	K	2	S	Y	500	M	N		Y	V	10.8	Y	S	DO
146	7/06	53	11.5	1055	210	195	BT	CO	S	U	2	T	Y	640	M	Y	G	Y	V	11.0	N	S	TF
147	7/06	53	11.5	1125	330	221	BT	CO		K	2	T	Y	735	M	N		Y	V	11.3	N	S	SP
148	7/06	53	11.5	1125	600	225	DR	CO		K	2	S	Y	730	M	N		Y	V	11.0	N	SN	SN
149	7/06	53	11.0	1140	300	265	DR	CO	K	K	2	S	Y	735	M	Y	K	Y	V	10.8	N	M	M
150	7/07	53	11.8	745	330	220	DR	CO	K	R	2	S	Y	720	M	Y	K	N	V	11.3	N	M	DO
151	7/07	49	11.3	850	600	271	DR	CO		S	2	S	Y	825	M	N		Y	V	11.0	Y	S	DO
152	7/07	49	11.3	910	120	136	DR	CO		K	2	S	Y	405	M	N		N	V	11.0	Y	S	SN
153	7/07	49	11.3	940	600	246	BT	CO		L	2	T	Y	840	M	N		Y	V	11.0	N	S	SP
154	7/10	54	12.0	630	120	180	DR	CO	K		2	S	Y	645	M	N		Y	V	11.8	Y	S	SP
155	7/10	54	11.3	645	120	240	DR	CO		F	2	S	Y	615	M	N		Y	V	11.0	Y	S	SP
156	7/10	54	11.5	750	300	177	DR	CO		S	2	S	Y	670	M	N		Y	V	11.3	Y	S	SN

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No.	Date Rele.	Water Temp.	River Mile	Time of Day	Seconds Played	Seconds To Tag	Method	Gear	#1 Hook Injury	#2 Hook Injury	Numb Hooks	Type Hook	Hook Removed	Length (mm)	Sex	Bleeding?	Where	Sea Lice	Condition	RM Rele	Guided	5 Day Fate	Final Fate
157	7/10	54	11.0	805	540	243	DR	CO		L	2	S	Y	950	F	N		Y	V	10.0	Y	M	M
158	7/10	54	12.3	835	600	297	BT	CO	H	U	2	T	N	775	M	N		Y	V	11.3	N	S	SP
159	7/10	54	13.5	1300	105	246	BT	CO		K	2	S	Y	545	M	N		Y	V	13.3	Y	S	SP
160	7/10	54	11.3	715	150	213	DR	CO	L		2	S	Y	670	M	N		Y	V	11.0	Y	H	H
161	7/10	54	11.0	700	300	186	DR	CO		K	2	S	Y	675	M	N		Y	V	10.8	Y	S	H
162	7/10	54	10.0	900	157	222	DR	CO	U	S	2	S	Y	575	M	N		Y	L	9.8	Y	S	UL
163	7/11	54	11.3	935	424	248	DR	CO		S	2	S	Y	665	M	N		Y	V	10.8	Y	S	SP
164	7/11	54	12.0	1100	133	192	BT	CO		K	2	S	Y	635	M	N		Y	V	11.8	Y	S	UL
165	7/12	52	11.0	655	300	217	DR	CO		K	2	S	Y	645	M	N		Y	V	10.5	N	S	SP
166	7/12	52	11.3	710	300	178	DR	CO		K	2	S	Y	600	M	N		Y	V	11.0	N	M	M
167	7/12	52	10.8	758	73	193	DR	CO		S	2	S	Y	515	M	N		Y	V	10.5	Y	DO	DO
168	7/12	52	10.0	900	750	268	DR	CO		S	2	S	Y	1080	F	N		Y	V	9.8	N	S	H
169	7/12	52	10.0	1000	180	242	DR	CO		S	2	S	Y	550	M	N		Y	V	9.8	Y	S	H
170	7/12	52	11.3	1005	2700	330	BT	CO		S	2	S	Y	1115	M	N		Y	V	9.0	Y	S	H
171	7/12	52	10.0	1103	300	206	DR	CO		S	2	S	Y	720	M	N		Y	V	9.8	Y	S	SP
172	7/13	52	11.0	740	180	180	DR	CO	K		2	S	Y	665	M	N		Y	V	10.8	Y	S	SP
173	7/13	52	11.5	815	270	329	DR	AL	S	K	2	S	Y	830	M	N		Y	V	11.3	N	S	SN
174	7/13	52	11.5	725	180	257	DR	CO		K	2	S	N	670	M	N		Y	V	11.0	Y	S	SP
175	7/13	52	11.3	825	180	315	DR	CO	S		1	S	Y	625	M	N		N	V	11.0	N	S	SP
176	7/13	52	11.0	845	180	234	DR	AL	L	L	2	S	Y	795	M	N		Y	V	10.8	N	H	H
177	7/13	52	11.5	910	300	230	DR	CO		K	2	S	Y	850	F	N		Y	V	11.0	Y	S	SP
178	7/13	52	12.0	925	230	270	DR	CO		S	2	S	N	615	M	Y	S	Y	V	11.8	Y	S	SP
179	7/13	52	11.5	955	540	215	DR	AL		L	2	S	Y	780	M	N		N	V	11.0	N	S	SP
180	7/13	52	10.0	1020	270	243	DR	CO	S	U	2	S	Y	895	M	Y	H	Y	V	9.8	Y	S	SP
181	7/14	55	11.3	755	191	150	BT	CO		L	2	T	Y	830	M	N		Y	V	11.0	Y	S	H
182	7/14	55	11.3	730	278	318	BT	CO		K	2	T	Y	805	M	N		Y	V	10.8	N	S	DO

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Appendix B1. (Page 8 of 10).

No.	Date Rele.	Water Temp.	River Mile	Time of Day	Seconds Played	Seconds To Tag	Method	Gear	#1 Hook Injury	#2 Hook Injury	Numb Hooks	Type Hook	Hook Removed	Length (mm)	Sex	Bleeding?	Where	Sea Lice	Condition	RM Rele	Guided	5 Day Fate	Final Fate
183	7/14	55	11.0	745	152	238	DR	CO	K	S	2	S	Y	685	M	N		Y	V	10.3	Y	S	TN
184	7/14	55	11.3	800	190	347	DR	CO	K	K	2	S	Y	615	M	N		Y	V	11.0	N	S	SP
185	7/14	55	10.5	925	290	407	BB	CO		L	2	S	Y	1170	M	N		Y	L	9.8	N	S	SP
186	7/14	55	11.3	958	180	290	DR	CO		K	2	S	Y	650	M	N		Y	V	11.0	N	S	SP
187	7/14	55	11.5	1023	300	235	DR	CO	S	L	2	S	Y	680	M	N		Y	V	11.0	Y	S	SP
188	7/17	54	11.0	725	140	249	DR	CO	L	K	2	S	Y	715	M	N		Y	V	10.8	Y	S	SP
189	7/17	54	11.0	750	180	284	DR	CO		S	2	S	Y	605	M	N		Y	V	10.5	Y	S	SP
190	7/17	54	10.0	825	260	241	DR	AL	K	L	2	S	Y	695	M	N		Y	V	9.5	N	S	SP
191	7/17	54	10.0	830	295	286	DR	CO		K	2	S	Y	895	F	N		Y	V	9.5	N	S	SP
192	7/17	54	10.0	840	150	219	DR	AL	U	K	2	S	Y	795	F	N		Y	V	9.8	N	S	SP
193	7/17	54	10.0	850	300	224	DR	CO	L	U	2	S	Y	1095	M	N		Y	V	9.5	N	S	TN
194	7/17	54	10.0	855	900	249	DR	AL		S	2	S	Y	1090	M	N		Y	V	9.5	Y	S	SP
195	7/17	54	10.0	920	190	292	DR	CO		S	2	S	Y	695	M	N		Y	V	9.5	N	S	SP
196	7/17	54	10.0	935	183	260	DR	CO		K	2	S	Y	700	M	N		Y	V	9.5	Y	S	SP
197	7/17	54	10.2	1010	150	276	DR	CO	S	K	2	S	Y	595	M	N		N	V	10.0	N	S	DO
198	7/17	54	10.0	1040	240	197	DR	CO		K	2	S	Y	770	M	N		Y	V	9.8	N	S	SP
199	7/17	54	10.0	1105	300	278	DR	AL		K	2	1	Y	985	F	N		Y	V	9.8	N	S	SP
200	7/17	54	10.0	1135	861	324	DR	CO		S	2	S	Y	1060	M	N		Y	V	9.8	N	S	SP
201	7/17	54	10.0	1155	490	215	DR	AL	S	K	2	S	Y	910	F	N		Y	V	9.8	N	S	SP
202	7/17	54	10.0	1225	194	285	DR	AL	U	K	2	S	Y	1055	F	N		Y	V	9.8	N	S	SP
203	7/17	54	10.5	1235	900	215	DR	CO	U	L	2	T	Y	1060	F	N		Y	V	10.3	N	S	SP
204	7/17	54	10.0	1310	112	146	DR	CO		K	2	S	Y	720	M	N		Y	V	9.8	N	S	SP
205	7/17	54	10.0	1310	369	178	DR	AL		S	2	S	Y	1000	M	N		Y	V	9.8	N	S	SP
206	7/17	54	10.0	1335	202	252	DR	AL		K	2	S	Y	920	F	N		Y	V	9.3	N	S	SP
207	7/17	54	10.0	1355	246	232	DR	CO		K	2	S	Y	965	F	Y	K	Y	V	9.8	Y	S	SP
208	7/18	55	13.0	650	898	228	BT	CO		S	2	S	Y	950	M	N		Y	V	11.8	Y	S	SP
209	7/18	55	10.0	730	300	209	DR	CO		L	2	S	Y	625	M	N		Y	V	9.5	Y	S	SP

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No.	Date Rele.	Water Temp.	River Mile	Time of Day	Seconds Played	Seconds To Tag	Method	Gear	#1 Hook Injury	#2 Hook Injury	Numb Hooks	Type Hook	Hook Removed	Length (mm)	Sex	Bleeding?	Where	Sea Lice	Condition	RM Rele	Guided	5 Day Fate	Final Fate
210	7/18	55	10.0	740	270	210	DR	CO		C	2	S	N	935	F	N		Y	V	9.5	Y	S	SP
211	7/18	55	10.0	750	103	149	DR	CO		K	2	S	Y	655	M	N		Y	V	9.8	Y	S	UL
212	7/18	55	10.0	803	102	170	DR	CO		U	2	S	Y	715	M	N		Y	V	9.8	Y	S	SP
213	7/18	55	10.0	830	300	205	DR	CO	L	K	2	S	Y	875	M	N		Y	V	9.5	Y	S	SN
214	7/18	55	11.3	910	300	228	DR	CO		K	2	S	Y	650	M	Y	K	Y	V	11.0	Y	M	M
215	7/18	55	11.3	925	120	317	DR	CO	S	K	2	S	Y	635	M	N		Y	V	10.8	Y	S	UL
216	7/19	54	10.8	650	120	200	BT	CO	K	S	2	T	Y	680	M	N		N	V	10.5	Y	S	SP
217	7/19	54	13.3	815	232	327	BT	CO		K	2	T	Y	885	F	N		Y	V	12.8	Y	S	TN
218	7/20	54	10.0	740	150	259	DR	CO		K	2	S	Y	695	M	Y	K	Y	V	9.8	N	S	SP
219	7/20	54	10.0	810	210	224	DR	CO		S	2	S	Y	850	F	N	C	Y	V	9.8	N	S	SP
220	7/20	54	12.3	850	1200	244	BT	CO	U	C	2	S	Y	930	F	N		Y	V	11.8	Y	S	SP
221	7/21	52	10.0	840	574	300	DR	CO		S	2	S	Y	1010	M	N		N	V	9.3	N	S	SP
222	7/21	52	11.0	810	20	360	DR	CO		K	2	S	Y	460	M	N		N	V	10.5	N	S	SP
223	7/21	52	13.5	1050	300	257	BT	CO	K	T	2	S	Y	715	M	N		N	V	13.3	Y	S	SP
224	7/24	51	12.8	655	363	256	DR	AL		S	2	S	N	1000	F	N		N	V	12.0	N	S	UL
225	7/24	51	10.8	725	528	255	DR	CO		S	2	S	Y	940	F	N		Y	V	10.5	N	H	H
226	7/24	51	11.8	730	3807	590	DR	CO		K	2	T	Y	1200	M	N		Y	L	10.8	N	DO	DO
227	7/24	51	10.5	1015	120	213	BT	AL		K	2	T	Y	820	M	N		Y	V	10.3	Y	S	SP
228	7/24	51	11.3	1056	420	289	DR	CO	S	S	2	S	Y	610	M	N		N	V	10.8	Y	S	SP
229	7/25	55	11.3	900	600	174	DR	AL		S	2	S	Y	1035	F	N		Y	V	11.0	Y	S	UL
230	7/25	55	11.3	912	190	269	DR	CO	S	C	2	S	N	870	F	N		Y	V	11.0	Y	S	DO
231	7/25	55	11.3	930	600	510	DR	CO	U	K	2	S	Y	915	F	N		Y	V	11.0	Y	S	SP
232	7/25	55	11.3	1020	249	222	DR	CO		K	2	S	Y	1030	F	N		Y	V	11.0	Y	S	H
233	7/25	55	11.0	1040	185	283	DR	CO		S	2	S	Y	920	M	N		Y	V	10.8	Y	S	SP
234	7/25	55	11.0	1130	153	297	DR	CO	L	S	2	S	Y	690	M	N		Y	V	10.8	N	TN	TN
235	7/26	53	11.3	703	105	192	DR	CO		K	2	S	Y	705	M	N		N	V	11.0	Y	S	SP
236	7/26	53	11.3	708	363	202	DR	CO		S	2	S	Y	820	F	N		Y	V	11.0	Y	S	SP

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No.	Date Rele.	Water Temp.	River Mile	Time of Day	Seconds Played	Seconds To Tag	Method	Gear	#1 Hook Injury	#2 Hook Injury	Numb Hooks	Type Hook	Hook Removed	Length (mm)	Sex	Bleeding?	Where	Sea Lice	Condition	RM Rele	Guided	5 Day Fate	Final Fate
237	7/28	53	13.0	905	330	297	BT	CO	K		2	S	Y	1085	M	N		N	V	12.8	N	S	SP
238	7/28	53	11.8	1220	720	222	BT	AL	K		1	S	Y	1095	F	N		Y	V	11.5	Y	S	SP
239	7/31	52	12.0	745	594	177	BT	AL	K		1	S	Y	880	F	Y	K	Y	V	11.3	Y	S	SP
240	7/31	52	10.0	900	884	217	DR	AL	S		1	S	Y	1045	F	N		Y	V	9.5	Y	S	SP
241	7/31	52	10.0	920	120	229	BB	AL	K		1	S	Y	690	M	N		Y	V	10.0	Y	S	SP
242	7/31	52	10.0	925	360	179	BB	AL	K		1	S	Y	915	F	Y	K	Y	V	9.8	N	S	SP
243	7/31	52	11.3	1100	370	213	BT	AL	K		1	S	Y	1020	F	Y	K	Y	V	10.8	Y	S	SP
244	7/31	52	10.8	1115	198	177	BT	AL	U		1	S	Y	905	F	Y	U	Y	V	10.0	Y	S	SP
245	7/31	52	12.3	1220	481	260	BT	AL	L		1	S	Y	1065	M	N		Y	V	11.8	N	S	SP

[a] Fishing Method
BB - Back Bounce
BT - Back Troll
DR - Drift

Terminal Gear
AL - Artificial lure
CO - Combination bait and lure

Type of Hook
S - Single
T - Treble

Condition
L - Lethargic
V - Vigorous

Final Fate
H - Sport Harvest
M - Mortality
SP - Spawner
DO - Fish dropped out to Cook Inlet and did not return
SN - Caught in commercial set net
TF - Tag failed
TN - caught in ADFG tagging crew's net
UL - Lost signal after fish moved upstream

Hook Injuries
C - Chin
F - Floor of mouth
G - Gill
H - Head(snag)
I - Eye
K - Corner of mouth
L - Lower jaw
R - Roof of mouth
S - Snag
T - Tongue
U - Upper jaw

5-Day Fate
H - Sport Harvest
M - Mortality
S - Survivor
DO - Fish dropped out to Cook Inlet and did not return
SN - Caught in commercial set net
TN - Caught in ADFG tagging crew's net