

**Fishery Data Series No. 10-17**

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**Distribution of Chum Salmon in the Taku River  
Drainage, 2004**

by

**James E. Andel**

March 2010

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Alaska Department of Fish and Game

Divisions of Sport Fish and Commercial Fisheries





***FISHERY DATA REPORT NO. 10-17***

**DISTRIBUTION OF CHUM SALMON IN THE TAKU RIVER DRAINAGE,  
2004**

By

James E. Andel

Alaska Department of Fish and Game and Division of Commercial Fisheries, Douglas

Alaska Department of Fish and Game  
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## ABSTRACT

A total of 168 radio-tagged chum salmon were tracked with stationary towers and aerial surveys to determine their spawning distribution in the Taku River Drainage in 2004. Of the 135 radio-tagged chum successfully tracked, 127 (94.1%) spawned in the Taku River mainstem between the Tulsequah and Inklin confluences. Through aerial radio tracking, surveying, and on-the-ground verification, it was evident that Taku chum demonstrated extensive use of braided channels on the west side of the Taku mainstem. No radio tags from verified spawners were tracked below the US border or into the Tulsequah, Inklin, or Nakina rivers. Several tracked fish were found utilizing spawning areas in Yellow Bluff, Chunk, Tuskwa, Shustahini, and Yonakina sloughs. In contrast to the general turbidity of the Taku mainstem, chum preferred but did not limit themselves to spawning areas characterized by clear ground water upwelling or the geographic presence of alluvial fans. Establishing an aerial survey index for the clear water spawning areas may provide useful information towards monitoring stock health of Taku chum salmon.

Key words: chum salmon, *Oncorhynchus keta*, Taku River, Tulsequah River, Inklin River, mark-recapture, radio telemetry, escapement, abundance, Alaska

## INTRODUCTION

Chum salmon, *Oncorhynchus keta*, returning to the Taku River represent the only Taku salmon stock that has experienced a persistent decline in abundance based on our current measures of harvest and fishery performance. Annual harvest data from the U.S. District 111 fishery (Taku Inlet) and fall chum catch data collected at the Canyon Island ADFG fish wheels suggest chum populations have been in decline since 1987 (Figure 1). These harvest and fishery performance numbers provide the only index of escapement available for Taku River chum salmon. In 1988, the Transboundary Technical Committee established an interim escapement goal of 50,000 to 80,000 chum salmon for the Taku River (TTC 1988). Since limited mark-recapture or aerial index survey estimates were available, the escapement goal was based on professional judgment of perceived run sizes at the time.

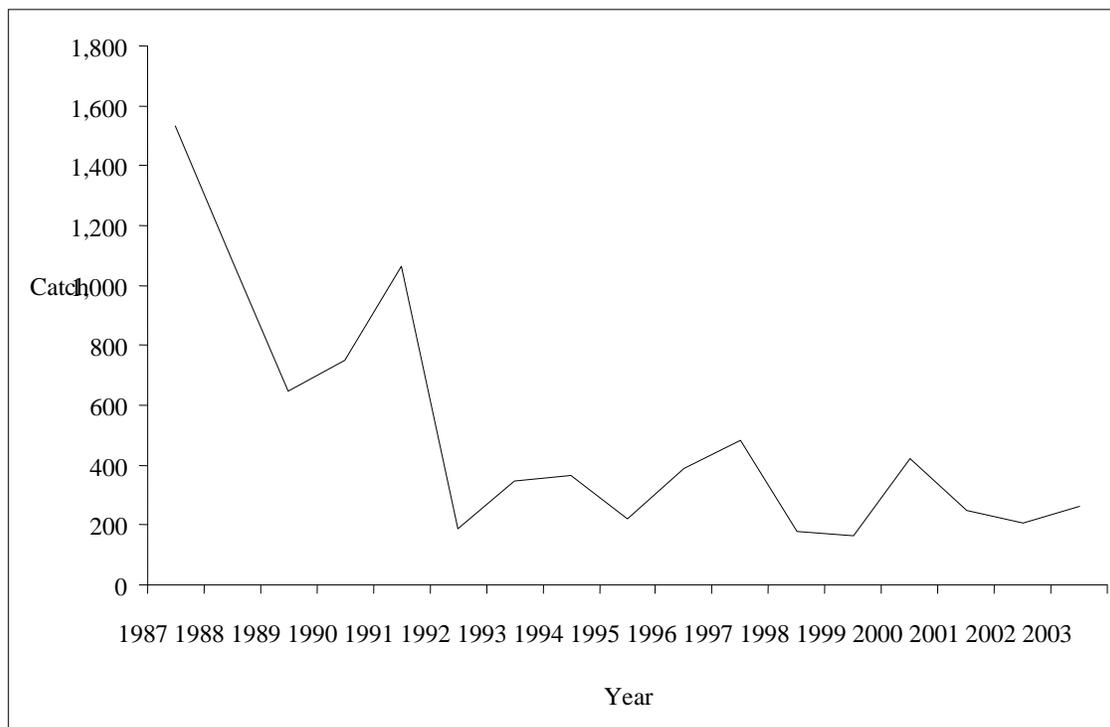


Figure 1.—Annual chum salmon fish wheel catches, Canyon Island, Taku River, 1987–2003.

Since that time, effort has focused on determining the feasibility of estimating chum salmon escapements. Escapement estimations of chum via mark-recapture have proved difficult and impractical, primarily due to low numbers of chum caught in the fish wheels and the upriver recovery fisheries which result in very low statistical precision. Additionally, the turbidity and unpredictability of Taku River water flow prohibits accurate and timely aerial survey counts resulting in low confidence of accurate escapement estimations.

Prior to this study, only limited information was available on the location and importance of chum salmon spawning areas within the drainage. Sporadic aerial surveys, a small cursory chum telemetry program in 2003, and recorded on-site concentrations of chum salmon spawning in the King Salmon flats area provided the first indications of spawning distribution and location (Andy Mcgregor, ADF&G biologist, Douglas, 2004, *personal communication*). Studies on Taku sockeye spawning distribution and abundance in 1988 briefly noted the presence of chum salmon spawning in the mainstem but did not provide specific locations (Eiler et al. 1988). No other substantial spawning areas have been identified, including none below the US/Canada border.

To determine upriver movements of adult salmon, radio telemetry had proven reasonably applicable and effective (Eiler 1995). In 2004, we used radio telemetry in an effort to determine the distribution of returning Taku River chum salmon and the location of principal spawning areas. Using radio telemetry to provide locations, quantity, and quality of chum salmon spawning habitat is an essential step in determining the feasibility of using mark-recapture methodology or aerial survey indices as measures of abundance. Establishment of a consistent method to determine abundance, distribution, and migratory timing is needed in order to improve management of Taku chum stocks.

## **OBJECTIVES**

The objectives of this study were to

1. estimate the proportions of chum salmon migrating up the Taku River drainage;
2. document chum spawning locations in the Taku River drainage; and,
3. evaluate the feasibility of estimating abundance of Taku River chum.

## **METHODS**

### **STUDY AREA DESCRIPTION**

The Taku River originates in the Stikine plateau of northwestern British Columbia, and drains an area of approximately 16,000 square kilometers (Figure 2). The merging of the Inklin and Nakina Rivers, 55 km upstream of the international border, forms the main body of the lower River. The river flows southwest from this point through the Coast Mountain Range and empties into Taku Inlet about 30 km east of Juneau, Alaska. Approximately 95% of the Taku River watershed lies within Canada.

The majority of the Taku River is turbid, with much of its discharge originating in glacial fields of the Coast Range Mountains. Discharge past Canyon Island (U.S.) varies from a winter low of 60 m<sup>3</sup>/sec in February, to a summer high of 1,097 m<sup>3</sup>/sec in June (Bigelow et al 1995).

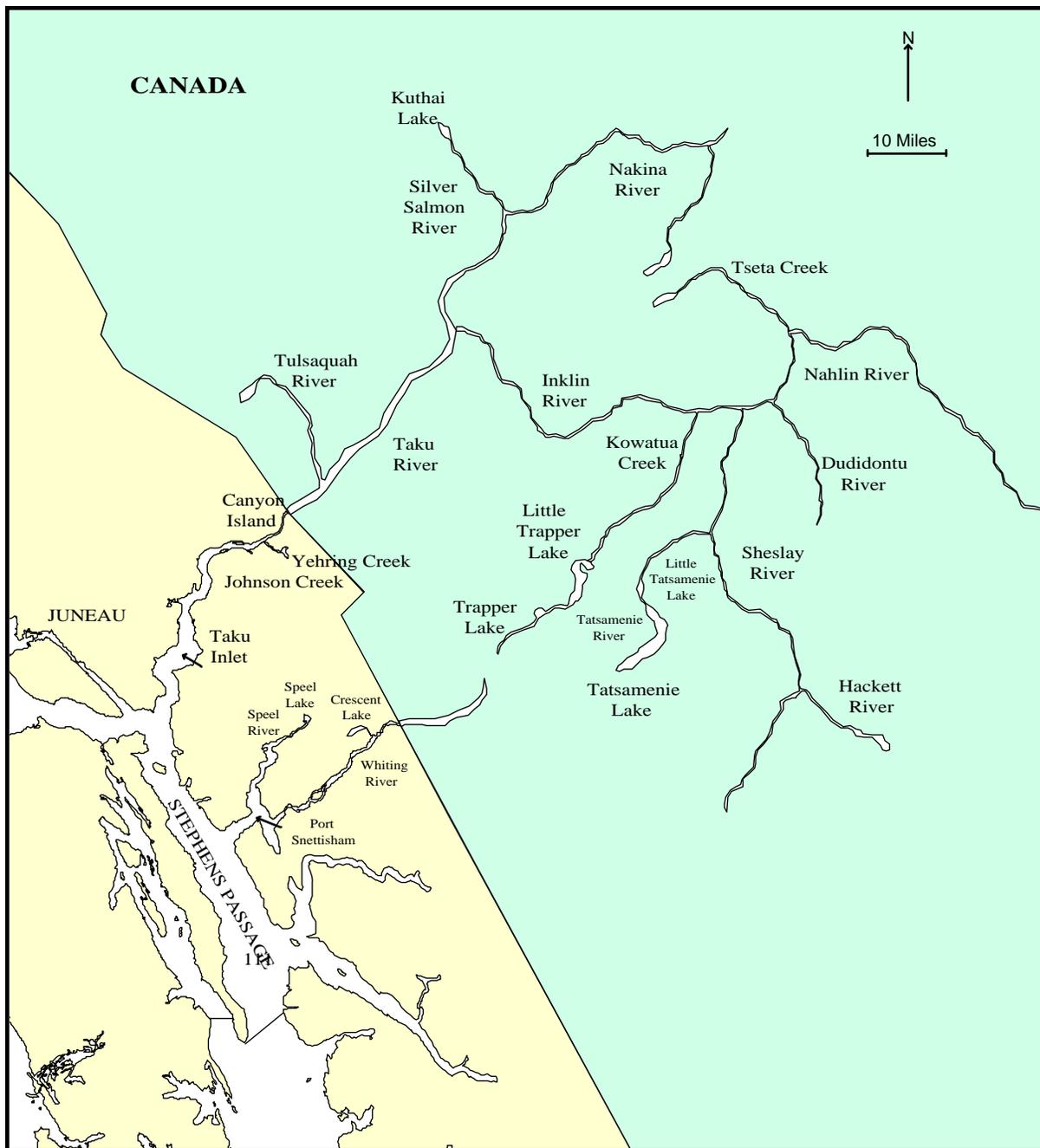


Figure 2.—Taku River drainage and associated tributaries, Alaska (yellow) and northern British Columbia, Canada (green).

## CAPTURE AND TAGGING

Migrating adult chum salmon were captured with 2 fish wheels at Canyon Island, located approximately 4 km downstream from the international border (Figure 2). Each fish wheel consisted of 2 aluminum pontoons in a framework, measuring approximately 12 m in length and 6 m in width and filled with closed-cell styrofoam for flotation, supporting an axle, paddle, and basket assembly. Two fish-catching baskets were rotated about the axle by the force of the water current against the baskets and/or paddles. As the fish wheel baskets rotated, they scooped up

salmon. V-shaped slides attached to the rib structure of each basket directed fish to aluminum liveboxes bolted to the outer sides of the pontoons.

The fish wheels were positioned in the vicinity of Canyon Island on opposite riverbanks, approximately 200 m apart, and have been operated in identical locations since 1984. They were secured in position by anchoring to large trees with 0.95 cm steel cable and were held out from, and parallel to, the shoreline by log booms. The Taku River channel at this location is ideal for fish wheel operation. The river is fully channelized through a relatively narrow canyon that has very steep walls.

The fish wheels rotated from 0 to 4 times per minute (rpm), depending on the water velocity and the number of attached paddles. When water levels subsided, more paddles were attached and the fish wheels were moved farther out from shore into faster water currents, to maintain a speed of basket rotation adequate to catch fish.

Salmon were dipnetted from the fish wheel liveboxes into a tagging trough partially filled with river water. Sex and length measurements were recorded, and scale samples taken from all chum salmon captured. The tagging and sampling procedures took from 40 to 60 seconds per fish to complete. The fish were then immediately and gently released back into the river.

Since we anticipated the number of radio tags available would be greater than the number of chum captured, every healthy chum captured was implanted with a radio tag. In an attempt to distribute tags evenly over the entire span of the run, tagging frequency was adjusted in proportion to run strength. Weekly tagging goals were established based on statistical weeks (Appendix A), and historical counts of Taku fish wheel catches and average run timing.

In general, fish wheel catches were sampled in the morning, afternoon, and evening. Less frequent checks, morning and evening, were made during lulls in the migration to minimize crew overtime. During peak migration times catches were sampled more frequently, early in the morning and late at night. In 2004, sampling occurred from August 8 to October 2.

Set gillnets 60 feet long and made of 5.25-inch stretch mesh were fished directly below Canyon Island during periods of extremely low water levels (September 12–13 and September 17–20). During these periods the fish wheels become ineffective. Set gillnets were watched continuously and captured fish were removed from the net as soon as possible. Nets were typically fished 3 to 4 hours per day. The tagging and sampling procedures for gill net caught chum salmon were identical to salmon captured in the fish wheels.

## **RADIO TRACKING EQUIPMENT AND TRACKING PROCEDURES**

Chum salmon were tagged with pulse encoded transmitters made by Lotek Wireless. Radio tags were encoded so each individual tag could be distinguished. Ten frequencies in the 148 to 149 MHz range with up to 12 encoded pulse patterns per frequency were used. Tags were inserted through the mouth of the fish and placed into the stomach using a small diameter polyvinyl chloride (PVC) tube plunger. Radio tags were inserted into the fish while in the sampling tub.

Secondary spaghetti tags (Floy Tag and Manufacturing Inc., Seattle, WA)<sup>1</sup> were also applied to all radio tagged chum salmon. Spaghetti tags were applied while one person held the fish in the

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<sup>1</sup> Mention of trade names does not constitute endorsement by ADF&G.

tagging trough and a second person inserted a 15 cm applicator needle and attached spaghetti tag through the dorsal musculature immediately below the dorsal fin. The ends of the spaghetti tag were then knotted together with a single overhand hitch. Secondary tags and marks (lower opercle punch) were used to identify spawning fates of radio tagged fish that either lost their radio tag, were captured in the upriver Canadian commercial fishery, or located on the spawning grounds during mainstem sampling routines.

Two stationary tracking stations were constructed at the entrance to Flannigan's Slough, directly below the U.S./Canada border, and at the confluence of the Inklin and Taku Rivers, 30 miles upriver from the border (Figure 2) Each tracking station included a steel enclosure unit that contained one 90AH gel-cell, deep-cycle battery, battery regulator, a model SRX400A scanning receiver, and an ASP-8 antenna switch box. One 50-watt solar array and two 4-element Yagi antenna were connected to each tracking station (one aimed upstream and one aimed downstream.) The stationary Lotek receivers were programmed to scan all frequencies at 3-second intervals. The receivers would scan using the downstream facing antenna, then the upstream facing antenna, and then both antennas at once. Data collected was stored within the 1 megabyte of memory within the receiver. When radio signals were detected, the receiver would pause for analysis of the signal and record the frequency, code, signal strength, date, and time signal was received for each antenna. Data was downloaded onto a laptop computer during each aerial survey (approximately every 7 to 10 days.)

Aerial tracking surveys of selected areas of the Taku River drainage were conducted on a weekly to bi-weekly basis through September and October. Aerial tracking was done to locate tags in areas not covered by the remote tracking stations (Tulsequah River), to locate fish the tracking stations did not record, and locate spawning sites located between the 2 remote tracking stations. Aerial tracking was done via Jet Ranger Helicopter with a 4-element Yagi antenna. Surveys were flown at altitudes varying from 100 to 800 ft at a speed of approximately 80 MPH. Locations of radio tagged fish tracked via aerial survey were generally determined with an accuracy of approximately 500 m.

## **DISTRIBUTION OF SPAWNERS**

Assumptions of the experiment to estimate spawning distribution include:

1. fates of radio-tagged fish are accurately determined;
2. tagging did not change the behavior (final spawning destination) of fish;
3. tagging effort was applied in proportion to abundance of immigration.

To address the first assumption, only radio tags that resumed upstream migration after tagging were considered in estimating proportional distribution. The combination of radio tracking towers, aerial surveys, and foot surveys led to the relocation of the majority of tags that resumed upriver migrations after tagging. In addition, radio tags and Floy tags were printed with return information and rewards offered to encourage returns of tags from harvested fish.

It was assumed that if radio tagged fish migrated past the Flannigan's slough radio tower and were again relocated upstream via aerial tracking, then handling and tagging had no effect.

The third assumption was considered true if fishing effort and catchability were constant for all stocks. Natural variations in river flow will cause variability in catchability, particularly when using fish wheels. Thus, sampling effort was held as constant as practical during the

immigration. The river level was recorded and graphed for comparison to catch rates at the fish wheel site.

## ESTIMATIONS OF PROPORTIONS

Each radio tagged fish was assigned one of 3 possible fates (Table 1; Pahlke et al. 1999). Each fish that was assigned a fate of 1 was then assigned to a final spawning area if applicable.

Table 1.—Criteria used to assign fates to radio-tagged chum salmon.

Fate Code	Criterion	Explanation
1	Probable spawning in a river or tributary	A chum salmon whose radio transmitter was tracked into a river or tributary, and remained in or was tracked downstream of that location. When a transmitter was tracked to more than one river or tributary, the last river or tributary was assumed to be the spawning location
2	Mortality or regurgitation	A chum salmon whose radio transmitter either did not advance upstream after tagging, or stopped in the mainstem Taku River and never tracked to an upstream location from Canyon Island.
3	Upriver harvest	A chum salmon captured in the inriver commercial, test, or aboriginal fisheries.

The proportion of chum salmon spawning in each area,  $\hat{P}_a$ , was estimated as follows:

$$\hat{P}_a = \frac{\sum_{t=1}^y \left( \frac{N_t}{n_t} \right) r_{a,t}}{\sum_{a=1}^x \sum_{t=1}^y \left( \frac{N_t}{n_t} \right) r_{a,t}}, \quad (1)$$

where,

$r_{a,t}$  = the number of fish tagged with radios in period  $t$  that were tracked to and assumed to spawn in area  $a$  ( $a = 1$  to  $3$ );

$N_t$  = the number of fish captured in fish wheels in period  $t$ ; and,

$n_t$  = the number of fish tagged in period  $t$  that were tracked to a spawning area.

Period ( $t$ ) refers to distinct spans of time when the tagging fraction was constant. Radio tags assigned to fates not associated with successful spawning (see Table 1) are ignored in computing  $\hat{P}_a$ , so the sum of the estimated proportions equals one.

## RESULTS

Between August 8 and October 2, 334 chum salmon were captured in the fish wheels and 34 were captured in gillnets at Canyon Island (Appendices B and C). During statistical weeks 38 and 39, water levels were so low, that the field crew did not operate the fish wheels for a number of days (Figure 3; Appendix B). Slightly over 10% of the chum salmon caught were 640 mm. in length (mideye-to-tail-fork or MEF; Figure 4); average length by age and percent by age of captured chum salmon are listed in Appendices D and E. One fishing day accounted for almost 9 percent of the total chum captured for the year (28 fish on August 21) which precipitated a decrease in our tagging distribution in order to ensure coverage of the total run (Figure 5). Of the 338 chum salmon captured, 168 were tagged. The weekly tag application rate varied from 1.0 to .5 tags per fish caught. Of the radio-tagged fish, 135 were relocated at least one time upriver via tracking station and aerial survey (Table 2). These 135 fish were designated as spawners. Of the remaining 33 tags, 6 were regurgitated near the tagging site, 10 were recorded downriver either as regurgitated tags or deaths, and 17 radio tags were not found after implantation. It was assumed the fates of these 17 tags were due either to deaths, regurgitations that had drifted downriver into salt water, or present in fish that had migrated to areas not covered by the tracking stations or aerial surveys.

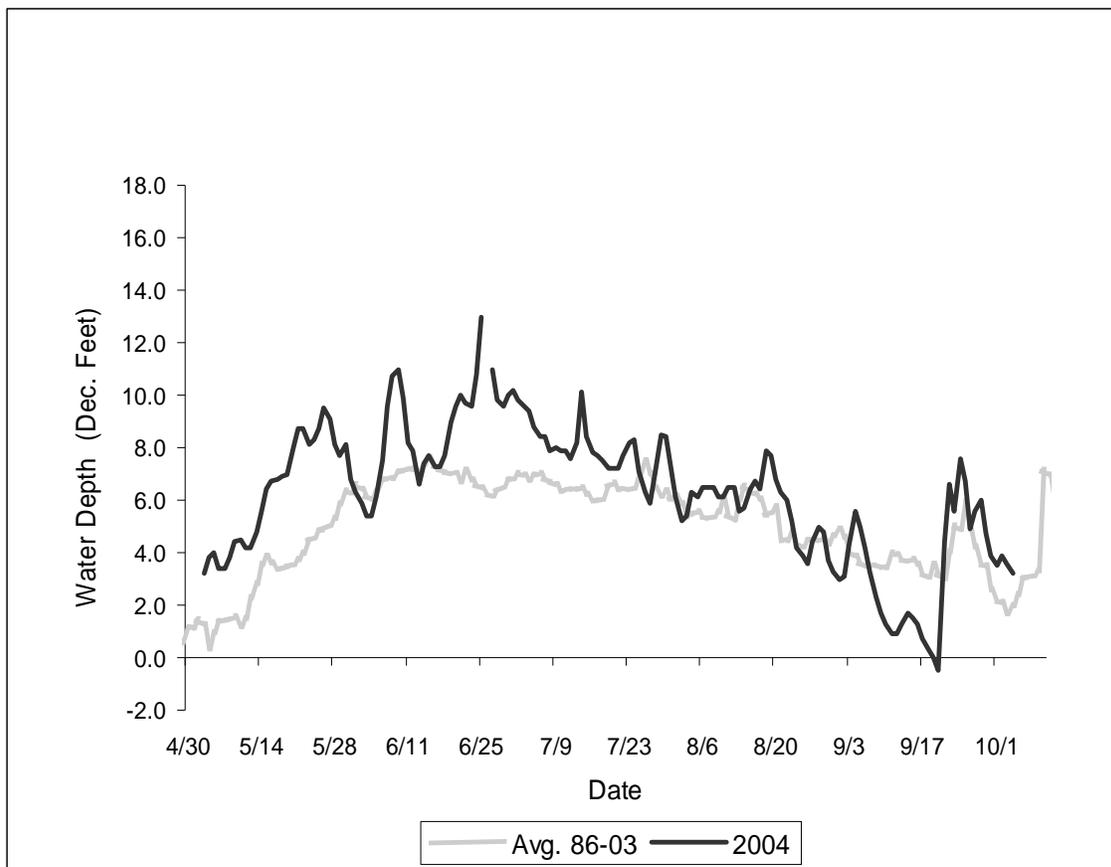


Figure 3.—Water levels measured at Canyon Island, 2004.

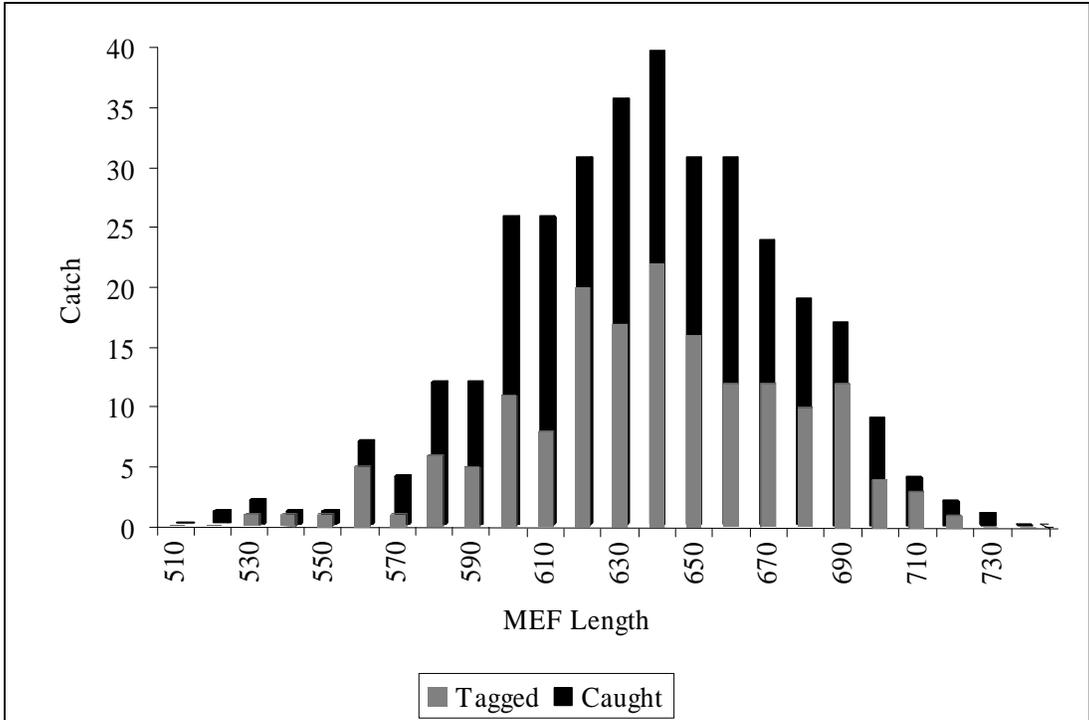


Figure 4.—Length frequencies of chum salmon caught and radio-tagged in the Taku River, 2004.

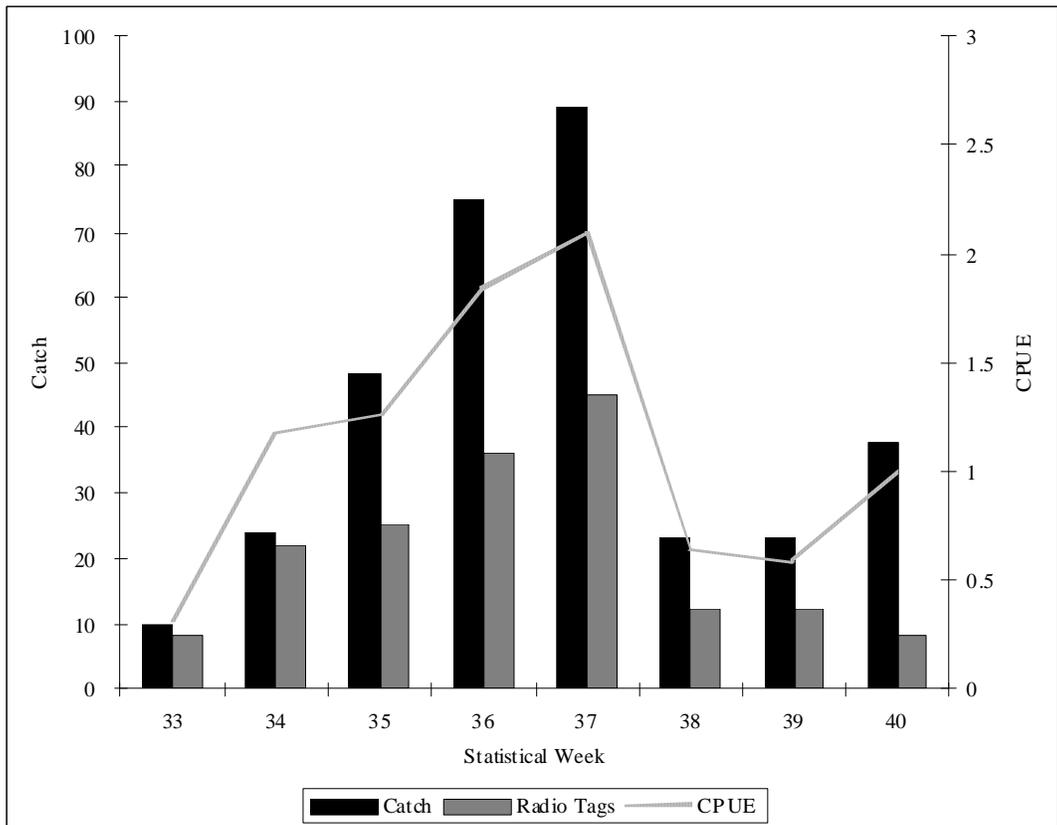


Figure 5.—Weekly catch, number of radio tags deployed, and CPUE of chum salmon in the Taku River, 2004.

Table 2.–Distribution of radio-tagged chum salmon in the Taku River drainage, 2004.

<b>Final Destination</b>	<b>Method</b>	<b>Number of Fish</b>	<b>Proportion</b>
<b>Inriver Fishery</b>	Fishery Return	5	0.04
	Tracking		
Above Inklin Confluence	station	0	0.00
Tulsequah River	Aerial Survey	0	0.00
Taku Mainstem:	Aerial Survey	127	0.94
<b>Total</b>		<b>132</b>	
<b>Unknown</b>		20	0.12
Regurgitation		6	0.04
Recorded Downstream		10	0.06
<b>Total</b>		<b>36</b>	
<b>Grand Total Tags Deployed</b>		<b>168</b>	

Of the 135 fish that migrated past the lower tracking station, 5 (3.7%) were captured in the Canadian Inriver fishery and 127 (94.1%) had final destinations within the Taku river mainstem between the Tulsequah and Inklin confluences (Figure 6). Two radio tags had final destinations recorded near Flannigan’s slough, and one radio tag was recorded within the Tulsequah River outlet. The signal strength recorded on these 3 radio tags was significantly higher than normal, suggesting the radio tags may have been removed from the water. These 3 radio tags were considered ‘unknown’, as verified spawning behavior could not be determined during subsequent aerial surveys or on-the-grounds observation. No radio tags were tracked into the Inklin or Nakina rivers via tracking station or aerial surveys.

Within the Taku mainstem, the majority of radio-tagged spawners were located within 6 general areas. Listed from south to north, the areas were Yellow Bluff slough, Tuskwa slough, Chunk slough, Shustahini slough, King Salmon flats, and Yonakina slough. On ground and aerial observations of active chum spawning behavior were made at Yellow Bluff, Tuskwa, Shustahini, King Salmon Flats area, and Yonakina slough. Because the water in Chunk slough is turbid and has low visibility, direct observations could not be made. In past years, mainstem sockeye sampling trips have observed chum salmon spawning in this area as recently as 2003.

## **DISCUSSION**

Chum salmon spawning activity was tracked and observed only within the Taku mainstem between the Tulsequah and Inklin confluences. No radio tags were tracked below the U.S. border, in the Tulsequah River, or in the Inklin and Nakina Rivers. One radio tag was tracked near the Tulsequah River outlet and 2 tags were tracked into Flannigan’s slough. Neither could be verified by subsequent surveys or on the grounds observation. The signal strength recorded was significantly higher than normal suggesting the radio tag may have been removed from the water. Water removal could have occurred either through predation or by the carcass washing up on a sand or gravel bar.

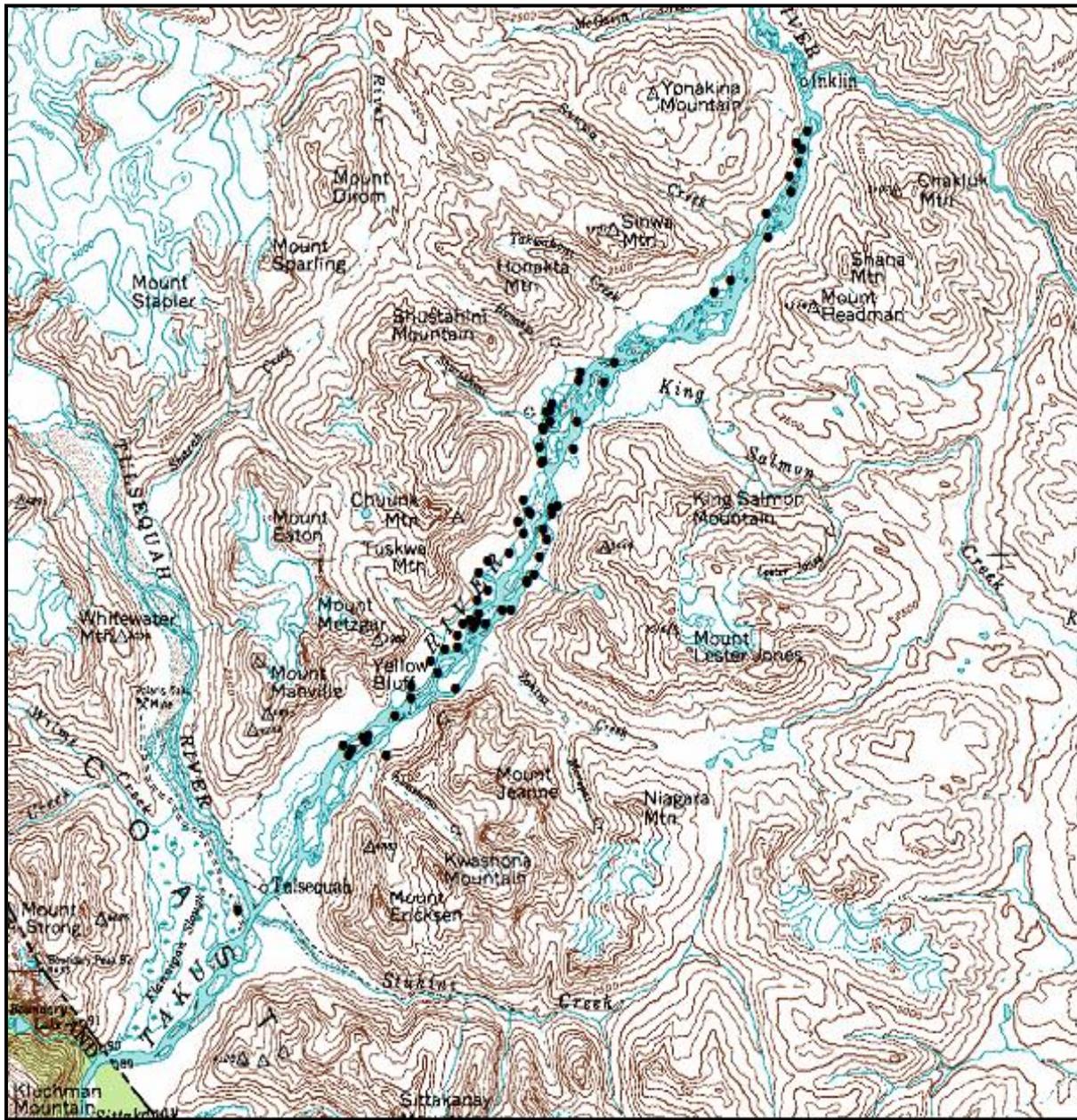


Figure 6.—GPS marked distribution of final destinations for radio tagged Taku chum salmon. Marks can represent more than one chum salmon.

Locating spawning habitat of Taku chum salmon is an important step towards establishing an index of abundance either through aerial surveys, spawning grounds counts, mark-recapture studies, or ideally, a combination of these methods. Through aerial radio tracking, surveying, and on the grounds verification, it was evident that Taku chum demonstrated extensive use of braided channels on the west side of the Taku mainstem. This area is normally characterized by turbid water, but several locations showed evidence of upwelling ground water which is commonly associated with chum spawning (Salo 1991). In addition, the presence of effluvial fans in the

mainstem area provides another periodic source of fresh water through rain and snow melt. The largest clusters of spawners were tracked to Yonakina, Chunk, Shustahini, Yellow Bluff, and Tuskwa sloughs. In contrast to historical aerial surveys, relatively few spawners were tracked into the King Salmon flats area.

The ground water upwelling and water run-off from alluvial fans continue to provide specific, productive spawning areas, despite the changes in river dynamics and river geography caused by the periodic floods on the Tulsequah River. In these areas (Tuskwa, Shustahini, and Yellow Bluff slough), aerial surveys may be an effective index of abundance, but in other areas the water clarity is not ideal (Chunk and Yonakina slough and King Salmon Flats) suggesting ground surveys and on-site sampling would be needed for abundance estimates.

During annual fall spawning grounds sampling expeditions for Taku mainstem sockeye salmon, chum spawning is frequently observed. Several live spawning chum salmon were found with secondary marks (tag punctures below dorsal fin) but none had kept their spaghetti-style Floy tags. It is recommended that if tagging continues, the use of Floy tubing shrunk onto monofilament fishing line or an equivalent tag be used. This will provide added durability and steam life for spawning grounds sampling recoveries. These styles of tags are currently used on the Taku Chinook mark-recapture project (McPherson et. al. 1997).

## REFERENCES CITED

- Bigelow, B. B., B. J. Bailey, M. M. Hiner, M. F. Schellekens, and K. R. Linn. 1995. Water resources data Alaska water year 1994. U.S. Geological Survey Water Data Report AK-94-1, Anchorage.
- Eiler, J., B. Nelson, R. Bradshaw, J. Greiner, and J. Lorenz. 1988. Distribution, stock composition and location and habitat type of spawning areas used by sockeye salmon on the Taku River. N.W.A.F.C. Processed Report. 88-24. Northwest and Alaska Fisheries Center, National Marine Fisheries Service, NOAA, Auke Bay Laboratory, Auke Bay, Alaska.
- Eiler, J. H. 1995. A remote satellite-linked tracking system for studying Pacific salmon with radio telemetry. *Transaction of the American Fisheries Society* 124: 184–193.
- McPherson, Scott A., David R. Bernard, M. Scott Kelley, Patrick A. Milligan, and Phil Timpany. 1998. Spawning Abundance of Chinook salmon in the Taku River in 1997. Alaska Department of Fish and Game, Fishery Data Series No. 98-41, Anchorage.
- Pahlke, K. P., P. Etherton, R. E. Johnson, and J. E. Andel. 1999. Abundance and distribution of the Chinook salmon escapement on the Alsek River, 1998. Alaska Department of Fish and Game, Fishery Data Series, No. 99-44, Anchorage.
- Salo, E. O. 1991. Life history of chum salmon (*Oncorhynchus keta*). In C. Groot and L. Margolis (eds.), *Pacific Salmon Life Histories*. University of British Columbia Press, Vancouver.
- TTC (Transboundary Technical Committee). 1988. Salmon management plan for the Transboundary Rivers, 1988. Pacific Salmon Commission Transboundary Technical Committee. Report TCTR (88)-2. Vancouver, British Columbia, Canada.



## **APPENDICES**

Appendix A.—Inclusive dates for statistical weeks in 2004.

Statistical Week	Dates		Statistical Week	Dates	
	From	To		From	To
1	1-Jan	3-Jan	28	4-Jul	10-Jul
2	4-Jan	10-Jan	29	11-Jul	17-Jul
3	11-Jan	17-Jan	30	18-Jul	24-Jul
4	18-Jan	24-Jan	31	25-Jul	31-Jul
5	25-Jan	31-Jan	32	1-Aug	7-Aug
6	1-Feb	7-Feb	33	8-Aug	14-Aug
7	8-Feb	14-Feb	34	15-Aug	21-Aug
8	15-Feb	21-Feb	35	22-Aug	28-Aug
9	22-Feb	28-Feb	36	29-Aug	4-Sep
10	29-Feb	6-Mar	37	5-Sep	11-Sep
11	7-Mar	13-Mar	38	12-Sep	18-Sep
12	14-Mar	20-Mar	39	19-Sep	25-Sep
13	21-Mar	27-Mar	40	26-Sep	2-Oct
14	28-Mar	3-Apr	41	3-Oct	9-Oct
15	4-Apr	10-Apr	42	10-Oct	16-Oct
16	11-Apr	17-Apr	43	17-Oct	23-Oct
17	18-Apr	24-Apr	44	24-Oct	30-Oct
18	25-Apr	1-May	45	31-Oct	6-Nov
19	2-May	8-May	46	7-Nov	13-Nov
20	9-May	15-May	47	14-Nov	20-Nov
21	16-May	22-May	48	21-Nov	27-Nov
22	23-May	29-May	49	28-Nov	4-Dec
23	30-May	5-Jun	50	5-Dec	11-Dec
24	6-Jun	12-Jun	51	12-Dec	18-Dec
25	13-Jun	19-Jun	52	19-Dec	25-Dec
26	20-Jun	26-Jun	53	26-Dec	30-Dec
27	27-Jun	3-Jul	54	31-Dec	—

Appendix B.—Fish wheel and gillnet daily effort (hours fished), catches, cumulative catches, water level and temperature, Canyon Island, Taku River, for statistical weeks 33 to 38, in 2004.

Stat Week	Date	FISHING EFFORT					WATER		CHUM SALMON				
		Fishwheel I		Fishwheel II		Gillnet Hours	Temp. (°C)	Level (dec.ft.)	Total Catches		Radio-Tagged		
		Effort	RPM	Effort	RPM				Daily	Cum.	Daily	Cum.	
33	8-Aug	22.33	2.6	21.83	2.4	0.0	7.3	6.5	1	1	0	0	
33	9-Aug	22.25	2.2	22.00	2.0	0.0	8.1	6.1	2	3	2	2	
33	10-Aug	9.25	2.6	10.33	2.3	0.0	8.4	6.1	1	4	1	3	
33	11-Aug	11.42	2.8	11.00	2.4	0.0	10.4	6.5	2	6	2	5	
33	12-Aug	23.16	2.6	22.50	2.4	0.0	8.7	6.5	4	10	2	7	
33	13-Aug	23.42	2.2	23.08	2.2	0.0	8.7	5.6	1	11	1	8	
33	14-Aug	23.08	2.3	22.67	2.1	0.0	8.5	5.7	0	11	0	8	
34	15-Aug	22.25	2.8	23.25	2.4	0.0	8.6	6.4	3	14	3	11	
34	16-Aug	22.42	3.0	22.16	2.4	0.0	8.4	6.7	3	17	3	14	
34	17-Aug	9.16	2.5	9.67	2.7	0.0	7.5	6.4	0	17	0	14	
34	18-Aug	12.16	3.0	11.83	2.7	0.0	9.0	7.9	3	20	3	17	
34	19-Aug	22.42	2.6	21.75	2.7	0.0	8.1	7.7	4	24	4	21	
34	20-Aug	21.67	2.1	21.58	1.7	0.0	7.8	6.8	9	33	9	30	
34	21-Aug	22.92	1.9	22.33	2.0	0.0	8.3	6.3	28	61	14	44	
35	22-Aug	22.83	1.2	22.75	1.7	0.0	8.0	6.0	5	66	1	45	
35	23-Aug	22.92	2.0	23.50	2.1	0.0	7.2	5.2	4	70	2	47	
35	24-Aug	22.42	1.5	22.42	1.0	0.0	9.0	4.2	10	80	4	51	
35	25-Aug	23.25	1.0	23.58	1.5	0.0	7.2	3.9	2	82	2	53	
35	26-Aug	10.25	1.2	11.50	1.1	0.0	7.3	3.6	4	86	2	55	
35	27-Aug	13.58	2.3	13.50	2.1	0.0	8.2	4.4	0	86	0	55	
35	28-Aug	23.75	2.5	23.83	2.4	0.0	7.5	5.0	0	86	0	55	
36	29-Aug	23.08	2.1	23.25	2.1	0.0	7.4	4.8	5	91	1	56	
36	30-Aug	22.92	1.2	23.16	1.6	0.0	7.8	3.7	14	105	7	63	
36	31-Aug	23.33	1.7	23.50	1.6	0.0	7.9	3.3	9	114	3	66	
36	1-Sep	22.25	1.3	22.83	1.5	0.0	7.6	3.0	4	118	1	67	
36	2-Sep	22.33	1.9	23.50	1.9	0.0	7.8	3.1	9	127	5	72	
36	3-Sep	23.08	2.1	23.25	2.2	0.0	7.5	4.3	16	143	7	79	
36	4-Sep	21.67	2.6	22.75	2.2	0.0	8.1	5.6	27	170	12	91	
37	5-Sep	23.00	1.5	22.58	1.5	0.0	6.5	5.0	42	212	17	108	
37	6-Sep	22.42	1.9	23.00	1.6	0.0	6.0	4.2	27	239	13	121	
37	7-Sep	22.67	1.5	23.16	1.5	0.0	6.5	3.3	13	252	7	128	
37	8-Sep	23.25	1.0	23.42	1.0	0.0	6.0	2.3	6	258	5	133	
37	9-Sep	23.33	1.0	23.75	1.0	0.0	6.0	1.7	2	260	0	133	
37	10-Sep	23.50	1.0	23.75	1.0	0.0	6.0	1.3	5	265	3	136	
37	11-Sep	23.75	0.5	23.83	0.5	0.0	7.0	0.9	1	266	0	136	
38	12-Sep	<b>NO FISHING—low water</b>					—	7.0	0.9	—	266	0	136
38	13-Sep	<b>NO FISHING—low water</b>					—	7.0	1.3	—	266	0	136
38	14-Sep	23.08	1.2	—	—	3.0	7.0	1.7	7	273	3	139	
38	15-Sep	23.83	0.1	—	—	4.0	7.0	1.5	4	277	3	142	
38	16-Sep	23.92	0.1	—	—	3.0	6.0	1.3	4	281	3	145	
38	17-Sep	<b>Wheels down—low water</b>					3.0	7.5	0.7	3	284	2	147
38	18-Sep	<b>Wheels down—low water</b>					4.0	7.0	0.3	6	290	2	149

Appendix C.—Fish wheel and gillnet daily effort (hours fished), catches, cumulative catches, water level and temperature, Canyon Island, Taku River, for statistical weeks 39 and 40, in 2004.

Stat		FISHING EFFORT					WATER		CHUM				
		Fishwheel I		Fishwheel II		Gillnet	Temp.	Level	Total Catches		Radio-Tagged		
Week	Date	Effort	RPM	Effort	RPM	Hours	(°C)	(dec.ft.)	Daily	Cum.	Daily	Cum.	
39	19-Sep	<b>NO FISHING—low water</b>					—	7.0	0.0		290	0	149
39	20-Sep	<b>Wheels down—low water</b>					4.0	7.0	-0.5	2	292	2	151
39	21-Sep	21.92	1.5	—	—	4.0	7.0	-0.5	2	292	2	151	
39	22-Sep	22.75	3.1	23.33	2.5	0.0	7.0	4.4	4	296	2	153	
39	23-Sep	21.00	2.4	23.08	2.0	0.0	6.5	6.6	2	298	1	154	
39	24-Sep	21.92	2.6	22.83	1.7	0.0	6.0	5.6	8	306	5	159	
39	25-Sep	22.50	2.0	23.50	1.5	0.0	6.0	7.6	5	311	1	160	
40	26-Sep	22.58	1.5	23.58	1.5	0.0	5.5	6.7	3	314	2	162	
40	27-Sep	23.08	2.4	23.50	2.3	0.0	5.5	4.9	9	323	1	163	
40	28-Sep	23.00	2.0	23.25	1.8	0.0	6.0	5.6	7	330	2	165	
40	29-Sep	22.83	1.3	23.16	1.4	0.0	6.0	6.0	6	336	3	168	
40	30-Sep	22.16	1.8	21.58	1.8	0.0	6.0	4.7	9	345	1	169	
40	1-Oct	23.33	2.0	23.08	1.5	0.0	6.8	3.9	8	353	1	170	
40	2-Oct	23.42	2.1	23.67	2.1	0.0	7.0	3.5	5	358	1	171	
<b>Totals</b>										360		171	

Appendix D.—Average length by age for chum salmon in Canyon Island, Taku River fish wheels by sex, 2004.

		<u>Brood Year and Age Class</u>				<b>Total</b>
		<u>2001</u>	<u>2000</u>	<u>1999</u>	<u>1998</u>	
<b>Combined Periods</b>		<b>0.2</b>	<b>0.3</b>	<b>0.4</b>	<b>0.5</b>	
<b>Male</b>	Avg. Length	633	634	666	—	644
	Std. Error	2.5	3.5	4.3	—	3.0
	Sample Size	2	94	45	—	141
<b>Female</b>	Avg. Length	—	615	649	660	577
	Std. Error	—	3.5	5.2	—	3.0
	Sample Size	—	101	54	1	156
<b>All Fish</b>	Avg. Length	633	623	657	660	634
	Std. Error	2.5	2.5	3.7	—	2.2
	Sample Size	2	201	101	1	305

Appendix E.—Number and percent by age, of chum salmon captured in the Canyon Island, Taku River fish wheels by sex, 2004.

		<u>Brood Year and Age Class</u>				<b>Total</b>
		<u>2001</u>	<u>2000</u>	<u>1999</u>	<u>1998</u>	
<b>Combined Periods</b>		<b>0.2</b>	<b>0.3</b>	<b>0.4</b>	<b>0.5</b>	
<b>Male</b>	Sample Size	2	94	45	—	141
	Percent	0.2	34.2	15.7	—	50.1
	Std. Error	0.1	4.5	3.2	—	4.2
<b>Female</b>	Sample Size	—	101	54	1	156
	Percent	—	33.5	16.2	0.1	49.9
	Std. Error	—	4.2	2.6	0.1	4.2
<b>All Fish</b>	Sample Size	2	201	101	1	305
	Percent	0.2	67.8	31.9	0.1	100.0
	Std. Error	0.1	3.8	3.8	0.1	—