RUN TIMING AND SPAWNING DISTRIBUTION OF COHO SALMON (*Oncorhynchus kisutch*) IN THE KENAI RIVER, ALASKA AND THEIR RELATION TO HARVEST STRATEGIES

by

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VITA

Jeffrey Allan Booth, son of William and Donna Booth, was born in Fargo, North Dakota, 28 March, 1960. He graduated from Fargo South High School, Fargo, North Dakota, in May 1978. In September 1980 he entered Montana State University, Bozeman, Montana, and received a Bachelor of Science degree in Fish and Wildlife Management in December 1984. He began graduate studies at Montana State University in September 1987.

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ABSTRACT

To determine run timing and spawning distribution of coho salmon (*Oncorhynchus kisutch*) in the Kenai River, Alaska, 216 fish were captured by fishwheel and drift netting and externally tagged with low-frequency (40-41 MHz) radio transmitters in 1988 and 1989. Eighty-nine fish were tagged during the early run (July through August) and 127 fish were tagged during the late run (September through December). Seventy-three percent of early-run fish were tracked to spawning sites in tributaries of the Kenai River and spawned in September and October. Ninety-six percent of late-run fish selected main-stem spawning sites and spawned October through March. The migration rate for early-run fish was 2.6-3.5 km/day compared to 3.8-4.9 km/day for late-run fish. Early-run coho salmon were harvested locally in commercial and sport fisheries while late-run fish were primarily harvested in sport and personal-use fisheries. Early-run coho salmon appear more susceptible to commercial and sport fishery harvest due to earlier run timing and slower migration rates. The differential run timing and migration rate between early and late-run coho salmon should be taken into consideration by harvest managers to ensure adequate escapement.

INTRODUCTION

The coho salmon (*Oncorhynchus kisutch*) is one of the most important species in recreational, commercial, and personal use fisheries in Alaska. The Kenai River supports a substantial run of coho salmon, which attracts one of the State's most popular sport fisheries and contributes from 20,000 to over 100,000 salmon annually to the Cook Inlet commercial fishery.

Existing management of coho salmon is based on catch per unit effort data of commercial fisheries as compared with historical averages. This has been effective in maintaining stocks, and providing an important food source for brown bears (*Ursus arctos*) and bald eagles (*Haliaeetus leucocephalus*). However, it is unclear whether recent increases in sport and commercial harvest reflect proportional increases in abundance (run strength), and whether optimum production is being achieved.

Data on commercial harvest and from Alaska Department of Fish and Game (Department) creel census and postal survey estimates indicate both effort and harvest have increased in sport and commercial fisheries in recent years (Table 1).

Table 1. Harvest of Kenai River coho salmon in commercial and sport fisheries, Alaska.

Fishery	Historical	Harvest 1986	1987	1988	1989
Sport	25,523[a]	48,621	26,056	35,776	43,401
Commercial[b]	47,588[c]	77,922	74,977	55,419	81,744

[a] 1976-1985
[b] Eastside set gill net
[c] 1966-1985

Sport harvest estimates indicate a bimodal return of coho salmon to the Kenai River. Harvest rates peak in early August (early run) and then decline until another peak (late run) occurs in late August and early September (Hammarstrom 1989). If these runs represent two discrete populations, the possibility of differential exploitation exists.

Because of recent increases in effort and harvest, more information is needed by managers to ensure long-term maintenance of populations. Basic biological data are needed to assess production models, to determine status of populations, and to establish escapement goals for Kenai River coho salmon. Specific objectives in this 2-yr study include: 1) determine run timing, to ascertain when these fish are susceptible to harvest, 2) determine spawning distribution and timing, to identify which tributaries and main-stem spawning sites are major contributors to the overall run of coho salmon in the Kenai River drainage, 3) determine migration rate, which is needed to determine how long fish are susceptible to harvest in the sport fishery, and 4) evaluate harvest potential to determine possible impact on discrete runs of fish.

STUDY AREA

The Kenai River (Figure 1) is located in southcentral Alaska on the Kenai Peninsula. This glacial river originates from Kenai Lake, 132 km from saltwater and has a drainage area of 5,563 km2. Twenty-seven kilometers below Kenai Lake, the river traverses Skilak Lake, about 24 km in length and flows another 80 km to Cook Inlet. Kenai River discharge is dependent on the outflow of Kenai and Skilak lakes and lacks the flow extremes characteristic of streams without glacial lakes in their headwaters. Although glacial melt produces turbid conditions throughout the year, water clarity increases during low-flow conditions (November through May). Mean annual flow in the Kenai River is approximately 142 m3/s with peak discharges of 550 to 850 m3/s occurring in late summer (Scott 1982). Winter flows range from 37 to 50 m3/s.

Several tributary streams enter the Kenai River from the Kenai National Wildlife Refuge including the Russian River (Figure 1). Major tributaries to the upper, middle and lower Kenai River include the Killey, Funny, and Moose rivers, and Slikok and Beaver creeks.

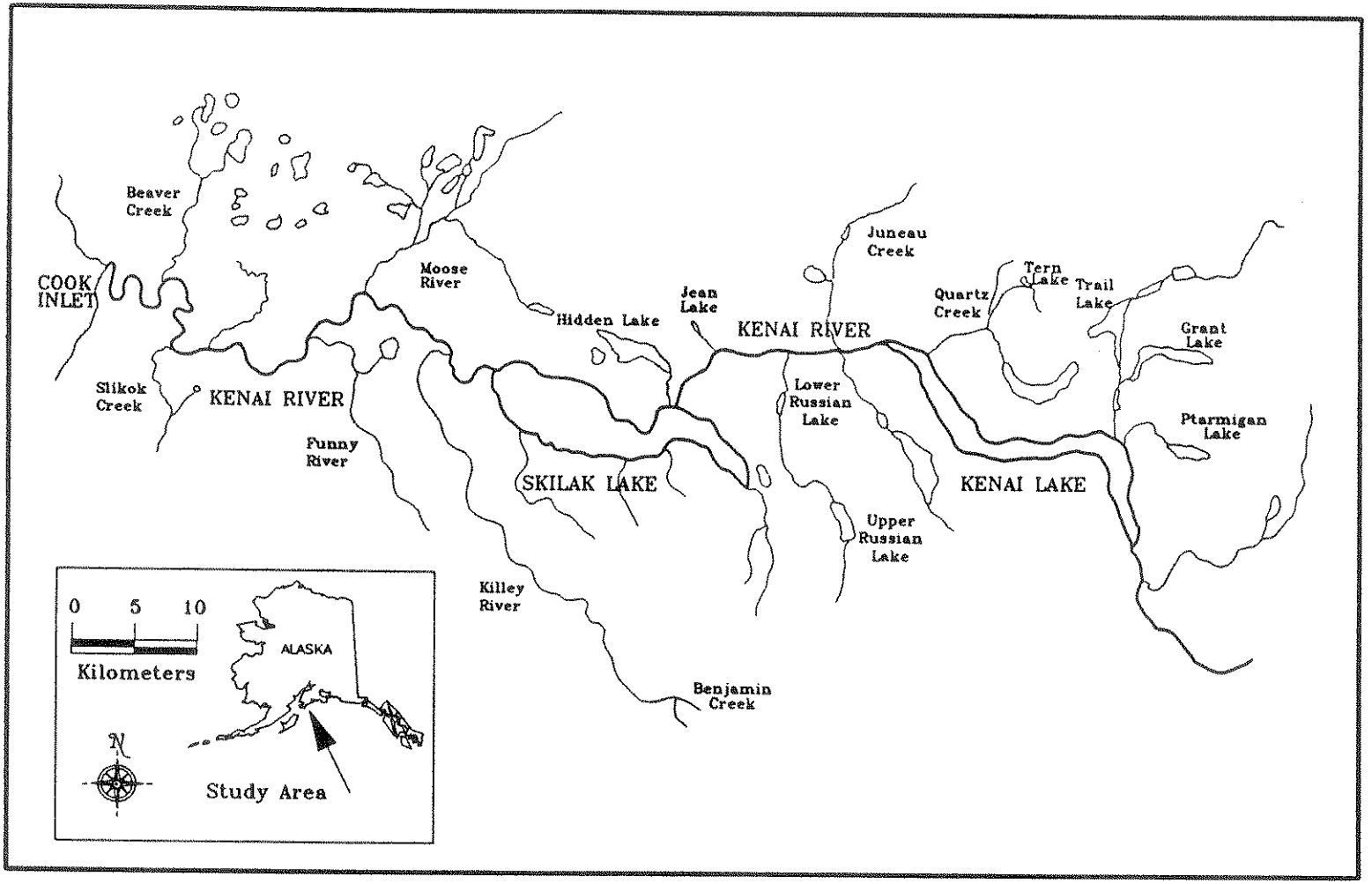

Figure 1. Map of the Kenai River System, Alaska.

METHODS

Run Timing

The timing of coho salmon runs in the Kenai River was determined using drift nets and a fishwheel catch. Drift netting was conducted weekly between river kilometer (rkm) 17.7 and 30.6, using small mesh (7.5-14.0 cm stretch mesh) gill nets (18.0 m long by 3.0 m deep). Drift netting commenced July 18 both years, and ended October 31 in 1988 and November 7 in 1989. Net webbing consisted of a twisted, multiple-strand twine, which was found to be less abrasive than monofilament. Coho salmon encountering these nets were entangled by their teeth and jaws.

Drift nets were fished perpendicular to the river channel, with the outside end of the floatline attached to a buoy and the other fixed to the boat. The net was drifted downstream and retrieved immediately when a fish was captured. This technique, perfected by Burger et al. (1983) and Hammarstrom et al. (1985), allowed us to alter our capture location to accommodate fluctuating water levels and icing conditions.

A Department operated fishwheel located at rkm 31 was used to assess run timing, to obtain fish for tagging, and to provide species composition data. The Department operated the fishwheel until early August and Kenai Fishery Assistance personnel operated it until ice-up

or low flow prohibited use. The fishwheel holding pen was checked daily for coho salmon beginning in July and continued until October 13, 1988 and October 27, 1989.

Catch per unit effort was determined from data obtained from drift netting and fishwheel catches and a weekly catch per hour was then calculated. This information was compared with harvest statistics gathered by the Department in the Cook Inlet commercial and personal-use fisheries, Kenai River sport fishery, and from a Department escapement estimate (side-scan sonar) to determine whether run timing and harvest trends were related. Sport harvest rates were smoothed by a 4 point moving average for graphic representation.

In 1989, four set gill nets were used to assess river entry of coho salmon after conditions prohibited drift netting and fishwheel operations. Experimental gill nets, with mesh sizes ranging from 7.6 cm to 15.2 cm, 18.3 m in length and 3.7 m in depth, were placed in the main-stem Kenai river between rkm 20 and rkm 54.7. These nets were fished continuously from November 14 to December 18. Nets were attached to the river bank and placed perpendicular to the river channel with the offshore end permanently anchored. A continuous loop, attached to the lead line of the net, allowed retrieval and setting of the nets from the shore daily. During heavy icing conditions the nets were allowed to freeze in place and were examined by cutting holes in the ice along the downstream side.

Spawning Distribution and Timing

Low-frequency (40-41 MHz) radiotelemetry was used to monitor coho salmon spawning distribution and timing and to determine migration rate. Radiotelemetry is a proven technique to monitor migration of salmon in Alaskan waters and my methods closely followed those previously developed (Burger et al. 1981, Hammarstrom et al. 1985, Bentz 1986).

Fish to be tagged were obtained from the drift netting and fishwheel operations. Tagging was accomplished by transferring the fish to a rigid tagging cradle where it was physically immobilized. A continuous flow of water was maintained through the cradle to minimize stress and eliminate the need for anesthesia. The cradle consisted of an aluminum trough with two sides, 80 cm long and 20 cm wide, joined with a 12 cm-wide base (Figure 2). One end was enclosed to prevent escape and one side was hinged to expedite fish insertion and removal. The hinged side was secured in an upright position during fish processing by an adjustable clip located on the cradle handle. To prevent injury to captured fish, the interior of the cradle was lined with a 9.5 mm thick closed cell pad and the outer edge of the 2-mm thick aluminum plate was bordered with a 9.5 mm diameter solid aluminum rod. A notched area along the top edge of the cradle allowed access to the dorsal area of the fish for tagging. A tail-loop of non-abrasive material was used to prevent fish from escaping during transfer to the cradle and during the tagging process. Information recorded for each fish tagged included date, tag number or frequency, capture location, length, and sex.

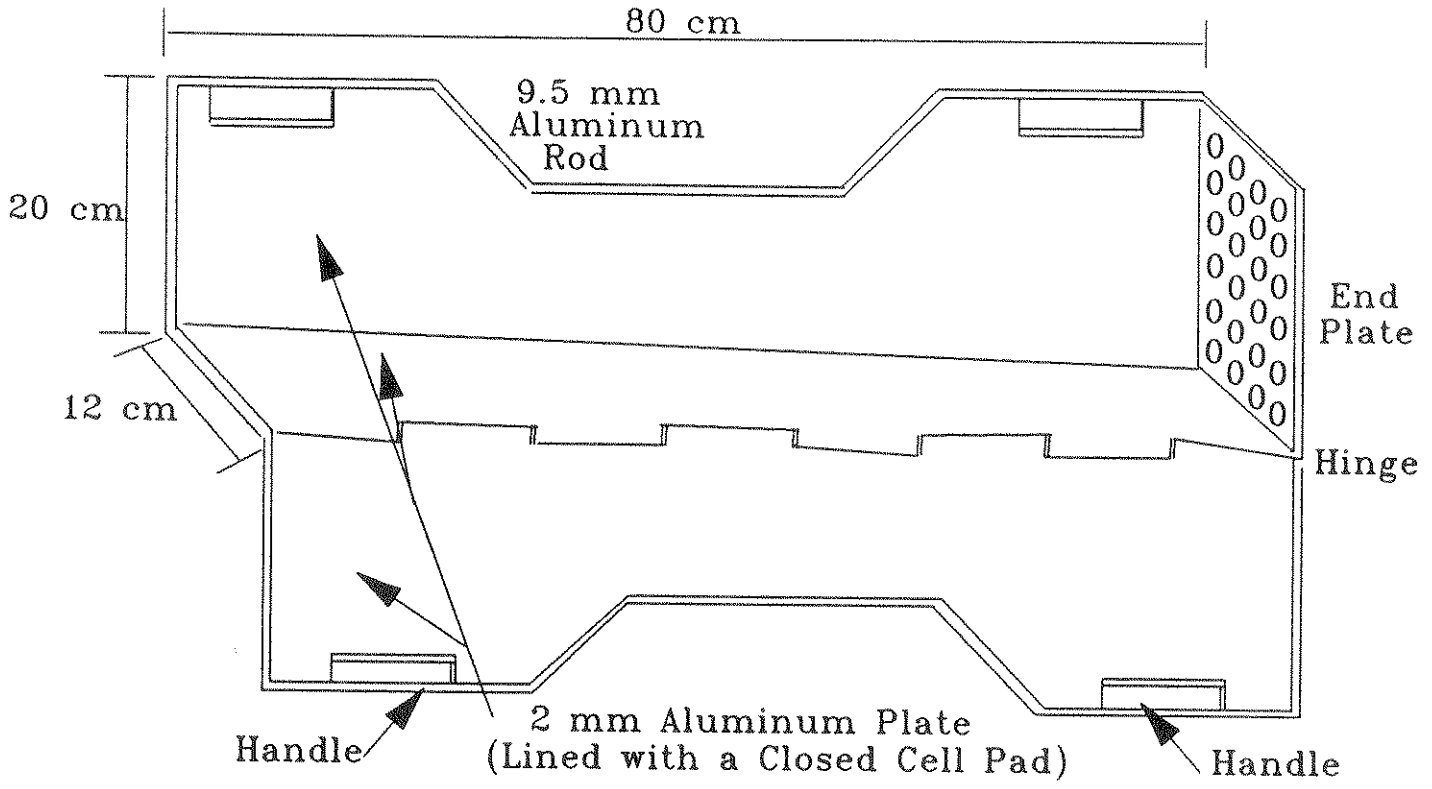

Figure 2. Salmon tagging cradle used in the coho salmon study on the Kenai River, Alaska.

All coho salmon captured were tagged with a radio transmitter or a sequentially-numbered spaghetti tag. Transmitters were deployed at a rate proportional to fish abundance as determined through catch per unit effort rates in the sport fishery and drift netting. Two hundred transmitters were used during the study with approximately 100 deployed for each run. Recovered tags were reused if battery life allowed. As recommended by Bentz (1986), only fish which exhibited a firm scale set were radio tagged.

Transmitters were attached externally to fish by running nickel pins, epoxied to the tags, through the interneural bones below the dorsal fin (Figure 3). Petersen discs were then threaded through the pins on the backside of the fish and secured by twisting a knot in the pin against the discs. Each transmitter was tested after implantation to ensure it was operating properly. Numbered spaghetti tags were inserted with a hollow needle through the skin, just below and posterior to the dorsal fin, and secured with an overhand knot.

Radiotelemetry equipment used on the project was manufactured by Advanced Telemetry Systems (ATS), Inc., Bethel, Minnesota. Transmitters had distinct frequencies in the 40-41 MHz range separated by 0.010 kHz, were powered by a single 1/2A, 3V lithium battery and were rated to have a 120-d transmitting life. The components and battery were encased in epoxy and were cylindrical in shape. Transmitters measured 45 mm long, 17 mm in diameter, and had a 35 cm-long teflon-coated wire antenna.

Programmable scanning receivers (ATS Model 200 B) were used to monitor movements of radio-tagged fish. Each transmitter frequency programmed into the receiver could be monitored individually at a

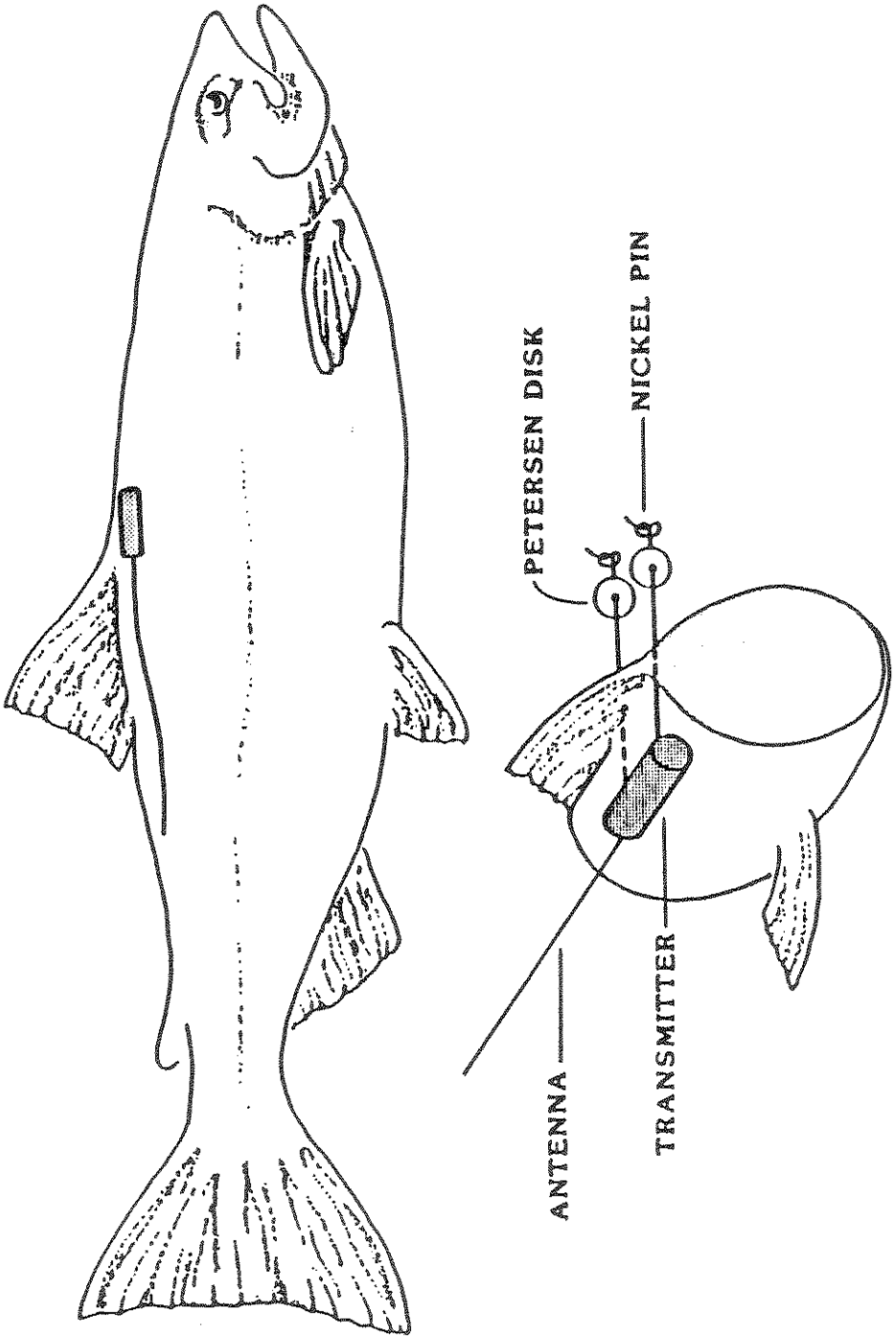

Figure 3. Schematic diagram of a salmon showing the attachment of a radio transmitter.

variable scan rate from 2 sec to 16 min, or each could be tracked manually. The audio signals were heard through the receiver's external speaker or headphones. Receivers were powered by either an internal rechargeable nickel-cadmium battery or a 12-V battery.

Radio tracking surveys were conducted two to three times per week from either a boat or a Cessna 185 airplane. Directional loop antennas, 60 cm in diameter, were used for tracking, and provided a receiving range of approximately 0.5 km from the boat and 2.5 km from aircraft.

Aerial tracking was done with two scanning receivers connected to a loop antenna attached to each aircraft wing. Each receiver was programmed to scan a different set of frequencies at a 2-sec scan rate. Loop antennas were attached by U-bolts to L-shaped brackets of aluminum tubing (3.8 cm outside diameter) and the brackets were inserted into a pipe (4.4 cm inside diameter) welded to the underside of each wing. Weather permitting, aerial tracking was conducted at 96-137 km/hr at an altitude of 213-305 m above the river.

Boat tracking was conducted on the Kenai River downstream from the outlet of Skilak Lake (rkm 80). While searching for radio tags from the boat, receivers cycled through frequencies at a scan rate of 2-4 sec, depending upon the number of active radio-tagged fish in the area. The boat was drifted downstream without power or operated at half throttle to avoid excessive outboard engine interference. As a signal was received, the boat was moved toward the signal until it could be received with a smaller, 23 cm diameter, loop antenna. Radio-tagged fish were then located to the nearest 10 m by triangulation.

To aid tracking, monitoring stations were established at rkm 72 and rkm 9.7 on the main stem of the river allowing us to continually monitor any upstream or downstream movement of radio-tagged fish past these locations. Each station consisted of a data logger (ATS Model 5040), receiver, 12-V battery, and a loop antenna. Receiving range of the data loggers covered a 183 m radius. The data loggers recorded the frequency, pulse rate, date and time that a radio-tagged fish was within monitoring distance. Reference tags were placed in the area to ensure that the data logging stations were operating properly at all times.

A laptop computer was used to download information stored on the data loggers in the field. This enabled retrieval of information on fish passage each week without having to disassemble the monitoring stations.

Fish locations were translated to the nearest 0.80 rkm from aerial photographs and topographic maps of the Kenai River. The location of each fish was plotted for each radio tracking survey and a composite plot was used to show migration pathway and spawning distribution of tagged salmon. Tag returns, observations from the sport fishery, and foot surveys were also plotted to show final destinations of tagged fish.

Spawning locations of radio-tagged coho salmon were defined as areas where milling behavior (movement within a 1.67 km^2 area) was detected for at least a 10-d period or followed by rapid downstream movement or no further upstream movement. A mortality mode in the radio-tags doubled the pulse rate after movement ceased for more than a 4 h period which allowed identification of fish that died, or shed their tag, and tracking ceased for that frequency. Foot surveys were conducted in

spawning areas to supplement and confirm telemetry data, observe and collect any tagged fish, count number of fish present, and determine spawning condition.

Aerial surveys were conducted on the main-stem Kenai River during low flow periods between December 1989 and March 1990 to monitor spawning activity and obtain index counts. Surveys were flown at an altitude of 30 to 90 m and at an airspeed of 90 to 105 km/hr.

For data analysis purposes, the river was divided into five study sections; downstream section below rkm 34, midstream section rkm 34-63.5, upstream section rkm 63.5-80.5, Skilak Lake rkm 80.5-104.5 and the interlake section between Skilak and Kenai lakes rkm 104.5-132 (Appendix A: Figures 12-15).

Migration Rate

Migration rates for coho salmon were determined by radiotelemetry. These rates were then used to determine the length of time early and late-run fish were available to the lower river sport fishery.

Mean migration rates of radio-tagged fish tracked past rkm 34 were determined from the time and location fish started their upstream movement until they reached their most upstream location. Migration rates were calculated by dividing the total distance traveled by the number of days traveled. The number of days fish were available to the lower river sport fishery was then estimated by dividing the distance between the mouth and the Soldotna Bridge (34 km) by their mean migration rate.

A t-test was conducted to determine if early and late-run migration rates differed significantly. A p-value of .05 was used to accept or reject the null hypothesis that the early-run mean was greater to or equal to the late-run mean.

Harvest

Department harvest information obtained from commercial, personal-use, and sport fisheries was used along with data collected from fishwheel and drift netting operations to determine the relationship between run timing and harvest. Harvest information was obtained from the Upper Cook Inlet (UCI) commercial fishing district. The harvest in set gill nets (set net) and drift gill nets (drift net) was used to determine the catch per net-day. The catch per net-hour was determined for the drift net operation in the Kenai River. The catch or harvest per unit of effort was used in each of these fisheries to determine peak harvest times and duration. These harvest trends were then compared with run timing information to determine any correlation.

RESULTS

Run Timing

Early Run

In 1988, coho salmon were present in Cook Inlet during the first opening of the UCI commercial set net fishery on July 1, 1988 (Figure 4). Coho salmon numbers began to build after this date with the catch continuing to increase in the commercial fishery until August 8 in the Cohoe and Ninilchik areas of UCI (Figure 5). The highest catch per unit effort occurred the last week the commercial fishery was open (August 7-15) in the Kalifonsky and Salamantof beach areas nearest the Kenai River (Appendix B: Tables 12-13).

Based on drift netting, fishwheel operation, and creel census data, the early run began to enter the Kenai River in late July, about 3 weeks after coho salmon began to appear in the UCI commercial fishery (Table 2).

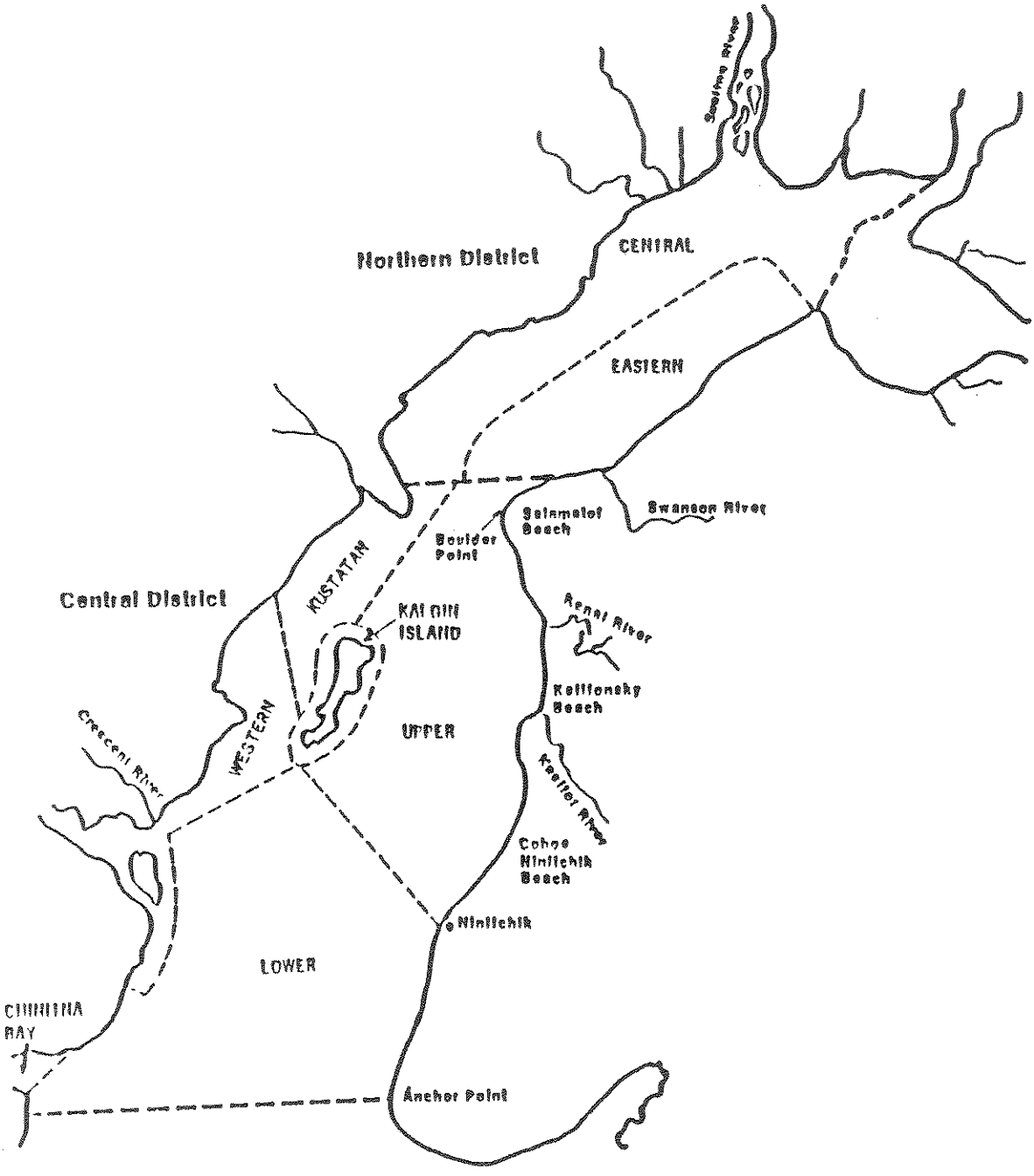

Figure 4. Commercial salmon fishing districts and subdistricts of Upper Cook Inlet, Alaska.

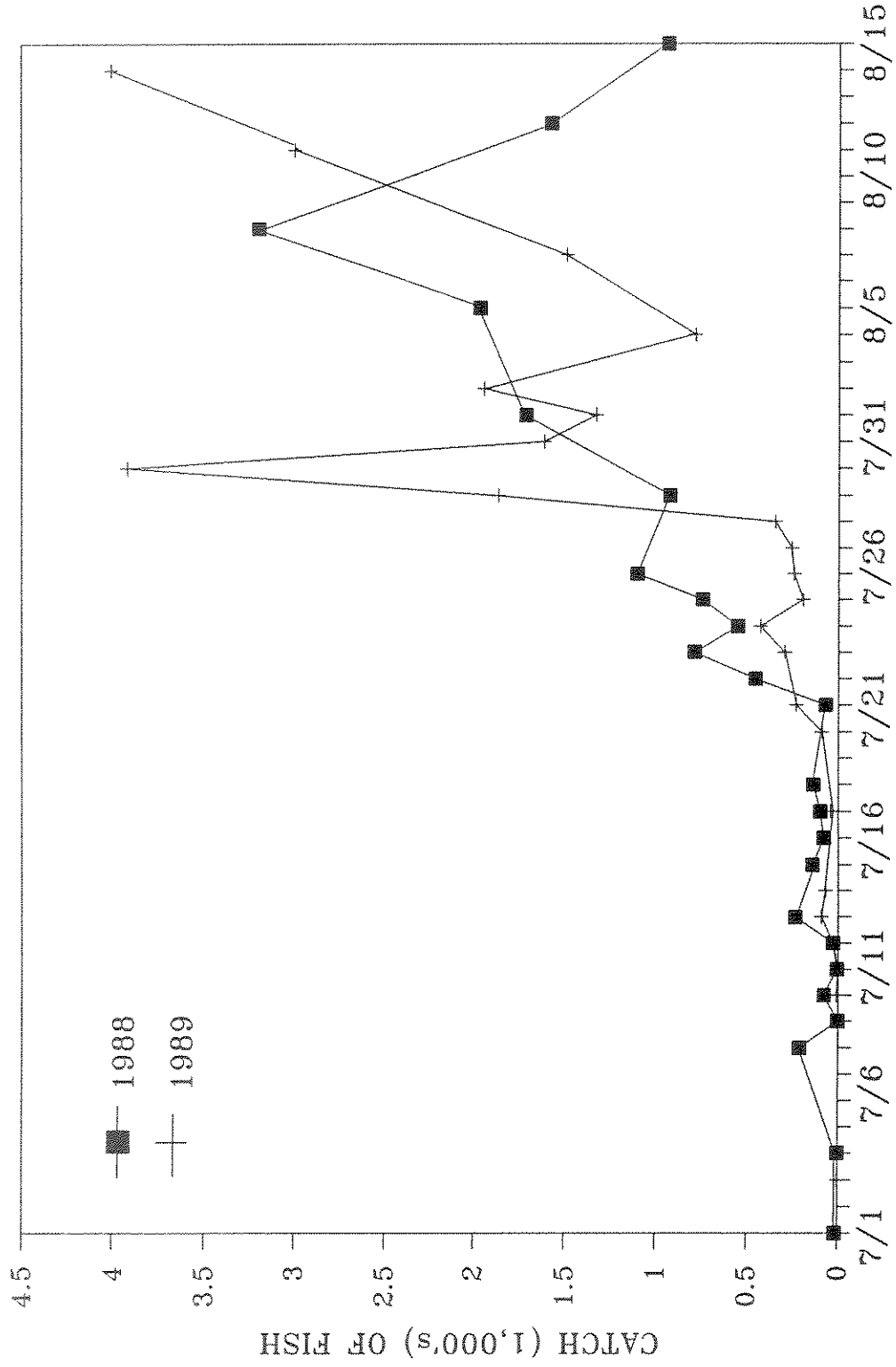

Figure 5. Commercial set gill net catch in the Cohoe and Ninilchik areas of Upper Cook Inlet, Alaska, 1988 and 1989 (Data source: Alaska Department of Fish and Game, Soldotna, Alaska).

Table 2. Date of first coho salmon observed in the Kenai River, Alaska, 1988 and 1989.

Data source	1988	1989
Drift netting	July 29	August 2
Fishwheel	July 27	August 4
Creel census	July 24	August 3

A rapid increase in the catch per unit effort by drift netting in early August indicated that increasing numbers of coho salmon were entering the Kenai River (Figure 6). At this time, the fishwheel catch per unit effort was also building and the harvest per unit effort in the sport fishery was increasing to an early peak on August 5 (Figure 7). Escapement counts, estimated by Department sonar July 1 through August 11, show coho salmon numbers at their highest the last 2 d of operation (Appendix C: Table 18).

The drift netting catch per unit effort declined slightly after peaking in early August. Harvest per unit effort for the sport fishery remained relatively high for the first 2 weeks of August and was followed by a much lower harvest per unit effort for the next 10 d. These trends followed the same general pattern shown by the mean harvest per unit effort in the sport fishery for the last 14 years, 1977-1990 (Figure 7). This low point, occurring in mid-August, was used as the dividing point between early and late-run fish in 1988.

In 1989, harvest in the UCI set net fishery initially increased at a slower rate than in 1988, indicating a later entry date into Cook Inlet (Figure 5). As in 1988, the highest catch per unit of effort occurred

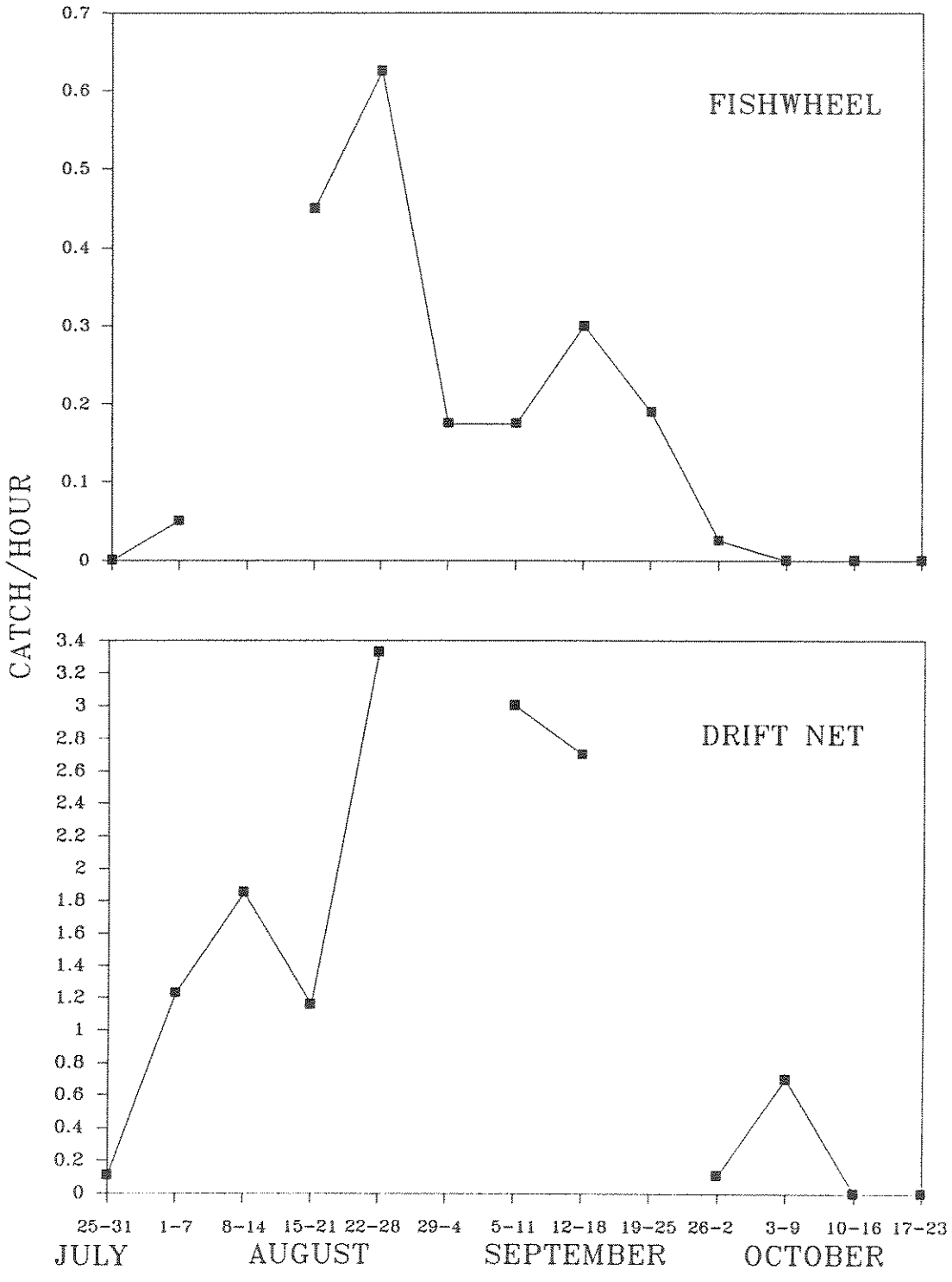

Figure 6. Catch per unit effort for coho salmon in fishweel and drift netting operations, Kenai River, Alaska, 1988.

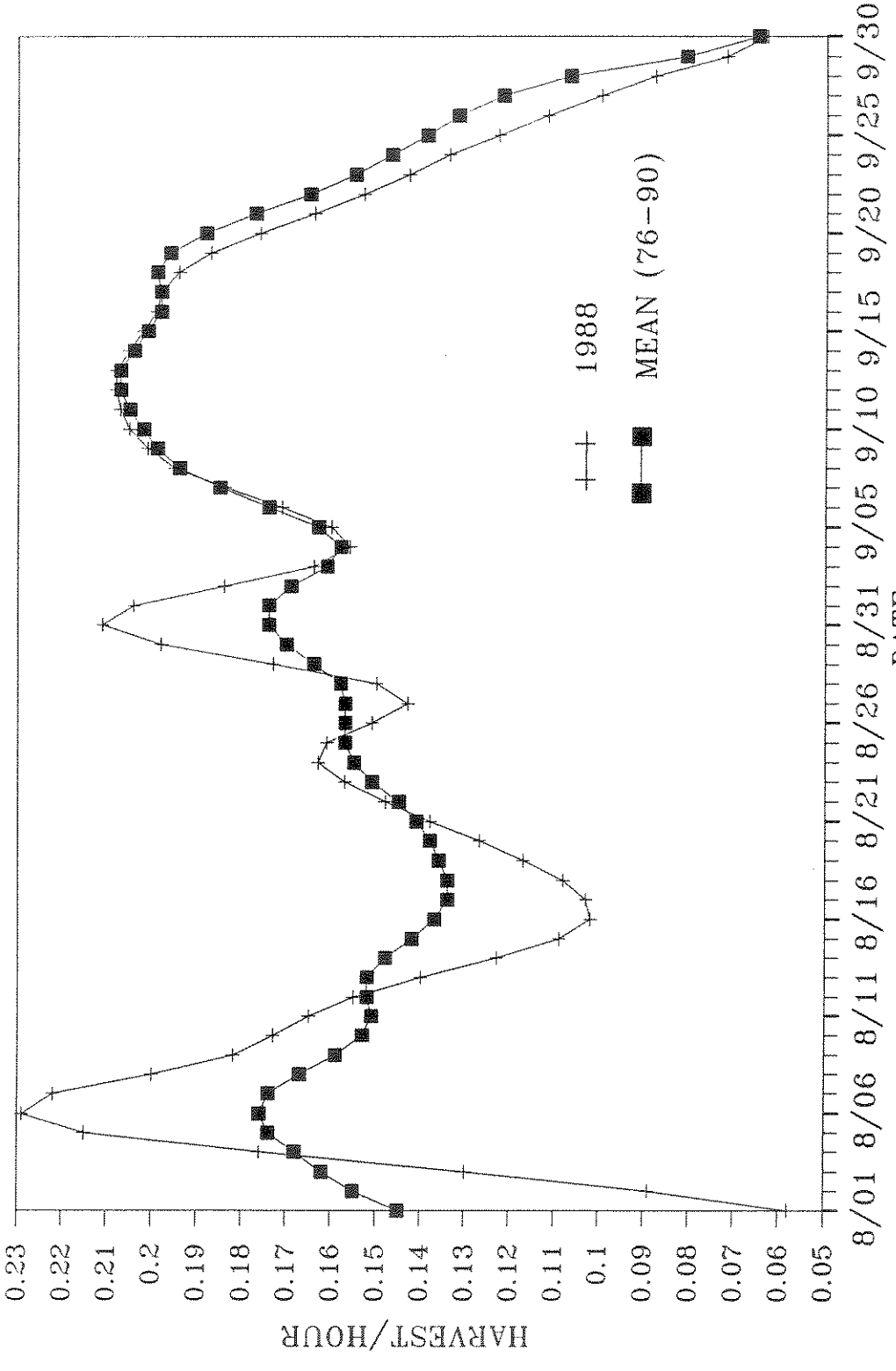

Figure 7. Daily harvest rate (harvest per angler-hour) of coho salmon in the lower river sport fishery, Kenai River, Alaska, 1988 (Data source: Alaska Department of Fish and Game, Soldotna, Alaska).

the last week the commercial fishery was open in the Kalifonsky and Salamantof beach areas (Appendix B: Tables 14-15).

In 1989, the early-run of coho salmon entered the Kenai River approximately 1 week later than in 1988 (Table 2). Substantial numbers of coho salmon were not evident in the lower Kenai River until mid-August, as indicated by the catch per unit of effort in our drift netting operation (Figure 8). Peak harvest rates in the sport fishery were also later than in 1988 (Figure 9). Catch rates dropped sharply in the fishwheel in late August. A high water event eventually led to complete disassembly on August 28. The fishwheel was not operational again until September 12.

The low point in the catch per unit of effort in fishwheel and drift net operations occurred in late August and early September. This was used as the dividing point between early and late-run fish in 1989.

Late Run

In 1988, the catch per unit effort increased to a second peak in late August and early September in the drift netting operation (Figure 6). This general pattern was similar to that of the harvest per unit effort in the sport fishery (Figure 7). Fish entering the river at this time were regarded as late-run fish although overlap between runs was suspected. Catch and harvest rates stayed high for 3 weeks then gradually fell off until the end of September.

The catch per unit effort in the fishwheel peaked in late August and began to decline soon after (Figure 6). No data were obtained in the

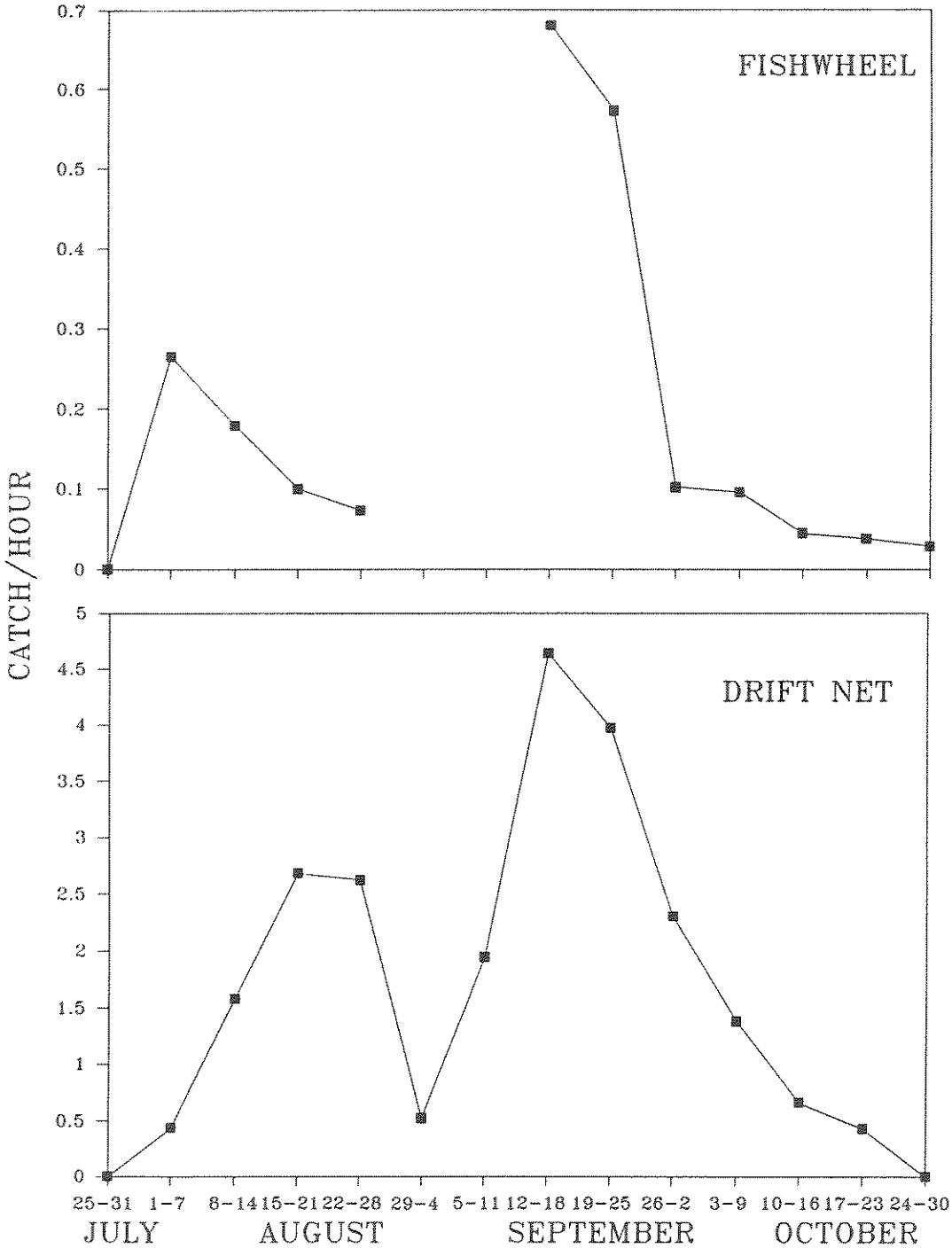

Figure 8. Catch-per-unit effort for coho salmon in fishwheel and drift netting operations, Kenai River, Alaska, 1989.

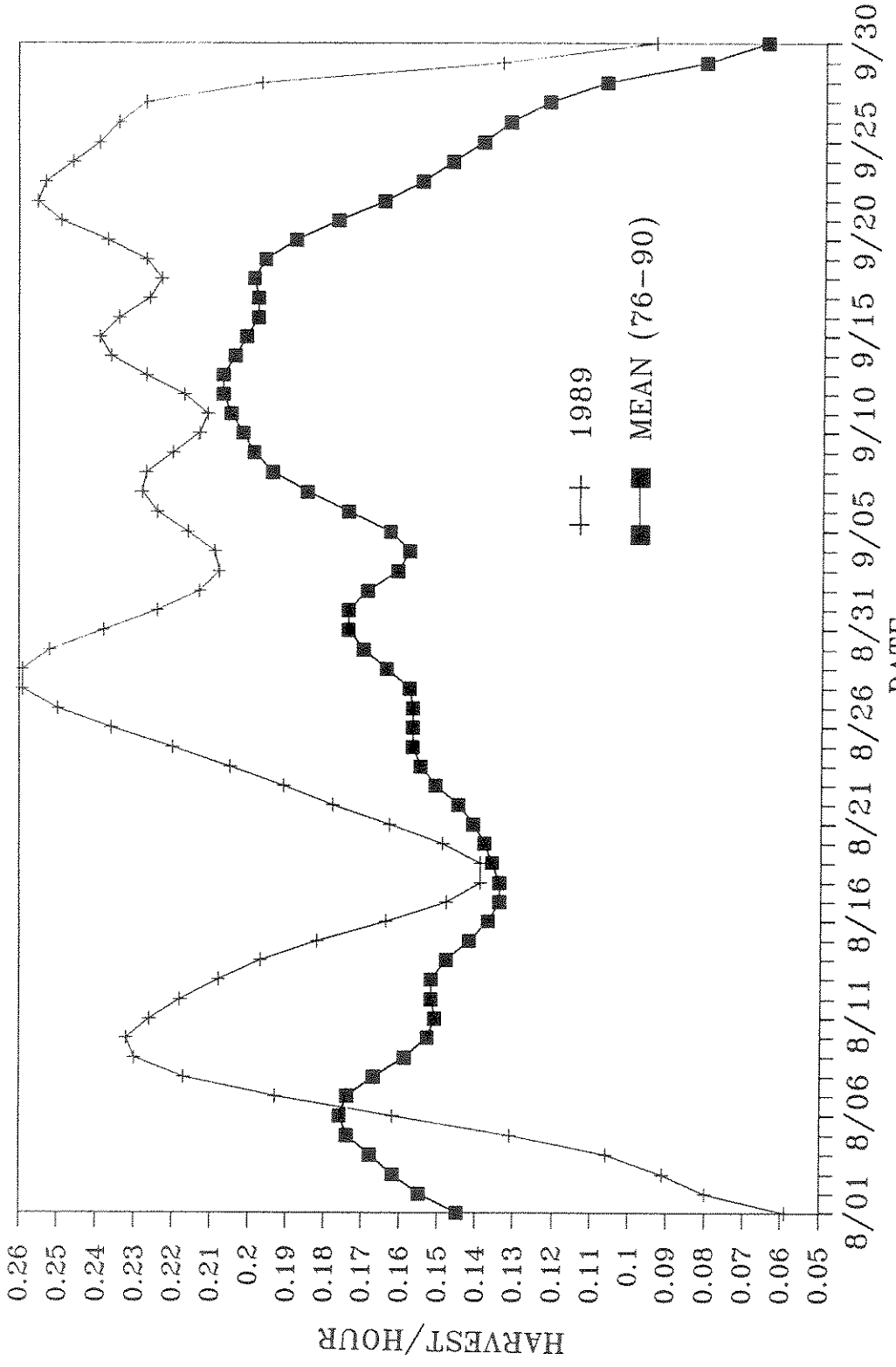

Figure 9. Daily harvest rate (harvest per angler-hour) of coho salmon in the lower river sport fishery, Kenai River, Alaska, 1989.

fishwheel the second week of August due to partial disassembly. The fishwheel was removed October 13 due to heavy icing conditions.

Drift netting in the lower river after mid-September captured few fish. As a result, the drift net operation was moved upriver in October to capture fish for tagging purposes. Therefore, no information was obtained on salmon entering the river after late September in 1988.

In 1989, the drift net catch per unit of effort showed a rapid increase the second week in September indicating substantial numbers of coho salmon were once again present in the lower river (Figure 8). The fishwheel catch per unit of effort was also at a seasonal peak after being inoperable for 2 weeks due to high water conditions in late August and early September.

After peaking in mid-September, the drift netting catch rate declined steadily to the end of October when netting in the lower river was terminated. The catch per unit of effort remained above 0.5 fish/h until late October. This was much higher than in 1988, indicating substantial numbers of late-run coho salmon were still entering the river.

The harvest per unit effort in the sport fishery showed several peaks in late August and September after a seasonal low on August 18 (Figure 9). A high harvest per unit effort (>0.2) was maintained through the month of September indicating substantial numbers of fish in the lower river.

Drift netting was not conducted in the lower river after October 27, 1989, but set gill nets in the main stem of the Kenai River provided limited information on entry of late-run fish. The last "fresh" coho

salmon was captured December 16, 1989 at rkm 54.7. This fish was bright silver in color, had loose scales and did not have any fresh water characteristics such as kype development, pink coloration, or scale set. The capture of "fresh" coho salmon in the lower and midstream sections in November and December indicates that the run timing of late-run coho salmon extends into at least mid-December.

Spawning Distribution and Timing

Two hundred sixteen coho salmon were captured and radio tagged in the Kenai River during 1988 and 1989 (Appendix D: Tables 22-23). Of these fish, 89 were tagged during the early run (July through August) and 127 during the late run (September through December). In addition, 392 fish were spaghetti tagged between July and November (Appendix D: Tables 24-25).

Early Run

In 1988, 45 early-run coho salmon were radio tagged. Twenty fish were tracked to their final spawning location, with 14 (70%) spawning in tributaries and six (30%) spawning in the main-stem Kenai River (Table 3). Four radio-tagged fish were captured in the sport fishery and four were harvested in the Cook Inlet commercial fishery. An additional four fish died within 7 d of tagging (Table 4). The remaining 13 radio-tagged fish were lost. Two fish that migrated out of the Kenai River after tagging were eventually found in the Kasilof River system, one

spaghetti-tagged fish was sport-caught near Crooked Creek and one radio-tagged fish was tracked to rkm 12.9 in that drainage.

Table 3. Spawning distribution and timing of early-run coho salmon radio-tagged in 1988.

Spawning site	Number of tagged fish	Spawning time
Kenai Mainstem	6	September
Killey River	5	September
King County Creek	3	September
Funny River	2	September
Moose River	2	September and October
Russian River	1	September
Trail Creek	1	September

The five coho salmon that were tracked to the Killey River were tagged between August 3 and August 30 (Appendix D: Table 22). These fish dispersed as far as Benjamin Creek, a clear-water tributary to the Killey River, approximately 48 km above the Kenai River confluence. The glacial nature of this river generally prohibits stream surveys. However, during a brief cold spell in September, water clarity improved to allow visual observation of spawning coho salmon throughout the river during aerial tracking surveys. Three radio-tagged fish tagged during the first 2 weeks of August were located in King County Creek, a tributary to Skilak Lake. Spawning coho salmon were observed in the lower reaches of this stream in September. Other spawning tributaries confirmed by radio tracking, were Trail Creek, Moose River, Funny River, and the Russian River.

Table 4. Final destination and number of coho salmon radio-tagged in the Kenai River, Alaska, 1988 and 1989.

Final destination	Early		Late		
	Number	Percent	Number	Percent	
		1988			
Spawned	20	44%	40	70%	
Tributary	14		1		
Kenai mainstem	6		39		
Sport Caught	4	9%	2	4%	
Lost	21	47%	15	26%	
Cook Inlet (commercial fishery)	4		-		
Mortality (7 days)	4		7		
Unknown[a]	12		8		
Stray	1		-		
Totals	45		57	=	102
		1989			
Spawned	10	23%	44	63%	
Tributary	8		2		
Kenai mainstem	2		42		
Sport caught	6	14%	4	6%	
Lost	28	64%	22	31%	
Tag loss	3		1		
Cook Inlet (data logger)	11		4		
Mortality (7 days)	9		10		
Unknown[a]	5		7		
Totals	44		70	=	114

[a] Unknown - tag failure, unreported harvest, tracking loss.

Six fish selected spawning areas in the main-stem Kenai River. Two fish spawned between rkm 30.5 and 37, three between rkm 43.4 and 50, and one spawned at rkm 64. Ground surveys found several other fish spawning near rkm 43.4-50 and rkm 64 but none near rkm 30.5-37. One of these fish located 3 d after the mortality mode was triggered, had not spawned.

In 1989, 44 early-run coho salmon were radio tagged. Ten (23%) were tracked to their final spawning location. Eight fish (80%) spawned in tributaries and two (20%) spawned in the main-stem Kenai River (Table 5). Six radio-tagged salmon were captured in the sport fishery, 11 fish migrated back out into Cook Inlet, and nine died within 7 d of tagging (Table 4). The remaining eight radio-tagged fish were lost.

Table 5. Spawning distribution and timing of early-run coho salmon radio-tagged in 1989.

Spawning site	Number of tagged fish	Spawning time
Kenai Mainstem	2	September
Moose River	3	September and October
Quartz Creek	3	September and October
Slikok Creek	1	September
Trail Creek	1	September and October

The three radio-tagged coho salmon tracked to the Moose River were all tagged on the same day (August 24) but in different locations in the lower river (Appendix D: Table 22). Ground surveys in this area led to

the recovery of two radio-tags. Three radio-tagged fish spawned in Quartz Creek. These three fish were tagged within a 4 d period in late August (Appendix D: Table 23). Ground surveys conducted in this area resulted in the recovery of two radio tags and one spaghetti tag (Appendix D: Tables 22-23). A radio-tagged fish that spawned in Slikok Creek was also recovered; however, no stream counts were obtained due to heavy brush. A tributary spawner in Trail Creek was not recovered.

The two fish that selected main-stem Kenai River spawning sites were located at rkm 54.7 and at rkm 106.2 (Table 6). Ground surveys near rkm 54.7 located several spawners in the area but the tag was not recovered. No surveys were conducted in the river section near rkm 106.2.

Additional waters used by early-run coho salmon for spawning in 1988 and 1989 included: Beaver, Soldotna, Jean, Juneau, Grant and Ptarmigan creeks. Ground surveys were conducted on these tributaries as time permitted to quantify use and determine time of spawning (Appendix C: Tables 20-21). Few fish were found, with the exception of Grant Creek. A weir operated by the Cook Inlet Aquaculture Association in Grant Creek counted 647 coho salmon between August 16 and October 17 in 1988. Peak numbers occurred in September. The weir was not operated in 1989. Undoubtedly, other tributaries not surveyed due to time and personnel constraints, remoteness and weather conditions are used for spawning.

Spawning of early-run coho salmon occurred primarily in September and October for tributary spawners and in September for main-stem Kenai River spawners. Stream surveys conducted on the East Fork Moose River and the outlet of Tern Lake showed peak spawning numbers in late September and October (Appendix C: Tables 20-21).

Table 6. Spawning areas and spawning times of radio-tagged coho salmon in the Kenai River drainage, Alaska, 1988 and 1989[a].

Location	Number of tagged fish 1988	1989	Spawning months S O N D J F M
Kenai River			
rkm 115.8-132	2	2	----------
rkm 106.2	0	1	-
rkm 79.6-78.8	2	1	----------
rkm 77.2-75.6	9	13	----------
rkm 74.8-73.2	6	10	----------
rkm 71.6-70.0	3	4	---------
rkm 68.4-67.6	2	4	-----
rkm 66.8-66.0	3	2	-----
rkm 65.2-63.5	3	0	---------
rkm 59.5-53.9	6	5	-----
rkm 51.5-48.3	3	0	-
rkm 43.4-38.6	1	1	-
rkm 37.0-30.5	5	0	-----
Funny River	2	0	-
Hidden Creek	0	1	-
Killey River	6	0	-
King County Creek	3	0	-
Moose River			
East Fork	2	2	-----
Outlet Swan Lake	0	1	-
Mainstem	0	2	-----
Quartz Creek	0	3	-----
Russian River	1	0	-
Slikok Creek	0	1	-
Trail Creek	1	1	-

[a] Observations include aerial and boat tracking.

Late Run

In 1988, 57 late-run fish were radio tagged. Thirty-four of these fish were captured in the lower river by drift net or fishwheel and 23 were tagged in the upper river after being captured by drift netting (Appendix D: Tables 22-23). Forty fish were eventually tracked to spawning areas (Table 4).

Thirty-nine fish selected spawning areas in the main-stem Kenai River, seven fish died within 7 d of tagging, eight were lost, and two fish were sport caught. Only one fish radio-tagged after September 1 selected a tributary for spawning. This fish was tracked to the lower Killey River in early October, approximately 3.2 km upstream of the confluence with the Kenai River.

Seventy-five percent of the late-run, main-stem spawners selected the river section between Naptown Rapids and Skilak Lake (rkm 63.5-80.5) (Table 7). These fish spawned from October through February. Another group of spawners (17.5%) selected the river section between Soldotna and Sterling (rkm 30.5-59.5) and spawned in September and early October. Two fish (5%) selected spawning sites in the upper river between Skilak and Kenai lakes and spawned in October and January.

Coho salmon were also observed spawning during low-flow periods from October through March. These areas were located in the main-stem Kenai River below Skilak (rkm 60-80) and Kenai Lakes (rkm 129-132). Two radio tags and three spaghetti tags were recovered during ground surveys at these locations (Appendix D: Tables 22-23).

Table 7. Spawning distribution and timing of late-run coho salmon radio-tagged in 1988 and 1989.

Spawning site	Number of tagged fish 1988	1989	Spawning time
Kenai River rkm 63.5-80.5	22	34	October - February
Kenai River rkm 30.5-59.5	15	6	October - November
Kenai River rkm 116-132	2	2	October - January

In 1989, 70 late-run fish were radio tagged. Sixty-six of these fish were captured in the lower river and four were tagged in the upper river (Appendix D: Table 23). Forty-four (63%) fish were tracked to spawning grounds (Table 4). Forty-two fish selected spawning areas in the main-stem Kenai River, 10 fish died within 7 d of tagging, 11 fish were lost, one fish shed its tag, and four fish were sport-caught. Only two fish, both radio tagged in the first week of September, spawned in tributaries. One fish was located in the lower Moose River and spawned in early October. The other fish was recovered after being removed from Hidden Creek by a predator.

As in 1988, most (77%) radio tagged late-run fish spawned in the main stem from October through February in the area between Naptown Rapids and Skilak Lake rkm 63.5-80.5 (Table 7). Another small group (14%) of spawners selected the area from rkm 30.5 to 59.5 and spawned in October and early November. Two fish (5%) selected spawning sites in the upper river between Skilak and Kenai lakes and spawned in November and December.

Aerial surveys, conducted January through April 1990, identified spawning activity occurring between rkm 63.5-130. Index counts were largest in January and February and no fish were observed in April (Table 8).

Migration Rate

Twenty-five early-run fish tracked above rkm 34 in 1988 had a mean migration rate of 2.6 km/d (Table 9). The mean migration rate of 23 early-run fish tracked in 1989 was 3.5 km/d. In 1988, late-run coho salmon migrated at a mean rate of 3.8 km/d compared to a mean rate of 4.9 km/d in 1989 (Table 9).

Early-run coho salmon were found to have a migration rate significantly slower than late-run fish both years ($P=0.016$ and $P=0.018$). Individual migration rates and total miles traveled for each radio-tagged coho salmon can be found in Appendix D: Tables 26-27.

Using these mean migration rates, the average early-run coho salmon was exposed to the lower Kenai River sport fishery for 10 to 13 d. Late-run fish with their faster migration rate were available to the fishery for 7 to 9 d.

Table 8. Aerial survey counts of coho salmon in the Kenai River, Alaska, 1990.

	Location									
Date	Bings Landing rkm 63.5	1st Hole rkm 66	2nd Hole rkm 68.4	Kenai Keys rkm 70.8	Thompsons Hole rkm 74	Renfros Hole rkm 74.8	Super Hole rkm 76.4	Rainbow Alley rkm 79.6	Kenai Lake Outlet rkm 130.0	Total
1/17	31	36	32	28	26	63	180	94	46	536
1/30	33	23	31	30	15	61	193	73	32	491
2/8	16	26	29	20	19	13	211	38	39	411
2/21	16	1	26	13	12	3	136	44	7	253
3/5	2	0	12	0	9	0	63	26	2	114
3/19	0	0	0	0	1	0	39	14	3	58
4/10	0	0	0	0	0	0	0	0	0	0

No counts prior to 1/17/90 due to high and turbid water conditions.

Table 9. Summary of migration rates (km per day) of coho salmon radio-tagged in the lower Kenai River, Alaska, 1988 and 1989.

Grouping		Number of tagged fish	Mean migration rate (km/day)	+ Standard - deviation
Early run				
	1988	25	2.6	1.6
	1989	23	3.5	1.7
Late run				
	1988	20	3.8	2.4
	1989	53	4.9	3.9

Harvest

Kenai River coho salmon were harvested by commercial, personal-use, and sport fisheries in 1988 and 1989. The UCI commercial fishery, made up of set nets and a drift net fleet, intercepted Kenai River fish in Cook Inlet waters. A personal-use fishery also intercepted Kenai River fish in salt water prior to their entry into the river while a sport fishery occurred in the main-stem Kenai River and several of its tributaries.

The eastside set net fishery of UCI harvested coho salmon July 1 to August 15 in 1988 and 1989. Both years, the early run of coho salmon bound for the Kenai River first appeared along the eastside beaches in substantial numbers in late July and peaked in abundance in early August. The commercial catch was estimated at 55,419 fish in 1988 and 81,744 in 1989 (Table 10). This included an estimated 40,373 and 56,791 coho salmon harvested in 1988 and 1989, respectively, from the Kalifonsky and Salamantof beach areas (Appendix B: Tables 12-15). A

Table 10. Estimated harvest of Kenai River coho salmon, Cook Inlet, Alaska, 1988 and 1989.

Fishery	Period	Estimated catch 1988	Estimated catch 1989
Commercial[a] (Upper District)			
Eastside set net	7/1 - 8/15	55,419	81,744
Drift net	7/1 - 8/15	263,701	Closed
	Total	319,120	81,744
Personal use[a]			
2nd weekend September		1,124	1,056
3rd weekend September		1,538	1,320
	Total	2,662	2,378
Recreational[a]			
Early run	8/1 - 31	24,281	27,206
Late run	9/1 - 30	11,495	16,195
	Total	35,776	43,401

[a]Data source: Alaska Department of Fish and Game, Soldotna, Alaska

total of 263,701 coho salmon were also harvested in the UCI drift net fishery in 1988 (Table 10). No fish were harvested by the drift net fishery in 1989 due to an emergency closure caused by the Exxon Valdez oil spill.

Coho salmon run strength, as measured by catch per unit effort data from the commercial fisheries in UCI, indicated an average return in 1988 (P. Ruesch, Alaska Department of Fish and Game, personal communication). The coho salmon return in 1989 was difficult to interpret, due to the lack of the drift net fishery, but available

harvest information indicated a later run timing that was average or better in strength. This run strength corresponds with the harvest rate in the eastside set net fishery which has been above average since 1984 (Figure 10).

The personal-use gill net fishery was open along the Kenai Peninsula shoreline from Boulder Point to Ninilchik on September 10, 11, 17 and 18 in 1988. This fishery primarily targets the late run of Kenai River coho salmon and total harvest was estimated at 2,662 fish (Table 10). In 1989, this fishery took place on September 11, 12, 18 and 19 and harvested an estimated 2,378 fish.

Coho salmon are among the most sought-after species in the Kenai River sport fishery. This fishery begins as adult coho salmon enter the Kenai River in mid to late July and continues into late fall and early winter. The majority of this effort and harvest occurs downstream from Skilak Lake from early August through late September.

In 1988, the estimated sport fish harvest was 35,776 coho salmon. This was divided into an early and late-run harvest of 24,281 and 11,495 fish, respectively (Table 10). In 1989, an estimated 43,401 coho salmon were harvested with 27,206 and 16,195 fish taken in the early and late runs, respectively.

Fishing pressure for coho salmon is minimal in most tributaries with the exception of the Russian River. The Alaska Statewide Harvest Survey (Mills 1988) estimates over 1,000 coho salmon are harvested in this stream annually.

Sixteen radio-tagged and nine spaghetti-tagged fish were recovered in the sport fishery in 1988 and 1989 (Appendix D: Tables 22-25). Limited

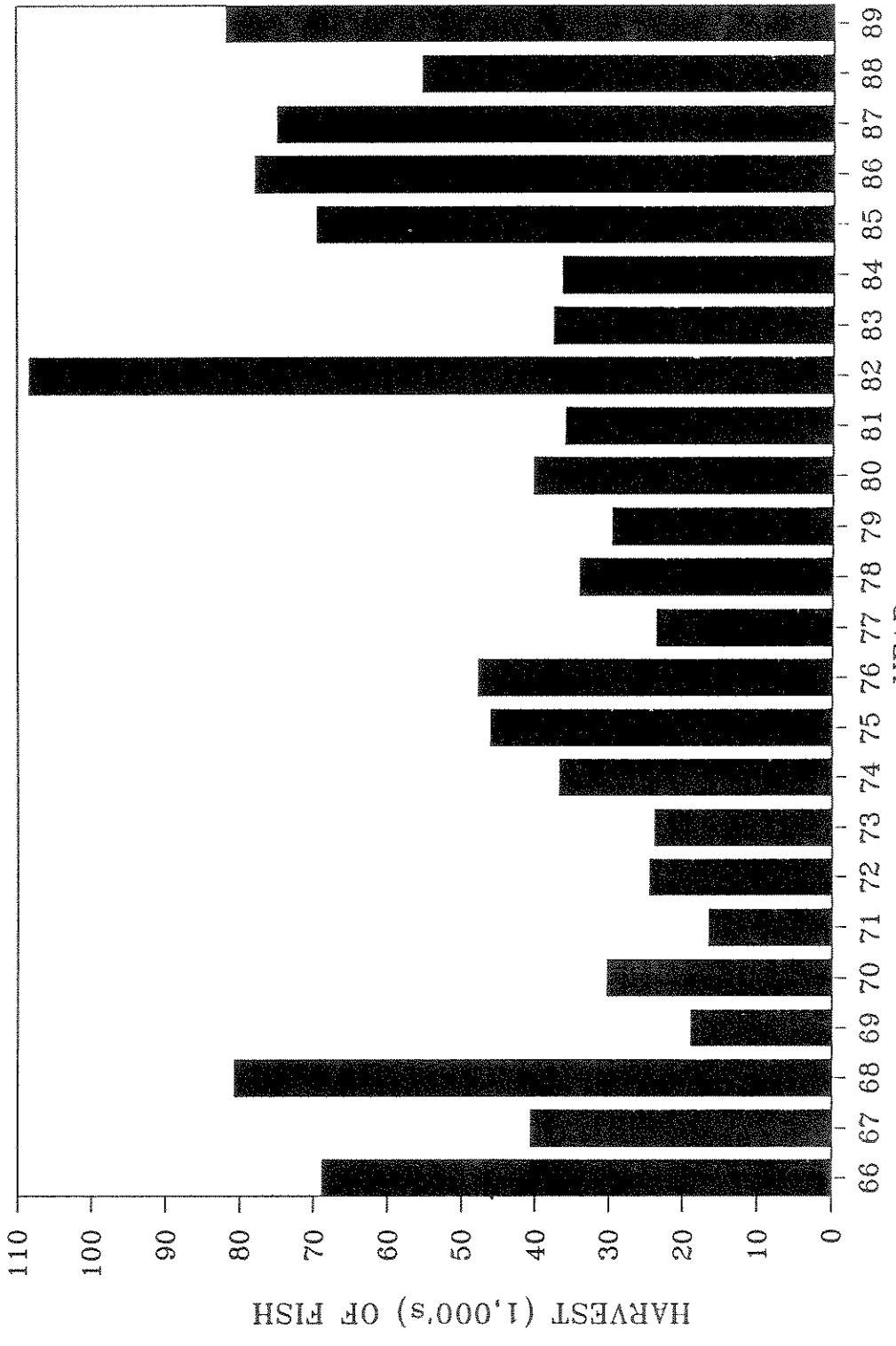

Figure 10. Coho salmon harvests from set nets on the eastside in the Upper Subdistrict of Cook Inlet, Alaska, 1966-1989.

information was collected on these fish as most were captured within a few days after being tagged.

DISCUSSION

Run Timing

Coho salmon from four major river systems, Kasilof, Kenai, Swanson, and Susitna, as well as several smaller systems, enter UCI starting in July each year (Ruesch 1989). These fish are harvested commercially in the Central District by a drift net fleet and by set nets in the Central and Northern Districts. Fish from all of these river systems are harvested together, creating a mixed-stock fishery.

Harvest data gathered from the commercial fishery are analyzed by area to estimate run timing, run strength, and escapement of fish as they pass through Cook Inlet to their river of origin. Tarbox (1988) estimated the migration rate of coho salmon through Cook Inlet to be 9.1 to 15.8 km/d; a rate requiring fish a minimum of 1 to 2 weeks to reach the Kenai River after entering Cook Inlet.

Comparisons of the timing of commercial catch data in Cook Inlet to my data on river entry provide supporting evidence for the accuracy of Tarbox's (1988) migration rate estimates. In river harvest and catch rates increased in early to mid-August in 1988 and 1989, indicating substantial numbers of fish were entering the Kenai River. This was approximately 1 to 2 weeks after commercial harvest rates in the Cohoe and Ninilchik beach areas reported increasing numbers of coho salmon in

their catch. An early peak, July 30, 1989, in the commercial catch is attributed to harvest of Susitna River stocks which have an earlier run timing through UCI than Kenai River stocks (Paul Ruesch, Alaska Department of Fish and Game, Soldotna, Alaska, personal communication). Later run timing of coho salmon in 1989, shown by the commercial harvest trend, was also seen in harvest and catch rates in the Kenai River. Commercial harvest trends, especially those in the eastside set nets, appear to be good indicators of Kenai River coho salmon run timing and strength. Little or no information on timing of runs is available from the commercial fishery on coho salmon returning to Cook Inlet after mid-August due to the seasonal closure of eastside districts on August 15. Data collected indicate that an early and a late run of coho salmon occur in the Kenai River. Peaks occur in early August and in late August to mid-September. Angler success, a general measure of abundance as measured in the Department's creel census (1976-1990), is the longest term data available and shows these two general peaks (Hammarstrom 1989). Catch rates in the fishwheel and drift netting operation also showed a bimodal run pattern that coincides with that of the sport fishery. The first peak is also supported by eastside set net catches prior to their seasonal August 15 closure.

A size difference between early and late-run fish also supports a bimodal entry pattern. Fish entering the Kenai River in August are smaller compared to fish entering in September and October (Appendix E: Table 28). This is also apparent in chinook salmon stocks (Oncorhynchus

tshawytscha) in the Kenai and Columbia river systems (Burger et al. 1983, Fulton 1968, Hammarstrom 1985).

Due to a continuum of fish entering the river, as seen in the creel catch statistics, the division between the two runs is not clear. However, fish entering in August (early run) are primarily smaller and tributary spawners and fish entering in September or later (late run) are primarily larger and main-stem spawners.

Bimodal runs of coho salmon occasionally occur in North America but are more apparent in Asian stocks (Scott and Crossman 1973). Typically adults enter streams and rivers from late summer to November and spawn in late fall and early winter (Drucker 1972, Shapovalov and Taft 1954). Coho salmon were found entering the Kenai River as late as mid-December and spawning as late as March. These fish may be unique as no other coho salmon in Alaska are known to arrive and spawn this late.

The differential run timing between early and late-run fish may result in different exploitation rates. The early run of coho salmon could potentially be exploited at a higher level since its timing coincides with the commercial fishery and an intensive sport harvest.

It is not currently possible to determine the exploitation rate on Kenai River coho salmon stocks due to unknown escapement and a mixed-stock commercial harvest. If exploitation rates are determined in the future, management strategies may need to be altered to ensure that

discrete runs are not overexploited. A harvest rate of over 67% is not recommended for Alaskan stocks of coho salmon (Shaul 1986).

In areas where escapement data are minimal, commercial harvest statistics may be the only information managers have to assess status of salmon stocks (Shaul et al. 1985). Harvest statistics are used to develop predictive models of runs in other areas (Mathews and Olson 1980, Zillges 1977). The best long-term index of coho salmon run timing and strength currently available to harvest managers is the trend shown in the Cook Inlet commercial fishery and the Kenai River sport fishery.

Spawning Distribution and Timing

The majority of early-run coho salmon radio tagged in the lower river selected tributary spawning areas. The majority of late-run fish selected main-stem spawning areas. Spawning took place in September and October for early-run fish and late-run spawning occurred during October through March. Similar results were reported for a smaller sample of coho salmon by Burger et al. (1983) and for chinook salmon (Burger et al. 1985, Hammarstrom et al. 1985).

Several tributaries were identified as coho salmon spawning areas. Tributaries that were used by more than one radio-tagged fish include the Funny, Moose, and Killey rivers and Quartz and King County creeks. The relative importance of each tributary is unknown. Currently, the only accurate coho salmon escapement data available are from the Department's Russian River weir where counts ranged from 607 in 1988 to 1,122 in 1989 (Athons and Hammarstrom 1988, Carlon and Vincent-Lang

1990). These are only partial counts, however, as the weir was pulled prior to complete passage of coho salmon. Additional tributaries surveyed for coho salmon in the past include the Moose River and Grant Creek (Flagg et al. 1986; Booth, in review). Escapement counts ranged from 980 to 3,926 fish in the Moose River and 643 to 1,816 fish in Grant Creek (Marcuson 1989).

In the late run, most radio-tagged fish spawned in the Kenai River between rkm 64 and 80. However, some spawning occurred in the midstream section (rkm 34-63.5). Burger (1983) found no coho salmon spawning below rkm 64. However, I observed active spawning between rkm 43.4 and 59.5.

One late-run fish, radio-tagged on October 24, 1988, spawned near rkm 132 in January after holding below Skilak Lake for 8 weeks. This may indicate that the river section below Skilak Lake is not only important for late-run spawning but may also be an important holding area for fish which spawn elsewhere. Several other radio-tagged fish held for long periods of time (18 to 67 d) in this upper section before spawning.

Stream life (average time spent on spawning grounds) of early-run coho salmon in this study averaged 17 d. Minard (1986) reported a mean stream life of 9 d for coho salmon. He found that early-run fish had a longer stream life than late-run fish. My radiotelemetry data suggest the opposite for Kenai River coho salmon. Early-run fish that spawned in tributaries lived 13 to 23 d after reaching their selected spawning area while late-run fish were found to live 18 to 67 d. Stream life for early-run tributary spawners was comparable to that of coho salmon in

the Puget Sound area where stream life averages 14 d (Shaul et al. 1985; Flint and Zillges 1980).

The longer stream life observed for late-run fish may have resulted from how I determined stream life. Radio-tagged fish were monitored until the mortality mode or a downstream movement was detected. Milling behavior (movement within a 1.6 km^2 area) was used to identify spawning areas. Prolonged milling in an area before spawning took place could have inflated these stream life calculations as compared to those found by Minard (1986) through direct observation.

Only one radio-tagged fish was known to move from the Kenai River to spawn in another river system. This was an early-run fish (tagged August 23) that moved from of the Kenai River 5 d after tagging. It was located 11 d later in the Kasilof River, approximately 17.6 km south of the Kenai River. A high degree of straying by landlocked coho salmon has been reported (Wenger 1982; Peck 1970). Straying of chinook salmon tagged in the lower Kenai River is well documented (Bendock and Alexandersdottir 1990; Burger et al. 1983; Conrad and Larson 1987; Conrad 1988). It is possible that many of the radio-tagged fish unaccounted for in my study were strays into the Kenai River and left the system after being tagged.

Spawning distribution and timing data suggest that the behavior of early and late-run coho salmon is similar to that of chinook salmon in the Kenai River: the majority of early-run fish spawn in tributaries while most late-run salmon use the main-stem Kenai River. A "thermal adaptation" hypothesis proposed by Burger et al. (1985) suggest that the different spawning areas and times for the two runs may be the result of

natural selection and adaptation to specific home-stream temperature. The later spawning time (as late as March in the main-stem Kenai River) may be related to the warming influence of Kenai and Skilak lakes that directly affect spawning areas. These late-run coho salmon are possibly unique as no other Alaska coho salmon stock has been documented entering fresh water as late as December or spawning as late as March.

Migration Rate

The migration rate of coho salmon in the Kenai River was comparable to that reported by other research in Alaska (Bentz 1986; Burger et al. 1981; Burger 1988)(Table 11). The in-river migration rate of 2.6-4.9 km/day was much slower than the estimated migration rate of 9.1-15.8 km/day through Cook Inlet (Tarbox 1988).

Table 11. Migration rates of radio-tagged coho salmon in the Little Susitna, Deshka and Kenai rivers, Alaska.

Location	Number	Mean migration rate (km/day)	Mean migration rate (mi/day)	Range (km/day)	Range (mi/day)
Little Susitna River (Bentz 1986)	26	3.2	2.0	1.3-5.0	0.8-3.1
Deshka River (Burger, et al. 1981)	5	3.2	2.0	1.9-5.9	1.2-3.7
Kenai River (Burger, unpublished data)	12	3.9	2.4	1.8-6.4	1.1-4.0
Kenai River (Booth, this study)	121	4.0	2.5	0.8-20.3	0.5-12.6

It was assumed that the migration rate of tagged salmon was constant and similar to that of untagged fish. Gray and Haynes (1979) reported that travel times and percent returns of externally tagged salmon was not significantly different from those of control fish. The only known effect of external transmitters in this study was slight muscle damage caused by the attachment pins. Holes where pins had penetrated the dorsal musculature enlarged slightly and some fungal infection was evident. This has been reported by others using external tags but had little or no noticeable affect on fish behavior (Mellas and Haynes 1985, Ross and McCormick 1981, Winter, et al. 1978). These findings support the assumption that movements of radio-tagged fish are representative of those of untagged fish. However, migration rates should be considered minimal as fish were not monitored continuously.

The reason for the reduced number of radiotagged early-run coho salmon successfully tracked in 1989 compared to 1988 is unknown. Several other coho salmon studies in Alaska have experienced problems due to high mortality rates of tagged fish (Bentz 1986; Burger et al. 1981). High mortality rates were found on fish tagged in the intertidal reaches in these studies. In my study, all fish radio tagged were captured above the intertidal reaches and had a firm scale set.

The difference in migration rate between early and late-run fish could result in different harvest levels in the lower river sport fishery. Early-run fish are exposed to anglers in the lower river for almost twice as long and thus are more likely to be caught. This should

be taken into consideration by managers as effort and harvest levels increase.

Harvest

Coho salmon destined for the Kenai River are presently allocated to commercial, personal-use, and sport fisheries. In the UCI Salmon Management Plan, the run is allotted primarily to recreational use, and the Department is asked to limit the harvest of this stock in the commercial fishery (Ruesch 1989). However, the timing of early-run coho salmon migrating through Cook Inlet coincides with the end of a large commercial sockeye salmon (*Oncorhynchus nerka*) fishery. In years with high returns of sockeye salmon, additional commercial fishing periods are permitted to harvest the surplus. Due to the nature of the mixed-stock commercial fishery in Cook Inlet, these additional fishing periods intercept more coho salmon.

The majority of coho salmon harvested in the eastside set net fishery are believed to be of Kenai River origin but fish from other systems such as the Kasilof, Susitna, and Swanson rivers are also present (K. Tarbox, Alaska Department of Fish and Game, Soldotna, Alaska, personal communication). Coho salmon harvested on the eastside beaches have age compositions that closely mimic those observed in the Kenai River which supports the assumption that they are of Kenai River origin (Vincent-Lang and McBride 1988). The set net harvest of coho salmon from the Kalifonsky and Salamantof beach areas, immediately north and south of the Kenai River mouth (Figure 4), may indicate an origin in the Kenai

River. The catch per unit of effort in these areas generally starts out very low in early July and typically is at the highest levels the last week of July and first 2 weeks of August. The catch rates in these areas may be the most useful tool to managers in predicting run timing and strength of Kenai River coho salmon.

Coho salmon harvest in the eastside set net fishery has been following an upward trend since 1977 and is currently well above the mean for the past 23 years. The large number of coho salmon harvested in 1989 may have been related to the lack of harvest in the drift net fishery. However the 1989 harvest was only slightly higher than in 1986 and 1987 when 76,922 and 74,997 fish were taken, respectively. During these same years the drift net fishery in UCI harvested 501,059 and 195,937 fish, respectively (Appendix B: Table 18). These harvest levels may be cause for concern to managers as allocation problems increase between commercial, subsistence, personal-use, and sport fisheries.

The September personal use fishery targets late-run coho salmon. This fishery has not changed in harvest level in recent years and does not appear to have much effect on coho salmon bound for the Kenai River as long as the current quota of 2,500 fish is maintained.

The majority of effort (78%) and coho salmon harvest (84%) in the sport fishery occur in the downstream section of the Kenai River (below rkm 34)(Hammarstrom 1989). Angler effort during the early run is generally twice that of the late run, resulting in a higher harvest of early-run fish in most years (Appendix B: Table 17). However, angler effort has been increasing dramatically the last 10 years for both early

and late runs (Figure 11). Sport harvest during 1988 and 1989 was greater than the past 14 year mean of 29,290 (Appendix B: Table 17).

Average daily migration rate of radio-tagged fish may be useful in evaluating the susceptibility of coho salmon in the lower river sport fishery. Although sample sizes were small, the difference in migration rate between early and late-run fish suggest a potential differential harvest.

Early-run coho salmon (tributary spawners) appear to be more susceptible to harvest in the lower river sport fishery than late-run fish due to a slower migration rate. However, the longer time spent in the main-stem Kenai River by the late run exposes them to possible harvest for a longer period. Late-run fish remained in some areas below Skilak and Kenai lakes for 5 to over 10 weeks, making them susceptible to concentrated angler effort.

Currently, no information is available on angler effort and harvest after September in the Kenai River. During this study five (31%) of the radio-tagged coho salmon captured in the sport fishery were harvested in the upper river section. These fish were caught in September and October, providing evidence that harvest does occur in this area well into October.

If sport fishing effort increases in the upper river section (rkm 63.5 and 80.5) certain management strategies may be needed to prevent over harvest of late-run fish. Time and area restrictions, lower bag limits, and terminal tackle restrictions are possible regulations that could be effective in maintaining viable population levels. Fishing activity after September has been assumed to be minimal and weather

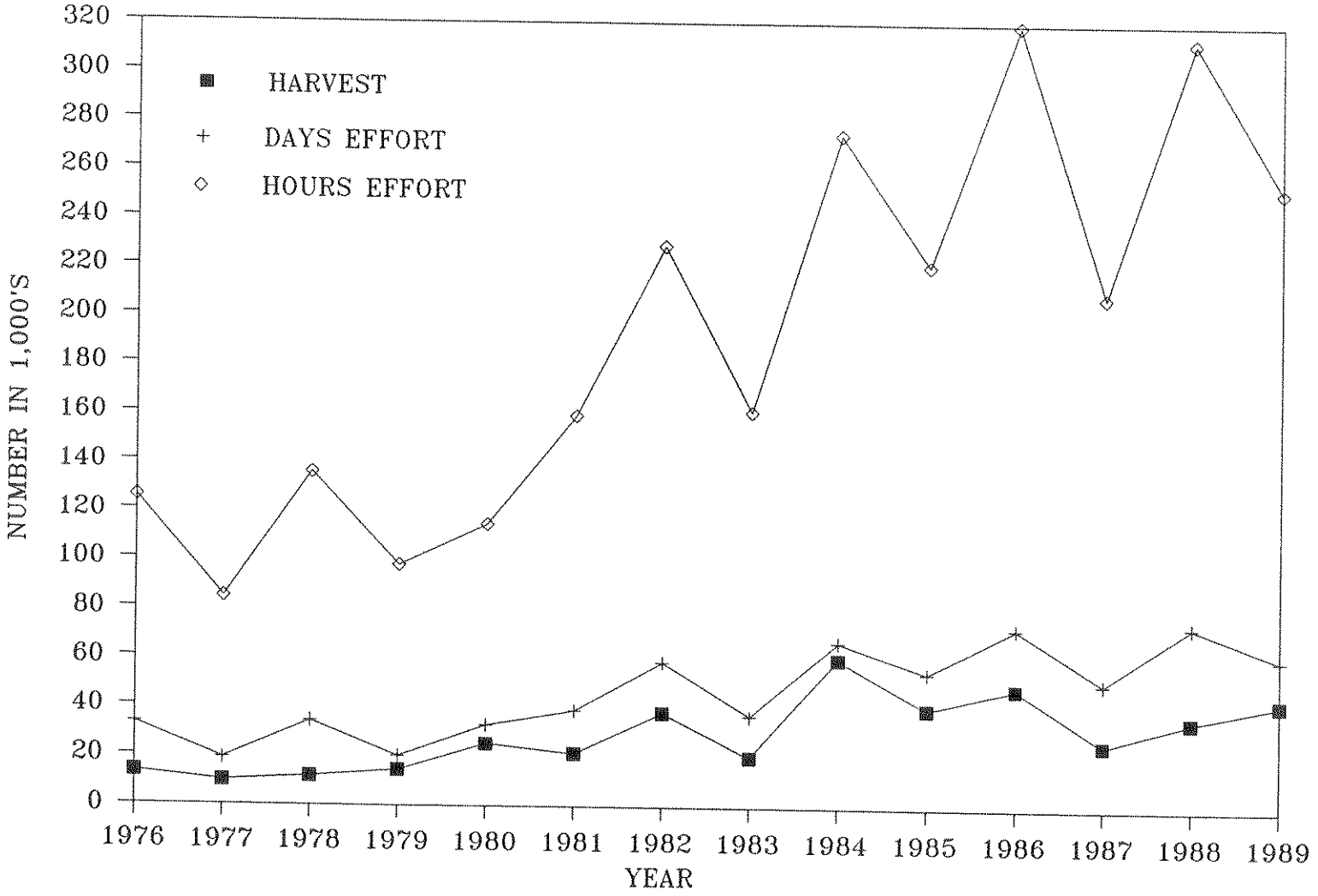

Figure 11. Historical summary of angler effort and harvest in the Kenai River coho salmon fishery, Alaska, 1976-1989 (Data source: Alaska Department of Fish and Game, Soldotna, Alaska).

dependent. However, I observed anglers fishing in the harsh conditions of October and November, 1989.

Commercial and sport fishery harvest levels are currently well above their historical means. Effort in the sport fishery is increasing steadily and the number of commercial fishing periods allowed is above average due to a surplus of sockeye salmon in recent years. This information leads to the conclusion that Kenai River coho salmon stocks are undergoing increasingly higher exploitation rates. The differential run timing and migration rate between early and late-run coho salmon suggests that these fish are being exploited at different levels. Managers should take this into consideration as effort and harvest levels increase in the future.

RECOMMENDATIONS

Present management strategies appear to be adequate in maintaining current population levels, since coho harvest rates have remained stable or increased in commercial and sport fisheries. Until coho salmon stocks can be differentiated in the mixed-stock marine fishery, managers are limited in their ability to harvest or protect discrete stocks of fish.

Information on the contribution of discrete coho salmon stocks to the commercial fishery would assist managers of the sport fishery in determining in-river escapement and aid in the development of escapement goals necessary to maintain viable population levels of coho salmon in the future. Investigations which would contribute to improved management of coho salmon include:

a. Extension of Department creel census to monitor fishing pressure in the upper river after September.

b. Enumeration of both early and late runs by side scan sonar to monitor escapement levels and help determine exploitation rates.

c. Coded wire tagging of smolts to differentiate stocks in Cook Inlet commercial harvest.

d. Development of a genetic stock identification program to estimate stock-specific harvest in the mixed-stock marine fisheries.

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APPENDICES

APPENDIX A

Study Sections

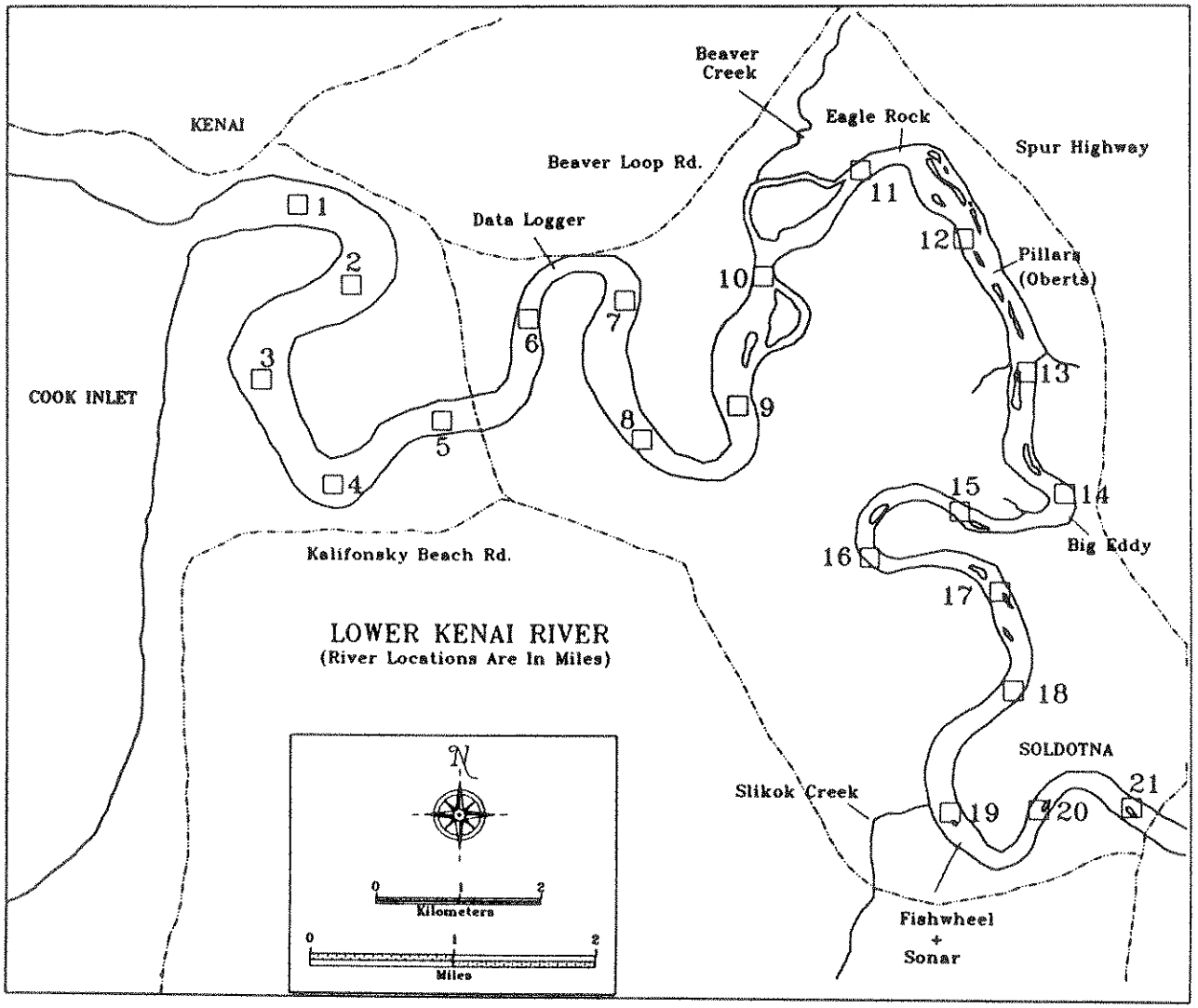

Figure 12. Lower study section of the Kenai River, Alaska (River Kilometer = River Mile x 1.609).

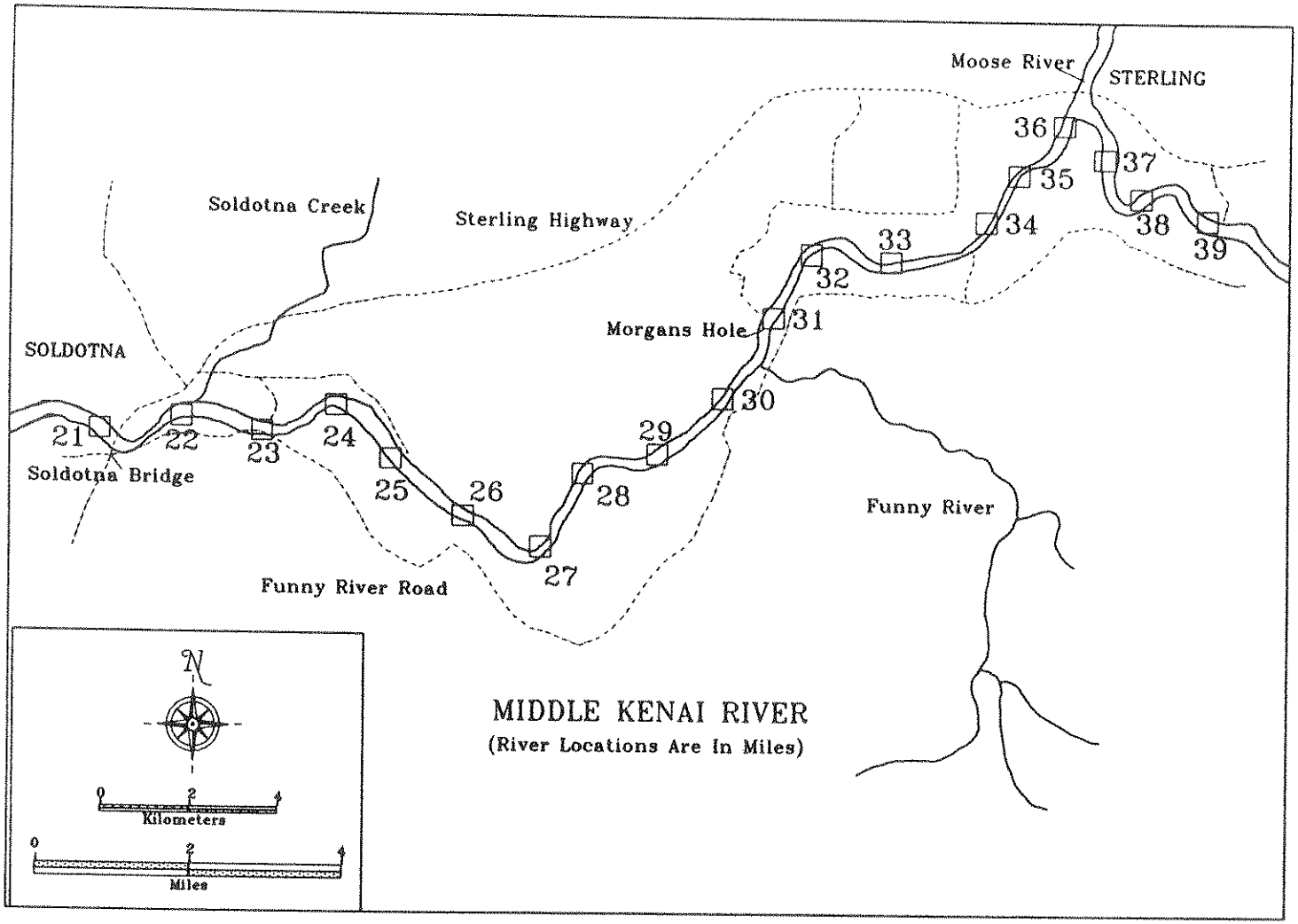

Figure 13. Middle study section of the Kenai River, Alaska (River Kilometer = River Mile x 1.609).

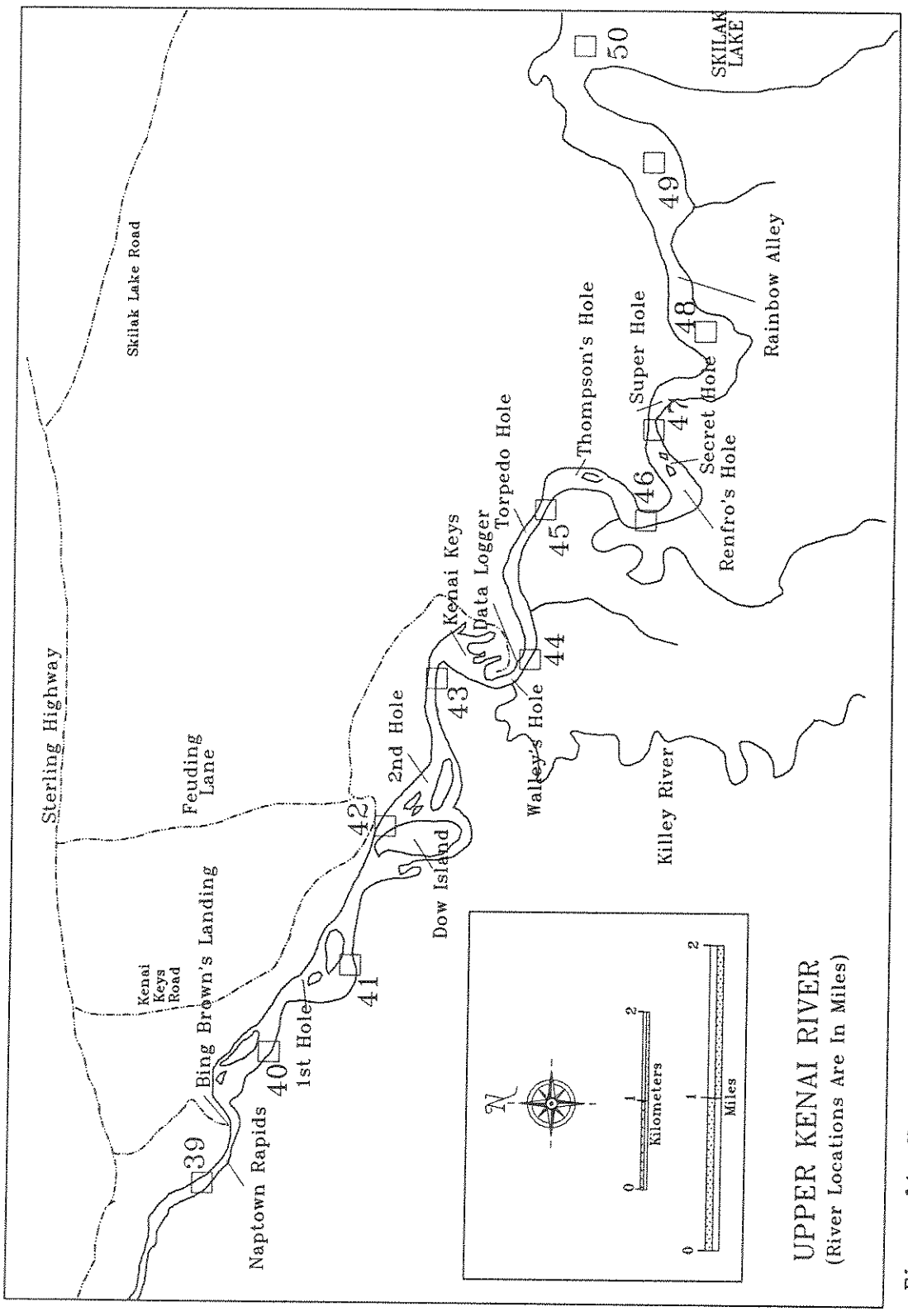

Figure 14. Upper study section of the Kenai River, Alaska (River Kilometers = River Mile x 1.609).

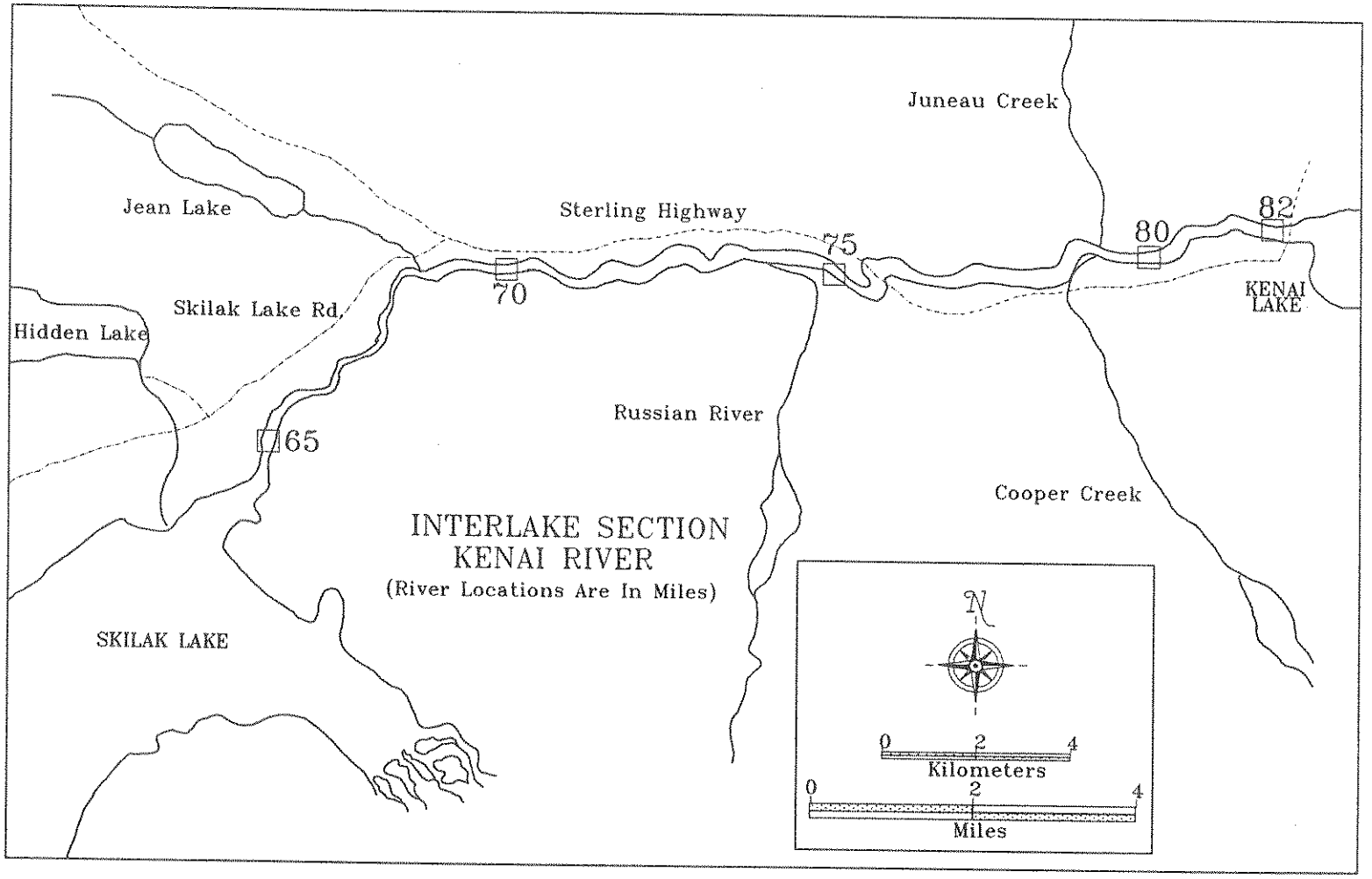

Figure 15. Interlake study section of the Kenai River, Alaska (River Kilometers = River Miles x 1.609).

APPENDIX B

Harvest

Table 12. Coho salmon harvest in the Kalifonsky Beach set gill net area of the Upper Subdistrict, Cook Inlet, Alaska, 1988[a].

Date		Number of deliveries	Daily catch per unit of effort	Catch	
				Daily	Cumulative
7/01	Friday	71	.13	9	9
7/04	Monday	92	.45	41	50
7/08	Friday	95	.04	4	54
7/09	Saturday	13	.08	1	55
7/10	Sunday	117	.15	18	73
7/11	Monday	131	.13	17	90
7/12	Tuesday	112	.19	21	111
7/13	Wednesday	101	.26	26	137
7/14	Thursday	11	.27	3	140
7/15	Friday	224	1.25	281	421
7/16	Saturday	156	.79	123	544
7/17	Sunday	214	1.08	231	775
7/18	Monday	161	.94	151	926
7/19	Tuesday	95	.79	75	1,001
7/21	Thursday	75	4.47	335	1,336
7/22	Friday	217	2.19	476	1,812
7/23	Saturday	129	.94	121	1,933
7/24	Sunday	132	.55	72	2,005
7/25	Monday	136	1.08	147	2,152
7/26	Tuesday	159	1.73	275	2,427
7/27	Wednesday	80	3.64	291	2,718
7/28	Thursday	88	6.55	576	3,294
7/29	Friday	157	5.22	820	4,114
7/30	Saturday	71	14.38	1,021	5,135
7/31	Sunday	71	22.56	1,602	6,737
8/01	Monday	127	9.25	1,175	7,912
8/05	Friday	98	13.96	1,368	9,280
8/08	Monday	86	12.69	1,091	10,371
8/12	Friday	54	23.37	1,262	11,633
8/15	Monday	47	44.51	2,092	13,725

[a] Data source: Alaska Department of Fish and Game, Soldotna, Alaska.

Table 13. Coho salmon harvest in the Salamantof Beach set gill net area of the Upper Subdistrict, Cook Inlet, Alaska, 1988[a].

Date		Number of deliveries	Daily catch per unit of effort	Catch	
				Daily	Cumulative
7/01	Friday	40	.57	23	23
7/04	Monday	47	.30	14	37
7/08	Friday	46	.65	30	67
7/11	Monday	84	.79	66	133
7/12	Tuesday	80	2.25	180	313
7/13	Wednesday	211	3.70	780	1,093
7/15	Friday	97	2.71	263	1,356
7/16	Saturday	79	6.14	485	1,841
7/17	Sunday	135	4.86	656	2,497
7/18	Monday	170	6.28	1,067	3,564
7/19	Tuesday	132	8.73	1,153	4,717
7/21	Thursday	68	2.85	194	4,911
7/22	Friday	153	8.52	1,303	6,214
7/23	Saturday	91	2.95	268	6,482
7/24	Sunday	121	6.02	728	7,210
7/25	Monday	91	7.43	676	7,886
7/26	Tuesday	104	10.53	1,095	8,981
7/27	Wednesday	84	5.40	454	9,435
7/28	Thursday	94	5.57	524	9,959
7/29	Friday	100	11.46	1,146	11,105
7/30	Saturday	78	10.95	854	11,959
7/31	Sunday	81	13.64	1,105	13,064
8/01	Monday	62	9.27	575	13,639
8/05	Friday	69	52.39	3,615	17,254
8/08	Monday	59	50.78	2,996	20,250
8/12	Friday	90	50.48	4,543	24,793
8/15	Monday	43	43.14	1,855	26,648

[a] Data source: Alaska Department of Fish and Game, Soldotna, Alaska.

Table 14. Coho salmon harvest in the Kalifonsky Beach set gill net area of the Upper Subdistrict, Cook Inlet, Alaska, 1989[a].

Date		Number of deliveries	Daily catch per unit of effort	Catch	
				Daily	Cumulative
7/03	Monday	73	.10	7	7
7/07	Friday	115	.03	4	11
7/10	Monday	122	.43	53	64
7/11	Tuesday	9	.00	0	64
7/12	Wednesday	109	.08	9	73
7/13	Thursday	233	.13	30	103
7/14	Friday	217	.23	50	153
7/15	Saturday	134	.32	43	196
7/16	Sunday	168	.45	76	272
7/17	Monday	229	.10	23	295
7/18	Tuesday	133	.20	27	322
7/19	Wednesday	166	.24	40	362
7/20	Thursday	215	.37	80	442
7/21	Friday	259	.58	151	593
7/22	Saturday	157	.75	118	711
7/23	Sunday	197	1.15	226	937
7/24	Monday	215	1.12	241	1,178
7/25	Tuesday	190	.47	89	1,267
7/26	Wednesday	254	.80	202	1,469
7/27	Thursday	208	.48	99	1,568
7/28	Friday	188	1.68	316	1,884
7/29	Saturday	178	8.02	1,428	3,312
7/30	Sunday	168	11.88	1,995	5,307
7/31	Monday	172	5.06	870	6,177
8/01	Tuesday	163	4.65	758	6,935
8/02	Wednesday	159	7.42	1,180	8,115
8/03	Thursday	86	8.02	690	8,805
8/04	Friday	126	9.25	1,165	9,970
8/07	Monday	74	11.73	868	10,838
8/11	Friday	50	23.76	1,188	12,026
8/14	Monday	33	24.97	824	12,850

[a] Data source: Alaska Department of Fish and Game, Soldotna, Alaska.

Table 15. Coho salmon harvest in the Salamantof Beach set gill net area of the Upper Subdistrict, Cook Inlet, Alaska, 1989[a].

Date		Number of deliveries	Daily catch per unit of effort	Catch	
				Daily	Cumulative
7/03	Monday	39	.18	7	7
7/07	Friday	69	.38	26	33
7/10	Monday	77	.47	36	69
7/13	Thursday	183	2.55	466	535
7/14	Friday	192	5.03	966	1,501
7/15	Saturday	186	3.31	616	2,117
7/16	Sunday	246	3.70	910	3,027
7/17	Monday	265	1.62	428	3,455
7/18	Tuesday	173	1.23	213	3,668
7/19	Wednesday	259	2.37	615	4,283
7/20	Thursday	314	1.89	595	4,878
7/21	Friday	239	3.74	894	5,772
7/22	Saturday	243	4.19	1,017	6,789
7/23	Sunday	186	7.76	1,443	8,232
7/24	Monday	125	15.59	1,949	10,181
7/25	Tuesday	133	7.61	1,012	11,193
7/26	Wednesday	202	13.18	2,662	13,855
7/27	Thursday	131	10.76	1,409	15,264
7/28	Friday	139	9.27	1,288	16,552
7/29	Saturday	104	56.31	5,856	22,408
7/30	Sunday	99	50.34	4,984	27,392
7/31	Monday	111	26.84	2,979	30,371
8/01	Tuesday	122	20.86	2,545	32,916
8/02	Wednesday	117	19.30	2,258	35,174
8/03	Thursday	82	18.26	1,497	36,671
8/04	Friday	82	16.11	1,321	37,992
8/07	Monday	57	33.37	1,902	39,894
8/11	Friday	41	53.80	2,206	42,100
8/14	Monday	31	59.39	1,841	43,941

[a] Data source: Alaska Department of Fish and Game, Soldotna, Alaska.

Table 16. Commercial coho salmon harvest by gear type in Upper Cook Inlet, Alaska, 1966-1989[a].

Year	Central district drift gill net Number of fish	Central district eastside set gill net Number of fish
1966	80,740	68,877
1967	52,692	40,738
1968	167,219	80,828
1969	32,113	18,988
1970	107,347	30,318
1971	28,875	16,589
1972	19,652	24,673
1973	27,805	23,901
1974	70,935	36,837
1975	84,412	46,209
1976	77,442	47,873
1977	106,284	23,693
1978	67,775	34,141
1979	106,696	29,727
1980	88,792	40,281
1981	221,923	36,031
1982	398,958	108,383
1983	318,208	37,666
1984	196,527	36,530
1985	337,066	69,735
1986	501,059	77,922
1987	195,937	74,977
1988	263,701	55,419
1989	Closed	81,744

[a] Data source: Alaska Department of Fish and Game, Soldotna, Alaska.

Table 17. Historical summary of the coho salmon sport fishery in the Kenai River, Alaska, 1976-1989[a].

	Early run				Late run				Total			
Year	Harvest	Days effort	Hours effort	Harvest/ hour	Harvest	Days effort	Hours effort	Harvest/ hour	Harvest	Days effort	Hours effort	Harvest/ hour
1976	7,711	21,178	84,707	0.091	5,513	11,672	40,852	0.135	13,224	32,850	125,559	0.105
1977	7,415	13,576	59,733	0.124	2,371	5,317	24,990	0.095	9,786	18,893	84,723	0.016
1978	5,236	17,847	78,446	0.067	6,644	16,376	57,313	0.116	11,880	34,223	135,759	0.088
1979	11,122	12,439	68,413	0.163	3,510	7,721	29,339	0.120	14,632	20,160	97,752	0.150
1980	15,668	22,095	77,220	0.203	9,545	10,699	37,447	0.255	25,213	32,794	114,667	0.220
1981	14,680	25,670	106,543	0.138	6,664	13,198	52,790	0.126	21,344	38,868	159,333	0.134
1982	24,827	41,838	167,834	0.148	13,351	16,967	61,082	0.219	38,178	58,805	228,916	0.167
1983	12,851	27,938	114,973	0.111	7,549	8,934	46,260	0.163	20,400	36,872	161,233	0.127
1984[b]	28,447	32,522	139,635	0.134	32,029	34,655	134,810	0.238	60,476	67,177	274,445	0.185
1985	17,950	30,965	128,480	0.140	22,146	23,988	92,755	0.239	40,096	54,953	221,235	0.181
1986	31,070	49,450	206,219	0.151	17,551	23,950	113,072	0.155	48,621	73,400	319,291	0.152
1987	17,321	33,521	139,784	0.124	8,735	17,359	69,087	0.126	26,056	50,880	208,871	0.125
1988	24,281	47,329	197,867	0.123	11,495	27,477	114,944	0.100	35,776	74,806	312,811	0.114
1989	27,206	40,688	169,657	0.160	16,195	20,806	82,836	0.196	43,401	61,494	252,493	0.172
Mean	17,556	29,790	124,251	0.134	11,664	17,080	68,398	0.163	29,220	46,870	192,649	0.138

a Data source: Alaska Department of Fish and Game, Soldotna, Alaska.
b Early run harvest for 1984 reflects only the August fishery. Coho salmon harvested incidental to chinook salmon (9,700) are not included in the catch-per-unit-effort data but are reflected in the harvest estimate.

APPENDIX C

Escapement

Table 18. Estimated salmon escapement (by sonar July 1-August 11) into the Kenai River, Alaska, 1988[a].

Date	Sockeye		Pink		Coho		Chinook	
	Daily	Cumulative	Daily	Cumulative	Daily	Cumulative	Daily	Cumulative
01 July	214	214	0	0	0	0	0	0
02 July	169	383	0	0	0	0	0	0
03 July	270	653	0	0	0	0	1	1
04 July	290	943	0	0	0	0	1	2
05 July	544	1,487	0	0	0	0	1	3
06 July	664	2,151	0	0	0	0	1	4
07 July	417	2,568	0	0	0	0	1	5
08 July	237	2,805	0	0	0	0	0	5
09 July	486	3,291	0	0	0	0	1	6
10 July	7,939	11,230	0	0	0	0	23	29
11 July	53,012	64,242	0	0	0	0	150	179
12 July	26,069	90,311	0	0	0	0	74	253
13 July	53,630	143,941	0	0	0	0	0	253
14 July	45,073	189,014	0	0	0	0	169	414
15 July	37,434	226,448	0	0	0	0	133	547
16 July	53,789	280,237	0	0	0	0	0	547
17 July	28,830	309,067	0	0	0	0	0	547
18 July	38,409	347,476	0	0	0	0	0	547
19 July	35,297	382,773	0	0	0	0	0	547
20 July	34,600	417,373	0	0	0	0	0	547
21 July	56,523	473,896	0	0	0	0	0	547
22 July	107,076	580,972	363	363	0	0	0	547
23 July	112,284	693,256	381	744	0	0	0	547
24 July	66,732	759,988	0	744	0	0	410	957
25 July	42,321	802,309	0	744	0	0	0	957
26 July	26,958	829,267	115	859	0	0	116	1,073
27 July	15,250	844,517	65	924	66	66	0	1,073
28 July	9,088	853,605	39	963	39	105	0	1,073
29 July	8,348	861,953	501	1,464	55	160	466	1,519
30 July	2,908	864,861	174	1,638	20	180	155	1,674
31 July	3,591	868,452	168	1,806	0	180	100	1,774
01 August	4,356	872,808	204	2,010	0	180	122	1,896
02 August	5,017	877,825	234	2,244	0	180	141	2,037
03 August	4,028	881,853	168	2,412	31	211	15	2,052
04 August	10,387	892,240	433	2,845	79	290	39	2,091
05 August	20,523	912,763	368	3,213	92	382	92	2,183
06 August	20,928	933,691	707	3,920	141	523	0	2,183
07 August	19,428	953,119	1,750	5,670	460	983	276	2,459
08 August	11,440	964,559	545	6,215	241	1,224	0	2,459
09 August	8,710	973,269	2,546	8,761	588	1,812	955	3,414
10 August	12,503	985,772	4,395	13,156	838	2,650	1,616	5,030
11 August	11,143	996,915	4,229	17,385	1,524	4,174	752	5,792

[a] Data source: Alaska Department of Fish and Game, Soldotna, Alaska.

Table 19. Estimated salmon escapement (by sonar July 1-August 11) into the Kenai River, Alaska, 1989[a].

Date	Sockeye		Pink		Coho		Chinook	
	Daily	Cumulative	Daily	Cumulative	Daily	Cumulative	Daily	Cumulative
01 July	132	132	2	2	0	0	0	0
02 July	692	824	8	10	0	0	0	0
03 July	1,064	1,888	12	22	0	0	0	0
04 July	495	2,383	6	28	0	0	0	0
05 July	1,488	3,871	17	45	0	0	0	0
06 July	6,221	10,092	69	114	0	0	0	0
07 July	8,075	18,167	90	204	0	0	0	0
08 July	5,008	23,175	0	204	0	0	43	43
09 July	3,685	26,860	24	228	0	0	48	91
10 July	6,382	33,242	41	269	0	0	83	174
11 July	4,592	37,834	29	298	0	0	60	234
12 July	35,054	72,888	1,240	1,538	0	0	83	317
13 July	86,787	159,675	1,588	3,126	0	0	0	317
14 July	99,801	259,476	2,262	5,388	0	0	0	317
15 July	77,612	337,088	0	5,388	0	0	0	317
16 July	49,755	386,843	1,171	6,559	0	0	0	317
17 July	76,478	463,321	0	6,559	0	0	0	317
18 July	92,575	555,896	0	6,559	0	0	0	317
19 July	31,516	587,412	614	7,173	0	0	0	317
20 July	85,602	673,014	124	7,297	0	0	0	317
21 July	127,382	800,396	1,201	8,498	0	0	0	317
22 July	104,724	905,120	6,638	15,136	0	0	0	317
23 July	116,954	1,022,074	5,221	20,357	0	0	0	317
24 July	64,628	1,086,702	0	20,357	0	0	0	317
25 July	30,430	1,117,132	260	20,617	0	0	0	317
26 July	49,366	1,166,498	377	20,994	0	0	81	398
27 July	71,354	1,237,852	0	20,994	0	0	0	398
28 July	51,194	1,289,046	2,025	23,019	0	0	0	398
29 July	40,838	1,329,884	785	23,804	0	0	0	398
30 July	23,023	1,352,907	131	23,935	0	0	0	398
31 July	16,818	1,369,725	211	24,146	0	0	106	504
01 August	30,218	1,399,943	0	24,146	0	0	0	504
02 August	21,110	1,421,053	0	24,146	0	0	0	504
03 August	16,869	1,437,922	50	24,196	150	150	0	504
04 August	14,873	1,452,795	44	24,240	133	283	0	504
05 August	12,775	1,465,570	208	24,448	1,111	1,394	0	504
06 August	22,461	1,488,031	367	24,815	1,953	3,347	0	504
07 August	29,897	1,517,928	0	24,815	97	3,444	0	504
08 August	18,488	1,536,416	0	24,815	117	3,541	0	504
09 August	8,537	1,544,953	65	24,880	240	3,801	22	526
10 August	13,699	1,558,652	105	24,985	385	4,186	35	561
11 August	16,897	1,575,549	0	24,985	784	4,970	0	561

[a] Data source: Alaska Department of Fish and Game, Soldotna, Alaska.

Table 20. Coho salmon escapement and survey counts conducted on selected tributaries of the Kenai River, Alaska, 1988.

Location		Method	Count period	Number of coho salmon
Beaver Creek (East Fork)		Stream count	9/27	10
Grant Creek		Weir[a]	8/16-10/17	647
Hidden Creek		Weir[b]	July-August	0
		Stream count	9/15	19
		Stream count	10/27	3
Jean Creek		Stream count	9/15	12
Juneau Creek		Stream count	9/15	13
Kenai River				
(rm 36 to rm 23)		Stream count	9/29	12
(rm 82 to rm 70)		Stream count	10/10	8
Killey River (lower 4 miles)		Stream count	10/2	12
Moose River (East Fork)				
(Kelly Lake to Watson Lake)		Stream count	9/11	60
(Kelly Lake to Egumen Lake)		Stream count	10/1	252
(Kelly Lake to Watson Lake)		Stream count	10/5	389
(Watson Lake to Kenai River)		Stream count	10/6-10/7	66
(Kelly Lake to Egumen Lake)		Stream count	10/27	29
Moose River (West Fork)		Stream count	9/23-9/24	16
Ptarmigan Creek		Stream count	9/15	2
Russian River		Weir[b]	8/11-9/11	607
		(also approximately 1200 behind weir)		
(lower river)		Stream count	9/7	26
(upper river)		Stream count	10/14	381
Slikok Creek		Stream count	8/15	20
Tern Lake	Inlet	Stream count	10/28	123
	Outlet	Stream count	10/28	43
	Inlet	Stream count	11/7	28
	Outlet	Stream count	11/7	12

[a] Data source: Cook Inlet Aquaculture Association, Kenai, Alaska.
[b] Data source: Alaska Department of Fish and Game, Soldotna, Alaska.

Table 21. Coho salmon escapement and survey counts conducted on selected tributaries of the Kenai River, Alaska, 1989.

Location	Method	Count period	Number of coho salmon
Hidden Creek	Weir[a]	6/15-8/31	56
	Stream count	9/29	46
	Stream count	10/11	14
Jean Creek	Stream count	9/29	5
Moose River			
East Fork (Watson Lake-Moose River)	Stream count	8/31	0
East Fork (Kelly-Peterson Lake)	Stream count	9/21	23
	Stream count	9/28	51
	Stream count	10/19	16
	Stream count	10/31	1
	Stream count	11/8	0
East Fork (Peterson Lake-Equmen Lake)	Stream count	9/21	180
	Stream count	9/28	222
	Stream count	10/19	19
	Stream count	10/31	2
	Stream count	11/8	0
East Fork (Equmen Lake-Watson Lake)	Stream count	9/28	114
	Stream count	10/19	17
	Stream count	10/31	2
	Stream count	11/8	0
Swan Lake (Outlet)	Stream count	10/4	163
Moosehorn Lake (Outlet)	Stream count	10/5	3
Moose River (Mainstem-Mouth)	Stream count	9/1	15
Tern Lake			
Outlet	Stream count	9/21	326
	Stream count	9/29	315
	Stream count	10/11	380
	Stream count	10/26	170
	Stream count	11/6	102
	Stream count	11/22	23
Inlet	Stream count	9/21	18
	Stream count	9/29	5
	Stream count	10/11	170
	Stream count	10/26	24
	Stream count	11/6	6
Russian River	Weir[a]	6/18-9/12	1122

[a] Data source: Alaska Department of Fish and Game, Soldotna, Alaska.

APPENDIX D

Tag Summary

Table 22. Data summary of radio-tagged coho salmon, Kenai River, Alaska, 1988.

Tagging date	Transmitter frequency (mHz)	Length (mm)	Sex[a]	Development[b]	Capture method	Final destination
7/29	40.022	430	F	1.0	Drift net	Cook Inlet set net
8/1	40.113	650	F	1.0	Drift net	Mortality rkm 19.3 (rm 12)
	40.042	550	M	1.0	Drift net	King County Creek
	40.063	530	M	2.0	Drift net	Lost rkm 18.5 (rm 11.5)
8/3	40.069	610	F	1.0	Drift net	Lost rkm 12.9 (rm 8)
	40.094	630	F	1.0	Drift net	Cook Inlet drift net
	40.083	625	M	1.0	Drift net	Moose River
	40.122	630	M	1.0	Drift net	Lost rkm 20.9 (rm 13)
	40.160	580	F	1.0	Drift net	Killey River
	40.172	660	F	1.0	Drift net	Lost rkm 10.5 (rm 6.5)
	40.179	600	F	1.0	Drift net	Lost rkm 11.3 (rm 7)
	40.222	560	F	1.0	Drift net	Mortality rkm 4.8 (rm 3)
8/5	40.142	520	F	1.0	Drift net	Lost rkm 38.6 (rm 24)
	40.212	620	F	1.0	Drift net	Cook Inlet set net
	40.230	600	M	1.0	Drift net	Kenai River rkm 35.4 (rm 22)
	40.240	530	F	1.0	Drift net	Sport caught rkm 20.9 (rm 13)
	40.251	570	M	1.0	Drift net	Funny River
	40.261	660	M	1.0	Drift net	Lost rkm 6.4 (rm 4)
	40.280	620	M	1.0	Drift net	Lost rkm 19.3 (rm 12)
	40.301	570	F	1.0	Drift net	Sport caught rkm 11.3 (rm 7)
8/9	40.321	560	M	1.0	Drift net	Killey River
	40.339	640	M	1.0	Drift net	Lost rkm 12.9 (rm 8)
	40.360	585	M	1.0	Drift net	King County Creek
	40.380	650	M	1.0	Drift net	Russian River
8/11	40.271	?	M	1.0	Drift net	Cook Inlet set net
	40.290	?	M	2.0	Drift net	Mortality rkm 24.1 (rm 15)
	40.310	?	F	2.0	Drift net	King County Creek
	40.330	?	M	1.0	Drift net	Trail Creek
8/16	40.022	535	F	1.0	Drift net	Kenai River rkm 49.9 (rm 31)
	40.094	625	F	1.0	Drift net	Lost rkm 24.1 (rm 15)
	40.354	665	F	1.0	Drift net	Moose River
	40.372	625	M	2.0	Drift net	Sport caught rkm 69.2 (rm 43)
	40.401	535	F	2.0	Drift net	Kenai River rkm 43.4 (rm 27)
8/18	40.421	650	M	2.0	Drift net	Killey River
	40.479	620	F	1.0	Drift net	Killey River
	40.439	665	M	2.0	Drift net	Kenai River rkm 30.6 (rm 19)

Table 22. (Continued).

Tagging date	Transmitter frequency (mHz)	Length (mm)	Sex[a]	Development[b]	Capture method	Final destination
8/23	40.241	600	M	2.0	Fishwheel	Kenai River rkm 37 (rm 23)
	40.530	595	F	1.0	Fishwheel	Lost rkm 31.4 (rm 19.5)
	40.550	615	F	2.0	Drift net	Funny River
	40.572	605	F	1.0	Fishwheel	Mortality rkm 22.5 (rm 14)
	40.581	685	M	2.0	Fishwheel	Kenai River rkm 67.6 (rm 42)
	40.510	630	F	1.0	Fishwheel	Lost rkm 2.4 (rm 1.5)
	40.461	720	M	2.0	Fishwheel	Stray Kasilof River
8/30	40.661	710	M	2.0	Drift net	Sport caught rkm 64.4 (rm 40)
	40.271	?	?	?	Fishwheel	Killey River
9/1	40.731	700	F	1.0	Fishwheel	Mortality rkm 11.3 (rm 7)
	40.589	600	F	2.0	Fishwheel	Sport caught rkm 20.9 (rm 13)
	40.671	670	M	1.0	Fishwheel	Lost rkm 31.4 (rm 19.5)
9/2	40.640	670	F	1.0	Fishwheel	Kenai River rkm 66.8 (rm 41.5)
	40.560	650	F	2.0	Fishwheel	Kenai River rkm 57.9 (rm 36)
	40.710	565	M	2.0	Fishwheel	Kenai River rkm 70 (rm 43.5)
9/6	40.413	680	M	1.0	Fishwheel	Lost rkm 22.5 (rm 14)
9/7	40.520	695	M	1.0	Fishwheel	Kenai River rkm 57.9 (rm 36)
	40.682	600	M	2.0	Fishwheel	Kenai River rkm 115.8 (rm 72)
	40.491	655	F	1.0	Drift net	Kenai River rkm 65.2 (rm 40.5)
	40.471	695	M	1.0	Drift net	Killey River
	40.450	705	M	2.0	Drift net	Kenai River rkm 57.5 (rm 32)
9/8	40.499	625	M	2.0	Fishwheel	Moose River (West Fork)
9/13	40.720	715	M	1.0	Fishwheel	Mortality rkm 19.3 (rm 12)
	40.700	600	M	2.0	Fishwheel	Kenai River rkm 59.5 (rm 37)
	40.750	655	M	2.0	Drift net	Kenai River rkm 74.8 (rm 46.5)
	40.740	690	M	2.0	Drift net	Kenai River rkm 70 (rm 43.5)
	40.692	610	M	2.0	Drift net	Lost rkm 31.4 (rm 19.5)
9/14	40.761	625	F	1.0	Fishwheel	Kenai River rkm 51.5 (rm 32)

Table 22. (Continued).

Tagging date	Transmitter frequency (mHz)	Length (mm)	Sex[a]	Development[b]	Capture method	Final destination
9/15	40.771	650	M	2.0	Fishwheel	Kenai River rkm 57.9 (rm 36)
9/21	40.780	675	F	1.0	Fishwheel	Lost rkm 24.1 (rm 15)
	40.790	630	M	2.0	Fishwheel	Kenai River rkm 56.3 (rm 35)
	40.814	620	F	2.0	Fishwheel	Kenai River rkm 57.9 (rm 36)
	40.830	560	M	2.0	Fishwheel	Kenai River rkm 30.6 (rm 19)
	40.853	610	F	1.0	Fishwheel	Lost rkm 23.3 (rm 14.5)
9/23	40.430	640	F	1.0	Fishwheel	Kenai River rkm 35.4 (rm 22)
	40.870	690	F	1.0	Fishwheel	Sport caught rm?
9/26	40.890	640	F	1.0	Fishwheel	Mortality rkm 13.7 (rm 8.5)
9/27	40.902	620	F	1.0	Drift net	Lost rkm 19.3 (rm 12)
10/4	40.942	670	F	1.0	Drift net	Kenai River rkm 78.8 (rm 49)
	40.932	600	M	1.0	Drift net	Kenai River rkm 73.2 (rm 45.5)
10/5	40.960	600	F	1.0	Drift net	Kenai River rkm 74 (rm 46.0)
	40.922	680	M	1.0	Drift net	Kenai River rkm 72.4 (rm 45)
	40.970	685	F	1.0	Drift net	Mortality rkm 14.5 (rm 9)
10/24	40.370	690	M	2.0	Drift net	Kenai River rkm 131.9 (rm 82)
	40.980	740	M	2.0	Drift net	Kenai River rkm 69.2 (rm 43)
	40.720	750	M	2.0	Drift net	Mortality rkm 22.5 (rm 14)
	40.392	700	F	1.5	Drift net	Kenai River rkm 73.2 (rm 45.5)
	40.992	665	F	1.5	Drift net	Kenai River rkm 75.6 (rm 47)
11/2	41.008	615	F	1.5	Drift net	Kenai River rkm 70.8 (rm 44)
	41.029	660	F	2.0	Drift net	Kenai River rkm 74.8 (rm 46.5)
	41.053	560	M	1.5	Drift net	Mortality rkm 62.8 (rm 39)
	41.091	670	F	1.5	Drift net	Kenai River rkm 67.6 (rm 42)
	41.071	660	M	1.5	Drift net	Kenai River rkm 75.6 (rm 47.0)

Table 22. (Continued).

Tagging date	Transmitter frequency (mHz)	Length (mm)	Sex[a]	Development[b]	Capture method	Final destination
11/10	41.100	700	F	1.5	Drift net	Kenai River rkm 62.8 (rm 39)
11/10	41.111	680	F	1.5	Drift net	Kenai River rkm 66 (rm 41)
	41.131	710	F	1.5	Drift net	Kenai River rkm 62.8 (rm 39)
	41.151	670	M	2.0	Drift net	Kenai River rkm 66 (rm 41)
	41.190	710	F	1.0	Drift net	Mortality rkm 62.8 (rm 39)
11/15	41.171	660	F	1.5	Drift net	Kenai River rkm 66 (rm 41)
	41.231	670	F	1.5	Drift net	Kenai River rkm 67.6 (rm 42)
	41.211	650	F	1.5	Drift net	Kenai River rkm 71.6 (rm 44.5)
	41.252	650	M	1.5	Drift net	Kenai River rkm 75.6 (rm 47)
	41.271	660	F	1.5	Drift net	Kenai River rkm 75.6 (rm 47)
	41.290	650	F	1.5	Drift net	Kenai River rkm 71.6 (rm 44.5)
11/21	41.312	680	F	1.5	Drift net	Kenai River rkm 65.2 (rm 40.5)
	41.332	530	M	1.5	Drift net	Kenai River rkm 64.4 (rm 40)

[a] M=Male, F=Female

[b] 1.0=Bright (no freshwater characteristics), 1.5=intermediate, 2.0=displaying freshwater characteristics.

Table 23. Data summary of radio-tagged coho salmon, Kenai River, Alaska, 1989.

Tagging date	Transmitter frequency (mHz)	Length (mm)	Sex[a]	Develop-ment[b]	Capture method	Final destination
8/2	40.010	600	F	1.0	Drift net	Cook Inlet
8/4	40.030	610	F	1.5	Drift net	Cook Inlet
	40.053	600	F	1.5	Drift net	Cook Inlet
	40.070	640	F	1.5	Drift net	Cook Inlet
	40.090	480	M	1.5	Drift net	Kenai River rkm 106.2 (rm 66)
	40.110	600	M	1.5	Drift net	Cook Inlet
	40.130	620	M	1.5	Drift net	Tag loss rkm 66 (rm 41)
8/9	40.040	610	M	1.5	Drift net	Kenai rkm 9.7 (rm 6) (mortality)
	40.150	560	M	1.0	Drift net	Cook Inlet
	40.170	570	F	1.5	Drift net	Kenai River rkm 54.7 (rm 34)
	40.180	590	F	1.5	Drift net	Sport caught rkm 27.4 (rm 17)
	40.100	460	M	1.5	Drift net	Tag loss (lower river)
	40.200	630	M	2.0	Drift net	Cook Inlet
8/10	40.230	590	M	1.5	Fishwheel	Mortality
	40.250	580	M	1.5	Fishwheel	Mortality
	40.260	570	M	1.5	Drift net	Kenai River (predator)
8/14	40.280	550	M	1.5	Drift net	Mortality
	40.320	590	M	1.5	Drift net	Cook Inlet
	40.330	590	M	1.5	Drift net	Lost (mid river)
8/15	40.350	570	M	1.5	Drift net	Sport caught rkm 33.8 (rm 21)
	40.370	620	M	2.0	Drift net	Sport caught rkm 33.8 (rm 21)
	40.390	580	F	1.5	Drift net	Lost (upper river)
	40.400	600	M	1.5	Drift net	Lost (lower river)
	40.420	630	F	1.5	Drift net	Sport caught rkm 27.4 (rm 17)
	40.440	600	M	1.5	Drift net	Mortality
	40.450	620	M	1.5	Drift net	Cook Inlet
	40.470	600	M	1.5	Drift net	Sport caught rkm 37 (rm 23)
	40.490	610	F	1.5	Drift net	Mortality
8/21	40.510	520	M	1.5	Drift net	Quartz Creek
	40.560	600	M	1.5	Drift net	Mortality

Table 23. (Continued).

Tagging date	Transmitter frequency (mHz)	Length (mm)	Sex[a]	Development[b]	Capture method	Final destination
8/22	40.540	630	F	1.5	Drift net	Lost (mid river)
	40.520	540	F	1.0	Fishwheel	Cook Inlet
8/23	40.580	560	F	1.5	Fishwheel	Cook Inlet
8/24	40.590	610	M	2.0	Drift net	Quartz Creek
	40.610	600	F	1.5	Drift net	Lost (lower river)
8/24	40.630	585	F	1.5	Drift net	Moose River
	40.650	555	M	1.5	Drift net	Moose River
	40.660	605	F	1.5	Drift net	Mortality
	40.727	510	M	1.5	Drift net	Moose River
8/25	40.740	600	F	1.5	Fishwheel	Quartz Creek
	40.760	580	M	1.5	Fishwheel	Trail River
	40.780	580	M	1.5	Fishwheel	Sport caught rkm 77.2 (rm 48)
	40.790	550	M	2.0	Fishwheel	Slikok Creek
8/29	40.810	605	M	1.5	Fishwheel	Mortality
9/06	40.840	710	M	1.5	Fishwheel	Kenai River rkm 67.6 (rm 42)
9/07	40.860	645	F	1.5	Fishwheel	Kenai River rkm 66.8 (rm 41.5)
	40.870	515	M	1.5	Fishwheel	Kenai River rkm 53.1 (rm 33)
	40.890	525	F	1.5	Fishwheel	Sport caught rkm 69.2 (rm 43)
9/07	40.900	640	M	2.0	Fishwheel	Kenai River rkm 75.6 (rm 47)
	40.920	590	F	1.5	Fishwheel	Kenai River rkm 76.4 (rm 47.5)
	40.930	580	M	1.5	Fishwheel	Kenai River rkm 73.2 (rm 45.5)
9/08	40.950	595	M	1.5	Fishwheel	Hidden Creek
	40.969	610	M	1.5	Fishwheel	Kenai River rkm 73.2 (rm 45.5)
	40.800	645	M	1.5	Fishwheel	Moose River
	40.980	630	M	1.5	Fishwheel	Kenai River rkm 71.6 (rm 44.5)
	41.039	590	F	1.5	Fishwheel	Cook Inlet
	41.060	635	M	1.5	Fishwheel	Kenai River rkm 74.8 (rm 46.5)
	41.100	600	M	1.5	Fishwheel	Kenai River rkm 74.8 (rm 46.5)
9/12	41.240	580	M	1.5	Fishwheel	Sport caught rkm 28.2 (rm 17.5)
	41.260	640	F	1.0	Fishwheel	Sport caught rkm 34.6 (rm 21.5)

Table 23. (Continued).

Tagging date	Transmitter frequency (mHz)	Length (mm)	Sex[a]	Development[b]	Capture method	Final destination
9/12	41.280	630	M	1.5	Fishwheel	Kenai River rkm 74 (rm 46.0)
	41.302	645	M	1.5	Fishwheel	Kenai River rkm 75.6 (rm 47)
	41.340	645	M	1.5	Fishwheel	Tag loss (mid river)
	41.360	680	M	1.5	Fishwheel	Kenai River rkm 75.6 (rm 47.0)
	41.380	680	M	1.5	Fishwheel	Kenai River rkm 38.6 (rm 24.0)
	41.400	660	M	1.5	Fishwheel	Kenai River rkm 117.5 (rm 73)
	41.420	635	M	1.5	Fishwheel	Sport caught rkm 37 (rm 23.0)
	41.120	620	F	1.5	Fishwheel	Lost (upper river)
	41.140	610	F	1.5	Fishwheel	Mortality
	41.160	630	M	1.5	Fishwheel	Cook Inlet
	41.180	580	F	1.5	Fishwheel	Kenai River rkm 70.08 (rm 44)
	41.198	580	M	1.5	Fishwheel	Kenai River rkm 75.6 (rm 47)
	41.222	545	M	2.0	Fishwheel	Lost (lower river)
	41.430	610	F	1.5	Fishwheel	Kenai River rkm 54.7 (rm 34)
	41.450	600	F	1.5	Fishwheel	Kenai River rkm 54.7 (rm 34)
	41.460	685	M	1.5	Fishwheel	Mortality
9/13	41.490	650	M	1.5	Drift net	Mortality
	41.480	640	M	1.5	Fishwheel	Mortality
9/19	40.300	590	M	1.5	Fishwheel	Kenai River rkm 74.8 (rm 46.5)
9/20	40.600	625	M	1.0	Drift net	Lost (mid river)
	41.080	495	M	1.5	Drift net	Kenai River rkm 75.6 (rm 47)
	41.510	630	M	1.0	Drift net	Mortality
9/21	41.790	620	M	1.5	Drift net	Kenai River rkm 75.6 (rm 47)
	41.530	580	M	1.5	Fishwheel	Kenai River rkm 67.6 (rm 42)
	41.540	610	M	1.5	Fishwheel	Cook Inlet
	41.560	610	M	1.5	Fishwheel	Kenai River rkm 66 (rm 41)
	41.582	675	M	1.5	Fishwheel	Mortality
	41.770	625	M	1.5	Fishwheel	Mortality

Table 23. (Continued).

Tagging date	Transmitter frequency (mHz)	Length (mm)	Sex[a]	Development[b]	Capture method	Final destination
9/26	41.808	650	M	1.5	Drift net	Kenai River rkm 70 (rm 43.5)
	41.830	640	M	1.5	Drift net	Kenai River rkm 74.8 (rm 46.5)
	41.850	630	M	1.5	Drift net	Kenai River rkm 73.2 (rm 45.5)
	41.870	645	F	1.5	Drift net	Lost (lower river)
9/27	41.911	685	F	1.5	Drift net	Lost (lower river)
	41.930	650	M	1.5	Drift net	Mortality
	41.890	655	F	1.5	Fishwheel	Kenai River rkm 74 (rm 46)
10/2	41.950	580	M	1.5	Drift net	Kenai River rkm 76.4 (rm 47.5)
	41.970	630	F	1.5	Drift net	Lost (mid river)
	41.990	640	M	1.5	Fishwheel	Kenai River rkm 130.3 (rm 81)
10/4	40.260	680	M	1.5	Fishwheel	Kenai River rkm 74.8 (rm 46.5)
	40.440	650	M	1.5	Drift net	Kenai River rkm 76.4 (rm 47.5)
10/5	40.021	685	M	1.5	Fishwheel	Kenai River rkm 57.1 (rm 35.5)
10/10	40.010	480	F	1.0	Drift net	Kenai River rkm 75.6 (rm 47.0)
10/11	40.040	610	F	1.0	Drift net	Mortality
	40.180	690	F	1.5	Drift net	Cook Inlet
10/17	40.420	645	M	1.5	Fishwheel	Kenai River rkm 78.8 (rm 49.0)
	41.350	630	F	1.5	Fishwheel	Kenai River rkm 59.5 (rm 37.0)
10/19	41.370	665	F	1.0	Fishwheel	Kenai River rkm 68.4 (rm 42.5)
10/24	40.470	570	F	1.0	Fishwheel	Kenai River rkm 75.6 (rm 47.0)
	40.510	675	F	1.0	Fishwheel	Kenai River rkm 75.6 (rm 47)
10/25	40.630	610	F	1.0	Fishwheel	Mortality
11/29	40.130	550	M	2.0	Drift net	Lost (upper river)
	40.650	635	F	2.0	Drift net	Kenai River rkm 75.6 (rm 47.0)

Table 23. (Continued).

Tagging date	Transmitter frequency (mHz)	Length (mm)	Sex[a]	Development[b]	Capture method	Final destination
11/29	40.780	525	F	1.5	Drift net	Kenai River rkm 68.4 (rm 42.5)
12/16	40.950	610	F	1.5	Drift net	Kenai River rkm 71.6 (rm 44.5)

[a] M=male, F=female

[b] 1.0=bright (no freshwater characteristics), 1.5=intermediate, 2.0=displaying freshwater characteristics

Table 24. Data summary of spaghetti-tagged coho salmon, Kenai, River, Alaska, 1988.

Tagging date	Tag number	Tag color	Mid-eye fork length	Sex[a]	Develop-ment[b]	Capture method	Final destination
8/8	0004	Pink	590	F	1	Fishwheel	?
	0005	Pink	680	M	1	Fishwheel	?
	0006	Pink	595	M	1	Fishwheel	?
	0007	Pink	640	F	1	Fishwheel	?
8/9	0009	Pink	570	M	1	Fishwheel	?
	0001	Pink	580	F	1	Drift net	?
	0002	Pink	580	M	1	Drift net	?
8/10	0011	Pink	590	F	1	Fishwheel	?
8/11	0012	Pink	?	?	?	Drift net	?
8/16	0003	Pink	580	F	1	Fishwheel	?
	0010	Pink	580	F	1	Fishwheel	?
	0013	Pink	570	F	1	Fishwheel	?
	0015	Pink	690	M	2	Fishwheel	?
	0016	Pink	520	M	2	Fishwheel	?
	0017	Pink	595	M	2	Drift net	?
8/17	0018	Pink	610	F	1	Fishwheel	?
8/18	0014	Pink	640	F	2	Drift net	?
	0019	Pink	635	F	?	Fishwheel	?
	0020	Pink	610	F	?	Fishwheel	?
	0021	Pink	655	M	?	Fishwheel	?
	0022	Pink	665	M	?	Fishwheel	?
	0023	Pink	620	F	?	Fishwheel	?
	0024	Pink	650	M	?	Fishwheel	?
8/19	0025	Pink	600	F	1	Fishwheel	?
	0026	Pink	570	F	1	Fishwheel	?
	0027	Pink	690	F	1	Fishwheel	?
	0028	Pink	600	F	2	Fishwheel	?
	0029	Pink	610	F	2	Fishwheel	Sport Caught 8/22 Kenai River rkm 16.1
	0030	Pink	630	F	1	Fishwheel	?
8/23	0031	Pink	620	M	2	Fishwheel	?
	0032	Pink	590	F	1	Fishwheel	?
	0038	Pink	620	M	1	Fishwheel	?
	0033	Pink	610	F	1	Fishwheel	?
	0034	Pink	620	M	2	Fishwheel	?
	0035	Pink	610	F	2	Fishwheel	?
	0036	Pink	590	F	1	Fishwheel	?
	0037	Pink	640	F	1	Fishwheel	?
	0039	Pink	590	M	2	Fishwheel	?
	0040	Pink	600	F	1	Fishwheel	?

Table 24. (Continued).

Tagging date	Tag number	Tag color	Mid-eye fork length	Sex[a]	Develop-ment[b]	Capture method	Final destination
8/23 Continued:							
	0041	Pink	550	M	2	Fishwheel	?
	0042	Pink	620	M	2	Fishwheel	?
	0043	Pink	600	M	1	Fishwheel	?
	0044	Pink	595	M	2	Fishwheel	?
	0045	Pink	580	F	1	Fishwheel	?
	0046	Pink	620	M	2	Fishwheel	?
	0047	Pink	640	M	2	Fishwheel	?
	0048	Pink	650	M	1	Fishwheel	?
	0049	Pink	640	M	2	Fishwheel	?
	0050	Pink	570	F	1	Fishwheel	?
	0052	Pink	615	F	1	Drift net	?
	0053	Pink	595	M	1	Drift net	Grant Creek Weir 9/11/88
	0051	Pink	640	F	1	Drift net	?
	0054	Pink	620	F	1	Drift net	?
	0055	Pink	630	F	1	Drift net	?
	0056	Pink	645	F	1	Drift net	?
	0057	Pink	570	F	1	Drift net	?
	0058	Pink	595	F	1	Drift net	?
8/24	0061	Pink	565	F	1	Fishwheel	?
	0062	Pink	575	M	2	Fishwheel	?
	0063	Pink	600	M	1	Fishwheel	?
	0064	Pink	555	F	1	Fishwheel	?
	0065	Pink	665	M	2	Fishwheel	?
	0066	Pink	625	F	1	Fishwheel	?
	0067	Pink	655	F	1	Fishwheel	?
	0068	Pink	570	M	1	Fishwheel	?
	0069	Pink	640	M	2	Fishwheel	?
	0071	Pink	665	F	1	Fishwheel	?
	0070	Pink	625	M	2	Fishwheel	?
8/25	0059	Pink	650	M	2	Fishwheel	?
	0060	Pink	550	M	2	Fishwheel	?
	0072	Pink	590	F	2	Fishwheel	?
	0073	Pink	690	M	2	Fishwheel	?
	0075	Pink	620	M	2	Fishwheel	?
8/26	0079	Pink	635	M	1	Fishwheel	?
	0076	Pink	580	M	1	Fishwheel	?
	0084	Pink	690	M	2	Fishwheel	?
	0080	Pink	625	M	2	Fishwheel	Recaptured in Fishwheel 9/14/88
	0086	Pink	690	M	2	Fishwheel	?
	0082	Pink	670	M	2	Fishwheel	?

Table 24. (Continued).

Tagging date	Tag number	Tag color	Mid-eye fork length	Sex[a]	Develop-ment[b]	Capture method	Final destination
8/26	0085	Pink	540	F	1	Fishwheel	?
	0087	Pink	610	F	1	Fishwheel	?
	0089	Pink	610	M	2	Fishwheel	?
	0081	Pink	620	M	2	Fishwheel	?
	0090	Pink	600	M	1	Fishwheel	?
	0093	Pink	665	M	2	Fishwheel	?
	0092	Pink	695	M	2	Fishwheel	Mortality 9/19/88 Kenai River rkm 16.1
	0091	Pink	660	M	1	Fishwheel	?
	0094	Pink	580	M	2	Fishwheel	?
8/30	0097	Pink	655	F	1	Drift net	?
	0098	Pink	670	F	1	Drift net	?
8/31	0100	Pink	650	F	1	Fishwheel	?
	0101	Pink	585	F	2	Fishwheel	?
	0102	Pink	600	M	2	Fishwheel	?
	0104	Pink	600	F	1	Fishwheel	?
9/1	0105	Pink	655	M	2	Fishwheel	?
9/2	0096	Pink	605	M	2	Fishwheel	?
	0103	Pink	620	M	2	Fishwheel	?
	0099	Pink	645	M	2	Fishwheel	?
	0106	Pink	680	F	1	Fishwheel	?
	0107	Pink	?	?	?	Fishwheel	?
9/7	0109	Pink	660	F	1	Drift net	?
	0108	Pink	685	F	1	Drift net	?
	0107	Pink	615	M	2	Fishwheel	?
	0111	Pink	695	M	1	Fishwheel	?
	0110	Pink	540	F	2	Fishwheel	?
9/8	0114	Pink	585	M	1	Fishwheel	?
	0116	Pink	630	F	1	Fishwheel	?
	0117	Pink	680	M	2	Fishwheel	Sport Caught 9/23/88 Kasilof River
9/10	0119	Pink	610	F	1	Fishwheel	?
	0118	Pink	560	M	2	Fishwheel	?
	0120	Pink	695	F	1	Fishwheel	?
9/13	0112	Pink	600	M	1	Fishwheel	?
	0113	Pink	690	F	1	Fishwheel	Sport Caught 9/15/88 Kenai River rkm 35.4
	0123	Pink	580	F	2	Fishwheel	?
	0124	Pink	550	M	2	Fishwheel	?

Table 24. (Continued).

Tagging date	Tag number	Tag color	Mid-eye fork length	Sex[a]	Develop-ment[b]	Capture method	Final destination
9/13	0126	Pink	570	M	1	Fishwheel	?
	0127	Pink	605	F	1	Fishwheel	?
	0125	Pink	630	M	1	Fishwheel	?
	0128	Pink	590	M	1	Fishwheel	?
	0129	Pink	570	F	1	Fishwheel	?
	0121	Pink	525	F	1	Drift net	?
9/14	0130	Pink	610	F	2	Fishwheel	?
	0131	Pink	650	F	1	Fishwheel	?
	0134	Pink	650	M	1	Fishwheel	?
9/15	0135	Pink	490	F	1	Fishwheel	?
	0132	Pink	610	F	1	Fishwheel	?
	0137	Pink	630	F	1	Fishwheel	?
	0133	Pink	610	F	2	Fishwheel	?
	0136	Pink	605	F	1	Fishwheel	?
	0138	Pink	615	F	2	Fishwheel	?
	0139	Pink	640	M	2	Fishwheel	?
9/16	0142	Pink	615	F	1	Fishwheel	?
9/21	0521	Orange	660	F	1	Fishwheel	?
	0522	Orange	660	F	1	Fishwheel	?
	0520	Orange	410	M	1	Fishwheel	?
	0524	Orange	660	F	1	Fishwheel	?
9/23	0525	Orange	675	F	1	Fishwheel	?
10/5	0526	Orange	640	F	1	Drift Net	?
10/24	0532	Orange	685	F	2	Drift Net	?
	0530	Orange	635	F	2	Drift Net	?
	0533	Orange	695	F	1	Drift Net	?
	0534	Orange	715	M	2	Drift Net	?
	0535	Orange	725	M	2	Drift Net	?
11/2	0536	Orange	715	F	2	Drift Net	?
	0537	Orange	720	M	2	Drift Net	?
	0531	Orange	585	M	2	Drift Net	?
	0539	Orange	710	F	2	Drift Net	?
	0541	Orange	700	M	2	Drift Net	?
11/10	0529	Orange	680	F	2	Drift Net	?
	0540	Orange	640	F	2	Drift Net	?
11/15	0544	Orange	690	M	2	Drift Net	?
	0543	Orange	580	M	2	Drift Net	?
11/21	0545	Orange	700	M	2	Drift Net	?
	0542	Orange	640	F	1	Drift Net	?

[a] M=Male, F=Female

[b] 1.0=Bright (no freshwater characteristics), 1.5=Intermediate, 2.0=Dislaying freshwater characteristics

Table 25. Data summary of spaghetti-tagged coho salmon, Kenai River, Alaska, 1989.

Tagging date	Tag number	Tag color	Mid-eye fork length	Sex[a]	Develop-ment[b]	Capture method	Final destination
8/2	00547	Orange	510	M	1.0	Drift net	?
8/4	00548	Orange	600	F	1.0	Drift net	?
8/8	00546	Orange	490	M	1.0	Drift net	?
8/10	00550	Orange	600	M	1.0	Drift net	?
	00551	Orange	680	F	1.0	Drift net	?
8/10	00552	Orange	530	M	1.0	Drift net	?
8/14	00553	Orange	530	F	1.0	Drift net	?
8/15	00554	Orange	560	M	1.0	Drift net	?
	00555	Orange	570	F	1.0	Drift net	?
	00556	Orange	500	M	1.5	Drift net	?
	00557	Orange	560	M	1.0	Drift net	?
8/18	00559	Orange	560	F	1.5	Fishwheel	?
8/21	00558	Orange	600	M	1.5	Fishwheel	?
8/22	00560	Orange	585	F	1.0	Drift net	?
8/23	00562	Orange	535	F	1.0	Fishwheel	?
8/24	00561	Orange	575	F	1.0	Drift net	?
	00563	Orange	385	F	1.0	Drift net	?
	00564	Orange	590	F	1.0	Drift net	?
8/25	00567	Orange	570	F	1.5	Drift net	?
	00568	Orange	610	F	1.0	Drift net	?
	00569	Orange	595	F	1.5	Drift net	Sport Caught 9/12/89 Kenai River rkm 118.3
	00570	Orange	590	M	1.5	Drift net	?
	00571	Orange	620	F	1.5	Drift net	?
	00572	Orange	570	F	1.5	Drift net	Sport Caught 9/18/89 Kenai River rkm 118.3
	00565	Orange	610	M	2.0	Fishwheel	?
	00566	Orange	580	F	1.5	Fishwheel	?
8/29	00573	Orange	520	M	1.5	Drift net	Sport Caught 8/31/89 Kenai River rkm 17.7
	00574	Orange	580	F	1.0	Drift net	?
	00575	Orange	550	F	1.5	Drift net	?
9/6	00143	Pink	590	F	1.0	Drift net	?
9/7	00144	Pink	555	M	1.0	Drift net	?
	00145	Pink	540	F	1.0	Drift net	?
	00147	Pink	560	F	2.0	Drift net	?
	00148	Pink	670	F	2.0	Drift net	?
	00149	Pink	610	F	2.0	Drift net	?

Table 25. (Continued).

Tagging date	Tag number	Tag color	Mid-eye fork length	Sex[a]	Develop-ment[b]	Capture method	Final destination
9/8	00150	Pink	590	F	1.5	Drift net	?
	00151	Pink	570	F	1.5	Drift net	?
	00152	Pink	565	M	1.5	Drift net	?
9/12	00156	Pink	635	F	1.0	Drift net	?
	00157	Pink	580	F	1.0	Drift net	?
	00158	Pink	665	M	1.5	Drift net	?
	00159	Pink	660	F	1.0	Drift net	?
	00160	Pink	615	F	1.5	Drift net	?
9/12	00161	Pink	415	M	1.0	Drift net	?
	00162	Pink	640	F	1.5	Drift net	?
	00163	Pink	600	F	1.5	Drift net	?
	00164	Pink	540	F	1.0	Drift net	?
	00165	Pink	635	F	1.5	Drift net	?
	00166	Pink	595	F	1.5	Drift net	Sport Caught 9/15/89 Kenai River rkm 32.2
	00167	Pink	570	F	1.5	Drift net	?
	00168	Pink	600	F	1.0	Drift net	?
	00169	Pink	570	M	1.5	Drift net	?
	00170	Pink	490	M	1.5	Drift net	?
	00153	Pink	525	M	1.0	Fishwheel	?
	00154	Pink	480	M	1.0	Fishwheel	?
	00155	Pink	575	F	1.5	Fishwheel	?
9/13	00180	Pink	590	M	1.5	Drift net	?
	00182	Pink	585	F	1.0	Drift net	?
	00183	Pink	570	F	1.0	Drift net	?
	00184	Pink	630	F	1.0	Drift net	?
	00185	Pink	640	F	1.0	Drift net	?
	00186	Pink	510	F	1.0	Drift net	?
	00187	Pink	510	M	1.0	Drift net	?
	00171	Pink	490	F	1.5	Fishwheel	?
	00172	Pink	610	F	1.0	Fishwheel	?
	00173	Pink	640	M	1.0	Fishwheel	?
	00174	Pink	660	M	1.0	Fishwheel	?
	00175	Pink	550	F	1.0	Fishwheel	?
	00176	Pink	630	M	1.0	Fishwheel	?
	00177	Pink	630	M	1.0	Fishwheel	?
	00178	Pink	500	F	1.5	Fishwheel	?
	00179	Pink	590	F	1.0	Fishwheel	?
9/14	00188	Pink	640	M	1.5	Fishwheel	?
	00189	Pink	555	F	1.0	Fishwheel	?
	00190	Pink	555	M	1.0	Fishwheel	?
	00191	Pink	620	F	1.0	Fishwheel	?

Table 25. (Continued).

Tagging date	Tag number	Tag color	Mid-eye fork length	Sex[a]	Develop-ment[b]	Capture method	Final destination
9/14	00192	Pink	485	M	1.0	Fishwheel	?
	00193	Pink	635	M	1.5	Fishwheel	?
	00194	Pink	655	F	1.0	Fishwheel	?
	00195	Pink	560	M	1.0	Fishwheel	?
	00196	Pink	630	M	1.0	Fishwheel	?
	00197	Pink	495	F	1.5	Fishwheel	?
	00198	Pink	570	M	1.0	Fishwheel	Sport Caught 9/20/89 Kenai River rkm 60.3
	00199	Pink	630	M	1.5	Fishwheel	?
	00200	Pink	660	M	1.5	Fishwheel	?
9/15	00202	Pink	655	M	1.0	Fishwheel	?
	00203	Pink	640	M	1.0	Fishwheel	?
	00204	Pink	610	M	1.0	Fishwheel	?
	00205	Pink	635	F	1.0	Fishwheel	?
	00206	Pink	615	F	1.0	Fishwheel	?
	00207	Pink	635	M	1.5	Fishwheel	?
	00208	Pink	610	M	1.5	Fishwheel	?
	00209	Pink	620	F	1.0	Fishwheel	?
	00210	Pink	655	M	1.0	Fishwheel	?
	00211	Pink	575	M	1.5	Fishwheel	?
	00212	Pink	650	F	1.0	Fishwheel	?
	00213	Pink	475	F	1.5	Fishwheel	?
	00214	Pink	610	M	1.0	Fishwheel	?
	00215	Pink	560	F	1.0	Fishwheel	?
	00216	Pink	580	M	1.5	Fishwheel	?
	00217	Pink	650	M	1.5	Fishwheel	?
	00218	Pink	660	M	1.0	Fishwheel	?
	00219	Pink	600	M	1.0	Fishwheel	?
	00220	Pink	620	F	1.0	Fishwheel	?
	00221	Pink	605	M	1.0	Fishwheel	?
	00222	Pink	665	M	1.5	Fishwheel	?
	00223	Pink	650	M	1.0	Fishwheel	?
9/20	00226	Pink	640	F	1.0	Drift net	?
	00227	Pink	610	M	1.0	Drift net	?
	00228	Pink	610	M	1.0	Drift net	?
	00229	Pink	620	M	1.5	Drift net	?
	00230	Pink	610	M	1.0	Drift net	?
	00231	Pink	615	M	1.5	Drift net	?
	00232	Pink	650	M	1.0	Drift net	?
	00233	Pink	670	M	1.5	Drift net	?
	00234	Pink	550	M	1.0	Drift net	?
	00224	Pink	630	F	1.0	Fishwheel	?

Table 25. (Continued).

Tagging date	Tag number	Tag color	Mid-eye fork length	Sex[a]	Develop-ment[b]	Capture method	Final destination
9/20	00225	Pink	650	F	1.0	Fishwheel	?
9/21	00240	Pink	675	M	1.0	Drift net	?
	00241	Pink	635	M	1.0	Drift net	?
	00242	Pink	505	M	1.5	Drift net	?
	00243	Pink	645	M	1.5	Drift net	?
	00244	Pink	655	M	1.5	Drift net	?
	00245	Pink	630	M	1.5	Drift net	?
	00246	Pink	650	F	1.5	Drift net	?
	00247	Pink	640	F	1.0	Drift net	?
	00248	Pink	620	M	1.5	Drift net	?
9/21	00249	Pink	590	F	1.0	Drift net	?
	00250	Pink	640	F	1.0	Drift net	?
	00251	Pink	630	M	1.5	Drift net	?
	00252	Pink	640	F	1.0	Drift net	?
	00235	Pink	590	M	1.0	Fishwheel	?
	00236	Pink	650	F	1.0	Fishwheel	?
	00237	Pink	590	F	1.0	Fishwheel	?
	00238	Pink	610	F	1.0	Fishwheel	?
	00239	Pink	590	F	1.0	Fishwheel	?
	00253	Pink	590	F	1.0	Fishwheel	?
	00254	Pink	620	M	1.0	Fishwheel	?
	00255	Pink	460	F	1.0	Fishwheel	?
	00256	Pink	595	M	1.5	Fishwheel	?
9/22	00257	Pink	570	F	1.0	Fishwheel	?
	00258	Pink	630	M	1.5	Fishwheel	?
	00259	Pink	680	F	1.0	Fishwheel	?
	00260	Pink	650	M	1.5	Fishwheel	?
	00261	Pink	615	M	1.0	Fishwheel	?
	00262	Pink	600	F	1.0	Fishwheel	?
	00263	Pink	600	F	1.0	Fishwheel	?
	00264	Pink	645	F	1.0	Fishwheel	?
	00265	Pink	625	M	1.0	Fishwheel	?
	00266	Pink	605	F	1.0	Fishwheel	?
	00267	Pink	490	F	1.0	Fishwheel	?
	00268	Pink	630	M	1.0	Fishwheel	?
	00269	Pink	530	F	1.0	Fishwheel	?
	00270	Pink	620	M	1.5	Fishwheel	?
9/23	00276	Pink	610	F	1.5	Fishwheel	?
	00274	Pink	530	F	1.0	Fishwheel	?
	00271	Pink	580	M	1.0	Fishwheel	?
	00272	Pink	610	F	1.0	Fishwheel	?
	00275	Pink	650	M	1.0	Fishwheel	?
	00277	Pink	620	F	1.0	Fishwheel	?
	00278	Pink	640	F	1.0	Fishwheel	?

Table 25. (Continued).

Tagging date	Tag number	Tag color	Mid-eye fork length	Sex[a]	Develop-ment[b]	Capture method	Final destination
9/23	00279	Pink	620	F	1.0	Fishwheel	?
	00280	Pink	580	F	1.0	Fishwheel	?
	00281	Pink	650	F	1.0	Fishwheel	?
	00282	Pink	530	M	1.0	Fishwheel	?
	00283	Pink	580	M	1.0	Fishwheel	?
	00284	Pink	670	M	1.0	Fishwheel	?
	00285	Pink	590	F	1.0	Fishwheel	?
	00286	Pink	585	M	1.0	Fishwheel	?
	00287	Pink	640	F	1.0	Fishwheel	?
	00288	Pink	630	M	1.0	Fishwheel	?
	00289	Pink	600	M	1.0	Fishwheel	?
	00290	Pink	660	F	1.0	Fishwheel	?
	00291	Pink	620	F	1.0	Fishwheel	?
	00292	Pink	580	M	1.0	Fishwheel	?
	00293	Pink	500	F	1.0	Fishwheel	?
	00294	Pink	590	F	1.0	Fishwheel	?
	00295	Pink	600	M	1.0	Fishwheel	?
	00296	Pink	640	F	1.0	Fishwheel	?
	00297	Pink	670	M	1.0	Fishwheel	?
	00298	Pink	660	M	1.5	Fishwheel	?
	00299	Pink	640	F	1.0	Fishwheel	?
	00300	Pink	630	F	1.0	Fishwheel	?
	00301	Pink	665	M	1.0	Fishwheel	?
	00302	Pink	590	F	1.0	Fishwheel	?
9/26	00307	Pink	600	F	1.0	Drift net	?
	00308	Pink	640	F	1.0	Drift net	?
	00309	Pink	470	F	1.0	Drift net	?
	00310	Pink	570	F	1.0	Drift net	?
	00311	Pink	630	F	1.0	Drift net	?
	00312	Pink	665	F	1.5	Drift net	?
	00313	Pink	635	F	1.0	Drift net	?
	00314	Pink	525	F	1.0	Drift net	?
	00315	Pink	615	F	1.0	Drift net	?
	00316	Pink	615	F	1.5	Drift net	?
	00317	Pink	640	F	1.0	Drift net	?
	00318	Pink	610	F	1.0	Drift net	?
	00303	Pink	610	F	1.0	Fishwheel	?
	00304	Pink	610	F	1.0	Fishwheel	?
	00305	Pink	590	F	1.0	Fishwheel	?
	00319	Pink	565	F	1.0	Fishwheel	?
9/27	00322	Pink	640	M	1.0	Drift net	?
	00323	Pink	640	M	1.5	Drift net	?
	00324	Pink	575	F	1.0	Drift net	?

Table 25. (Continued).

Tagging date	Tag number	Tag color	Mid-eye fork length	Sex[a]	Develop-ment[b]	Capture method	Final destination
9/27	00325	Pink	610	F	1.0	Drift net	?
	00326	Pink	630	F	1.0	Drift net	?
	00320	Pink	600	F	1.0	Fishwheel	?
	00321	Pink	675	M	1.0	Fishwheel	?
9/28	00327	Pink	610	F	1.0	Fishwheel	?
9/29	00328	Pink	610	F	1.0	Fishwheel	?
9/30	00329	Pink	460	F	1.5	Fishwheel	?
	00330	Pink	640	F	1.5	Fishwheel	?
	00332	Pink	660	F	1.0	Fishwheel	?
	00333	Pink	590	F	1.0	Fishwheel	?
	00334	Pink	630	F	1.0	Fishwheel	?
	00335	Pink	625	M	1.5	Fishwheel	?
10/2	00337	Pink	630	M	1.5	Drift net	?
	00338	Pink	570	M	1.0	Drift net	?
	00339	Pink	540	F	1.0	Drift net	?
	00340	Pink	480	M	1.0	Drift net	?
	00341	Pink	630	F	1.0	Drift net	?
	00342	Pink	625	F	1.0	Drift net	?
	00343	Pink	580	F	1.0	Drift net	?
	00344	Pink	620	F	1.0	Drift net	?
	00345	Pink	640	M	1.0	Drift net	?
	00346	Pink	630	F	1.0	Drift net	?
	00347	Pink	640	M	1.5	Drift net	?
	00348	Pink	550	F	1.0	Fishwheel	?
10/3	00349	Pink	630	F	1.0	Fishwheel	Sport Caught 10/6/89 Kenai River rkm 51.5
	00350	Pink	610	F	1.0	Fishwheel	?
	00351	Pink	660	F	1.0	Fishwheel	?
	00352	Pink	640	M	1.0	Fishwheel	?
10/4	00354	Pink	620	F	1.5	Fishwheel	?
10/5	00357	Pink	600	F	1.0	Drift net	?
	00358	Pink	610	M	1.5	Drift net	?
	00355	Pink	635	M	1.5	Fishwheel	?
	00356	Pink	450	F	1.0	Fishwheel	?
10/6	00359	Pink	620	F	1.0	Fishwheel	?
10/10	00360	Pink	520	F	1.0	Drift net	?
10/11	00362	Pink	480	F	1.0	Drift net	?
10/20	00361	Pink	640	F	1.0	Fishwheel	?

[a] M=Male, F=Female

[b] 1.0=Bright (no freshwater characteristics), 1.5=Intermediate, 2.0=Displaying freshwater characteristics

Table 26. Summary of migration rates of coho salmon radio tagged in the lower Kenai River, Alaska, 1988.

Date	Transmitter frequency (MHz)	Final destination rkm (rm)	Release site rkm (rm)	Total distance traveled km (mi)	Daily migration rate km (mi)
8/1	40.042	King County Creek	18.5 (11.5)	70.0 (43.5)	2.3 (1.4)
8/3	40.083	Moose River	18.5 (11.5)	87.7 (54.5)	2.3 (1.4)
	40.160	Killey River	18.5 (11.5)	49.1 (30.5)	2.4 (1.5)
8/5	40.142	Lost 39.4 (24.5)	20.1 (12.5)	19.3 (12.0)	3.9 (2.4)
	40.212	Cook Inlet net	19.3 (12.0)	16.1 (10.0)	3.9 (2.4)
	40.251	Funny River	19.3 (12.0)	41.8 (26.0)	2.1 (1.3)
	40.301	Sport catch 11.3 (7)	19.3 (12.0)	25.7 (16.0)	1.4 (0.9)
8/9	40.321	Killey River	20.1 (12.5)	99.0 (61.5)	1.6 (1.0)
	40.339	Lost 23.2 (14.5)	19.3 (12.0)	4.0 (2.5)	1.3 (0.8)
	40.360	King County Creek	19.3 (12.0)	69.2 (43.0)	3.5 (2.2)
	40.380	Russian River	19.3 (12.0)	111.0 (69.0)	2.3 (1.4)
8/11	40.310	King County Creek	26.5 (16.5)	61.9 (38.5)	3.2 (2.0)
	40.330	Trail Creek	20.1 (12.5)	163.3 (101.5)	3.4 (2.1)
8/16	40.022	Kenai 49.9 (31)	20.9 (13.0)	29.0 (18.0)	2.4 (1.5)
	40.354	Moose River	28.2 (17.5)	78.0 (48.5)	7.9 (4.9)
	40.372	Sport catch 69.2 (43)	28.2 (17.5)	41.0 (25.5)	2.6 (1.6)
	40.401	Kenai 43.4 (27)	27.4 (17.0)	16.1 (10.0)	0.8 (0.5)
8/18	40.421	Killey River	29.0 (18.0)	66.0 (41.0)	1.6 (1.0)
	40.479	Killey River	29.0 (18.0)	62.8 (39.0)	1.6 (1.0)
	40.439	Kenai 30.6 (19)	29.0 (18.0)	1.6 (1.0)	1.6 (1.0)
8/23	40.241	Kenai 37.0 (23)	31.4 (19.5)	5.6 (3.5)	1.9 (1.2)
	40.550	Funny River	29.0 (18.0)	29.0 (18.0)	1.3 (0.8)
	40.581	Kenai 67.6 (42)	31.4 (19.5)	36.2 (22.5)	2.3 (1.4)
8/30	40.661	Sport catch 64.4 (40)	22.5 (14.0)	43.4 (27.0)	6.3 (3.9)
	40.271	Killey River	31.4 (19.5)	42.6 (26.5)	1.4 (0.9)
9/2	40.640	Lost 66.8 (41.5)	31.4 (19.5)	35.4 (22.0)	6.0 (3.7)
	40.560	Kenai 57.9 (36)	31.4 (19.5)	26.5 (16.5)	1.4 (0.9)
	40.710	Kenai 77.2 (48)	31.4 (19.5)	45.9 (28.5)	2.4 (1.5)
9/7	40.520	Kenai 57.9 (36)	31.4 (19.5)	26.5 (16.5)	1.9 (1.2)
	40.682	Kenai 115.8 (72)	31.4 (19.5)	84.5 (52.5)	6.1 (3.8)
	40.491	Kenai 64.4 (40)	20.1 (12.5)	49.3 (27.5)	4.5 (2.8)
	40.471	Killey River	20.1 (12.5)	50.7 (31.5)	7.2 (4.5)
	40.450	Kenai 51.5 (32)	28.2 (17.5)	23.3 (14.5)	2.6 (1.6)
9/8	40.499	Kenai 67.6 (42)	31.4 (19.5)	36.2 (22.5)	4.5 (2.8)
9/13	40.700	Kenai 59.5 (37)	30.6 (19.0)	29.0 (18.0)	3.2 (2.0)
	40.750	Kenai 72.4 (45)	28.2 (17.5)	44.2 (27.5)	1.4 (0.9)
	40.740	Kenai 69.2 (43)	28.2 (17.5)	45.1 (28.0)	2.9 (1.8)
9/14	40.761	Kenai 51.5 (32)	31.4 (19.5)	20.1 (12.5)	10.1 (6.3)
9/21	40.790	Kenai 56.3 (35)	31.4 (19.5)	40.2 (25.0)	2.4 (1.5)
	40.814	Kenai 57.9 (36)	31.4 (19.5)	26.5 (16.5)	5.3 (3.3)

Table 26. (Continued).

Date	Transmitter frequency (MHz)	Final destination rkm (rm)	Release site rkm (rm)	Total distance traveled km (mi)	Daily migration rate km (mi)
9/23	40.430	Kenai 35.4 (22)	31.4 (19.5)	4.0 (2.5)	1.3 (0.8)
10/4	40.942	Skilak Lake	28.2 (17.5)	68.4 (42.5)	2.4 (1.5)
	40.932	Kenai 74.4 (45)	24.1 (15.0)	49.0 (30.5)	5.5 (3.4)
10/5	40.960	Kenai 74.0 (46)	28.5 (11.5)	56.3 (35.0)	4.7 (2.9)
	40.922	Kenai 70.8 (44)	28.5 (11.5)	52.3 (32.5)	1.0 (0.6)

Table 27. Summary of migration rates of coho salmon radio tagged in the lower Kenai River, Alaska, 1989.

Date	Transmitter frequency (MHz)	Final destination rkm (rm)	Release site rkm (rm)	Total distance traveled km (mi)	Daily migration rate km (mi)
8/4	40.053	Cook Inlet	20.1 (12.5)	10.5 (6.5)	1.8 (1.1)
8/8	40.090	Kenai 106.2 (66)	20.1 (12.5)	86.1 (53.5)	4.8 (3.0)
	40.130	Kenai 66.0 (41)	20.1 (12.5)	45.9 (28.5)	2.9 (1.8)
8/9	40.100	Kenai 35.4 (22)	23.3 (14.5)	12.1 (7.5)	2.1 (1.3)
	40.170	Kenai (lost)	23.3 (14.5)	4.8 (3.0)	4.8 (3.0)
	40.180	Kenai 28.2 (17.5)	23.3 (14.5)	4.8 (3.0)	1.3 (.8)
8/10	40.260	Kenai 49.1 (30.5)	28.2 (17.5)	20.9 (13.0)	1.9 (1.2)
8/15	40.350	Kenai 33.8 (21)	25.7 (16.0)	8.0 (5.0)	1.9 (1.2)
	40.370	Kenai 33.8 (21)	28.2 (17.5)	5.6 (3.5)	1.0 (.6)
	40.390	Kenai 71.6 (44.5)	28.2 (17.5)	43.4 (27.0)	6.1 (3.8)
	40.420	Kenai 27.4 (17)	17.7 (11.0)	9.7 (6.0)	4.8 (3.0)
	40.470	Kenai 37.0 (23)	18.5 (11.5)	18.5 (11.5)	3.1 (1.9)
	40.490	Kenai 38.6 (24)	18.5 (11.5)	20.1 (12.5)	3.1 (1.9)
8/21	40.510	Quartz Creek	28.2 (17.5)	116.6 (72.5)	4.8 (3.0)
	40.560	Kenai 30.6 (19)	23.3 (14.5)	7.2 (4.5)	3.7 (2.3)
	40.540	Kenai 42.6 (26.5)	23.3 (14.5)	19.3 (12.0)	5.5 (3.4)
8/24	40.590	Quartz Creek	23.3 (14.5)	113.4 (70.5)	3.2 (2.0)
	40.630	Moose River	25.7 (16.0)	57.9 (36.0)	2.4 (1.5)
	40.650	Moose River	23.3 (14.5)	53.9 (33.5)	2.7 (1.7)
	40.727	Moose River	28.2 (17.5)	49.1 (30.5)	3.1 (1.9)
8/25	40.740	Quartz Creek	23.3 (14.5)	116.7 (72.5)	3.9 (2.4)
	40.760	Trail River	23.3 (14.5)	144.0 (89.5)	7.1 (4.4)
	40.780	Kenai 77.2 (48)	23.3 (14.5)	53.9 (33.5)	6.8 (4.2)
9/6	40.840	Kenai 67.6 (42)	28.2 (17.5)	41.0 (25.5)	4.7 (2.9)
9/7	40.860	Kenai 66.8 (41.5)	27.4 (17.0)	39.4 (24.5)	4.8 (3.0)
	40.870	Kenai 53.1 (33)	28.2 (17.5)	24.9 (15.5)	11.1 (6.9)
	40.890	Kenai 69.2 (43)	28.2 (17.5)	41.0 (25.5)	5.1 (3.2)
	40.900	Kenai 75.6 (47)	28.2 (17.5)	47.5 (29.5)	2.3 (1.4)
	40.920	Kenai 76.4 (47.5)	28.2 (17.5)	47.5 (29.5)	4.0 (2.5)
	40.930	Kenai 73.2 (45.5)	28.2 (17.5)	45.1 (28.0)	3.5 (2.2)
9/8	40.950	Hidden Creek	28.2 (17.5)	87.7 (54.5)	20.3 (12.6)
	40.969	Kenai 71.6 (45.5)	22.5 (14.0)	50.7 (31.5)	7.2 (4.5)
	40.800	Moose River	22.5 (14.0)	41.8 (26.0)	3.5 (2.2)
	40.980	Kenai 71.6 (44.5)	28.2 (17.5)	43.4 (27.0)	3.1 (1.9)
	41.040	Kenai 76.4 (47.5)	28.2 (17.5)	48.3 (30.0)	4.3 (2.7)
	41.060	Kenai 74.8 (46.5)	30.6 (19.0)	44.2 (27.5)	3.7 (2.3)
	41.100	Kenai 74.8 (46.5)	28.2 (17.5)	46.7 (29.0)	3.5 (2.2)
9/12	41.240	Kenai 28.2 (17.5)	23.3 (14.5)	4.8 (3.0)	4.8 (3.0)
	41.260	Kenai 34.6 (21.5)	28.2 (17.5)	4.8 (3.0)	3.1 (1.9)
	41.280	Kenai 74.0 (46)	28.2 (17.5)	45.1 (28.0)	5.8 (3.6)
	41.302	Kenai 75.6 (47)	28.2 (17.5)	47.5 (29.5)	5.6 (3.5)

Table 27. (Continued).

Date	Transmitter frequency (MHz)	Final destination rkm (rm)	Release site rkm (rm)	Total distance traveled km (mi)	Daily migration rate km (mi)
	41.340	Kenai 32.2 (20)	28.2 (17.5)	4.0 (2.5)	8.0 (5.0)
	41.360	Kenai 75.6 (47)	28.2 (17.5)	49.1 (30.5)	2.3 (1.4)
	41.380	Kenai 38.6 (24)	28.2 (17.5)	10.5 (6.5)	5.3 (3.3)
	41.400	Kenai 117.5 (73)	28.2 (17.5)	90.1 (56.0)	6.0 (3.7)
	41.420	Kenai 37.0 (23)	28.2 (17.5)	8.8 (5.5)	2.3 (1.4)
	41.120	Kenai 65.2 (40.5)	31.4 (19.5)	33.8 (21.0)	3.4 (2.1)
	41.180	Kenai 70.8 (44)	31.4 (19.5)	35.4 (22.0)	3.2 (2.0)
	41.198	Kenai 75.6 (47)	31.4 (19.5)	44.2 (27.5)	3.5 (2.2)
	41.430	Kenai 54.7 (34)	31.4 (19.5)	25.7 (16.0)	2.3 (1.4)
	41.450	Kenai 54.7 (34)	31.4 (19.5)	23.3 (14.5)	2.4 (1.5)
9/19	40.300	Kenai 74.8 (46.5)	31.4 (19.5)	43.4 (27.0)	1.3 (.8)
9/20	40.600	Kenai 35.4 (22)	28.2 (17.5)	7.2 (4.5)	3.7 (2.3)
	41.080	Kenai 75.6 (47)	28.2 (17.5)	47.5 (29.5)	5.3 (3.3)
	41.510	Kenai 54.7 (34)	23.3 (14.5)	31.4 (19.5)	12.6 (7.8)
	41.790	Kenai 75.6 (47)	28.2 (17.5)	47.5 (29.5)	3.2 (2.0)
	41.530	Kenai 67.6 (42)	31.4 (19.5)	73.2 (45.5)	6.8 (4.2)
	41.560	Kenai 66.0 (41)	31.4 (19.5)	4.0 (2.5)	2.1 (1.3)
	41.582	Kenai 35.3 (22)	31.4 (19.5)	4.0 (2.5)	4.0 (2.5)
9/26	41.808	Kenai 70.0 (43.5)	28.2 (17.5)	46.7 (29.0)	2.6 (1.6)
	41.830	Kenai 74.6 (46.5)	28.2 (17.5)	49.1 (30.5)	7.4 (4.6)
	41.850	Kenai 73.2 (45.5)	23.3 (14.5)	45.9 (28.5)	4.2 (2.6)
	41.911	Kenai 31.4 (19.5)	28.2 (17.5)	3.2 (2.0)	3.2 (2.0)
9/27	41.890	Kenai 74.0 (46)	31.4 (9.5)	46.7 (29.0)	4.3 (2.7)
10/2	41.950	Kenai 76.2 (47.5)	29.8 (18.5)	45.9 (28.5)	5.8 (3.6)
	41.970	Kenai 49.9 (31)	28.2 (17.5)	21.7 (13.5)	3.1 (1.9)
	41.990	Kenai 130.3 (81)	31.4 (19.5)	99.0 (61.5)	5.3 (3.3)
10/4	40.265	Kenai 74.8 (46.5)	28.2 (17.5)	6.4 (4.0)	5.8 (3.6)
	40.445	Kenai 76.2 (47.5)	23.3 (14.5)	53.1 (33.0)	4.8 (3.0)
10/5	40.021	Kenai 57.1 (35.5)	31.4 (19.5)	31.4 (19.5)	10.5 (6.5)
10/10	40.015	Kenai 75.6 (47)	29.0 (18.0)	46.7 (29.0)	2.6 (1.6)
10/11	40.045	Kenai 75.6 (47)	23.3 (14.5)	48.3 (30.0)	7.2 (4.5)
10/17	40.425	Kenai 78.8 (49)	31.4 (19.5)	47.5 (29.5)	5.8 (3.6)
	41.350	Kenai 59.5 (37)	31.4 (19.5)	23.3 (14.5)	2.3 (1.4)
10/19	41.370	Kenai 68.4 (42.5)	31.4 (19.5)	38.6 (24.0)	5.1 (3.2)
10/24	40.470	Kenai 75.6 (47)	31.4 (19.5)	43.4 (27.0)	2.1 (1.3)

APPENDIX E.

Fish Length

Table 28. Mean length of coho salmon sampled in the lower Kenai River, Alaska, 1988-1989.

Run	Year	Sample number	Range (mm)	Mean (mm)	SD
Early run	1988	40[a]	430 - 720	607	57
		433[b]	350 - 740	624	--
	1989	44[a]	460 - 640	584	38
		118[b]	495 - 627	585	--
Late run	1988	34[a]	560 - 715	646	41
		562[b]	470 - 760	653	--
	1989	66[a]	480 - 710	623	46
		162[b]	563 - 637	616	--

[a] Data source: this study.
[b] Data source: Alaska Department of Fish and Game, Soldotna, Alaska