TATLAWIKSUK RIVER WEIR SALMON STUDIES
1998 - 2001

By
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OEO/ADA STATEMENT

REPORT SUMMARY PAGE

Title: Tatlawiksuk River Weir Salmon Studies, 1998 – 2001

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   - Identify spawning populations of salmon, and their run sizes in the Kuskokwim River watershed
2. Fisheries Monitoring
   - Assess impact of changes in regulations in mesh size on size and sex of fish caught.

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Study Duration: long-term

Key Words: chinook salmon, *Oncorhynchus tshawytscha*, chum salmon, *O. keta*, coho salmon, *O. kisutch*, escapement, age-sex-length, Tatlawiksuk River, Kuskokwim River, resistance board weir, longnose suckers, *Catostomus catostomus.*

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The salmon escapement monitoring program on the Tatlawiksuk River is a cooperative project operated jointly by the Kuskokwim Native Association (KNA) and the Commercial Fisheries Division of the Alaska Department of Fish and Game (ADF&G). Since inception of the project in 1998, operational funds have been provided to KNA from a number of sources including a grant from the National Fish and Wildlife Foundation (# 1998-0241), a grant from the Federal Office of Subsistence Management (# FIS 00-007) and a U.S. Bureau of Indian Affairs grant administered by the Bering Sea Fishermen's Association (BSFA; # E004401023). In addition, other groups such as The Kuskokwim Corporation and Sport Fish Division of ADF&G have provided in-kind support to the project in the form of land-use authorization for the camp, facilities for weir fabrication, and welding services. Support from the ADF&G included assistance from staff biologists, a Fish and Wildlife Technician crew leader and some operational costs.

Funding for the support provided by ADF&G was through a combination of State General Funds, a grant from the National Oceanic and Atmospheric Administration (NOAA) under the Western Alaska Fishery Disaster Relief Program (# NA 96FW0196) and a grant from the Federal Office of Subsistence Management (# FIS 01-117).

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- 1998 crew: Stephen Blanchett (ADF&G) and David Gregory (KNA).
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- 2000 crew: Chris Bach (ADF&G) and Sam Gregory (KNA).
- 2001 crew: Ricky Cilletti (KNA) and Russell Corona (ADF&G).

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FOREWARD

Part of the mission of this project is to promote local involvement and to develop the effectiveness of KNA in salmon resource management. Since inception, the project's crew has consisted of one locally hired KNA technician and one ADF&G technician. The project also annually serves as a platform to host several student interns from surrounding communities to offer "hands-on" work experience at the weir (funded under FIS 01-088).

Oversight of field operations is shared between the KNA and ADF&G. Both organizations make use of the weir data during inseason salmon management deliberations. ADF&G takes the lead in data management, data analysis and reporting; however, more of this responsibility is expected to shift to KNA pending the proposed addition of a fishery biologist position to KNA staff.

The Tatlawiksuk River weir has developed into a useful tool for salmon management. Ideally the project will continue to operate as a cooperative project, with active participation by KNA and ADF&G staff, but the outlook for future funding is unstable. Future funding from BSFA is tenuous due to instability in their grant program. Funding sources for ADF&G involvement have included state general funds and the Western Alaska Disaster grant. The Western Alaska Disaster grant will no longer be available following the 2002 field season. New funding sources will need to be identified for both KNA and ADF&G if the Tatlawiksuk River weir is to continue beyond the 2002.

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ABSTRACT

Tatlawiksuk River salmon escapements were annually monitored from 1998 through 2001 using weir designs that evolved over time. Total annual escapements of chinook salmon *Oncorhynchus tshawytscha* were 1,494 fish in 1999, 817 fish in 2000 and 2,011 fish in 2001. The project ended prematurely on 7 July in 1998, and only 970 chinook salmon were actually observed; however, some speculation on the 1998 total annual chinook escapement is discussed. Total annual escapement of chum salmon *O. keta* was 9,656 fish in 1999, 7,044 fish in 2000 and 23,718 fish in 2001. Only 5,726 chum salmon were actually observed in 1998; however, some speculation on the 1998 total annual chum escapement is discussed. Total annual escapement of coho salmon *O. kisutch* was 3,449 fish in 1999 and 10,501 fish in 2001. No coho salmon were observed in 1998 because of the premature termination of project operations. The project ended prematurely on 14 August in 2000; 5,756 coho salmon were actually observed, but some speculation is offered on the total annual coho escapement in 2000.

The age-sex-length (ASL) composition of the total annual chinook escapements was not estimated for any of the years of operations because of difficulty in obtaining adequate numbers of fish for sampling. The ASL compositions of the total annual chum salmon escapements in 1999, 2000 and 2001 were generally consistent with trends seen at other escapement monitoring projects in the Kuskokwim River drainage. The ASL compositions of the total annual coho salmon escapements in 1999 and 2001 were also generally consistent with historic trends seen elsewhere in the Kuskokwim River drainage.

The Alaska Board of Fisheries classified Kuskokwim River chinook and chum salmon as “stocks of concern” in early 2001, which is inclusive of the populations spawning in the Tatlawiksuk River. It is believed that escapements to the Tatlawiksuk River benefited from the consequent closure of the Kuskokwim River commercial fishery in June and July 2001, and from the institution of the weekly subsistence fishing schedule. The total annual escapements of chinook and chum salmon in 2001 were substantially greater then were observed in 1999 or 2000. Still, the adequacy of the chinook, chum and coho salmon escapements is unclear because of the lack of formal escapement goals for the Tatlawiksuk River.

Coho salmon have not been classified as a stock of concern; however, annual run abundance to the Kuskokwim River has declined since 1996 resulting in reduced commercial harvests and variable escapement levels. Likewise, the coho escapements to the Tatlawiksuk River have also been variable. Assessments of coho escapements to the Tatlawiksuk River have been difficult due to persistent challenges with high water conditions in late summer that seem to be especially prominent in the Tatlawiksuk River drainage.

Key Words: chinook salmon, *Oncorhynchus tshawytscha*, chum salmon, *O. keta*, coho salmon, *O. kisutch*, escapement, age-sex-length, Tatlawiksuk River, Kuskokwim River, resistance board weir, longnose suckers, *Catostomus catostomus.*

INTRODUCTION

The Kuskokwim River drains an area approximately 50,000 square miles, 11 percent of the total area of Alaska (Figure 1; Brown 1983). Each year mature salmon *Oncorhynchus spp.* return to the river and support intensive subsistence and commercial fisheries that produce an average annual harvest of about a million salmon (Burkey et al. 2001). The subsistence fishery is a vital cultural component for most Kuskokwim Area residents, and the subsistence salmon harvest contributes substantially to the regional food base (Coffing 1991, Coffing 1997a, Coffing 1997b, Coffing et al. 2000). The commercial salmon fishery in the Kuskokwim Area, though modest in value compared to other areas of Alaska, has been an important component of the market economy of lower river communities (Buklis 1999, Burkey et al. 2001). The salmon that contribute to these fisheries spawn and rear in nearly every tributary of the Kuskokwim River basin; however, few spawning streams receive any rigorous salmon escapement monitoring. The dearth of escapement data limits the ability of management authorities to assess the adequacy of escapements and the effects of management decisions. The Tatlawiksuk River weir is one of several initiatives begun in the late 1990's to help address this data gap in the Kuskokwim River salmon management program. The need to address this escapement data gap became even more critical in September 2000, when the Alaska Board of Fisheries (BOF) classified both Kuskokwim River chinook *Oncorhynchus tshawytscha* and chum salmon *O. keta* as "stocks of concern" because of the chronic inability of managers to maintain expected harvest levels (5 AAC 39.222; Burkey et al. 2000a, Burkey et al. 2000b).

Historically, only two long-term escapement monitoring projects have operated in the Kuskokwim River basin: Kogrukluk River weir (1976 to present; Salomone 2001) and Aniak River Sonar (1980 to present; Fair 2000). These tributaries constitute a modest fraction of the total Kuskokwim River basin, and are incomplete in their representation of the diversity of salmon populations that contribute to subsistence, commercial and sport harvests. In addition, the passage estimates generated from the Aniak River sonar project are not apportioned to species and this has been the subject of some criticism over the years. Other escapement monitoring projects have been developed within the Kuskokwim River basin, but these initiatives were short-lived (Burkey et al. 2001). In addition, several streams, including the Tatlawiksuk River, are sometimes surveyed for spawning salmon using small fixed-winged aircraft (Appendix A.1 and A.2; Burkey et al. 2001). The aerial surveys are typically flown in late July when chinook salmon are believed to be at peak spawning abundance. The Tatlawiksuk River weir, coupled with other initiatives begun in the late 1990's, provides some of the additional escapement monitoring required for sustainable salmon management (Mundy 1998, Holmes and Burkett 1996).

The goal of salmon management is to provide for sustainable long-term fisheries, and this is achieved in part by ensuring adequate numbers of salmon escape the fisheries to spawn each year. Since 1960, management of the Kuskokwim River subsistence, commercial, and sport fisheries has been the responsibility of the Alaska Department of Fish and Game (ADF&G). Management authority for the subsistence fishery was broadened in October 1999 to include the federal government under Title VIII of the Alaska National Interest Lands Conservation Act (ANILCA), with the U.S. Fish and Wildlife Service (USFWS) being the federal agency most involved in the Kuskokwim Area. In addition, Tribal groups such as Kuskokwim Native Association (KNA) are charged by their constituency to actively promote a healthy and sustainable subsistence salmon fishery. These and other groups have combined their resources to development several new projects, including the Tatlawiksuk River weir, in order to better achieve their common goal of providing for sustainable long-term salmon fisheries in the Kuskokwim River.

Sustainable salmon fisheries require more than just adequate escapement. Escapement projects, such as the Tatlawiksuk River weir, commonly serve as platforms for collecting other types of information that are useful for salmon management and research. Knowledge of the age-sex-length (ASL) compositions of salmon populations can provide insights into understanding fluctuations in salmon abundance and for developing spawner-recruit relationships used in formulating escapement goals (DuBois and Molyneaux 2000). The collection of ASL data is typically included in most escapement monitoring projects (e.g., Harper 1997, Tobin and Harper 1998, Menard 1999). In addition, water temperature, water chemistry and stream discharge are all fundamental variables of the stream environment that directly and indirectly influence salmon productivity (Hauer and Lambert 1996). These variables are affected by human activities (mining, timber harvesting, man-made impoundments, etc.; NRC 1996); or climatic changes (El Nino and La Nina events), which can in turn affect stream productivity and the timing of events such as salmon migration and spawning (Kruse 1998). The operational plan for the Tatlawiksuk River weir includes collecting ASL and habitat monitoring data.

Objectives

The objectives of the Tatlawiksuk River weir project are as follows:

1. determine the daily and total annual escapements of chinook, chum and coho salmon from 15 June through 20 September;

2. estimate the ASL composition of the total chinook, chum and coho *O. kisutch* salmon escapements from a minimum of three pulse samples, one collected from each third of the run, such that 95 percent simultaneous confidence intervals for the age composition in each pulse are no wider than 0.20 ($\alpha = 0.05$ and $d = 0.10$);

3. monitor the climatic variables of the Tatlawiksuk River such as daily water temperature and water level;

4. and profile the water chemistry of the Tatlawiksuk River (conductivity, pH, alkalinity, turbidity, color, calcium, magnesium and iron) at low to high water levels.

METHODS

Study Site

The Tatlawiksuk River is a tributary of the middle Kuskokwim basin and provides spawning and rearing habitat for chinook, chum and coho salmon (ADF&G 1998). Small numbers of sockeye *O. nerka* and pink *O. gorbucha* salmon also occur in the river. The Tatlawiksuk River originates in the foothills of the Alaska Range (Figure 2; Brown 1983), where it flows southwesterly for 70 miles, draining an area of 813 square miles, before joining the Kuskokwim River at river mile (rm) 383. Throughout most of the river's course, it meanders across wide flat valleys vegetated with white spruce and scattered birch or aspen. Black spruce is more characteristic in the more poorly drained parts of the basin (Brown 1983). Dense stands of willow and alder occur on sand and gravel bars. Extensive bog flats and swampy lowlands in the lower reaches of the basin are drained by unnamed streams that join the Tatlawiksuk River from the southeast and northeast, adding to the dark brown color of the water. The gradient of the lower fifty miles is approximately eight feet per mile.

Local residents report that Athabaskan groups once harvested salmon from the Tatlawiksuk River with fish fences and traps (Andrew Gusty Sr., Stony River, personal communication). This activity is said to have occurred as late as the mid 1900's. Biologists from ADF&G have periodically documented salmon escapements in the Tatlawiksuk River since 1968 through aerial surveys (Appendix A.2; Schneiderhan 1983, Burkey and Salomone 1999). Aerial surveys were sporadic and generally limited to the mainstem of the Tatlawiksuk River. The surveys were timed to coincide with peak chinook and chum salmon spawning activity.

Senka's Landing is the nearest settlement to the weir project site. Located on the mainstem of the Kuskokwim River, approximately 7 miles downstream from the mouth of the Tatlawiksuk River, Senka's Landing is the homestead of the Gregory family. Five permanent residents live at the homestead. The Gregory's periodically sell gasoline for retail and they have allowed some of the weir camp equipment to be stored at their homestead over the winter. Senka's Landing does not have telephone service, but the Gregory's can be contacted through the bush message service offered by KSKO radio in McGrath.

Approximately nine miles farther downstream, tucked among several islands, is the community of Stony River, population 43 (Williams 1997). The town does not have a grocery store. Gasoline can be purchased in Stony River, but availability is limited and unreliable. Several small air taxi carriers service Stony River from Aniak. The carriers offer scheduled stops six days a week.

Fish Passage

Weir Design

Overview. A weir site reconnaissance was conducted in the lower Tatlawiksuk River in August of 1997 (Appendix B). A suitable weir installation site was identified adjacent to a bluff at about rm 2.5. The channel was approximately 220-ft in width, including exposed gravel bars along the stream margin. A fixed weir was installed in 1998 to enumerate salmon escapement, but the weir design was modified in subsequent years to improve performance. In 1999 the fixed weir was replaced with a resistance board weir that included 70-ft of the fixed weir sections for use in the resistance board weir design. Additional resistance board weir panels were added in 2001, reducing the fixed weir sections to 20-ft on the north bank and a 5-ft on the south bank. Several other design modifications were implemented in 2001 including the use of additional substrate anchors, the replacement of galvanized wire rope with stainless steel wire rope, and improvements in panel design that are described in a separate document (Stewart 2002).

Fixed Weir. The fixed weir used in 1998 was similar in design to the weir used on the George River (Molyneaux et al. 1997), and consisted of aluminum panels and stringers supported by wooden tripods that were weighted down with sandbags. The spacing between pickets was 1 13/16-in. The rigidity of the aluminum pickets combined with the narrow spacing allowed for a complete census of all but the smallest returning salmon. Small resident species were able to slip through the panels.

Resistance Board Weir. The resistance board weir was based on a design developed by the USFWS (Tobin 1994). The primary exceptions to the USFWS design were that each panel was 36-in wide instead of 48-in wide, and the panel connectors were integrated into the stringers in place of the connecting yokes. Other differences included, floating bulkheads constructed of the same material as the resistance board panels, the incorporation of fixed weir sections along the stream margin, and the rounding of stringer edges to reduce the likelihood of abrading fish. Details of the design and function of these components are described in a separate document (Stewart 2002). The spacing between pickets used in the resistance board panels was 1¼-in. The pickets had some flexibility, but the narrow spacing allowed for a complete census of all but the smallest returning salmon. Small resident species were able to slip through the panels.

Passage Chute / Trap. The passage chute consisted of an opening in the weir that allowed fish to pass upstream of the weir and into a live trap. The passage chute was located near the deepest section of the channel, where salmon tend to travel most. The passage chute was composed of two opposing floating bulkheads that were installed in place of a resistance board panel. The bulkheads formed a 2.5-ft wide passage that lead to the live trap.

The live trap acted as a cage for trapping fish used in biological sampling and as a platform for counting fish passage. The live trap measured 8-ft (length), by 5-ft (width), by 5-ft (height). The upper and lower perimeters of the trap frame were composed of welded 3-in by 1 $^{1}/_{2}$-in aluminum channel, with 1 $^{3}/_{8}$-in holes punched in it spaced 1 $^{3}/_{16}$-in apart. The vertical frame supports were composed of four 5.5-ft sections of 1-in schedule 40 aluminum conduit, which were vertically welded to the upper and lower perimeters of the trap frame. Removable 6-ft lengths of 1-in IMC (1 $^{5}/_{16}$-in outside diameter) galvanized steel conduit were inserted into the frame perimeter holes as pickets. Spacing between the pickets was $^{1}/_{16}$-in wider than the spacing used in the resistance board panel design, but the rigidity of the steel pickets allowed for a complete census of the salmon. The trap floor was a sheet of aluminum welded to the lower perimeter of the frame. An 8-ft by 5-ft frame composed of 2-in by 12-in dimensional lumber was lashed to the top of the trap for use as a counting platform.

The entrance of the trap was formed by a collapsible fyke gate, and the exit consisted of a removable 16-in wide gate. A counting chute measuring 24-in (length), by 24-in (width), by 32-in (height) was positioned upstream of the trap in front of the exit gate. The hinged sides of the chute were made of 1-in schedule 40 aluminum conduit welded to aluminum angle. Spacing between the chute conduit was the same as the trap conduit. Attached to the base of the counting chute was a hinged ramp that could be raised to direct fish toward the water's surface for better viewing when water clarity was impaired, and to slow fish passage when it was too fast for an accurate census.

Weir Installation and Operation

Installation and Operational Period. Weir installation typically began in early June. The target operational period was 15 June through 20 September, which spans the majority of the salmon runs.

Counting. All fish passing upstream through the passage chute and trap were enumerated by species. Each day the entrance of the trap was opened by 0800 hours to allow fish to enter the holding pen. When fish were not needed for ASL sampling, the exit gate was opened to allow fish to pass upstream. The hinged gate was adjusted to ensure that fish could be identified by species. The technician was positioned above the exit gate and enumerates passage with a zeroed multiple tally counter. Counting continued for a minimum of one hour, or until passage waned to near zero, then the exit gate was closed. The technician immediately recorded the fish passage into a notebook and zeroed the tally counter for the next count. This procedure was typically repeated several times throughout the day to avoid delaying fish in their journey upstream, even when passage was slow. Each day the daily counts were transferred from the notebook to the logbook form entitled *"Hourly Fish Passage"* (Appendix C.1). Examples of all the logbook forms appear in Appendix C. Daily counts were then tallied and recorded on the logbook form entitled *"Daily Fish Passage* (Appendix C.2).

Weir Cleaning and Inspection. Cleaning was performed each day before 1000 hours. Cleaning consisted of walking across the weir to partially submerge each panel, thereby allowing the current to wash debris downstream. A rake was sometimes used to push larger debris loads off the weir. The cleaning operation was repeated throughout the day as needed. Spent salmon and carcasses (hereafter referred to as carcasses) that wash up on to the weir were counted by species and sexed, then passed downstream. The carcass count was recorded in the passage notebook and transferred to the *"Hourly Carcass Count"* (Appendix C.3) portion of the logbook at the end of the counting day. Final carcass counts for the day were tallied by species and sex, and recorded on the "*Daily Carcass Count*" (Appendix C.4) section of the logbook. Each time the weir was cleaned, a visual inspection was made of the weir panels, substrate rail, fish trap, and fixed weir sections to ensure no openings would allow fish to pass upstream. If conditions did not allow for an adequate visual inspection, then snorkel gear was used to ensure there were no breaches in the weir.

Estimating Missed Salmon Passage

Estimates of salmon passage occasionally needed to be made for periods of one or more days when the weir was not operational because of a breach. The method used to make an estimate depended on the circumstances surrounding the inoperable period. A minor breach may have been disregarded if the problem was remedied quickly and unobserved passage was thought inconsequential. Otherwise, passage for a single day was estimated as an extrapolation based on the average passage one or two days before and one or two days after the inoperable period. Daily estimated passage for inoperable periods lasting two or more days was calculated by a linear extrapolation of the average passage two days before and after the inoperable period using the following formula:

$$\hat{n}_{d_i} = \alpha + \beta \cdot i - n'_{d_i} \qquad (1)$$

$$\alpha = \frac{n_{d_1 -1} + n_{d_1 -2}}{2}$$

$$\beta = \frac{(n_{d_I +1} + n_{d_I +2}) - (n_{d_1 -1} + n_{d_1 -2})}{2(I+1)}$$

for (1, 2,…, *i*,…*I*)

where:

$\hat{n}_{d_i}$ = estimated passage for the i^{th} day (1,2,..*i*,..*I*) of a multiple day breach event;

n'_{d_i} = partial counts (if any) from a given day of the inoperable period;

n_{d_I+1} = actual passage the first day after the end of inoperable period (d_I);

n_{d_I+2} = actual passage the second day after the inoperable period;

n_{d_1-1} = actual passage one day before the inoperable period;

n_{d_1-2} = actual passage two days before the inoperable period;

I = number of days the inoperable period lasted

Extended inoperable periods may have also been estimated using the daily proportions from other years, or a neighboring project, if there was evidence supporting similar run timing between the data sets. These estimates were calculated in a two-step process. In the first step, the cumulative estimate was calculated for the entire inoperable period from the corresponding cumulative passage of the known data set using the following formula:

$$n_{2t2} = \frac{n_{2t1} \times n_{1t2}}{n_{1t1}} \qquad (1)$$

where:

n_{2t2} = estimated cumulative number of fish for the inoperable period *t2*;

n_{2t1} = cumulative number of fish from the data set to be estimated for the known time period *t1*;

n_{1t2} = cumulative number of fish from the comparative data set for the inoperable period *t2*;

n_{1t1} = cumulative number of fish from the comparative data set for the known time period *t1*.

In the second step, daily fish passage estimates were calculated from the cumulative estimate for the inoperable period and the corresponding daily passage proportions of the known data set using the following formula:

$$n_{2d} = \frac{n_{1d} \times n_{2t2}}{n_{1t2}} \qquad (2)$$

where:

n_{2d} = estimated daily fish passage;

n_{1d} = daily passage of fish from the comparative data set during each day of the inoperable period;

n_{2t2} = estimated cumulative number of fish for the inoperable period *t2*;

n_{1t2} = cumulative number of fish from the comparative data set for the inoperable period *t2*;

Similarly, when operations started after 15 June, or ended prior to 20 September, passage was estimated by daily proportions from other years, or a neighboring project, to span the 15 June through 20 September target operational period. Daily estimates were assumed to be zero if the period of estimation spanned only a few days, and historical abundance data for that same time period was near zero.

Downstream Fish Passage

For various reasons, fish sometimes migrated downstream and required an avenue to safely pass below the weir. This behavior was especially prevalent among longnose suckers *Catostomus catostomus* that migrated downstream in late summer. To accommodate these fish, several downstream passage chutes were incorporated into the weir as needed. Each downstream chute consisted of one or two weir panels with their resistance boards laid flat. The force of the water caused the distal end of the panel to dip close to, or just below the water surface. The result was a chute of water passing over the distal end of the panel. The crew located downstream passage chutes in areas where fish tended to congregate on the weir. Sometimes a sandbag was placed on the panel for additional effect. The weir crew had to be diligent in watching for fish traveling upstream over these chutes. If such behavior was observed, the crew was instructed to immediately adjust the chutes to preclude upstream passage.

Boat Passage

Boats passed over the Tatlawiksuk River weir at a designated 'boat gate' located near the thalweg of the channel. The boat gate consisted of a section of three resistance board panels, each having a 2-ft by 3-ft sheet of ½-in UHMW (Ultra High Molecular Weight) polyethylene plastic secured to the upper surface of the distal end of the panel. The last 1-ft of the distal end of the panel pickets were bent downward at a 30° angle, and the plastic sheet was bent to fit the bend of the pickets. The plastic sheet helped to protect the panels from the abrasion of passing boats. The resistance boards on these panels were adjusted so that the distal end of the panel dipped close to the water surface. The weight of a passing boat caused these panels to submerge. The panels would then resurface after the boat cleared the gate.

During average water level conditions, most of the traffic consisted of boats with jet-drive engines. These boats could pass upstream and downstream over the boat gate with no special requirements other than reducing their speed. Operators of boats with propeller-drive engines had to follow some additional procedures.

When passing downstream, boats with prop-engines were turned off and the engine was placed in the tilt position as the boat drifted over the gate. When passing upstream, boats with prop-engines were either towed over the weir by the weir crew or boat passengers used a towline to pull their boat over the weir. The towline consisted of a 50-ft section of floating rope secured to a #138 Duckbill™ anchor driven into the river bottom approximately 25-ft upstream of the weir in the center of the boat gate. The rope floated on the surface and extended approximately 15-ft downstream of the weir. As a boat operator approached the weir from down river, he or she took hold of the towline, turned off the engine, placed the motor in the tilt position, and then pulled the boat upstream along the towline. Once clear of the weir, the propeller was placed back in the water, the engine was re-started, and the passengers continued their journey.

Salmon Age-Sex-Length Sampling

Following procedures described by DuBois and Molyneaux (2000), scale samples, and sex and length information were collected to estimate the ASL composition of the chinook, chum and coho salmon escapements. A pulse sampling design was used, in which intensive sampling was conducted for one or two days followed by a few days without sampling. The goal for each pulse was to collect samples from 210 chinook, 200 chum and 170 coho salmon. These sample sizes were selected so that simultaneous 95% confidence interval estimates of age composition proportions would be no wider than 0.20 for each pulse (Bromaghin 1993). Recommended sample sizes were increased an additional 8 to 9% to account for unusable scales. The minimum acceptable number of pulse samples was three per species – one pulse sample from each third of the run.

Scales used in age determination were removed from the preferred area of the fish (INPFC 1963). A minimum of three scales were taken from each fish and mounted on gum cards. Sex was determined by visually examining external morphology, keying on the development of the kype, roundness of the belly and the presence or absence of an ovipositor. Length was measured to the nearest millimeter from mid-eye to the fork of the tail. Sex and length data were recorded with other pertinent information in a field notebook, and transferred to computer mark-sense forms. After sampling, each fish was released upstream of the weir. The gum cards and data forms were sent to the ADF&G office for processing.

In the ADF&G office, an impression of each gum card was made on a thin sheet of cellulose acetate following methods described by Clutter and Whitesel (1956). The scale impressions were magnified using a microfiche reader, and the age of the fish was determined through visual identification of annuli. The ages were recorded on the original computer mark-sense forms containing the sex and length data. Ages were reported using European notation in which two digits, separated by a decimal, refer to the number of freshwater and marine annuli. Total age, from the time of spawning, is the sum of the two digits plus one to account for the year prior to the formation of the first annuli.

The completed computer mark-sense forms were processed with an OPSCAN machine to produce ASCII computer files. The ASCII files were processed to produce two summaries, one file of the age and sex composition of each pulse sample, and another file with length statistics. These summaries were used to estimate the ASL composition of the entire annual chinook, chum and coho salmon escapement in the Tatlawiksuk River. The season passage of each species was temporally stratified into blocks of time each of which contained one pulse sample. Efforts were made to establish strata so that a pulse sample was taken during the central portion of each stratum. The ASL composition of the pulse sample was assumed to be representative of total fish passage during the stratum. Within each stratum, the number of fish in each age-sex category was estimated as the product of the proportion for that age-sex category in the pulse sample, multiplied by the total number of fish that passed upstream during that stratum. The numbers of fish in each age-sex category were summed over all the strata to estimate the total annual escapement of each species by age-sex category.

Length summary statistics (mean, standard error, range) for each species were reported by stratum and age-sex category. The overall season mean length by age-sex category was estimated by weighting the stratum mean lengths by the passage of each species during that stratum (DuBois and Molyneaux 2000).

The original ASL gum cards, acetates and mark-sense forms were archived at the ADF&G office in Anchorage. The computer files, including ASCII and summary files were archived by ADF&G in the Anchorage office.

Habitat Profiling

Stream Temperature

Temperature was measured with a thermometer scaled in increments of 0.1^{o}C. The thermometers were calibrated preseason against a precision thermometer certified by the National Institute of Standards and Technology.

Stream temperature measurements for the Tatlawiksuk River were collected from a station on the south shore, approximately 75-yds downstream from the weir. Measurements were made at least once each day at 0730 or 1030 hours. The thermometer was submerged a few centimeters below the water surface about an arm's length off shore and allowed to stand undisturbed for one or two minutes until the temperature reading had stabilized, then the reading was recorded in the "*Climatology*" section of the camp logbook (Appendix C.5).

Stream Discharge and River Stage

The discharge of the Tatlawiksuk River was periodically estimated using methods described by the U. S. Geological Survey (Rantz 1982). Velocities were measured using a Price AA current-meter with a top-setting wading rod. Stream discharge was calculated using the conventional current-meter method. The information collected for calculating discharge was recorded in the "*Stream Discharge*" section of the camp logbook (Appendix C.6).

Daily operations included monitoring fluctuations in water level with a standardized staff gage. The staff gage consisted of a metal rod incremented in centimeters and secured to a stake that had been driven into the stream channel near camp. The height of the water surface as measured against the staff gage represented the "stage" of the water level above an arbitrary datum plane. The stage of the water level was measured at least once each morning and recorded in the "*Climatology*" section of the camp logbook (Appendix C.5). Measurements were recorded more frequently when water levels were changing rapidly. For the purposes of this report, a river stage in excess of 100 cm was considered to be a high water event.

The staff gage was calibrated against semi-permanent benchmarks that were intended to allow for consistency of the stage measurements among years (Appendix D). These benchmarks consisted of sections of aluminum pipe, each several feet in length, driven into the gravel with only a few inches showing above the gravel surface. This was done to reduce the likelihood of the pipe being washed out or damaged by ice flows during break-up. The exposed tip of each pipe corresponded to specific stage height above the datum plane. Multiple benchmarks were established as an additional safeguard to loss.

Water Chemistry

Water samples were collected at low, intermediate and high water levels to provide a profile of the water chemistry under different flow regimes. Water samples were collected from upstream of the weir at a point approximately mid-channel. The water was collected from just under the surface using a 500-ml polyethylene bottle. The bottle was thoroughly pre-rinsed with water from the same general location. The sample bottle was capped under water to avoid any air space. An external label was affixed to the bottle to identify the date and time the sample was collected, stream name, general location, collectors name, ADF&G contact name and contact phone number. The sample was then stored in a cool and dark location until transport to the ADF&G limnology laboratory in Soldotna was arranged. Sampling was done early in the week and timed so that transport could occur within 24-hours of the sampling event. Limnology laboratory personnel were notified once the sample was in transit to ensure they were prepared to receive the sample.

In the laboratory, conductivity (temperature compensated to 25^{o} C) was measured using a YSI conductance meter equipped with a platinum electrode (cell constant = 1.0 cm^{-1}). The pH was measured with a Corning pH/ion meter. Alkalinity was determined by acid titration to pH 4.5 using 0.2 N H_2SO_4 (APHA 1985). Turbidity, expressed as nephelometric turbidity units (NTU), was measured with a HF DRT-1000 turbidimeter after linear calibration. Color was determined on a filtered (Whatman GFF) sample by measuring the spectrophotometric absorbance at 400 nm and converting to equivalent platinum cobalt (Pt) units (Koenings et al. 1987). Calcium and magnesium were determined from separate EDTA (0.1 N) titrations after Golterman (1969), and total iron was analyzed by reduction of ferric iron with hydroxylamine during hydrochloric acid digestion as described by Strickland and Parsons (1972). Reactive silicon was determined using the method of ascorbic acid reduction to molybdenum blue after Stainton et al. (1977).

Acidified (pH <2) samples were analyzed for multiple trace elements by Elemental Research, Inc., Vancouver, British Columbia, Canada using inductively coupled plasma mass spectrometry (ICP-MS). In essence, samples were converted into an aerosol, which was injected into high temperature argon plasma. The aerosol was vaporized or decomposed into atoms. The concentration of trace elements was determined by measuring the amount of light absorption.

RESULTS

1998

Operations

A fixed weir was operated from 18 June through 7 July 1998 when operations ended prematurely. Continuous rain on 6 July caused the water level to rise abruptly on 7 July (Appendix E.1). The increased flow brought with it debris that had been accumulating along the riverbanks throughout the two previous years of low water conditions. By the evening of 7 July the debris load required the crew to increase cleaning efforts on the weir. In the early morning of 8 July, following several hours of nearly continuous cleaning efforts, the crew began to remove panels as the water level approached 100 cm. Nearly all the weir panels and tripods were salvaged, but about half the stringers remained on the river bottom until water clarity allowed for recovery. Rain and high water levels continued through early August, which prevented reinstallation of the weir. On 7 August a crew returned to camp and closed down the facility for the season. The weir materials were stored on site, and camp items were stored at Senka's Landing. For the remainder of August the crew was reassigned to the resistance board weir projects on the Middle Fork Goodnews (ADF&G) and Andreafsky Rivers (USFWS, Yukon drainage) for cross training.

Fish Passage

Chinook Salmon. The total annual chinook salmon escapement was not determined in 1998 because of the premature termination of the project. However, a total of 970 chinook salmon were observed passing upstream through the weir from 18 June to 7 July (Table 1). The total annual escapement was not estimated because of the premature termination of the project. The first chinook salmon was observed on 20 June and they continued to pass upstream through 7 July when the weir became inoperable.

Chum Salmon. The total annual chum salmon escapement was not determined in 1998 because of the premature termination of the project. However, a total of 5,726 chum salmon were observed passing upstream through the weir from 18 June to 7 July (Table 2). Again, the total annual escapement was not estimated because of the premature termination of the project. The first chum salmon was observed on 21 June and they continued to pass upstream through 7 July when operations ended.

Coho Salmon. No coho salmon were observed in 1998 because of the premature end date of operations.

Other Species. Upstream passage in 1998 also included 3,246 longnose suckers, 3 northern pike *Esox lucius*, and 14 whitefish *Coregonus spp.* (Appendix F.1).

Carcass Counts. Salmon carcass counts in 1998 included 36 chum salmon (Appendix G). The first chum salmon carcass was found on 28 June.

ASL Data

Chinook Salmon. Scale samples were collected along with sex and length information from 17 chinook salmon in 1998. Estimating the ASL composition of total annual chinook escapement was not possible because of the premature termination of the project. Age was determined for 15 of the 17 fish sampled; thirteen were age-1.3 fish (86.7 %) and two were age-1.4 fish (13.3%) (Table 3). Eleven of the sampled fish were males (73.3%) and four were females (26.7%). Male chinook salmon lengths ranged from 575 mm to 789 mm, while the female lengths ranged from 681 mm to 725 mm (Table 4).

Chum Salmon. Scale samples, and sex and length information were collected from 336 chum salmon in 1998. The ASL composition of the chum escapement was not determined in 1998 because of the premature termination of the project. Age was determined for 330 of the 336 fish sampled; 278 were age-0.3 fish (84.2%), 51 were age-0.4 fish (15.5%) and 1 was an age-0.5 fish (0.3%) (Table 5). The sample included 204 males (61.8%) and 126 females (38.2%). Male chum salmon lengths ranged from 517 to 691 mm, while female lengths ranged from 509 to 635 mm (Table 6).

Habitat Profiling

Summaries of the habitat data are presented in Appendix E. Water temperature, air temperature and water level were measured nearly every morning from 15 June through 8 July (Appendix E.1). During this time, water temperatures ranged from 7° C to 12.5° C, and air temperatures ranged from 5°C to 15°C. Stage measurements of the daily water levels ranged from 39 cm to 100 cm. The highest stage measurement occurred on 8 July, at which point the weir became inoperable for the remainder of the season. No estimate of discharge was made for the Tatlawiksuk River in 1998.

A water sample was collected from the Tatlawiksuk River on 7 August for chemical analysis. The sample was processed at the ADF&G limnology laboratory. Results are described in Appendix E.2.

1999

Operations

In 1999 the Tatlawiksuk River weir was operated from 15 June through 20 September. The fixed panel weir was installed at the start of the season. Materials for a new resistance board weir were delivered to the camp on 22 June and installation of the new weir began on 2 July. Operations transitioned from the fixed panel weir to the resistance board weir on 6 July. The 1999 season was interrupted by a high water event from 10 to 23 August, during which time the weir was inoperable (Appendix E.3). The fixed panel sections became compromised when the river stage exceeded 100 cm and the panels had to be temporarily removed to prevent their loss. The fish trap and counting chute were submerged at a river stage of approximately 100 cm. The submersion of the counting chute combined with turbidity of the high water made fish identification and counting impossible. The resistance board panels submerged only after the river stage exceeded approximate 150 cm. The weir was operational again by the evening of 23 August when the river stage receded to approximately 92 cm. The weir remained operational through the end of the season on 20 September.

Fish Passage

Chinook Salmon. The total annual chinook salmon escapement was determined to be 1,494 fish in 1999, including an estimated passage of 81 fish (5.4%) during the inoperable periods (Table 1). Passage estimates were made for periods when the weir was inoperable on 11 and 27 July, and 10 through 23 August. Passage estimates for 11 and 27 July were derived from a linear extrapolation based on the average observed passage that occurred one day before and one day after the these inoperable periods. The passage estimate for the 10 through 23 August inoperable period was derived from a linear extrapolation based on the average observed passage that occurred two days before and two days after the inoperable periods.

The first chinook salmon was observed on 23 June, the ninth day of operation, and the peak daily passage of 720 fish occurred on 20 July. The median passage date was 18 July, and the central fifty-percent of the run occurred between 12 and 20 July. The last chinook salmon was observed on 2 September.

Chum Salmon. Chum salmon escapement was determined to be 9,656 fish in 1999, including an estimated passage of 509 fish (5.3%) during the inoperable periods (Table 2). Passage estimates were made for periods when the weir was inoperable on 11 and 27 July, and 10 through 23 August. Passage estimates for 11 and 27 July were derived from a linear extrapolation based on the average observed passage that occurred one day before and one day after the these inoperable periods. The passage estimate for the 10 through 23 August inoperable period was derived from a linear extrapolation based on the average observed passage that occurred two days before and two days after the inoperable periods.

The first chum salmon was seen on 24 June, the tenth day of operation, and the peak daily passage of 663 fish occurred on 20 July. The median passage date was 19 July, and the central fifty-percent of the run occurred between 12 and 25 July. The last chum salmon was observed on 6 September.

Coho Salmon. The total annual coho salmon escapement was determined to be 3,449 fish in 1999, including an estimated passage of 482 fish (14.0%) during the inoperable periods (Table 7). Passage estimates were made for periods when the weir was inoperable on 11 and 27 July, and 10 through 23 August. The passage estimates for 11 and 27 July were derived from a linear extrapolation based on the average observed passage that occurred one day before and one day after the inoperable periods. The estimated passage for the 10 through 23 August inoperable period was derived using the daily proportions of coho salmon passage at the George River weir in 1999.

The first coho salmon was observed on 25 July, the 41st day of operation. Peak daily passage of 303 fish occurred on 10 September. The median passage date was 2 September, and the central fifty-percent of the run occurred between 28 August and 9 September. Coho salmon were still passing in small numbers when the weir was dismantled on 20 September.

Other Species. The 1999 passage also included 6 sockeye salmon, 1 pink salmon, 5 northern pike, 13 Arctic grayling *Thymallus arcticus*, and 5,093 longnose suckers (Appendix F.1 and F.2). Ninety percent of the longnose suckers passed upstream by 29 June, the 15th day of operation. Small numbers of suckers migrated back downstream throughout the summer, with most of the downstream passage occurring in late July and August.

Carcass Counts. Salmon carcass counts in 1999 included 37 chinook salmon, 611 chum salmon and 3 coho salmon (Appendix G). The first chinook carcass was found on 28 July, the 43rd day of operations; and chinook carcass counts peaked at 11 fish on 9 August. The first chum salmon carcass was found on 1 July the 16th day of operations; and chum carcass counts peaked at 59 fish on 4 August. The first coho carcass was found on 30 August the 76th day of operations; and coho carcasses were still passing the weir when it was dismantled on 21 September.

ASL Data

Chinook Salmon. Scale samples, and sex and length information were collected from 15 chinook salmon in 1999, but too few fish were sampled to estimate the ASL composition of the total annual chinook escapement. Age was determined for 7 of the 15 fish sampled and included one age-1.3 fish (14.3%) and six age-1.4 fish (85.7%) (Table 3). Four of the chinook salmon were male (57.1%) and three were female (42.9%). Male fish ranged in length from 690 to 925 mm, while females ranged from 885 to 905 mm (Table 4).

Chum Salmon. Scale samples, and sex and length information were collected from 880 chum salmon in 1999. The samples were collected from six pulses with sample sizes ranging from 40 to 220 fish per pulse. Age was determined for 856 of the 880 fish sampled (97.2%). The aged ASL sample accounted for 8.9% of the total annual chum escapement and was adequate for estimating the ASL composition of the chum escapement (Table 5 and 6). The chum escapement was partitioned into six temporal strata based on the dates when the samples were taken. As applied to the total annual escapement, age-0.3 chum salmon were the most abundant age class (72.1%), followed by age-0.4 (27.5%), age-0.5 (0.3%), and age-0.2 fish (0.1%). The sex composition of the chum escapement was estimated to include 5,081 females (52.6%) and 4,576 males (47.4%). The average length for age-0.3, -0.4 and -0.5 male chum salmon was 586 mm, 606 mm and 601 mm, respectively. For females, age-0.3 and -0.4 fish averaged 557 mm and 570 mm in length. There was also one female age-0.2 fish with a length of 530. Overall, male chum salmon lengths ranged from 423 to 697 mm while female lengths ranged from 479 to 680 mm.

Coho Salmon. Scale samples were collected along with sex and length information from 350 coho salmon in 1999. The samples were collected from 3 pulses with sample sizes ranging from 64 to 170 fish per pulse. Age was determined for 287 of the 350 fish sampled (82.0%). The aged ASL data accounted for 8.3% of the total annual coho escapement and was adequate for estimating the ASL composition of the coho escapement (Tables 8 and 9). The coho escapement was partitioned into 3 temporal strata based the dates when the samples were taken. As applied to total annual escapement, age-2.1 coho was the most abundant age class (79.1%), followed by age-3.1 (12.9%) and age-1.1 (8.0%). The sex composition of the coho escapement was estimated to include 1,493 females (43.3%) and 1,956 males (56.7%). The average length of male age-1.1, -2.1 and -3.1 coho salmon was 501 mm, 551 mm and 560 mm, respectively. For female coho salmon, the respective average lengths were 491 mm, 555 mm and 565 mm. Overall, male coho salmon lengths ranged from 445 mm to 675 while female lengths ranged from 415 to 615 mm.

Habitat Profiling

Water temperature, air temperature and water level were generally measured every morning from 13 June through 20 September (Appendix E.3). During this time, water temperatures ranged from 7° C to 14° C, and air temperatures ranged from -3° C to 20° C. Stage measurements of the daily water levels ranged from 35 cm to 120 cm. A high water event dominated much of August and caused the weir to be inoperable for 14 days. The highest recorded stage measurement during this event was 120 cm, which occurred on 11 August. The weir became operational again once the water level receded to a stage of 92 cm.

From measurements taken on 15 June, the discharge of the Tatlawiksuk River at the weir site was estimated to be 1,167 ft^3/s (33.1 m^3/s) at a river stage of 42.5 cm (Appendix E.4). No water samples were collected from the Tatlawiksuk River in 1999 for chemical analysis.

2000

Operations

In 2000 the Tatlawiksuk River weir was operated from 15 June to 14 August, and employed the resistance board design that was successfully used in 1999. The project was operational through the majority of the chinook and chum salmon runs, but the weir was not operational for most of the coho run. Project operations were interrupted by a high water event on 2 August that rendered the weir inoperable (Appendix E.5). The crew was able to resume operations on 3 August once the water level receded. Another high water event rendered the weir inoperable on

14 August and the anchors holding the substrate rail failed on 16 August. The river stage was estimated to have exceeded 200 cm during this event. A 30-ft section of the rail system and resistance board panels were damaged, and the damage was substantial enough to preclude operations for the remainder of the season.

Fish Passage

Chinook Salmon. The total annual chinook salmon escapement in 2000 was determined to be 817 fish, including an estimated passage of 10 fish (1.3%) for the inoperable periods (Table 1). Passage estimates were made for periods when the weir was inoperable on 2 August, and for 14 August through 20 September. The estimated passage on 2 August was derived from an extrapolation using the average observed passage that occurred for two days before, and two days after the inoperable period. The estimated passage for the 14 August through 20 September period was derived using the daily proportions of chinook salmon passage at the George River weir in 2000.

The first chinook salmon was observed on 18 June, the fourth day of operation. The median passage date was 8 July, and the central fifty-percent of the run occurred between 2 and 12 July. Peak daily passage of 149 fish occurred on 2 July. The last chinook salmon was observed on 13 August.

Chum Salmon. The total annual chum salmon escapement in 2000 was determined to be 7,044 fish, including an estimated passage of 115 fish (1.6%) for the inoperable periods (Table 2). Passage estimates were made for periods when the weir was inoperable on 2 August, and for 14 August through 20 September. The estimated passage on 2 August was derived from an extrapolation using the average observed passage that occurred for two days before, and two days after the inoperable period. The estimated passage for the 14 August through 20 September period was derived using the daily proportions of chinook salmon passage at the George River weir in 2000.

The first chum salmon was observed on 15 June, the first day of operation. Peak daily passage of 611 fish occurred on 12 July. The median passage date was 12 July, and the central fifty-percent of the run occurred between 6 and 19 July. The last chum salmon was observed on 13 August.

Coho Salmon. The total annual coho salmon escapement was not determined in 2000 because the premature termination of the project occurred early in the coho run. However, it was determined that a total of 5,756 coho salmon passed upstream through the weir prior to 14 August, including an estimated passage of 110 fish (1.9 %) for the 2 August inoperable period (Table 7). The estimate was derived from an extrapolation based on the average observed passage that occurred for two days before, and two days after the inoperable period.

The first coho salmon was observed on 19 July, the 35th day of operation. Coho salmon were still passing the weir site in significant numbers after the weir became inoperable on 14 August.

Other Species. Passage in 2000 also included 1 northern pike, 1 Arctic grayling, and 1,052 longnose suckers (Appendix F.1). Ninety percent of the longnose suckers passed upstream by 3 July, the 19th day of operation. Small numbers of suckers migrated back downstream throughout the summer, with most of the downstream passage occurring in late July and August.

Carcass Counts. Salmon carcass counts in 2000 included 11 chinook salmon and 293 chum salmon (Appendix G). The first chinook carcass was found on 5 July, the 20th day of operations. The first chum salmon carcass was found on 1 July the 16th day of operations. No coho salmon carcasses were observed in 2000.

ASL Data

Chinook Salmon. Scale samples, and sex and length information were collected from eight chinook salmon in 2000. The sample was too small to estimate the ASL composition of the total annual chinook escapement. Age was determined for seven of the eight fish sampled and included one age-1.2 fish (14.3%), one age-1.3 fish (14.3%) and five age-1.4 fish (71.4%) (Table 3). Five of the fish were male (71.4%) and two were female (28.6%). Male chinook salmon ranged in length from 540 to 795 mm, while females ranged from 690 to 770 mm (Table 4).

Chum Salmon. Scale samples, and sex and length information were collected from 789 chum salmon in 2000. The samples were collected from five pulses with sample sizes ranging from 54 to 204 fish per pulse. Age was determined for 705 of the 789 fish sampled (89.3%). The aged samples accounted for 10.1% of the total annual chum escapement and was adequate for estimating the ASL composition of the escapement (Tables 5 and 6). The chum escapement was partitioned into five temporal strata based on the dates when the samples were taken. As applied to the total annual escapement, age-0.3 chum was the most abundant age class (57.6%), followed by age-0.4 (39.9%), age-0.2 (2.0%), and age-0.5 (0.5%). The sex composition of the total annual chum escapement was estimated to include 3,359 females (48.2%) and 3,606 males (51.8%). The average length for age-0.2, -0.3, and -0.4 male chum salmon was 557 mm, 587 mm and 613 mm, respectively. There were no age-0.5 males in the sample. The average length for age-0.2, -0.3 and -0.4 female chum salmon was 528 mm, 555 mm, and 576 mm, respectively. There were two age-0.5 female chum in the aged sample, each having a length of 590 mm. Overall, male chum salmon lengths ranged from 490 to 680 mm while female lengths ranged from 455 to 675 mm.

Coho Salmon. Scale samples, and sex and length information were collected from 219 coho salmon in 2000. The ASL composition of the coho escapement was not estimated because of the premature termination of project operations. Age was determined for 188 of the 219 fish sampled (Table 8). All the samples were age-2.1 fish (100%). Sex composition of the sample included 113 males (60.1%), and 75 females (39.9%). Male coho salmon lengths ranged from 430 to 640 mm while female lengths ranged from 470 to 600 mm (Table 9).

Habitat Profiling

Water temperature, air temperature and water level were generally measured every morning from 25 June through 6 August (Appendix E.5). Water temperatures ranged from 9° C to 17° C, and air temperatures ranged from 4° C to 25° C. Stage measurements of the daily water levels ranged from 28 cm to 92 cm. A high water event estimated to exceed 200 cm dominated much of August and caused the weir anchors to fail. The highest recorded stage measurement in 2000 was 92 cm, which occurred on 6 August.

From measurements taken on 4 August, the discharge of the Tatlawiksuk River at the weir site was estimated to be 58.2 m^3/s (2,055 ft^3/s) at a river stage of 82 cm (Appendix E.6).

Three water samples were collected from the Tatlawiksuk River in 2000. The samples were collected on 16 June, and 5 and 15 August. The samples were processed at the ADF&G Limnology Laboratory. Results are described in Appendix E.2.

2001

Operations

In 2001 the Tatlawiksuk River weir was operated from 20 June through 15 September. The weir was relocated approximately 50 yards upstream of the original site because of changes in the channel morphology. In addition, 45 feet of resistance board panels were added to the weir to reduce the length of fixed weir needed. The #138 Duckbill™ rail anchors were augmented with MR-2 Manta Ray™ anchors and 4-ft x 8-in auger style anchors to avoid another failure as occurred in 2000. In addition, double strands of 5/16-in. stainless steel wire rope were used to connect the rail to the anchors in the deeper sections of the channel, and the length of wire rope used was increased from 15 to 20-ft. Furthermore, the galvanized resistance board harness wire rope was replaced with stainless steel wire rope. One other modification was that the harness routing was retrofitted with harness bearings to increase the harness' return radius (Stewart 2002).

Other changes included the relocation of the fish trap to a shallower section of the channel in an effort to increase weir operations during high water events. In addition, the stringers of existing resistance board panels were rounded along the bottom edge of the panels to reduce possible chaffing of salmon as they nose along the weir before passing upstream.

Operations in 2001 were interrupted by four high water events, but the weir never failed and operations always resumed when water levels receded. Periods when the weir was rendered inoperable because of high water included: 24 to 25 July, 27 July, 31 July to 3 August and 17 to 27 August. Typically the weir became inoperable when the river stage exceeded an average of 129 cm. The weir returned to an operable state when the river stage receded to an average of 118 cm.

Fish Passage

Chinook Salmon. The total annual chinook salmon escapement in 2001was determined to be 2,011 fish, including an estimated passage of 38 fish (1.9%) during the inoperable periods and during the pre- and post-operational periods (Table 1). Passage estimates were made for periods when the weir was inoperable on 24 through 25 July, 27 July, 31 July through 3 August and 17 through 27 August. The estimated passage for the 24 through 25 July period was derived from a linear extrapolation using the average observed passage that occurred two days before, and one day after this inoperable period. The estimated passage for 27 July was derived from an extrapolation using the average observed passage that occurred one day before, and two days after the inoperable date. The estimated passages for the 31 July through 3 August and 17 through 27 August periods were derived from linear extrapolations using the average observed passage that occurred two days before, and two days after these periods.

The daily chinook passage for the pre-operational period of 15 to 19 June and the post-operational period of 16 to 20 September were assumed to be zero fish.

The first chinook salmon was observed on 21 June, the second day of operation. Peak daily passage of 428 fish occurred on 6 July. The median passage date was 6 July, and the central fifty-percent of the run occurred between 1 and 13 July. The last chinook salmon was observed on 27 August.

Chum Salmon. The total annual chum salmon escapement was determined to be 23,718 fish in 2001, including an estimated passage of 1,609 fish (6.8%) during the inoperable periods and during the pre- and post-operational periods (Table 2). Passage estimates were made for periods when the weir was inoperable on 24 through 25 July, 27 July, 31 July through 3 August and 17 through 27 August. The estimated passage for the 24 through 25 July inoperable period was derived from a linear extrapolation using the average observed passage that occurred two days before, and one day after this inoperable period. The estimated passage for the 27 July inoperable period was derived from an extrapolation using the average observed passage that occurred one day before, and two days after this inoperable period. The estimated passage for the 31 July through 3 August and 17 through 27 August inoperable periods was derived from a linear extrapolation using the average observed passage that occurred two days before, and two days after these inoperable periods.

The daily chum passage for the pre-operational period of 15 to 19 June and the post-operational period of 16 to 20 September were assumed to be zero fish.

The first chum salmon was observed on 21 June, the second day of operation. Peak daily passage of 1,607 fish occurred on 18 July. The median passage date was 15 July, and the central fifty-percent of the run occurred between 10 and 20 July. The last chum salmon was observed on 3 September.

Coho Salmon. The total annual coho salmon escapement was determined to be 10,501 fish in 2001, including an estimated passage of 4,832 fish (46.0%) during the inoperable periods and during the pre- and post-operational periods (Table 7). Passage estimates were made for periods when the weir was inoperable on 24 through 25 July, 27 July, 31 July through 3 August, and 17 through 27 August. The estimated passage for the 24 through 25 July inoperable period was derived from a linear extrapolation using the average observed passage that occurred two days before, and one day after this inoperable period. The estimated passage for the 27 July inoperable period was derived from an extrapolation using the average observed passage that occurred one day before, and two days after this inoperable period. The estimated passage for the 31 July through 3 August and 17 through 27 August inoperable periods was derived from a linear extrapolation using the average observed passage that occurred two days before, and two days after these inoperable periods.

The daily coho passage during the pre-operational period of 15 to 19 June was assumed to be zero fish. Weir operations were discontinued after 15 September and passage was estimated for the 16 through 20 September post-operational period based on a linear extrapolation using the average observed passage that occurred on the last two days of operation and an assumed passage of zero fish after 20 September.

The first coho salmon was observed on 28 July, the 39th day of operation. Peak daily passage of 864 fish occurred on 14 August. The median passage date was 18 August, and the central fifty-percent of the run occurred between 14 and 24 August. Coho salmon were still passing the weir in small numbers when the weir was dismantled on 16 September.

Other Species. The 2001 passage also included 3 sockeye salmon, 3 pink salmon, 7 Arctic grayling, 4 northern pike, 7 whitefish and 2,916 longnose suckers (Appendix F.1 and F.2). Ninety percent of the longnose suckers passed upstream by 15 July, the 26th day of operation. Small numbers of suckers migrated back downstream throughout the summer, with most of the downstream passage occurring in late July and August.

Carcass Counts. Salmon carcass counts in 2001 included 20 chinook salmon, 2 sockeye salmon, 1,180 chum salmon and 4 coho salmon (Appendix G). The first chinook carcass was found on 23 July, the 33rd day of operations; and chinook carcass counts peaked at 3 fish on 3 August. The first chum salmon carcass was found on 29 June, the ninth day of operations; and chum carcass counts peaked at 65 fish on 27 July. The first coho carcass was found on 31 August, the 72nd day of operations; and coho carcasses were still passing the weir site when it was dismantled on 16 September.

ASL Data

Chinook Salmon. Scale samples, and sex and length information were collected from 89 chinook salmon in 2001, but too few fish were sampled for estimating the ASL composition of the total annual chinook escapement. Age was determined for 74 of the 89 fish sampled and included 9 age-1.2 fish (12.2%), 29 age-1.3 fish (39.2%), 33 age-1.4 fish (44.6%) and 3 age-1.5 fish (4.1%) (Table 3). The aged sample included 45 male (60.8%) and 29 female fish (39.2%). Male chinook salmon lengths ranged from 455 to 860 mm, female lengths ranged from 740 to 1010 mm (Table 4).

Chum Salmon. Scale samples, and sex and length information were collected from 898 chum salmon in 2001. The samples were collected from seven pulses with sample sizes ranging from 62 to 231 fish per pulse. Age was determined for 847 of the 898 fish sampled (94.3%). The aged ASL sample accounted for 3.6% of the total annual chum escapement and was adequate for estimating the ASL composition of the total escapement (Tables 5 and 6). The chum escapement was partitioned into seven temporal strata based on the dates when the samples were taken. As applied to the total annual escapement, age-0.3 chum was the most abundant age class (65.7%), followed by age-0.4 (33.5%). Age-0.2 and -0.5 fish were equal in abundance (0.4% each). The sex composition was estimated to include 12,107 females (51.0%) and 11,610 males (49.0%). The average length for age-0.2, -0.3, -0.4 and -0.5 male chum salmon was 522 mm, 581 mm, 599 mm and 653 mm, respectively. The average length for age-0.2, -0.3 and -0.4 female chum salmon was 505 mm, 550 mm and 574 mm, respectively. There were no age-0.5 female chum salmon in the aged sample. Male chum salmon lengths ranged from 458 to 687 mm and female lengths ranged from 454 to 654 mm.

Coho Salmon. Scale samples were collected along with sex and length information from 569 coho salmon in 2001. The samples were collected from four pulses with sample sizes ranging from 58 to 171 fish per pulse. Age was determined for 518 of the 569 fish sampled (91.0%). The aged ASL sample accounted for 4.9% of the total annual coho escapement and was adequate for estimating the ASL composition of the coho escapement (Tables 8 and 9). The coho escapement was partitioned into four temporal strata based on the dates when the samples were taken. As applied to the total annual escapement, age-2.1 coho was the most abundant age class (91.2%), followed by age-3.1 (6.6%) and age-1.1 (2.2%). The sex composition was estimated to include 5,471 females (52.1%) and 5,031 males (47.9%). The average length for age-1.1, -2.1 and -3.1 male coho salmon was 538 mm, 569 mm and 587 mm, respectively. The average length for age-1.1, -2.1 and -3.1 female coho salmon was 554 mm, 572 mm and 571 mm, respectively. Male coho salmon lengths ranged from 410 to 669 mm and female lengths ranged from 456 to 632 mm.

Habitat Profiling

Water temperature, air temperature and water level were generally measured every morning from 15 June through 20 September (Appendix E.7). Water temperature ranged from 5.5° C to 15° C, and air temperature ranged from 1° C to 20° C. Stage measurements of the observed daily water levels ranged from 49 cm to 216 cm. High water events began on 23 July and 17 August. The highest recorded stage measurement was 216 cm, which occurred on 21 August. The peak river stage was estimated at approximately 220 cm on 21 August.

No estimate of discharge was made for the Tatlawiksuk River in 2001. No water chemistry samples were taken from the Tatlawiksuk River in 2001.

DISCUSSION

Operations

The weir design used on the Tatlawiksuk River has evolved over the years in response to various challenges. The goal has been to employ a weir design that allows for reliable assessment of the salmon populations with minimal down time. Inoperable periods are inevitable, mostly caused by high water events, so the optimal weir design also needs to allow for a quick recovery following such events. The fixed-panel weir used in 1998 failed in this regard. Fortunately, the crew removed most of the weir materials from the river before the floodwaters and debris load became overwhelming. Still, enough materials were lost to inhibit reinstallation. In 1999 the fixed-panel weir was replaced with a resistance board weir similar to the design used successfully on the Middle Fork Goodnews and East Fork Andreafsky Rivers (Menard 1999, Tobin and Harper 1998). Since 1999, several improvements have been incorporated into the resistance board weir used on the Tatlawiksuk River and progress has been made toward achieving the design goal.

The resistance board panels used in 1999 improved performance during high water events, but the fixed-panel sections used along the stream margins were prone to scouring, which compromised operations. The replacement of the fixed-panel sections with additional resistance board panels in 2001 improved performance by reducing the amount of fixed weir. The remaining five feet of fixed-panel weir along the south bank did sustain minor scouring during high water in 2001, but the shallower water along this length allowed for preventive maintenance during high water events and for quick repairs once water levels receded.

The anchoring system also underwent some modification following the failure that occurred in 2000. The failure was caused by scouring that started at the fixed weir sections, and progressed to the substrate rail. As the gravel was scoured away from the rail system, the duckbill anchors were pulled out of the substrate. Replacement of the fixed-panels with additional resistance board panels in 2001 helped to remedy the scouring problem. In addition, the anchoring system was augmented with Manta Ray™ and auger anchors. The Manta Ray™ anchors had a larger surface area than the Duckbill™ anchors, which increased the strength of the rail system, and reduced the possibility of another weir failure. The Manta Ray™ anchors were placed so that they alternated with the Duckbill™ anchors throughout most of the channel width. The auger anchors were less costly than the other anchors, but their installation was limited to the loose gravel near shore. The shaft of the auger anchors was often exposed above the surface and this was undesirable because of the navigational hazard and risk of dislodgment during the breakup of ice in the spring.

Another refinement incorporated in 2001 was to replace the single strand of wire rope used to connect the rail to the anchors with a double strand. This reinforcement increased the overall strength of the connection and created a back-up if one of the strands failed.

Other refinements incorporated in 2001 included replacing the resistance board harnesses with stainless steel wire rope to avoid corrosion and to extend the useful life of the panels. Each panel was also retrofitted with harness bearings to avoid "kinking" the wire rope. Details of the harness bearing are described by Stewart (2002).

The fish counting chute periodically caused some impediment to operations. The counting chute, which was located where fish exited the fish trap, was 2.5-ft in height. In 1999, the counting chute was rendered inoperable at river stages in excess of 100 cm because the water level exceeded the height of the counting chute. To compensate, the trap was relocated to a shallower section of the channel in 2001 where it was operational to a river stage up to 130 cm.

Water turbidity was another challenging element to the operation of the Tatlawiksuk River weir. Fish identification becomes difficult when water level increases because of the concurrent decrease in clarity. The design of the fish trap introduced in 1999 addressed this challenge by adding a movable ramp to the counting chute that could be raised in a manner that directed fish toward the water's surface. A similar trap design used in 1998 proved to be too fragile. A limitation to the 1999 design was that once water levels reached the top of the counting chute, which was approximately 100 cm, the ramp had to be raised too high to effectively pass fish. For the future, a taller counting chute and ramp could be built.

The design changes implemented at the Tatlawiksuk River weir have improved the effectiveness of project operations by reducing inoperable periods, but effective operation includes more than just optimizing the structural components.

The purpose for operating weirs is to provide reliable assessment of the salmon populations, which in turn will aid in salmon management. In our efforts to achieve this goal, project leaders and their crews must conduct themselves in a manner that ensures they do no harm to the fish populations. Salmon have limited energy stores locked within their bodies for completing the mission they undertake to perpetuate the spawning population. The activities we undertake to manage these fish should in no way jeopardize completion of that mission. The project leaders, crew leaders and crew members charged with the design and operation of the Tatlawiksuk and other weirs need to be vigilant in regard to this responsibility, recognize conditions that threaten the well being of the fish populations, and take actions to safeguard the populations even if it means a void in the database.

When the Tatlawiksuk River weir was inoperable because of high water conditions, the crew was instructed to leave the fish passage gates open to avoid impeding fish migration. When fish displayed hesitancy in passing through the fish trap, crews were instructed to open additional sections of the weir to encourage fish passage, to pass fish at any time of the day or night fish wanted to move, and to forgo collecting biological samples if the added stress appeared detrimental to fish passage. Our goal is reliable escapement assessment to improve salmon management. Part of our goal includes operating projects in a manner that ensures the well being of the fish we are mandated to protect.

Fish Passage

Chinook Salmon

The chinook salmon escapement to the Tatlawiksuk River in 2001 of 2,011 fish was higher than the escapement of 1,494 fish in 1999, or the 817 chinook salmon in 2000 (Figure 3). In 1998, project operations ended prematurely on 7 July, but up until that date the cumulative chinook salmon passage was tracking similar to 2001. If we assume the run timings were similar between these two years, then the total annual chinook salmon escapement to the Tatlawiksuk River in 1998 would have been approximately 1,400 fish. This approximation is a speculative exercise used to show the potential run size of chinook salmon in 1998.

Complete run timing information for chinook salmon is available for only 1999, 2000 and 2001 (Table 1). The run timing was similar in 2000 and 2001, but 1999 was much later (Figure 4). Judging by the mid-point of the escapement, the 1999 run timing was about 10 to 12 days later than 2000 or 2001.

Currently no formal escapement goals exist for Tatlawiksuk River chinook salmon to serve as a benchmark for assessing the adequacy of the annual escapement. Instead, we are left with making comparisons with abundance indicators from elsewhere in the Kuskokwim River drainage, particularly those few systems that do have formal escapement goals.

The years 1999 and 2000 were considered to be especially poor years for chinook escapement throughout most of the Kuskokwim River drainage (Burkey et al 2000a). Escapement in the

Kogrukluk River was half to a third of the goal in those years (Figure 5). The index counts from aerial stream surveys were also down by about as much (Figure 6, Appendix A.1; Burkey et al. 2001). In contrast, chinook escapements in 2001 were generally near goal. A similar pattern of abundance was seen in the Tatlawiksuk River chinook escapements; low passages were seen in 1999 and 2000, followed by a 35 and 148% increase in 2001 (Figure 3 and 7).

Assessing the 1998 chinook escapement is more speculative because of the protracted high water conditions that occurred throughout the Kuskokwim River drainage that year. While the chinook escapement to the Kogrukluk River was cautiously described as having achieved the escapement goal in 1998, the results from aerial surveys of index streams fell well short of escapement goals (Figure 5, Figure 6, Appendix A.1; Burkey et al. 2001). The available information neither supports nor refutes the speculation that chinook escapement to the Tatlawiksuk River was relatively good in 1998, with a total annual escapement of around 1,400 fish.

The number of chinook salmon seen in the Tatlawiksuk River is influenced by the harvest activity that occurs in the mainstem Kuskokwim River. Chinook salmon are perhaps the most important salmon species for subsistence fishers in the Kuskokwim River. The average annual subsistence harvest includes 82,762 chinook salmon, which is more than any of the other salmon species, and the trend has been fairly stable for more than a decade (Burkey et al. 2001). The directed commercial harvest of chinook salmon was discontinued in 1987 in response to a prolonged period of low chinook salmon runs and in recognition of the subsistence priority for harvesting whatever surplus existed over escapement needs. An incidental harvest of chinook salmon continued in the chum salmon directed commercial fishery. The average annual incidental commercial harvest during the 1990s was 23,387 chinook salmon, but the harvest trend has been decreasing the past few years (Burkey et al. 2001). The down turn in harvest in 1999 and 2000 is believed to be reflective of an overall decrease in run size; however, low commercial harvests in 1993, 1994 and 1996 through 1998 were caused in part by conservation measures directed at chum salmon and / or limits in the commercial salmon markets.

Kuskokwim River chinook salmon were classified as a stock of concern by the Alaska BOF in September 2000. More specifically, they were listed as a yield concern because of the chronic inability of managers to maintain expected harvest levels (5AAC 39.222; Burkey et al 2000a). Throughout the Kuskokwim River drainage, chinook escapements were poor in 1999 and 2000. Even subsistence fishers commented on the low abundance in these years (Figure 5; Burkey et al. 2001). Furthermore, the outlook for 2001 was for another poor chinook salmon run.

As a consequence, the Alaska BOF instituted a rebuilding plan that had three components. First, there was little expectation of any commercial fishing during June and July of 2001 to avoid the incidental harvest of chinook salmon. The outlook was purposely phrased as “little expectation” as a hedge in case the salmon runs returned much stronger than was expected. Second, subsistence fishers were placed on a fishing schedule that was intended to allow blocks of salmon to pass through the fishery unmolested, while still providing fishers with adequate time to achieve their harvest needs. Third, the Alaska BOF limited the recreational sport fishers to one chinook salmon per day, down from the normal bag limit of three fish per day. Furthermore, on 10 May 2001 the federal subsistence board adopted an Emergency Action, which closed all federal waters within the Yukon Delta National Wildlife Refuge to the sport harvest of chinook salmon.

Inherent in the establishment of a rebuilding plan is the need for benchmarks that define what it is the plan is trying to achieve and some means of measuring success. Escapement goals provide such a measure, but the Tatlawiksuk River does not have any escapement goals. Kuskokwim River tributaries that do have escapement goals were generally at 30 to 50 percent of their goals in 1999 and 2000; applying these same proportions to the Tatlawiksuk River translates to an escapement target of between 1,600 and 2,400 chinook salmon. The total annual escapement to the Tatlawiksuk River in 2001 of 2,011 chinook salmon was within this target range (Figure 3 and 7). Most other escapement monitoring projects throughout the Kuskokwim River had similar improvements in chinook escapement, the one exception being the George River (Figure 5 and 6).

Chum Salmon

The chum salmon escapement to the Tatlawiksuk River in 2001 of 23,718 fish was almost 2.5 times higher than the 9,656 fish in 1999, and almost 3.5 times higher than the escapement of 7,044 fish in 2000 (Figure 3). In 1998, project operations ended prematurely on 7 July, but up until that date the cumulative chum salmon passage was tracking above all other years. The rate of passage in 1998 was most similar to 2001, and if we assume similar run timings, then the total annual chum salmon escapement at the Tatlawiksuk River would have been approximately 36,000 fish in 1998. This approximation is a speculative exercise used to show the potential run size of chum salmon in 1998.

Complete run timing information for chum salmon is only available for 1999, 2000 and 2001 (Table 2). Run timing was earliest in 1999 with a mid-point of 19 July, the mid-point was 12 July for 2000, and 15 July for 2001 (Figure 4). The timing of the central fifty percent of the runs overlapped broadly between all three years.

As was described for chinook salmon, no formal escapement goals exist for Tatlawiksuk River chum salmon. Until goals are developed, the adequacy of the annual escapements can only be assessed through comparisons with other abundance indicators, particularly comparisons made to those few escapement projects that have formal escapement goals.

Throughout most of the Kuskokwim River drainage, the years 1999 and 2000 were considered to be especially poor years for chum salmon escapement (Burkey et al 2000b). Passage at both the Kogrukluk River weir and Aniak River sonar were well below the formal escapement goals in both years (Figure 8). Likewise, the escapements in the Tatlawiksuk River were low in 1999 and 2000.

In 2001, however, the chum escapements in the Kogrukluk and Aniak Rivers were about twice the levels observed in 1999 and 2000, and above their escapement goals (Figure 8). Again, a comparable increase in abundance was seen in the Tatlawiksuk River (Figure 3 and 9).

For 1998, the level of confidence in the data is suspect, still the estimated chum salmon passage at Kogrukluk River weir, and the chum salmon passage index at Aniak River sonar, were both above their formal escapement goals as they were in 2001 (Figure 8). Arguably, this offers some credence to the relatively high approximation of chum salmon escapement for the Tatlawiksuk River in 1998.

The level of chum salmon escapement seen in the Tatlawiksuk River is influenced by the harvest activity that occurs in the mainstem Kuskokwim River. The subsistence harvest levels for chum salmon have generally declined over the past few decades, but this species continues to be an important food source for subsistence users. The average annual subsistence harvest over the past decade includes 75,143 chum salmon, which ranks second only to chinook salmon in numbers of fish harvested (Burkey et al. 2001). Over eighty percent of this subsistence harvest occurs downstream of the Tatlawiksuk River confluence. The commercial fishery that typically operates on the lower Kuskokwim River in June and July has an average annual harvest of 261,412 chum salmon (Burkey et al. 2001). The commercial harvest has been waning since the late 1980's, because of low run sizes and because of decreasing market interest in the species. The especially low commercial harvests that occurred in 1993, and in 1997 through 2001, were driven by low run sizes (Burkey et al 2000b).

In September 2000 the Alaska BOF classified Kuskokwim River chum salmon as a yield concern because of the chronic inability of managers to maintain expected harvest levels (5AAC 39.222; Burkey et al 2000b). The BOF finding considered this trend to be driven by a decrease in chum salmon productivity, and independent of the confounding influence of the waning commercial market for chum salmon. This finding lead state managers to develop a rebuilding plan that called for a more conservative harvest management strategy for chum salmon. First, there was little expectation of any commercial fishing during June and July of 2001. The outlook was purposely phrased as "little expectation" as a hedge in case the chum salmon run came back unexpectedly strong. Second, subsistence fishers were placed on a fishing schedule that was intended to protract the harvest and allow blocks of salmon to pass through the fishery unmolested. The subsistence fishing schedule was, however, intended to provide fishers with adequate time to achieve their harvest needs. Third, the Alaska BOF limited recreational sport fishers to 1 chum per day, down from the normal bag limit of 5 fish per day. Furthermore, on 10 May 2001 the federal subsistence board adopted an Emergency Action, which closed all federal waters within the Yukon Delta National Wildlife Refuge to the sport harvest of chum salmon.

The rebuilding plan brought attention to the need for establishing benchmarks that better defined what managers where trying to achieve, and that provided some measure of assessing success. Escapement goals provided just such a measure, but the Tatlawiksuk River does not have any escapement goals. Kuskokwim River tributaries that do have escapement goals were generally at about half to a third of their escapement goals in 1999 and 2000; applying these same proportions to the Tatlawiksuk River translates to an escapement target of between 14,000 and 29,000 chum salmon. The total annual escapement to the Tatlawiksuk River in 2001 of 23,718 chum salmon was within this target range (Figure 3 and 9). Most other escapement monitoring projects throughout the Kuskokwim River had similar improvements in chum salmon escapement (Figure 8).

Coho Salmon

Assessing coho salmon escapement in the Tatlawiksuk River has been especially challenging. The coho run occurs during late summer when rain and high water events are commonplace. Furthermore, the weather patterns during late summer focus an inordinate amount of rain in streams draining the west side of the Alaska Range, which includes the Tatlawiksuk River. In 1998, high water levels ended operation of the fixed-panel weir on 7 July, which was well before any coho salmon entered the river. In 1999, high water interrupted operations from 10 to 23 August, but the crew was able to get the new resistance board weir back into operation in time to assess the bulk of the coho run (Figure 10). Uninterrupted passage assessment on the nearby George River provided a model for estimating the missed passage on the Tatlawiksuk River in 1999.

In 2000, after witnessing two weeks of high daily passage rates, the Tatlawiksuk River weir failed under the stress of high water (Figure 10). Sufficient damage was incurred to preclude reinstallation that season. Again, assessment of coho passage on the George River was largely uninterrupted, and allowed for some speculation as to potential total annual coho escapement on the Tatlawiksuk River.

In 2001, high water again interrupted operations from 17 to 27 August (Figure 10). The crew was able to resume operations after 27 August, but the coho passage was waning by that date. Weir operations on the George River were suspended by high water during the same time period, and this precluded the use of the George River weir to model missed passage on the Tatlawiksuk River. Instead, the missed passage on the Tatlawiksuk River was estimated through linear interpolation.

Despite the trials of late summer weir operation, the information obtained from the Tatlawiksuk River does allow for some speculations as to the relative abundance of the coho salmon escapements to that system. The total escapement in 1999 of 3,449 coho salmon includes 2,967 fish that were actually observed (86%), while the remaining 482 fish were estimated based on the run timing at the George River weir (Table 7 and Figure 3). The total escapement in 2001 of 10,501 coho salmon includes 5,669 fish that were actually observed (54%), with the remaining 4,832 fish being estimated from a linear extrapolation. Arguably, the reliability of these escapement values are suspect because of the degree of the escapement that was estimated; still, the exercise support the conclusion that coho escapement to the Tatlawiksuk River was considerably greater in 2001 than it was in 1999.

Deriving a total escapement estimate for 2000 is even more speculative than that described above because of the early termination of the project, but the exercise gives some indication of Tatlawiksuk River coho salmon abundance in 2000. If we use the run timing observed at the George River as the basis for extrapolating escapement for the Tatlawiksuk River, the result for 2000 is a total escapement of around 30,000 coho salmon. Of this number only 5,646 fish were actually observed through 14 August (18%; Table 7), the remaining 24,354 fish were estimated from the George River extrapolation. The authors make no pretense as to the reliability of this estimate, although it can be argued that the logic is not too far removed from that used to derive some biological escapement goals (Clark 2001a, 2001b). We do, however, believe that the exercise affirms the conclusion that the escapement of coho salmon into the Tatlawiksuk River in 2000 was likely much greater than the escapements in 1999 and 2001, but how much greater is unknown.

Run timing information for coho salmon in the Tatlawiksuk River is confounded by the same data gaps that impact estimates of the total annual escapement. One conclusion that seems clear, however, is that the run timing in 1999 was much later that the run timing in 2001 (Table 7 and Figure 4). The difference may be as much as 15 days.

There are no formal escapement goals for Tatlawiksuk River coho salmon, so the adequacy of annual escapements can only be assessed through comparison with other projects, particularly the Kogrukluk River weir because that is the only project in the area with a formal coho escapement goal. The task is further complicated by the uncertainty associated with the total annual coho escapements for the Tatlawiksuk River. As an alternative, the comparisons can also be made based on the relative ranked order of abundance. For the Tatlawiksuk River, the ranked order of coho escapement from lowest to highest is: 1999, 2001 and 2000. The annual escapements at Kogrukluk River weir ranked in that same sequence (Figure 11). Half the coho escapement goal was achieved at the Kogrukluk River in 1999, and the 2001 escapement was below goal as well. The goal was achieved in 2000.

The ranking differed at the George River weir (Figure 11). The 1999 coho run still had the lowest escapement, but the largest escapement occurred in 2001 instead of 2000.

Comparable data for the Kwethluk and Takotna River weirs is only available for 2000 and 2001 (Figure 11). For both projects the escapement in 2000 was greater than the escapement in 2001 as was determined for the Tatlawiksuk River.

The level of coho salmon escapement seen in the Tatlawiksuk River is influenced by the harvest activity that occurs in the mainstem Kuskokwim River. The average annual subsistence harvest in the Kuskokwim River includes 34,799 coho salmon, which is a distant third in comparison to the chinook and chum salmon harvests (Burkey et al. 2001). Over eighty percent of the subsistence harvest occurs downstream of the Tatlawiksuk River confluence. The subsistence harvest of coho salmon has generally declined over the past decade, but the harvest in 2000 increased to 51,696 fish, the second highest on record. The increase was due in part to people using coho salmon to compensate for the low abundance of chinook and chum salmon that year.

Most of the annual coho harvest occurs in the commercial fishery that typically operates on the lower Kuskokwim River in late July and August. The average annual commercial harvest includes 468,650 coho salmon (Burkey et al. 2001). Annual harvests have sharply declined since the peak in 1996, and the decline is mostly attributed to low run sizes. The Alaska BOF has not yet classified Kuskokwim River coho as a stock of concern, partially because of the limited escapement data available for this species.

The relatively high volume of coho salmon harvested in the commercial fishery, coupled with the price paid per pound, makes coho salmon the most valuable species for Kuskokwim River commercial fishers (Burkey et al. 2001). Part of the significance of this fact is that the sale of these fish supports the subsistence activities pursued by the fishers and their families.

Other Species

Sockeye and pink salmon have been seen in the Tatlawiksuk River in some years, but in small numbers (Appendix F.2). The highest observed passage of six sockeye salmon occurred in 1999. The highest observed passage of three pink salmon occurred in 2001. Pink salmon can pass through the pickets of the weir, but none have been observed doing so. Most likely, the sightings of sockeye and pink salmon in the Tatlawiksuk River are the result of straying.

Other fish species that utilize the Tatlawiksuk River as a spawning tributary include longnose suckers and whitefish. Longnose suckers are the most abundant (Appendix F.1). They begin entering the river before the weir is installed and 90 percent of the fish typically pass upstream of the weir by the first week of July. The highest recorded longnose sucker passage occurred in 1999 with a total of 5,903 fish passing the weir.

In late July and early August, longnose suckers migrated back downstream at the end of their spawning period and this created some challenges for weir operations. Most of the suckers are small enough to pass through the spaces between pickets, but not all of them. Passage chutes are incorporated into the weir to accommodate the downstream sucker passage. The timing of the downstream migration often coincided with periods of high water. The complete submergence of panels during high water events further facilitates downstream sucker migration.

Small numbers of whitefish are seen passing upstream through the weir in some years. The highest recorded whitefish passage of 14 fish occurred in 1999; however, most whitefish can freely pass between the weir pickets, so this count does not reflect the true number of whitefish in the Tatlawiksuk River. Schools of small fish are often seen passing though the fish trap and counting chute. Some of these fish are thought to be a species of whitefish.

Northern pike and Arctic grayling also occur in the Tatlawiksuk River and are occasionally seen passing upstream through the weir. Most of these fish, especially the Arctic grayling, were small enough to pass upstream and downstream through the weir pickets without being observed.

Stream Life

The carcasses of spawned out salmon that wash up on the weir are tallied to provide information about the number of days fish are resident upstream of the weir. This time period is generally termed "stream life". Stream life for chinook and chum salmon in the Tatlawiksuk River was estimated by determining the number of days between the median upstream fish passage date by species, and the median downstream carcasses passage date of that species. Determining stream life for coho salmon was problematic because coho salmon carcasses were still passing the weir site after project operations ended in any given year.

In 1999, 2000 and 2001, the respective stream life for chinook salmon was 20, 26 and 24 days for an average of 23 days between years (Figure 12). This data will help in determining optimal aerial survey timing, and can be used for determining trends in chinook salmon stream life over time.

In 1999, 2000 and 2001, the respective stream life for chum salmon was 12, 11 and 14 days for an average of 12 days between years (Figure 13). This data will help in determining optimal aerial survey timing, and can be used for determining trends in chum salmon stream life over time.

ASL Data

For the purposes of this report, the authors will focus on describing ASL trends seen within the Tatlawiksuk River data set coupled with broad reference to the generalized trends described by DuBois and Molyneaux (2000). Probably the greatest value in collecting ASL information is for future applications when it can contribute to developing spawner-recruit models used for establishing escapement goals (e.g., Clark and Sandone 2001). The information can also be used for forecasting future runs, and to illustrate long-term trends in the ASL composition (e.g., Bigler et al. 1996).

Chinook Salmon

The samples collected for Tatlawiksuk River chinook salmon were not adequate for estimating ASL composition of the total annual chinook escapement for any of the years that the weir was operated (Table 3 and 4). The need for collecting chinook ASL samples had to be weighed against the need to efficiently pass chinook salmon and the other fish upstream.

The standard procedure of filling the trap with fish before sampling did not work well for chinook salmon. Part of the difficulty was that chinook salmon were outnumbered by other species. When the trap was opened for a sampling period, it would typically fill with the more abundant chum salmon. The crew would sort through many chum salmon to find one chinook salmon to sample. In addition, chinook salmon demonstrated some hesitancy towards entering the fish trap, especially when the trap already had fish in it. Chinook salmon that did enter the trap were sometimes also seen backing out of it. To compensate, the crew sometimes sat at the entrance of the fish trap and manually opened and closed the gate to prevent fish from finding their way back out. This method proved ineffective as evidenced by the small sample sizes collected in 1998 through 2000 (Table 3 and 4).

In an effort to improve the success rate for sampling chinook salmon, sampling procedures were modified to include "active sampling" in 2001. This procedure was followed concurrent with a normal counting shift. One crew member counted fish normally at the front of the trap, and a second crew member sat at the back of the trap observing fish as they entered. When a chinook salmon was observed entering the trap, the crew members concurrently closed the front and rear gates to trap the fish. The crew sampled the fish immediately, released it upstream, and resumed normal fish passage. The entire procedure lasted only a couple of minutes. Active sampling was also done with a lone crew member using a pulley system to close the gates.

The use of active sampling in 2001 improved the number of chinook samples to 89 fish, but was still inadequate for estimating ASL composition of the total annual chinook escapement. In 2002 sampling procedures will be refined by increasing active sampling effort during periods of high chinook passage.

Chum Salmon

The samples collected from Tatlawiksuk River chum salmon were adequate for characterizing the ASL composition of the escapements in 1999, 2000 and 2001 (Table 5 and 6), and revealed no striking anomalies. Age-0.3 fish accounted for 57.6% to 72.1% of the total annual escapements in all three years, which is within the historic range observed in Kuskokwim River chum salmon populations (DuBois and Molyneaux 2000). Furthermore, within each year the proportion of age-0.3 fish increased as the season progressed (Figure 14), which is the typical pattern observed at most other escapement monitoring projects. Interestingly, the two pulse samples of ASL data collected in 1998 had an exceptionally large percentage of age-0.3 chum salmon, but the relative strength of the cohort did not carry through into 1999 as a strong return of age-0.4 fish.

Female chum salmon accounted for about half the escapement populations each year (Table 5), which is common for all but the Kogrukluk River where females are chronically in short supply (DuBois and Molyneaux 2000). In addition, within each year the proportion of females passing the weir steadily increased as the season unfolded (Figure 15). Again, this is a common pattern with Kogrukluk River being the only outlier.

Findings from the length data collected from Tatlawiksuk River chum salmon were also unremarkable (Table 6). The length ranges by age-sex category were within the historic ranges of other Kuskokwim River spawning populations (DuBois and Molyneaux 2000). Older chum salmon were consistently larger than younger fish, except in a very few age-sex categories with sample sizes. Males were also consistently larger than females, both within individual pulse samples and for the population as a whole. The data in each age-sex category also demonstrated the standard decrease in average length of chum salmon as each season progressed (Figure 16).

Coho Salmon

The samples collected from Tatlawiksuk River coho salmon were only adequate for characterizing the ASL composition of the 1999 and 2001 escapements (Table 8 and 9). Project operations prematurely ended in 1998 before the coho salmon run began, and in 2000 operations ended while coho passage was still building (Figure 10). As with chum salmon, the annual ASL compositions depicted by the coho samples were well within the historic ranges seen at other projects (DuBois and Molyneaux 2000). The age composition was dominated by age-2.1 coho salmon, which comprised 79.1% and 91.2% of the total annual escapements in 1999 and 2001. The proportion of age-2.1 fish increased as the season progressed in 2001 (Figure 17), mostly because the contribution of age-3.1 fish diminished with time. The age data from 1999 did not show any change in the composition with time, but samples were lacking from the tail end of the run.

Female coho salmon accounted for nearly half the total annual escapements in both 1999 and 2001 (Table 8), and the proportion of females appeared to be relatively consistent throughout the season (Figure 18). Although not unique, the consistency does contrast some to the more common pattern where the female proportion increases through the season. In particular, the pattern of an increasing female proportion was documented in samples from the Kuskokwim River commercial fishery in 1997 and 1998 where the sex of each fish was confirmed through internal examination of the gonads (DuBois and Molyneaux 2000). The pattern, however, was not evident in sex-confirmed samples collected from the commercial harvest in 2000 (unpublished). Notwithstanding this inconsistency, part of the findings reported by DuBois and Molyneaux is that coho salmon can be difficult to sex based solely on external morphology, so weir crews need to be especially diligent when sexing coho salmon. Additionally, the variability around the estimates derived from smaller sample sizes can obscure the detection of patterns in ASL composition.

Findings from the length data collected from the Tatlawiksuk River coho salmon were unremarkable (Table 9). The length ranges by age-sex category were generally within the historic ranges seen in other Kuskokwim River spawning populations (DuBois and Molyneaux 2000). Older coho salmon did tend to be longer than younger fish. Male and female coho salmon where about the same average length within a specific year, and the average length increased as the season progressed (Figure 19). Coho salmon from 2001 were generally about 20 mm longer than the fish from 1999, but this difference could be a consequence of changes in the method used to measure fish. In 1999 fish were measured out of the water with a straight edge meter stick, while in 2001 the fish were measured in the water with a fish cradle that was also equipped with a straight edged meter stick.

Habitat Profiling

From 1998 through 2001, water temperatures fluctuated between 5.5 °C and 17 °C, while air temperature fluctuated between -3 °C and 25 °C. It should be noted that in some years, air and water temperatures were not recorded for the entire targeted operational period because of late start-up, early take-out and premature termination of project operations. Air and water temperature did not have an obvious effect on fish passage in any given year.

From 1998 through 2001, observed river stage fluctuated between 28 cm and 216 cm. In some years, river stage measurements were not recorded for the entire targeted operational period because of late start-up, early take-out and premature termination of project operations. Rising water levels did not cause an obvious increase in passage for chinook, chum or coho salmon; however, some moderate to large increases in daily passage for these species do correspond with increasing water level (Figure 7, 9 and 10).

Of the four benchmarks established for monitoring water level in the Tatlawiksuk River, only two remained at the close of the 2001 field season (Appendix D). These benchmarks are not permanent structures. Their height above the datum plane should be linked to a permanent structure along the stream bank, but this has yet to be done. The instability of the bluff along camp side of the river prevents the possibility of a permanent link to the benchmarks; however, using a benchmark more distant from the camp is an option. These benchmarks will have to be evaluated and maintained on an annual basis to ensure their utility in comparing annual and inter-annual water levels.

Discharge measurements were not taken in each year of the project. Reasons for this include the lack of adequately trained personnel, equipment not being available, and the premature termination of project operations.

CONCLUSIONS

1) The evolution of the weir and modification of operational procedures since inception of the

Tatlawiksuk River weir project has:

a) increased the reliability of the weir to span the targeted operational period,
b) and increased the overall effectiveness of the weir regarding accomplishment of project objectives.

2) **The daily and total annual escapements of chinook, chum and coho salmon at the Tatlawiksuk River weir project have:**
   a) indicated that the chinook and chum salmon escapements in 2001 were much higher than the 1999 and 2000 escapements,
   b) and indicated coho salmon escapement in 2001 was higher than 1999, but that escapement in 2000 was likely the highest of the three years of operation.

3) **The ASL data collected at the Tatlawiksuk River weir project has:**
   a) indicated trends similar to existing ASL data of Kuskokwim River salmon stocks,
   b) indicated a need to re-assess chinook salmon ASL sampling goals and procedures.

4) **The habitat profile data collected at the Tatlawiksuk River weir project has:**
   a) allowed for comparative water levels between years and enabled better assessment of weir performance.

RECOMMENDATIONS

Operations

- **The weir design used on the Tatlawiksuk River should incorporate an additional passage gate that can be moved to different sections of the channel as needed to accommodate upstream fish passage during high or low water conditions.** The Tatlawiksuk River weir currently has one passage gate that is incorporated into the fish trap. The location of the gate and trap are essentially fixed once the weir is installed. An additional gate, one that is without the fish trap and movable, should be designed to fit in place of a weir panel. As conditions warrant, the moveable gate could be positioned in deeper or shallower water to enhance the effectiveness of fish passage and to allow the weir to remain operational. Measures are currently being taken to fabricate a gate as described above that will be available for use during the 2002 field season.

- **Videography should be incorporated into a fish gate to allow for continuous fish passage opportunity.** Fish have the opportunity to pass upstream of the weir only during those periods of the day when the gates are opened. Concerns have periodically been raised that this practice could potentially have a negative influence on fish passage. The long and successful histories of projects such as the Kogrukluk and Karluk River weirs tend to refute this concern; however, the potential for harm does exist if weir crews fail to employ an adequate passage schedule. One means of addressing this concern is to leave the passage gate open continuously and to monitor fish passage through the gate remotely by means of a video camera mounted above the fish passage gate as described by Otis and Dickson (2002). Caveats to this approach include: equipment costs; availability of a power source to continuously operate the video equipment; the availability of skilled technicians to install, operate and maintain the equipment; and the added likelihood that fish passage data will be lost due to equipment failure, human error or other complications.

Fish Passage

- **Operation of the Tatlawiksuk River weir should be integrated into an array of long-term escapement monitoring projects for assessing chinook, chum and coho salmon escapements in the Kuskokwim River drainage.** The Kuskokwim River supports one of the largest subsistence salmon fisheries in the state. Sustainable management of this fishery requires a reliable and long-term escapement monitoring program to provide a context within which management decisions can be made and population trends assessed. Long-term sustainability also requires that salmon escapements be distributed in a manner that conserves genetic diversity within the exploited populations. One approach to addressing these needs is to establish an array of well-distributed long-term escapement monitoring projects that are effective at indexing total annual escapement for chinook, chum and coho salmon. The Tatlawiksuk River weir has a proven record of effective operation, especially for chinook and chum salmon, and should be included in this array of projects as representing streams of the central Kuskokwim River basin that drain from the west side of the Alaska Range.

  While the development of a project that offers a total run reconstruction is desirable, such a project should only be developed and operated concurrent with a means to assess the validity of the estimates and the distribution of the escapement. A well distributed array of long-term escapement monitoring projects, which would include projects such as the Tatlawiksuk River weir, offer the type of verification that is required to provide confidence in total run reconstruction estimates and to assess escapement distribution.

- **Establish escapement goals for Tatlawiksuk River chinook, chum and coho salmon**. Sustainable management of salmon fisheries requires that enough salmon spawn each year so that adequate numbers of fish are produced to compensate for harvest and other sources of fish mortality (NRC 1996). The spawning population is referred to as the escapement, and ADF&G has authority to establish the salmon escapement goals required to maintain sustainable salmon fisheries (5 AAC 39.223). State managers seek to establish escapement goals that produce maximum sustained yield (MSY); however, determining MSY requires a rigorous level of information about stock specific spawner-recruit relationships that is lacking for the Tatlawiksuk River, as it is for every other stream in the Kuskokwim River drainage. Alternatively, ADF&G can establish sustainable escapement goals (SEG) for salmon stocks, such as those in the Tatlawiksuk River, for which reliable total annual escapement estimates can be made, but lacks sufficient information to estimate the range of escapements that produce MSY (5 AAC 39.223). An SEG, however, does require that the data series be sufficient to demonstrate sustained yields over a 5- to 10-year period.

The Alaska State Policy for Statewide Salmon Escapement Goals (5 AAC 39.223) directs escapement goals to be defined as ranges. Furthermore, the Alaska State Policy for the Management of Sustainable Salmon Fisheries (5 AAC 39.222) directs managers to maintain evenly distributed salmon escapements within the bounds of the escapement goal range. As such, the escapement goal range to be established for the Tatlawiksuk River should be broad enough to allow for future determination of spawner-recruit relationships should that capacity become possible. The lower end of the escapement goal range; however, should be established at a level that will reasonably safeguard against undesirable changes in biological productivity, biological diversity, or ecosystem structure and functions, from one human generation to the next as described in the Alaska State Policy for the Management of Sustainable Salmon Fisheries (5 AAC 39.222)

The power of an established escapement goal is that is serves as a basis for directing management actions and for safeguarding salmon spawning and rearing habitat. If escapement is projected to fall below the escapement goal range, then managers are expected to take remedial actions, such as restricting harvest. Conversely, if the escapement is projected to be above the escapement goal range, then managers may be able to liberalize harvest levels.

- **Collect genetic stock identification information for chinook, chum, and coho salmon that would allow for the identification of Tatlawiksuk River salmon in the mixed stock harvest of the Kuskokwim River.** Development of an effective stock identification technique would provide a means of determining productivity of salmon populations in the Tatlawiksuk River and elsewhere in the Kuskokwim River drainage.

ASL Data

- **Samples size objectives for ASL sampling should be re-evaluated for chinook salmon so that they are more appropriate to the actual run sizes encountered in the Tatlawiksuk River.** Under the current methods, the crew is expected to annually collect samples from 630 chinook salmon; i.e., three pulses each consisting of 210 fish. The total annual chinook run in the Tatlawiksuk River, however, has only ranged from 817 to 2,011 fish. The current ASL sampling size objectives are design for larger populations, and are not appropriate for the chinook population found in the Tatlawiksuk River.

Project Management

- **Tatlawiksuk River weir should continue to be operated as a joint project between KNA and ADF&G.** The partnership arrangement that has developed between KNA and ADF&G in the operation of weir projects has proven to be a successful strategy. Each organization compliments the partnership by providing an element that the other cannot. For example, KNA provides a communication link that keeps local residents more informed and less prone to the distrust and misinformation that results when locals are not involved. In the minds of many local residents, the active involvement of KNA adds an element of trust and acceptance to the project that ADF&G needs. The lack of these elements resulted in political pressures that lead to the discontinuation of the Kwethluk River weir in 1992 and the Tuluksak River weir in 1995. The lack of local trust also prompted the investment of public funds into unsuccessful locally operated projects such as the subsistence test fishery (Kuskokwim Fishermen's Cooperative 1990) and Kwethluk River counting tower (Hooper 2001). In contrast, the partnership of the KNA and ADF&G weirs contributed to the successful reinstatement of the Kwethluk and Tuluksak River weirs as cooperative projects in 1999 and 2001 respectively.

  Hiring local residents is another area where KNA is more effective than ADF&G. Local residents typically view "local" hire in terms of hiring within their own communities, whereas local hire within the ADF&G hiring process is defined much more broadly. The ADF&G hiring process is also more difficult for rural people to access and perhaps intimidating as well. People who never considered applying to work with the state, readily applied to work as fishery technicians with KNA.

  Finally, the proximity of KNA facilities to the weir project provides logistical benefits for staging and for responding to various inseason project needs. In this respect, KNA functions much like a satellite office of ADF&G.

  Despite the attributes described above, KNA would have a difficult time managing the Tatlawiksuk River weir without ADF&G assistance. Part of the difficulty relates to the focus and scale of the two organizations. The KNA staff consists of a dozen or so permanent employees who are responsible for a wide range of health and social service programs within their region. One permanent employee manages the Natural Resource and Subsistence programs. The small size of the KNA organization makes it especially vulnerable to periodic staff turnover and the potential loss of project continuity. The professionally trained fisheries staff of ADF&G has a greater depth of experience in fisheries project management; both in terms of on-site field experience, and broader aspects such as planning, data management, data analysis and reporting writing. The staffing available through KNA cannot match the depth of experience that ADF&G has to offer.

Recently, KNA applied for a five-year grant to add a fishery biologist to their staff. If the KNA proposal is accepted, the organization will be empowered to assume a greater share of the responsibility for management of the Tatlawiksuk River weir, as well as other fisheries projects that KNA operates in partnership with other agencies. However, the addition of one fishery biologist to their staff will not replace the support structure KNA receives from ADF&G. The goals and objectives of the grant program that would fund this fishery biologist position are ambitious. Under the grant conditions, the biologist would have responsibilities throughout the Kuskokwim River drainage, well beyond the current geographical scope of KNA. In addition, this fishery biologist position is expected to engage in a wide range of program and policy issues. Instead of assuming the current workload shared by KNA and ADF&G, the addition of the fishery biologist position will actually expand the scope and level of involvement that KNA has in fisheries issues. The biologist position will enhance KNA's ability to effectively engage in fishery management and research forums such as the Kuskokwim River Salmon Management Group, the Kuskokwim Fisheries Resource Coalition, the state and federal advisory councils, and State Board of Fisheries, and the Federal Subsistence Board. As currently outlined in the grant conditions, the addition of this fishery biologist position will do more to increase the overall workload rather than redistributing the existing workload between KNA and ADF&G, so ADF&G will need to continue as an active partner with KNA if the Tatlawiksuk River weir and other fisheries projects are expected to continue to operate.

- **Improve the operational stability of the Tatlawiksuk River weir through establishment of a long-term funding source.** The Kuskokwim River supports one of the largest subsistence salmon fisheries in the state. Sustainable management of this fishery requires a strong and stable escapement monitoring program to provide a context within which management decisions can be made and population trends assessed. As described in this report, the Tatlawiksuk River weir is an effective tool that should be included in this long-term monitoring program, but current funding sources for both KNA and ADF&G are unstable and short-term.

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TABLES

Table 1. Historical chinook salmon passage at Tatlawiksuk River weir, 1998 - 2001.

Date	Daily				Cumulative				Percent Passage			
	1998	1999	2000	2001	1998	1999	2000	2001	1998	1999	2000	2001
6/15	0 b	0	0	0 b	0	0	0	0		0	0	0
6/16	0 b	0	0	0 b	0	0	0	0		0	0	0
6/17	0 b	0	0	0 b	0	0	0	0		0	0	0
6/18	0	0	2	0 b	0	0	2	0		0	0	0
6/19	0	0	2	0 b	0	0	4	0		0	0	0
6/20	1	0	0	0	1	0	4	0		0	0	0
6/21	0	0	0	1	1	0	4	1		0	0	0
6/22	0	0	1	2	1	0	5	3		0	1	0
6/23	8	4	0	1	9	4	5	4		0	1	0
6/24	12	2	10	3	21	6	15	7		0	2	0
6/25	7	2	0	5	28	8	15	12		1	2	1
6/26	12	6	20	71	40	14	35	83		1	4	4
6/27	37	4	2	18	77	18	37	101		1	5	5
6/28	31	14	5	38	108	32	42	139		2	5	7
6/29	23	5	2	15	131	37	44	154		2	5	8
6/30	5	2	22	105	136	39	66	259		3	8	13
7/01	99	16	26	364	235	55	92	623		4	11	31
7/02	182	5	149	24	417	60	241	647		4	29	32
7/03	171	13	47	27	588	73	288	674		5	35	34
7/04	224	26	30	13	812	99	318	687		7	39	34
7/05	74	14	42	111	886	113	360	798		8	44	40
7/06	62	15	17	428	948	128	377	1,226		9	46	61
7/07	22	14	18	170	970	142	395	1,396		10	48	69
7/08	c	13	13	21		155	408	1,417		10	50	70
7/09	c	21	73	29		176	481	1,446		12	59	72
7/10	c	40	51	29		216	532	1,475		14	65	73
7/11	c	79 a	45	14		295	577	1,489		20	71	74
7/12	c	118	50	48		413	627	1,537		28	77	76
7/13	c	54	9	150		467	636	1,687		31	78	84
7/14	c	64	0	48		531	636	1,735		36	78	86
7/15	c	24	8	47		555	644	1,782		37	79	89
7/16	c	65	20	12		620	664	1,794		41	81	89
7/17	c	6	47	19		626	711	1,813		42	87	90
7/18	c	146	5	31		772	716	1,844		52	88	92
7/19	c	20	8	36		792	724	1,880		53	89	93
7/20	c	381	10	17		1,173	734	1,897		79	90	94
7/21	c	18	2	8		1,191	736	1,905		80	90	95
7/22	c	9	16	21		1,200	752	1,926		80	92	96
7/23	c	86	7	11		1,286	759	1,937		86	93	96
7/24	c	46	5	13 b		1,332	764	1,950		89	93	97
7/25	c	33	8	9 b		1,365	772	1,959		91	94	97
7/26	c	18	2	6		1,383	774	1,965		93	95	98
7/27	c	14 a	3	5 b		1,397	777	1,970		94	95	98
7/28	c	10	1	2		1,407	778	1,972		94	95	98
7/29	c	22	1	8		1,429	779	1,980		96	95	98
7/30	c	15	6	3		1,444	785	1,983		97	96	99
7/31	c	6	1	5 b		1,450	786	1,988		97	96	99
8/01	c	6	2	4 b		1,456	788	1,992		97	96	99
8/02	c	1	3 b	3 b		1,457	791	1,995		98	97	99
8/03	c	4	8	2 b		1,461	799	1,997		98	98	99
8/04	c	3	2	2		1,464	801	1,999		98	98	99
8/05	c	5	0	1		1,469	801	2,000		98	98	99
8/06	c	3	1	1		1,472	802	2,001		99	98	100
8/07	c	2	1	2		1,474	803	2,003		99	98	100
8/08	c	4	3	2		1,478	806	2,005		99	99	100
8/09	c	0	1	0		1,478	807	2,005		99	99	100

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Table 1. (page 2 of 2)

Date	Daily				Cumulative				Percent Passage			
	1998	1999	2000	2001	1998	1999	2000	2001	1998	1999	2000	2001
8/10	c	1 b	1	1		1,479	808	2,006		99	99	100
8/11	c	1 b	1	0		1,480	809	2,006		99	99	100
8/12	c	1 b	0	2		1,481	809	2,008		99	99	100
8/13	c	1 b	1	1		1,482	810	2,009		99	99	100
8/14	c	1 b	2 b	0		1,483	812	2,009		100	99	100
8/15	c	1 b	1 b	0		1,484	814	2,009		100	100	100
8/16	c	1 b	1 b	0		1,485	814	2,009		100	100	100
8/17	c	1 b	0 b	0 b		1,486	814	2,009		100	100	100
8/18	c	1 b	0 b	0 b		1,487	815	2,009		100	100	100
8/19	c	1 b	1 b	0 b		1,488	815	2,009		100	100	100
8/20	c	0 b	0 b	0 b		1,488	815	2,009		100	100	100
8/21	c	0 b	0 b	0 b		1,488	815	2,009		100	100	100
8/22	c	0 b	0 b	0 b		1,488	816	2,009		100	100	100
8/23	c	0 b	1 b	0 b		1,488	816	2,009		100	100	100
8/24	c	0	0 b	0 b		1,488	816	2,009		100	100	100
8/25	c	1	0 b	0 b		1,489	816	2,009		100	100	100
8/26	c	0 a	1 b	0 b		1,489	817	2,009		100	100	100
8/27	c	0	0 b	2 b		1,489	817	2,011		100	100	100
8/28	c	0	0 b	0		1,489	817	2,011		100	100	100
8/29	c	0	0 b	0		1,489	817	2,011		100	100	100
8/30	c	0	0 b	0		1,489	817	2,011		100	100	100
8/31	c	0	0 b	0		1,489	817	2,011		100	100	100
9/01	c	0	0 b	0		1,489	817	2,011		100	100	100
9/02	c	1	0 b	0		1,490	817	2,011		100	100	100
9/03	c	0	0 b	0		1,490	817	2,011		100	100	100
9/04	c	0	0 b	0		1,490	817	2,011		100	100	100
9/05	c	0	0 b	0		1,490	817	2,011		100	100	100
9/06	c	0	0 b	0		1,490	817	2,011		100	100	100
9/07	c	0	0 b	0		1,490	817	2,011		100	100	100
9/08	c	0	0 b	0		1,490	817	2,011		100	100	100
9/09	c	0	0 b	0		1,490	817	2,011		100	100	100
9/10	c	0	0 b	0		1,490	817	2,011		100	100	100
9/11	c	0	0 b	0		1,490	817	2,011		100	100	100
9/12	c	0	0 b	0		1,490	817	2,011		100	100	100
9/13	c	0	0 b	0		1,490	817	2,011		100	100	100
9/14	c	0	0 b	0		1,490	817	2,011		100	100	100
9/15	c	0	0 b	0		1,490	817	2,011		100	100	100
9/16	c	0	0 b	0 b		1,490	817	2,011		100	100	100
9/17	c	0	0 b	0 b		1,490	817	2,011		100	100	100
9/18	c	0	0 b	0 b		1,490	817	2,011		100	100	100
9/19	c	0	0 b	0 b		1,490	817	2,011		100	100	100
9/20	c	0	0 b	0 b		1,490	817	2,011		100	100	100
Total	970	1,490	817	2,011								
Obs.	970	1,413	807	1,973								
Est. (%)	0	5.2	1.3	1.9								

a = Daily passage was estimated due to the occurance of a hole in the weir.
b = The weir was not operational; daily passage was estimated.
c = The weir was not operational; daily passage was not estimated
d = Partial day count, passage was not estimated.

Table 2. Historical chum salmon passage at Tatlawiksuk River weir, 1998 - 2001.

Date	Daily				Cumulative				Percent Passage			
	1998	1999	2000	2001	1998	1999	2000	2001	1998	1999	2000	2001
6/15	0 b	0	1	0 b	0	0	1	0		0	0	0
6/16	0 b	0	1	0 b	0	0	2	0		0	0	0
6/17	0 b	0	0	0 b	0	0	2	0		0	0	0
6/18	0	0	2	0 b	0	0	4	0		0	0	0
6/19	0	0	0	0 b	0	0	4	0		0	0	0
6/20	0	0	0	0	0	0	4	0		0	0	0
6/21	5	0	2	3	5	0	6	3		0	0	0
6/22	4	0	7	4	9	0	13	7		0	0	0
6/23	12	0	1	30	21	0	14	37		0	0	0
6/24	25	18	18	22	46	18	32	59		0	0	0
6/25	26	7	30	61	72	25	62	120		0	1	1
6/26	65	18	97	131	137	43	159	251		0	2	1
6/27	197	25	7	69	334	68	166	320		1	2	1
6/28	275	67	10	143	609	135	176	463		1	2	2
6/29	195	67	3	133	804	202	179	596		2	3	3
6/30	146	58	88	368	950	260	267	964		3	4	4
7/01	464	91	176	440	1,414	351	443	1,404		4	6	6
7/02	529	86	492	143	1,943	437	935	1,547		5	13	7
7/03	556	101	280	171	2,499	538	1,215	1,718		6	17	7
7/04	1,005	110	147	162	3,504	648	1,362	1,880		7	19	8
7/05	1,011	94	325	488	4,515	742	1,687	2,368		8	24	10
7/06	757	141	155	618	5,272	883	1,842	2,986		9	26	13
7/07	454	171	175	778	5,726	1,054	2,017	3,764		11	29	16
7/08	c	158	109	900		1,212	2,126	4,664		13	30	20
7/09	c	324	462	1,061		1,536	2,588	5,725		16	37	24
7/10	c	391	247	1,399		1,927	2,835	7,124		20	40	30
7/11	c	404 a	391	596		2,331	3,226	7,720		24	46	33
7/12	c	416	611	1,179		2,747	3,837	8,899		28	54	38
7/13	c	280	169	1,199		3,027	4,006	10,098		31	57	43
7/14	c	361	33	1,301		3,388	4,039	11,399		35	57	48
7/15	c	268	266	1,330		3,656	4,305	12,729		38	61	54
7/16	c	377	367	1,092		4,033	4,672	13,821		42	66	58
7/17	c	339	257	1,201		4,372	4,929	15,022		45	70	63
7/18	c	404	183	1,607		4,776	5,112	16,629		49	73	70
7/19	c	160	144	859		4,936	5,256	17,488		51	75	74
7/20	c	663	88	699		5,599	5,344	18,187		58	76	77
7/21	c	306	176	761		5,905	5,520	18,948		61	78	80
7/22	c	275	238	650		6,180	5,758	19,598		64	82	83
7/23	c	628	158	614		6,808	5,916	20,212		71	84	85
7/24	c	322	152	511 b		7,130	6,068	20,723		74	86	87
7/25	c	338	114	391 b		7,468	6,182	21,114		77	88	89
7/26	c	205	85	270		7,673	6,267	21,384		79	89	90
7/27	c	214 a	122	206 b		7,886	6,389	21,590		82	91	91
7/28	c	222	93	169		8,108	6,482	21,759		84	92	92
7/29	c	130	94	178		8,238	6,576	21,937		85	93	92
7/30	c	285	141	230		8,523	6,717	22,167		88	95	93
7/31	c	141	72	190 b		8,664	6,789	22,357		90	96	94
8/01	c	171	41	176 b		8,835	6,830	22,533		91	97	95
8/02	c	125	37 b	163 b		8,960	6,867	22,696		93	97	96
8/03	c	141	18	149 b		9,101	6,885	22,845		94	98	96
8/04	c	60	15	131		9,161	6,900	22,976		95	98	97
8/05	c	57	8	139		9,218	6,908	23,115		95	98	97
8/06	c	35	9	96		9,253	6,917	23,211		96	98	98
8/07	c	43	12	95		9,296	6,929	23,306		97	98	98
8/08	c	24	5	62		9,320	6,934	23,368		97	98	99
8/09	c	42	2	69		9,362	6,936	23,437		98	98	99

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Table 2. (page 2 of 2)

Date	Daily				Cumulative				Percent Passage			
	1998	1999	2000	2001	1998	1999	2000	2001	1998	1999	2000	2001
8/10	c	30 b	5	36		9,392	6,941	23,473		98	99	99
8/11	c	28 b	7	38		9,420	6,948	23,511		98	99	99
8/12	c	26 b	8	38		9,446	6,956	23,549		98	99	99
8/13	c	24 b	9	27		9,470	6,965	23,576		99	99	99
8/14	c	22 b	10 b	19		9,492	6,975	23,595		99	99	99
8/15	c	20 b	4 b	23		9,512	6,979	23,618		99	99	100
8/16	c	17 b	4 b	8		9,529	6,983	23,626		99	99	100
8/17	c	15 b	4 b	14 b		9,544	6,987	23,640		99	99	100
8/18	c	13 b	2 b	13 b		9,557	6,989	23,653		100	99	100
8/19	c	11 b	6 b	12 b		9,568	6,995	23,665		100	99	100
8/20	c	9 b	14 b	11 b		9,577	7,009	23,675		100	100	100
8/21	c	7 b	8 b	9 b		9,584	7,017	23,684		100	100	100
8/22	c	4 b	0 b	8 b		9,588	7,017	23,692		100	100	100
8/23	c	1 b	2 b	7 b		9,589	7,019	23,699		100	100	100
8/24	c	1	0 b	6 b		9,590	7,019	23,705		100	100	100
8/25	c	0	6 b	4 b		9,590	7,025	23,709		100	100	100
8/26	c	2 a	2 b	3 b		9,592	7,027	23,712		100	100	100
8/27	c	2	2 b	2 b		9,594	7,029	23,714		100	100	100
8/28	c	0	2 b	1		9,594	7,031	23,715		100	100	100
8/29	c	0	2 b	0		9,594	7,033	23,715		100	100	100
8/30	c	0	2 b	0		9,594	7,035	23,715		100	100	100
8/31	c	1	0 b	0		9,595	7,035	23,715		100	100	100
9/01	c	0	4 b	0		9,595	7,039	23,715		100	100	100
9/02	c	1	0 b	2		9,596	7,039	23,717		100	100	100
9/03	c	0	2 b	1		9,596	7,041	23,718		100	100	100
9/04	c	0	0 b	0		9,596	7,041	23,718		100	100	100
9/05	c	1	2 b	0		9,597	7,044	23,718		100	100	100
9/06	c	2	0 b	0		9,599	7,044	23,718		100	100	100
9/07	c	0	0 b	0		9,599	7,044	23,718		100	100	100
9/08	c	0	0 b	0		9,599	7,044	23,718		100	100	100
9/09	c	0	0 b	0		9,599	7,044	23,718		100	100	100
9/10	c	0	0 b	0		9,599	7,044	23,718		100	100	100
9/11	c	0	0 b	0		9,599	7,044	23,718		100	100	100
9/12	c	0	0 b	0		9,599	7,044	23,718		100	100	100
9/13	c	0	0 b	0		9,599	7,044	23,718		100	100	100
9/14	c	0	0 b	0		9,599	7,044	23,718		100	100	100
9/15	c	0	0 b	0		9,599	7,044	23,718		100	100	100
9/16	c	0	0 b	0 b		9,599	7,044	23,718		100	100	100
9/17	c	0	0 b	0 b		9,599	7,044	23,718		100	100	100
9/18	c	0	0 b	0 b		9,599	7,044	23,718		100	100	100
9/19	c	0	0 b	0 b		9,599	7,044	23,718		100	100	100
9/20	c	0	0 b	0 b		9,599	7,044	23,718		100	100	100
Total	5,726	9,599	7,044	23,718								
Obs.	5,726	9,147	6,928	22,109								
Est. (%)	0.0	4.7	1.6	6.8								

a = Daily passage was estimated due to the occurance of a hole in the weir.
b = The weir was not operational; daily passage was estimated.
c = The weir was not operational; daily passage was not estimated
d = Partial day count, passage was not estimated.

Table 3. Age and sex of chinook salmon at the Tatlawiksuk River weir based on escapement samples collected with a live trap, 1998 - 2001.

Year	Sample Dates	Sample Size	Sex	1.2 Esc.	1.2 %	1.3 Esc.	1.3 %	1.4 Esc.	1.4 %	1.5 Esc.	1.5 %	Total Esc.	Total %
1998[a]	7/1, 7	15	M		0.0		66.7		6.7		0.0		73.3
			F		0.0		20.0		6.6		0.0		26.7
			Total		0.0		86.7		13.3		0.0		100.0
1999	Entire Run	7	M		0.0		14.3		42.9		0.0		57.1
			F		0.0		0.0		42.8		0.0		42.9
			Total		0.0		14.3		85.7		0.0	1490	100.0
2000	7/6, 13, 16, 21	7	M		14.3		14.3		42.8		0.0		71.4
			F		0.0		0.0		28.6		0.0		28.6
			Total		14.3		14.3		71.4		0.0	817	100.0
2001	6/30, 7/2-3, 5, 8	34	M		14.7		55.9		8.8		0.0		79.4
			F		0.0		2.9		17.7		0.0		20.6
			Subtotal		14.7		14.3		26.5		0.0		100.0
	7/11-14, 16, 19	40	M		10.0		20.0		15.0		0.0		45.0
			F		0.0		2.5		45.0		7.5		55.0
			Subtotal		10.0		14.3		60.0		0.0		100.0
	Season	74	M		12.2		36.5		12.2		0.0		60.8
			F		0.0		2.7		32.4		4.1		39.2
			Total		12.2		39.2		44.6		4.1	2011	100.0

[a] The weir washed out in 1998, escapement numbers are not available.

Table 4. Mean length (mm) of chinook salmon at the Tatlawiksuk River weir based on escapement samples collected with a live trap, 1998 - 2001.

Year	Sample Dates	Sex		Age Class 1.2	1.3	1.4	1.5
1998	7/1, 7	M	Mean Length		728	789	
			Std. Error		33	-	
			Range		575- 879	789- 789	
			Sample Size	0	10	1	0
		F	Mean Length		705	697	
			Std. Error		13	-	
			Range		681- 725	697- 697	
			Sample Size	0	3	1	0
1999	Entire Run	M	Mean Length		690	863	
			Std. Error		-	45	
			Range		690-690	775-925	
			Sample Size	0	1	3	0
		F	Mean Length			894	
			Std. Error			6	
			Range			885-905	
			Sample Size	0	0	3	0
2000	7/6, 13, 16, 21	M	Mean Length	540	795	740	
			Std. Error	-	-	20	
			Range	540- 540	795-795	715- 780	
			Sample Size	1	1	3	0
		F	Mean Length			730	
			Std. Error			40	
			Range			690- 770	
			Sample Size	0	0	2	0
2001	6/30, 7/2-3, 5, 8	M	Mean Length	530	675	800	
			Std. Error	24	13	8	
			Range	455-605	580-760	790- 815	
			Sample Size	5	19	3	0
		F	Mean Length		818	830	
			Std. Error		-	35	
			Range		818- 818	744- 936	
			Sample Size	0	1	6	0

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Table 4. (page 2 of 2)

Year	Sample Dates	Sex		Age Class			
				1.2	1.3	1.4	1.5
2001	7/11-14, 16, 19	M	Mean Length	525	686	772	
(Cont.)			Std. Error	7	19	23	
			Range	515-546	602- 767	699- 860	
			Sample Size	4	8	6	0
		F	Mean Length		752	819	955
			Std. Error		-	16	48
			Range		752- 752	740- 935	859- 1010
			Sample Size	0	1	18	3
	Season	M	Mean Length	528	678	781	
			Std. Error	14	11	16	
			Range	455-605	580- 767	699- 860	
			Sample Size	9	27	9	0
		F	Mean Length		785	821	955
			Std. Error		-	15	48
			Range		752- 818	740- 936	859- 1010
			Sample Size	0	2	24	3

Table 5. Age and sex of chum salmon at the Tatlawiksuk River weir based on escapement samples collected with a live trap, 1998 - 2001.[ab]

Year	Sample Dates (Stratum Dates)	Sample Size	Sex	Age Class 0.2 Esc.	0.2 %	0.3 Esc.	0.3 %	0.4 Esc.	0.4 %	0.5 Esc.	0.5 %	To Esc.
1998 [c]	6/29 - 7/1	166	M		0.0		50.0		13.3		0.6	
			F		0.0		30.7		5.4		0.0	
			Subtotal		0.0		80.7		18.7		0.6	
	7/6 - 7	164	M		0.0		48.8		11.0		0.0	
			F		0.0		39.0		1.2		0.0	
			Subtotal		0.0		87.8		12.2		0.0	
	Season	330	M		0.0		49.4		12.2		0.3	
			F		0.0		34.9		3.3		0.0	
			Total		0.0		84.2		15.5		0.3	
1999	7/9 - 11 (6/24 - 7/13)	193	M	0	0.0	1,004	33.2	659	21.8	16	0.5	1,678
			F	0	0.0	800	26.4	549	18.1	0	0.0	1,349
			Subtotal	0	0.0	1,804	59.6	1,208	39.9	16	0.5	3,027
	7/16 - 17 (7/14 - 19)	194	M	0	0.0	738	38.6	374	19.6	0	0.0	1,112
			F	10	0.5	630	33.0	157	8.2	0	0.0	797
			Subtotal	10	0.5	1,368	71.6	531	27.8	0	0.0	1,909
	7/21 - 22 (7/20 - 24)	195	M	0	0.0	551	25.1	236	10.8	0	0.0	788
			F	0	0.0	1,125	51.3	282	12.8	0	0.0	1,406
			Subtotal	0	0.0	1,676	76.4	518	23.6	0	0.0	2,194
	7/26 - 28 (7/25 - 31)	119	M	0	0.0	529	34.4	103	6.7	13	0.8	645
			F	0	0.0	696	45.4	194	12.6	0	0.0	890
			Subtotal	0	0.0	1,225	79.8	297	19.3	13	0.8	1,535
	8/3 - 8/4 (8/1 - 6)	117	M	0	0.0	176	29.9	51	8.5	0	0.0	227
			F	0	0.0	327	55.6	35	6.0	0	0.0	362
			Subtotal	0	0.0	503	85.5	86	14.5	0	0.0	589
	8/9 (8/7 - 9/6)	38	M	0	0.0	99	28.9	10	2.7	0	0.0	99
			F	0	0.0	229	65.8	8	2.6	0	0.0	247
			Subtotal	0	0.0	328	94.7	18	5.3	0	0.0	346
	Season	856	M	0	0.0	3,097	32.3	1,433	14.8	29	0.3	4,549
			F	10	0.1	3,807	29.8	1,225	12.7	0	0.0	5,051
			Total	10	0.1	6,904	72.1	2,658	27.5	29	0.3	9,600
2000	6/25 - 26 (6/15 - 30)	41	M	0	0.0	39	14.7	143	53.6	0	0.0	182
			F	0	0.0	20	7.3	65	24.4	0	0.0	85
			Subtotal	0	0.0	59	22.0	208	78.0	0	0.0	267
	7/6, 10, 12- 13 (7/1 - 13)	133	M	28	0.8	1,040	27.8	1,012	27.1	0	0.0	2,080
			F	0	0.0	872	23.3	759	20.3	28	0.8	1,659
			Subtotal	28	0.8	1,912	51.1	1,771	47.4	28	0.8	3,739
	7/15 - 16 (7/14-18)	156	M	21	1.9	305	27.6	128	11.5	0	0.0	454
			F	0	0.0	468	42.3	184	16.7	0	0.0	652
			Subtotal	21	1.9	773	69.9	312	28.2	0	0.0	1,106
	7/21-22, 24 (7/19 - 25)	180	M	24	2.2	374	35.0	190	17.8	0	0.0	589
			F	6	0.6	339	31.7	131	12.2	6	0.6	481
			Subtotal	30	2.8	713	66.7	321	30.0	6	0.6	1,070
	7/28 - 30 (7/26- 8/13)	195	M	40	5.1	224	26.2	75	7.2	0	0.0	301
			F	20	2.6	369	44.6	133	14.3	0	0.0	482
			Subtotal	60	7.7	593	70.8	208	21.5	0	0.0	783
	Season	705	M	113	1.6	1,983	28.2	1,549	21.9	0	0.0	3,645
			F	26	0.4	2,067	29.4	1,271	18.0	34	0.5	3,398
			Total	139	2.0	4,050	57.6	2,820	39.9	34	0.5	7,043

-Continued-

Table 5. (page 2 of 2)

Year	Sample Dates (Stratum Dates)	Sample Size	Sex	Age Class 0.2 Esc.	0.2 %	0.3 Esc.	0.3 %	0.4 Esc.	0.4 %	0.5 Esc.	0.5 %	To Esc.
2001	6/29 - 30	62	M	0	0.0	140	14.5	389	40.3	0	0.0	529
	(6/20 - 30)		F	0	0.0	171	17.8	264	27.4	0	0.0	435
			Subtotal	0	0.0	311	32.3	653	67.7	0	0.0	964
	7/2 - 4	92	M	0	0.0	286	14.1	1,033	51.1	0	0.0	1,319
	(7/1 - 6)		F	0	0.0	220	10.9	484	23.9	0	0.0	703
			Subtotal	0	0.0	506	25.0	1,517	75.0	0	0.0	2,022
	7/9 - 11	138	M	0	0.0	1,855	26.1	1,031	14.5	52	0.7	2,938
	(7/7 - 13)		F	0	0.0	2,062	29.0	2,113	29.7	0	0.0	4,174
			Subtotal	0	0.0	3,917	55.1	3,144	44.2	52	0.7	7,112
	7/16 - 17	194	M	0	0.0	3,461	42.8	876	10.8	42	0.5	4,378
	(7/14 - 20)		F	0	0.0	2,752	34.0	959	11.9	0	0.0	3,711
			Subtotal	0	0.0	6,213	76.8	1,835	22.7	42	0.5	8,089
	7/23	64	M	50	1.6	1,249	39.1	250	7.8	0	0.0	1,549
	(7/21 - 26)		F	0	0.0	1,349	42.2	299	9.4	0	0.0	1,648
			Subtotal	50	1.6	2,598	81.3	549	17.2	0	0.0	3,197
	7/30	66	M	0	0.0	383	33.3	70	6.0	0	0.0	453
	(7/27-8/1)		F	35	3.0	575	50.0	87	7.6	0	0.0	696
			Subtotal	35	3.0	958	83.3	157	13.6	0	0.0	1,149
	8/4-8, 13-15	231	M	10	0.9	389	32.9	46	3.9	0	0.0	446
	(8/2 - 9/15)		F	5	0.4	692	58.4	41	3.5	0	0.0	738
			Subtotal	15	1.3	1,081	91.3	87	7.4	0	0.0	1,184
	Season	847	M	60	0.2	7,763	32.7	3,693	15.6	93	0.4	11,610
			F	40	0.2	7,819	33.0	4,248	17.9	0	0.0	12,107
			Total	100	0.4	15,582	65.7	7,941	33.5	93	0.4	23,717
	Grand	2,408	M	173	0.4	12,843	31.8	6,675	16.5	122	0.3	19,804
	Total [d]		F	76	0.2	13,693	33.9	6,744	16.7	34	0.1	20,556
			Total	249	0.6	26,536	65.7	13,419	33.2	156	0.4	40,360

[a] The number of fish in each stratum age and sex category are derived from the sample percentages; discrepancies in sums are attributed to rounding errors.

[b] The number of fish in "Season" summaries are the strata sums; "Season" percentages are derived from the sums.

[c] The weir washed out in 1998; escapement estimates are not available.

[d] The number of fish in the "Grand total" are the sum of the "Season" totals; percentages are derived from those sums.

otal
%
63.9
36.1
100.0
59.8
40.2
100.0
61.8
38.2
100.0
55.4
44.6
100.0
58.2
41.8
100.0
35.9
64.1
100.0
42.0
58.0
100.0
38.5
61.5
100.0
31.6
68.4
100.0
47.4
52.6
100.0
68.3
31.7
100.0
55.6
44.4
100.0
41.0
59.0
100.0
55.0
45.0
100.0
38.5
61.5
100.0
51.8
48.2
100.0

otal
%
54.8
45.2
100.0
65.2
34.8
100.0
41.3
58.7
100.0
54.1
45.9
100.0
48.4
51.6
100.0
39.4
60.6
100.0
37.7
62.3
100.0
49.0
51.0
100.0
49.1
50.9
100.0

Table 6. Mean length (mm) of chum salmon at the Tatlawiksuk River weir based on escapement samples collected with a live trap, 1998 - 2001.[a]

Year	Sample Dates (Stratum Dates)	Sex		Age Class 0.2	0.3	0.4	0.5
1998[b]	6/29 - 7/1	M	Mean Length		594	610	608
			Std. Error		3	9	-
			Range		517- 661	534- 691	608- 608
			Sample Size	0	83	22	1
		F	Mean Length		562	588	
			Std. Error		3	8	
			Range		511- 606	551- 635	
			Sample Size	0	51	9	0
	7/6 - 7	M	Mean Length		588	614	
			Std. Error		3	5	
			Range		518- 679	585- 668	
			Sample Size	0	80	18	0
		F	Mean Length		555	571	
			Std. Error		2	12	
			Range		509- 595	559- 582	
			Sample Size	0	64	2	0
1999	7/9 - 11	M	Mean Length		588	608	581
	(6/24 - 7/13)		Std. Error		4	4	-
			Range		530- 660	540- 655	581- 581
			Sample Size	0	64	42	1
		F	Mean Length		556	565	
			Std. Error		4	6	
			Range		479- 614	510- 668	
			Sample Size	0	51	35	0
	7/16 - 17	M	Mean Length		588	604	
	(7/14 - 19)		Std. Error		4	5	
			Range		423- 697	530- 683	
			Sample Size	0	75	38	0
		F	Mean Length	530	565	583	
			Std. Error	-	4	6	
			Range	530- 530	500- 680	542- 620	
			Sample Size	1	64	16	0
	7/21 - 22	M	Mean Length		582	603	
	(7/20 - 24)		Std. Error		4	6	
			Range		520- 634	537- 660	
			Sample Size	0	49	21	0
		F	Mean Length		554	570	
			Std. Error		2	6	
			Range		500- 625	520- 633	
			Sample Size	0	100	25	0

-Continued-

Table 6. (page 2 of 5)

Year	Sample Dates (Stratum Dates)	Sex		Age Class 0.2	0.3	0.4	0.5
1999 (cont.)	7/26 - 28 (7/25 - 31)	M	Mean Length		583	609	625
			Std. Error		4	9	-
			Range		545- 640	570- 640	625- 625
			Sample Size	0	41	8	1
		F	Mean Length		563	575	
			Std. Error		4	5	
			Range		500- 620	540- 618	
			Sample Size	0	54	15	0
	8/3 - 8/4 (8/1 - 6)	M	Mean Length		593	600	
			Std. Error		5	9	
			Range		535- 669	551- 634	
			Sample Size	0	35	10	0
		F	Mean Length		548	557	
			Std. Error		3	14	
			Range		496- 592	500- 610	
			Sample Size	0	65	7	0
	8/9 (8/8 - 9/6)	M	Mean Length		579	635	
			Std. Error		9	-	
			Range		535- 630	635- 635	
			Sample Size	0	11	1	0
		F	Mean Length		549	555	
			Std. Error		5	-	
			Range		480- 595	555- 555	
			Sample Size	0	25	1	0
	Season	M	Mean Length		586	606	601
			Range		423- 697	530- 683	581- 625
			Sample Size	0	275	120	2
		F	Mean Length	530	557	570	
			Range	530- 530	479- 680	500- 668	
			Sample Size	1	359	99	0
2000	6/25 - 26 (6/15 - 30)	M	Mean Length		598	627	
			Std. Error		12	5	
			Range		580- 655	590- 680	
			Sample Size	0	6	22	0
		F	Mean Length		577	588	
			Std. Error		3	6	
			Range		570- 580	565- 625	
			Sample Size	0	3	10	0

-Continued-

Table 6. (page 3 of 5)

Year	Sample Dates (Stratum Dates)	Sex		Age Class 0.2	0.3	0.4	0.5
2000 (cont.)	7/6, 10, 12- 13 (7/1 - 13)	M	Mean Length	560	586	613	
			Std. Error	-	4	5	
			Range	560- 560	535- 650	540- 660	
			Sample Size	1	37	36	0
		F	Mean Length		562	580	590
			Std. Error		7	8	-
			Range		455- 620	500- 675	590- 590
			Sample Size	0	31	27	1
	7/15 - 16 (7/14-18)	M	Mean Length	568	590	613	
			Std. Error	15	5	8	
			Range	540- 590	535- 680	550- 675	
			Sample Size	3	43	18	0
		F	Mean Length		552	571	
			Std. Error		4	4	
			Range		500- 670	530- 600	
			Sample Size	0	66	26	0
	7/21-22, 24 (7/19 - 25)	M	Mean Length	574	590	605	
			Std. Error	2	4	5	
			Range	570- 580	520- 680	550- 670	
			Sample Size	4	63	32	0
		F	Mean Length	520	557	562	590
			Std. Error	-	3	4	-
			Range	520- 520	490- 620	540- 600	590- 590
			Sample Size	1	57	22	1
	7/28 - 30 (7/26- 8/13)	M	Mean Length	539	584	598	
			Std. Error	9	4	11	
			Range	490- 590	500- 655	540- 670	
			Sample Size	10	51	14	0
		F	Mean Length	531	542	567	
			Std. Error	8	3	7	
			Range	515- 560	480- 610	480- 640	
			Sample Size	5	87	28	0
	Season	M	Mean Length	557	587	613	
			Range	490- 590	500- 680	540- 680	
			Sample Size	18	200	122	0
		F	Mean Length	528	555	576	590
			Range	515- 560	455- 670	480- 675	590- 590
			Sample Size	6	244	113	2

-Continued-

Table 6. (page 4 of 5)

Year	Sample Dates (Stratum Dates)	Sex		Age Class 0.2	0.3	0.4	0.5
2001	6/29 - 30	M	Mean Length		599	608	
	(6/20 - 30)		Std. Error		10	7	
			Range		560- 645	520- 680	
			Sample Size	0	9	25	0
		F	Mean Length		556	588	
			Std. Error		7	5	
			Range		505- 590	550- 625	
			Sample Size	0	11	17	0
	7/2 - 4	M	Mean Length		589	594	
	(7/1 - 6)		Std. Error		7	4	
			Range		556- 632	522- 687	
			Sample Size	0	13	47	0
		F	Mean Length		553	568	
			Std. Error		7	5	
			Range		512- 576	536- 615	
			Sample Size	0	10	22	0
	7/9 - 11	M	Mean Length		588	611	676
	(7/7 - 13)		Std. Error		5	6	-
			Range		540- 637	564- 657	676- 676
			Sample Size	0	36	20	1
		F	Mean Length		566	581	
			Std. Error		3	4	
			Range		529- 613	534- 626	
			Sample Size	0	40	41	0
	7/16 - 17	M	Mean Length		581	600	624
	(7/14 - 20)		Std. Error		3	8	-
			Range		489- 667	513- 656	624- 624
			Sample Size	0	83	21	1
		F	Mean Length		550	565	
			Std. Error		3	5	
			Range		488- 624	528- 611	
			Sample Size	0	66	23	0
	7/23	M	Mean Length	518	575	574	
	(7/21 - 26)		Std. Error	-	7	5	
			Range	518- 518	526- 646	558- 586	
			Sample Size	1	25	5	0
		F	Mean Length		536	561	
			Std. Error		5	8	
			Range		485- 587	544- 598	
			Sample Size	0	27	6	0

-Continued-

Table 6. (page 5 of 5)

Year	Sample Dates (Stratum Dates)	Sex		Age Class 0.2	0.3	0.4	0.5
2001 (cont.)	7/30 (7/27-8/1)	M	Mean Length		573	551	
			Std. Error		5	7	
			Range		527- 614	533- 566	
			Sample Size	0	22	4	0
		F	Mean Length	507	540	528	
			Std. Error	3	4	13	
			Range	504- 509	483- 588	494- 565	
			Sample Size	2	33	5	0
	8/4-8, 13-15 (8/2 - 9/15)	M	Mean Length	543	565	582	
			Std. Error	13	4	12	
			Range	530- 556	458- 641	537- 626	
			Sample Size	2	76	9	0
		F	Mean Length	492	533	550	
			Std. Error	-	2	7	
			Range	492- 492	454- 654	516- 573	
			Sample Size	1	135	8	0
	Season	M	Mean Length	522	581	599	653
			Range	518- 556	458- 667	513- 687	624- 676
			Sample Size	3	264	131	2
		F	Mean Length	505	550	574	
			Range	492- 509	454- 654	494- 626	
			Sample Size	3	322	122	0
	Grand Total [c]	M	Mean Length	540	585	606	627
			Range	490- 590	423- 697	513- 687	581- 676
			Sample size	21	739	373	4
		F	Mean Length	521	554	573	590
			Range	492- 560	454- 680	480- 675	590- 590
			Sample size	10	925	334	2

[a] "Season" mean lengths are weighted by the escapement passage in each stratum.

[b] The weir washed out in 1998; this year is excluded from the "Grand Total"

[c] "Grand Total" mean lengths are simple averages of the "Season" mean lengths.

Table 7. Historical coho salmon passage at Tatlawiksuk River weir, 1999 - 2001.

Date	Daily			Cumulative			Percent Passage		
	1999	2000	2001	1999	2000	2001	1999	2000	2001
6/15	0	0	0	0	0	0	0		0
6/16	0	0	0	0	0	0	0		0
6/17	0	0	0	0	0	0	0		0
6/18	0	0	0	0	0	0	0		0
6/19	0	0	0	0	0	0	0		0
6/20	0	0	0	0	0	0	0		0
6/21	0	0	0	0	0	0	0		0
6/22	0	0	0	0	0	0	0		0
6/23	0	0	0	0	0	0	0		0
6/24	0	0	0	0	0	0	0		0
6/25	0	0	0	0	0	0	0		0
6/26	0	0	0	0	0	0	0		0
6/27	0	0	0	0	0	0	0		0
6/28	0	0	0	0	0	0	0		0
6/29	0	0	0	0	0	0	0		0
6/30	0	0	0	0	0	0	0		0
7/01	0	0	0	0	0	0	0		0
7/02	0	0	0	0	0	0	0		0
7/03	0	0	0	0	0	0	0		0
7/04	0	0	0	0	0	0	0		0
7/05	0	0	0	0	0	0	0		0
7/06	0	0	0	0	0	0	0		0
7/07	0	0	0	0	0	0	0		0
7/08	0	0	0	0	0	0	0		0
7/09	0	0	0	0	0	0	0		0
7/10	0	0	0	0	0	0	0		0
7/11	0 a	0	0	0	0	0	0		0
7/12	0	0	0	0	0	0	0		0
7/13	0	0	0	0	0	0	0		0
7/14	0	0	0	0	0	0	0		0
7/15	0	0	0	0	0	0	0		0
7/16	0	0	0	0	0	0	0		0
7/17	0	0	0	0	0	0	0		0
7/18	0	0	0	0	0	0	0		0
7/19	0	2	0	0	2	0	0		0
7/20	0	0	0	0	2	0	0		0
7/21	0	1	0	0	3	0	0		0
7/22	0	0	0	0	3	0	0		0
7/23	0	0	0	0	3	0	0		0
7/24	0	1	0 b	0	4	0	0		0
7/25	1	0	0 b	1	4	0	0		0
7/26	0	0	0	1	4	0	0		0
7/27	1 a	0	0 b	2	4	0	0		0
7/28	2	3	1	4	7	1	0		0
7/29	9	2	0	13	9	1	0		0
7/30	1	25	8	14	34	9	0		0
7/31	1	11	18 b	15	45	27	0		0
8/01	0	40	42 b	15	85	69	0		1
8/02	0	110 b	29 b	15	195	98	0		1
8/03	0	172	17 b	15	367	114	0		1
8/04	0	215	42	15	582	156	0		1
8/05	2	173	91	17	755	247	0		2

-Continued-

Table 7. (page 2 of 2)

Date	Daily			Cumulative			Percent Passage		
	1999	2000	2001	1999	2000	2001	1999	2000	2001
8/06	0	129	47	17	884	294	0		3
8/07	5	277	74	22	1,161	368	1		4
8/08	1	108	135	23	1,269	503	1		5
8/09	1	267	130	24	1,536	633	1		6
8/10	3 b	619	264	27	2,155	897	1		9
8/11	5 b	730	212	32	2,885	1,109	1		11
8/12	2 b	1,123	306	33	4,008	1,415	1		13
8/13	9 b	1,429	314	42	5,437	1,729	1		16
8/14	12 b	319 d	864	54	5,756	2,593	2		25
8/15	13 b	c	530	67		3,123	2		30
8/16	27 b	c	860	94		3,983	3		38
8/17	37 b	c	652 b	129		4,635	4		44
8/18	45 b	c	610 b	173		5,245	5		50
8/19	26 b	c	567 b	199		5,812	6		55
8/20	72 b	c	525 b	270		6,337	8		60
8/21	75 b	c	482 b	343		6,819	10		65
8/22	33 b	c	439 b	375		7,258	11		69
8/23	57 b	c	397 b	446		7,655	13		73
8/24	103	c	354 b	549		8,009	16		76
8/25	88	c	311 b	637		8,320	18		79
8/26	93 a	c	269 b	730		8,589	21		82
8/27	97	c	226 b	827		8,815	24		84
8/28	181	c	185	1,008		9,000	29		86
8/29	171	c	182	1,179		9,182	34		87
8/30	93	c	204	1,272		9,386	37		89
8/31	184	c	176	1,456		9,562	42		91
9/01	239	c	64	1,695		9,626	49		92
9/02	170	c	87	1,865		9,713	54		92
9/03	140	c	107	2,005		9,820	58		94
9/04	190	c	88	2,195		9,908	64		94
9/05	193	c	80	2,388		9,988	69		95
9/06	103	c	33	2,491		10,021	72		95
9/07	30	c	43	2,521		10,064	73		96
9/08	35	c	55	2,556		10,119	74		96
9/09	53	c	38	2,609		10,157	76		97
9/10	303	c	13	2,912		10,170	84		97
9/11	81	c	61	2,993		10,231	87		97
9/12	81	c	29	3,074		10,260	89		98
9/13	99	c	30	3,173		10,290	92		98
9/14	82	c	38	3,255		10,328	94		98
9/15	51	c	56	3,306		10,384	96		99
9/16	26	c	39 b	3,332		10,423	96		99
9/17	32	c	31 b	3,364		10,454	97		100
9/18	18	c	24 b	3,382		10,478	98		100
9/19	56	c	16 b	3,438		10,493	100		100
9/20	17	c	8 b	3,455		10,501	100		100
Total	3,455	5,756	10,501						
Obs.	2,967	5,646	5,669						
Est. (%)	14.1	1.9	46.0						

a = Daily passage was estimated due to the occurance of a hole in the weir.
b = The weir was not operational; daily passage was estimated.
c = The weir was not operational; daily passage was not estimated.
d = Partial day count, passage was not estimated.

Table 8. Age and sex of coho salmon at the Tatlawiksuk River weir based on escapement samples collected with a live trap, 1999 - 2001.[ab]

Year	Sample Dates (Stratum Dates)	Sample Size	Sex	1.1 Esc.	1.1 %	2.1 Esc.	2.1 %	3.1 Esc.	3.1 %	Total Esc.	Total %
1999	8/26- 28	87	M	89	6.9	598	47.1	74	5.7	761	59.8
	(7/25 - 8/30)		F	44	3.4	408	32.2	59	4.6	511	40.2
			Subtotal	133	10.3	1,006	79.3	133	10.3	1,272	100.0
	9/1- 2	136	M	34	3.7	380	41.2	75	8.1	489	52.9
	(8/31 - 9/4)		F	14	1.4	360	38.9	61	6.6	434	47.1
			Subtotal	48	5.1	740	80.1	136	14.7	923	100.0
	9/7, 9	64	M	59	4.7	551	43.7	98	7.8	709	56.3
	(9/5 - 9/20)		F	39	3.1	433	34.4	79	6.3	551	43.7
			Subtotal	98	7.8	984	78.1	177	14.1	1,260	100.0
	Season	287	M	181	5.2	1,529	44.3	246	7.1	1,956	56.7
			F	97	2.8	1,201	34.8	199	5.8	1,493	43.3
			Total	278	8.0	2,730	79.1	445	12.9	3,455	100.0
2000	8/4, 8/8-8/10, 8/14	188	M		0.0		60.1		0.0		60.1
	(7/19-8/14)		F		0.0		39.9		0.0		39.9
			Subtotal		0.0		100.0		0.0		100.0
	Season	188	M		0.0		60.1		0.0		60.1
			F		0.0		39.9		0.0		39.9
			Total		0.0		100.0		0.0		100.0
2001	8/6 - 9	147	M	8	0.7	483	43.5	30	2.7	521	46.9
	(7/28 - 8/11)		F	7	0.7	498	44.9	83	7.5	588	53.1
			Subtotal	15	1.4	981	88.4	113	10.2	1,109	100.0
	8/13 - 15	139	M	89	1.5	2,699	43.9	265	4.3	3,052	49.6
	(8/12 - 22)		F	88	1.4	2,831	46.0	177	2.9	3,097	50.4
			Subtotal	177	2.9	5,530	89.9	442	7.2	6,149	100.0
	8/30 - 9/2	145	M	39	1.4	1,200	42.8	38	1.4	1,277	45.5
	(8/23 - 9/7)		F	0	0.0	1,432	51.0	97	3.4	1,529	54.5
			Subtotal	39	1.4	2,632	93.8	135	4.8	2,806	100.0
	9/13 - 15	87	M	0	0.0	181	41.4	0	0.0	181	41.4
	(9/8 - 15)		F	0	0.0	257	58.6	0	0.0	257	58.6
			Subtotal	0	0.0	438	100.0	0	0.0	438	100.0
	Season	518	M	135	1.3	4,562	43.4	334	3.2	5,031	47.9
			F	96	0.9	5,018	47.8	357	3.4	5,471	52.1
			Total	231	2.2	9,580	91.2	691	6.6	10,502	100.0

[a] The number of fish in each stratum age and sex category are derived from the sample percentages; discrepancies in sums are attributed to rounding errors.

[b] The number of fish in "Season" summaries are the strata sums; "Season" percentages are derived from the sums.

Table 9. Mean length (mm) of coho salmon at the Tatlawiksuk River weir based on escapement samples collected with a live trap, 1999 - 2001.[a]

Year	Sample Dates (Stratum Dates)	Sex		Age Class 1.1	2.1	3.1
1999	8/26- 28	M	Mean Length	508	538	548
	(7/25 - 8/30)		Std. Error	17	8	14
			Range	450- 542	420- 600	522- 595
			Sample Size	6	40	5
		F	Mean Length	511	547	562
			Std. Error	26	6	17
			Range	462- 550	448- 580	522- 600
			Sample Size	3	28	4
	9/1- 2	M	Mean Length	492	552	572
	(8/31 - 9/4)		Std. Error	11	8	10
			Range	460- 530	440- 675	500- 610
			Sample Size	5	56	11
		F	Mean Length	563	554	546
			Std. Error	3	5	17
			Range	560- 565	430- 615	465- 610
			Sample Size	2	53	9
	9/7, 9	M	Mean Length	495	565	561
	(9/5 - 9/20)		Std. Error	28	8	10
			Range	445- 540	415- 620	530- 590
			Sample Size	3	28	5
		F	Mean Length	445	564	581
			Std. Error	30	5	14
			Range	415- 475	520- 610	540- 605
			Sample Size	2	22	4
	Season	M	Mean Length	501	551	560
			Std. Error	12	5	7
			Range	445- 542	415- 675	500- 610
			Sample Size	14	124	21
		F	Mean Length	491	555	565
			Std. Error	17	3	9
			Range	415- 565	430- 615	465- 610
			Sample Size	7	103	17

-Continued-

Table 9. (page 2 of 3)

Year	Sample Dates (Stratum Dates)	Sex		Age Class 1.1	2.1	3.1
2000	8/4, 8/8 - 8/10, 8/14	M	Mean Length	0	569	0
	(7/19 - 8/14)		Std. Error	0	3	0
			Range	0 - 0	430 - 640	0 - 0
			Sample Size	0	113	0
		F	Mean Length	0	556	0
			Std. Error	0	3	0
			Range	0 - 0	470 - 600	0 - 0
			Sample Size	0	75	0
	Season	M	Mean Length	0	569	0
			Std. Error	0	3	0
			Range	0 - 0	430 - 640	0 - 0
			Sample Size	0	113	0
		F	Mean Length	0	556	0
			Std. Error	0	3	0
			Range	0 - 0	470 - 600	0 - 0
			Sample Size	0	75	0
2001	8/6 - 9	M	Mean Length	580	559	583
	(7/28 - 8/11)		Std. Error	0	6	8
			Range	580 - 580	410 - 669	567 - 600
			Sample Size	1	64	4
		F	Mean Length	547	557	549
			Std. Error	0	3	5
			Range	547 - 547	468 - 600	514 - 570
			Sample Size	1	66	11
	8/13 - 15	M	Mean Length	534	562	585
	(8/12 - 22)		Std. Error	14	5	11
			Range	520 - 548	481 - 628	563 - 640
			Sample Size	2	61	6
		F	Mean Length	555	567	569
			Std. Error	13	3	14
			Range	542 - 568	456 - 623	539 - 604
			Sample Size	2	64	4

-Continued-

Table 9. (page 3 of 3)

Year	Sample Dates (Stratum Dates)	Sex		Age Class 1.1	2.1	3.1
2001 (cont.)	8/30 - 9/2 (8/23 - 9/7)	M	Mean Length	540	590	600
			Std. Error	25	6	4
			Range	515 - 564	434 - 668	596 - 603
			Sample Size	2	62	2
		F	Mean Length	0	587	594
			Std. Error	0	3	7
			Range	0 - 0	530 - 632	576 - 617
			Sample Size	0	74	5
	9/13 - 15 (9/8 - 15)	M	Mean Length	0	577	0
			Std. Error	0	7	0
			Range	0 - 0	488 - 647	0 - 0
			Sample Size	0	36	0
		F	Mean Length	0	577	0
			Std. Error	0	4	0
			Range	0 - 0	483 - 620	0 - 0
			Sample Size	0	51	0
	Season	M	Mean Length	538	569	587
			Std. Error	12	3	9
			Range	515 - 580	410 - 669	563 - 640
			Sample Size	5	223	12
		F	Mean Length	554	572	571
			Std. Error	13	2	7
			Range	542 - 568	456 - 632	514 - 617
			Sample Size	3	255	20

[a] "Season" mean lengths are weighted by the escapement passage in each stratum.

FIGURES

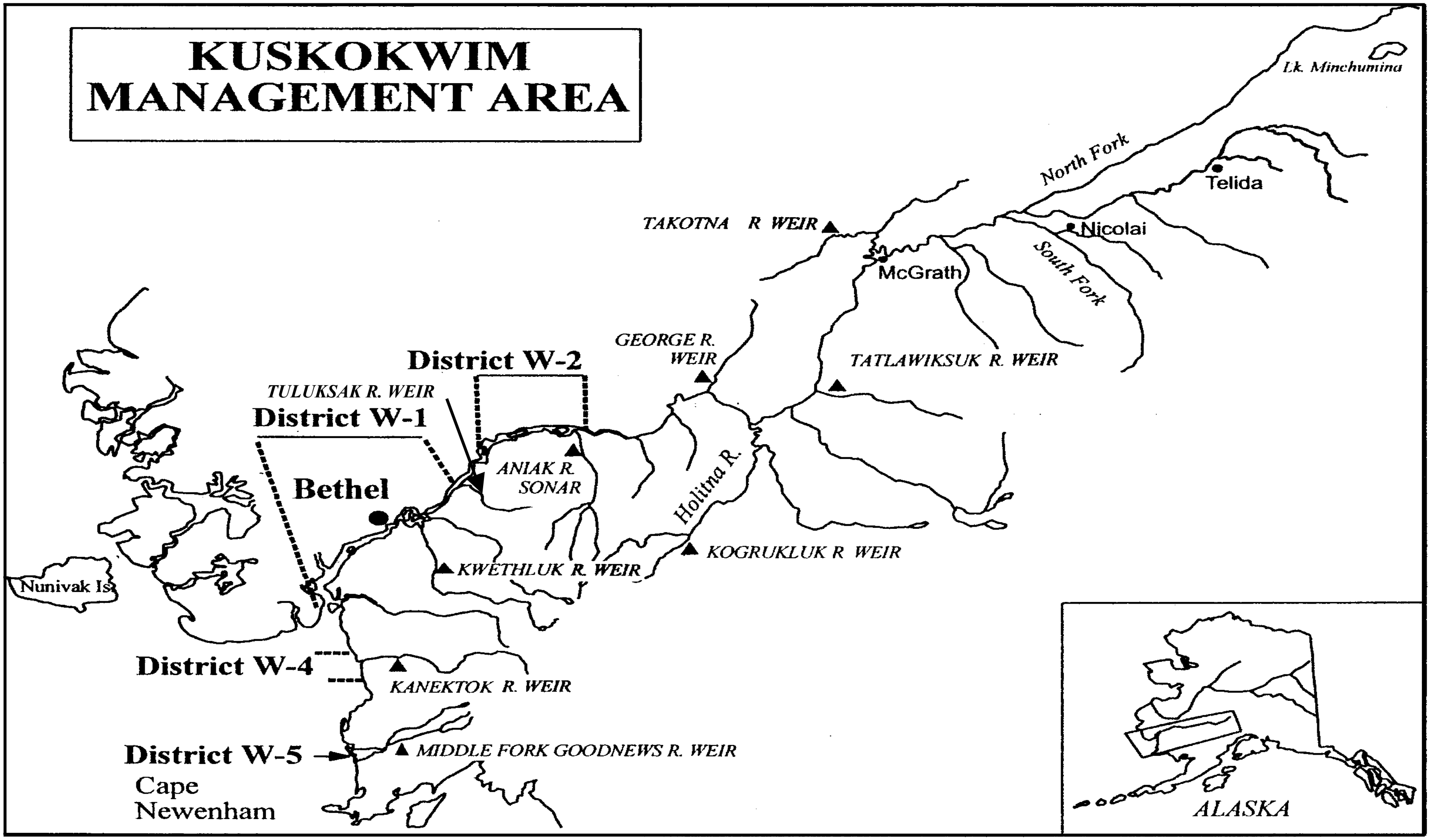

Figure 1. Kuskokwim Area salmon management districts and escapement monitoring projects.

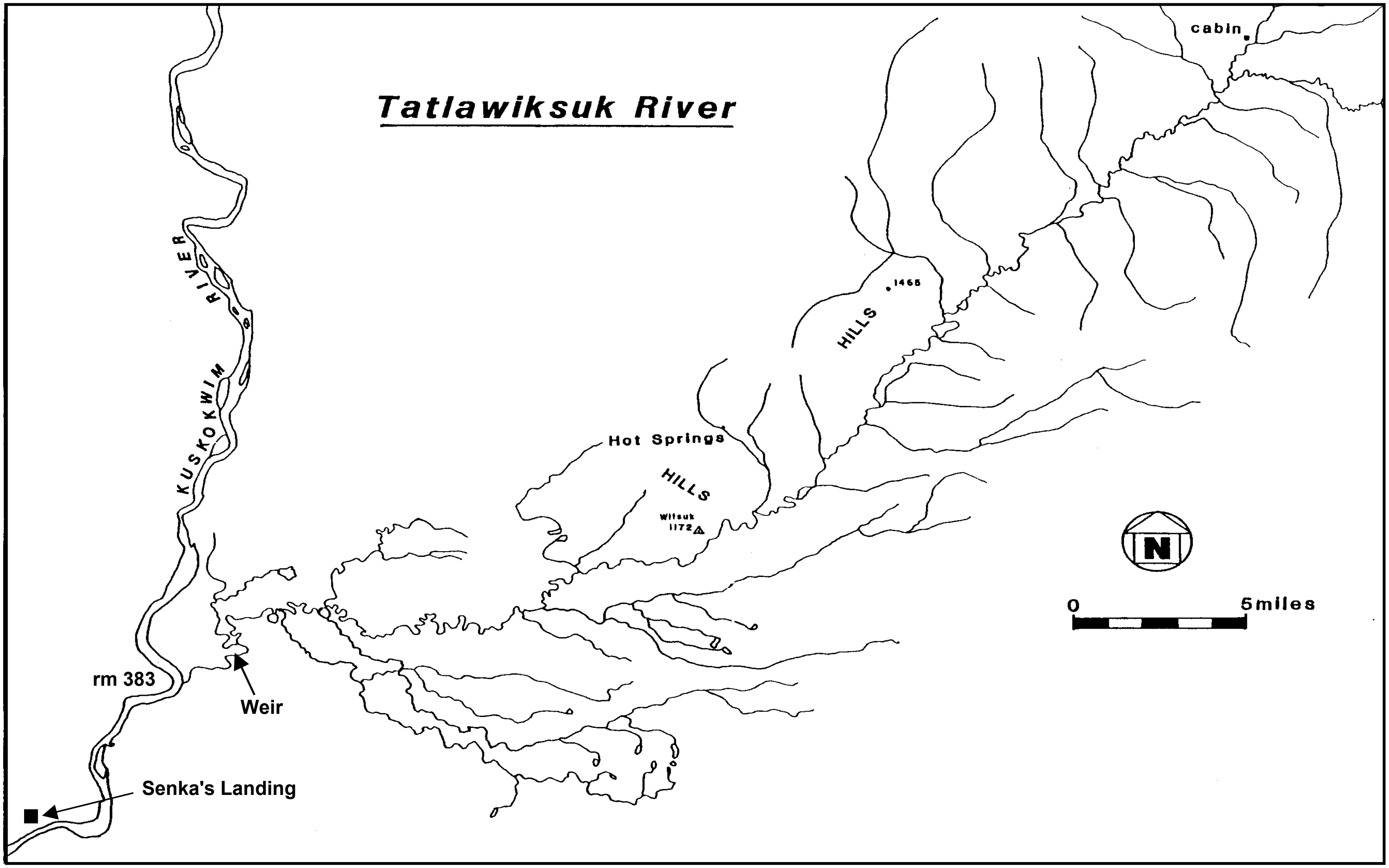

Figure 2. Tatlawiksuk River, middle Kuskokwim River basin.

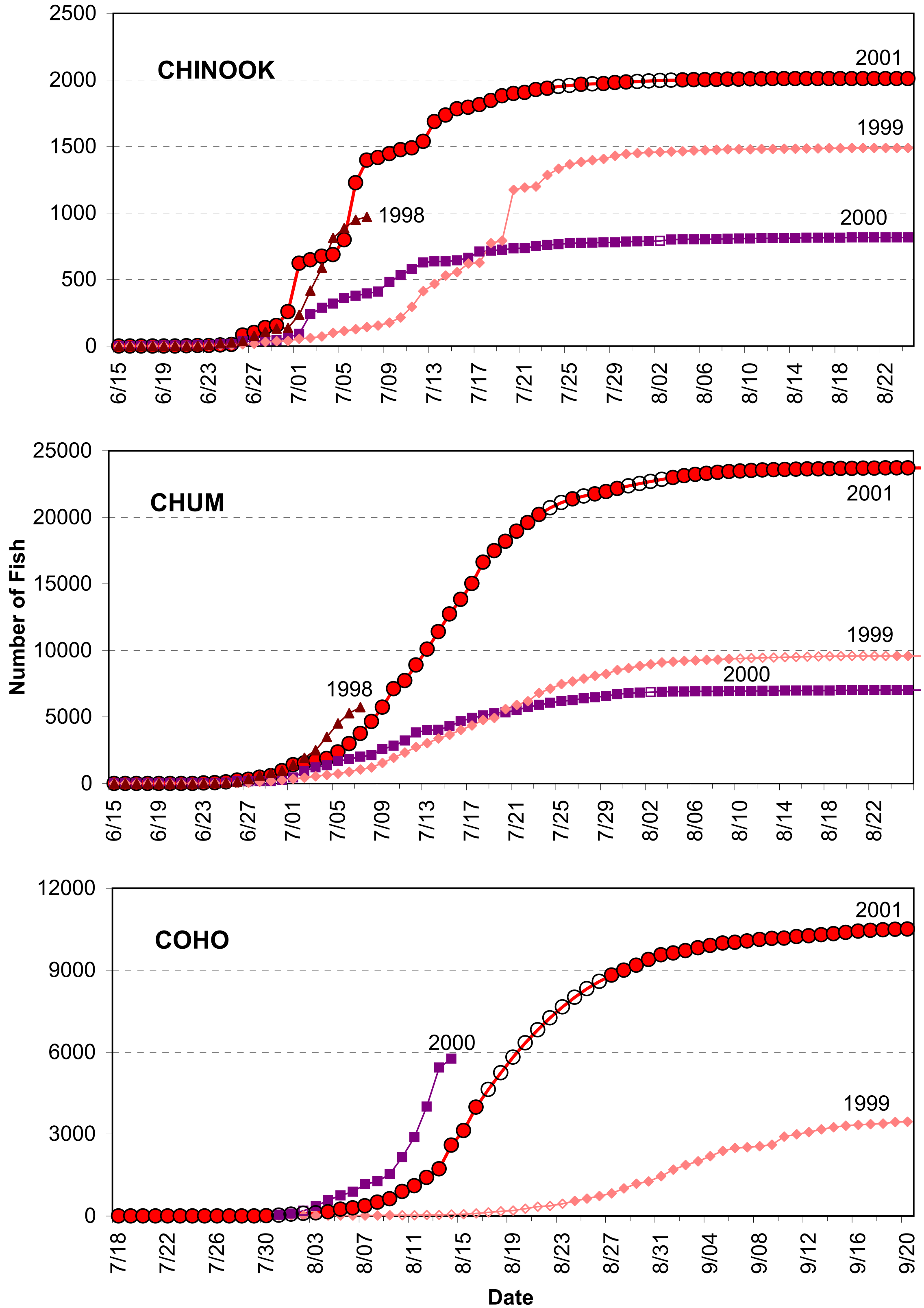

Figure 3. Historical cumulative passage of chinook, chum and coho salmon at the Tatlawiksuk River weir. (Solid data points represent observed passage, open data points represent estimated passage.)

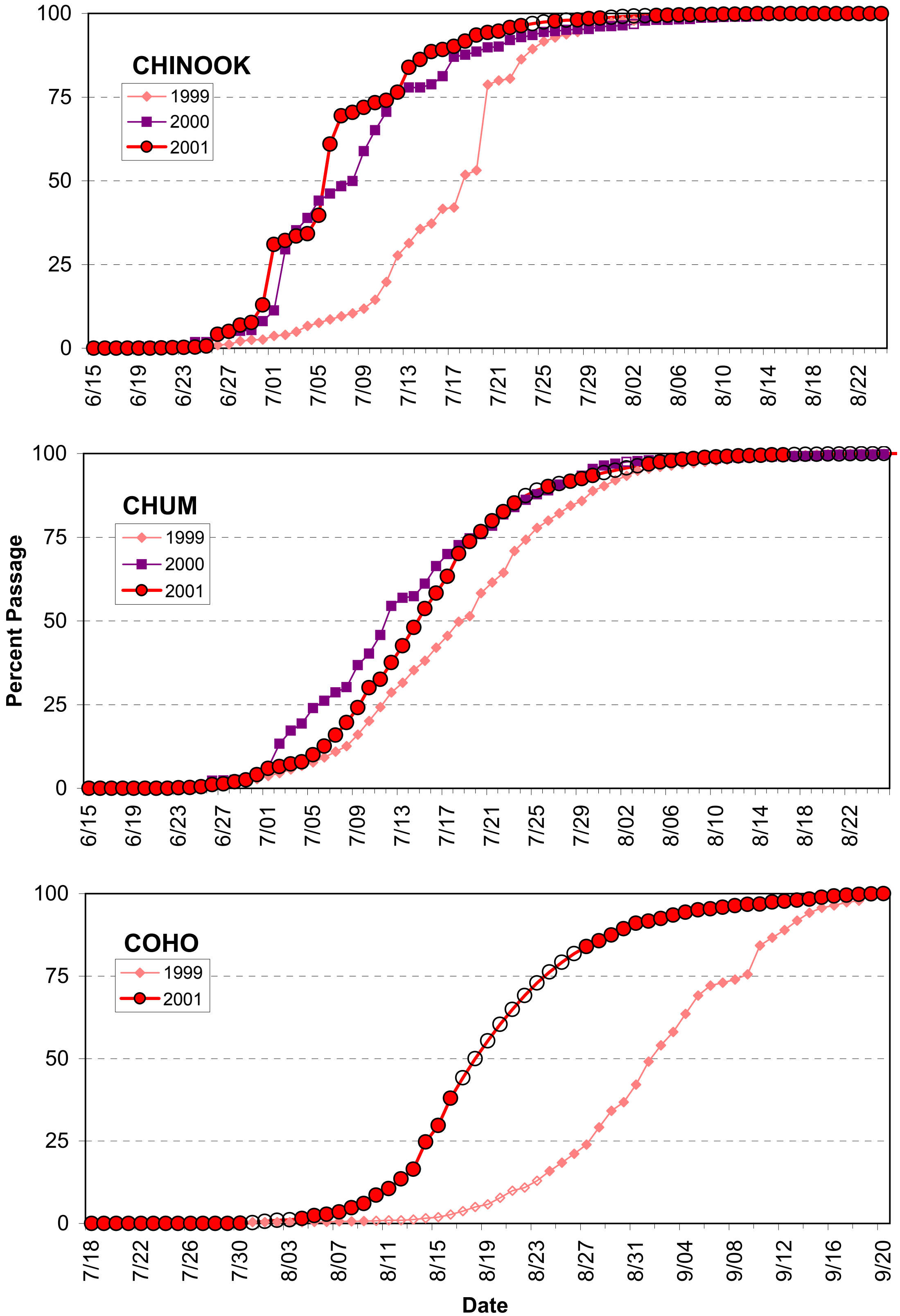

Figure 4. Historical percent passage of chinook, chum and coho salmon at the Tatlawiksuk River weir. (Solid data points represent observed passage, open data points represent estimated passage.)

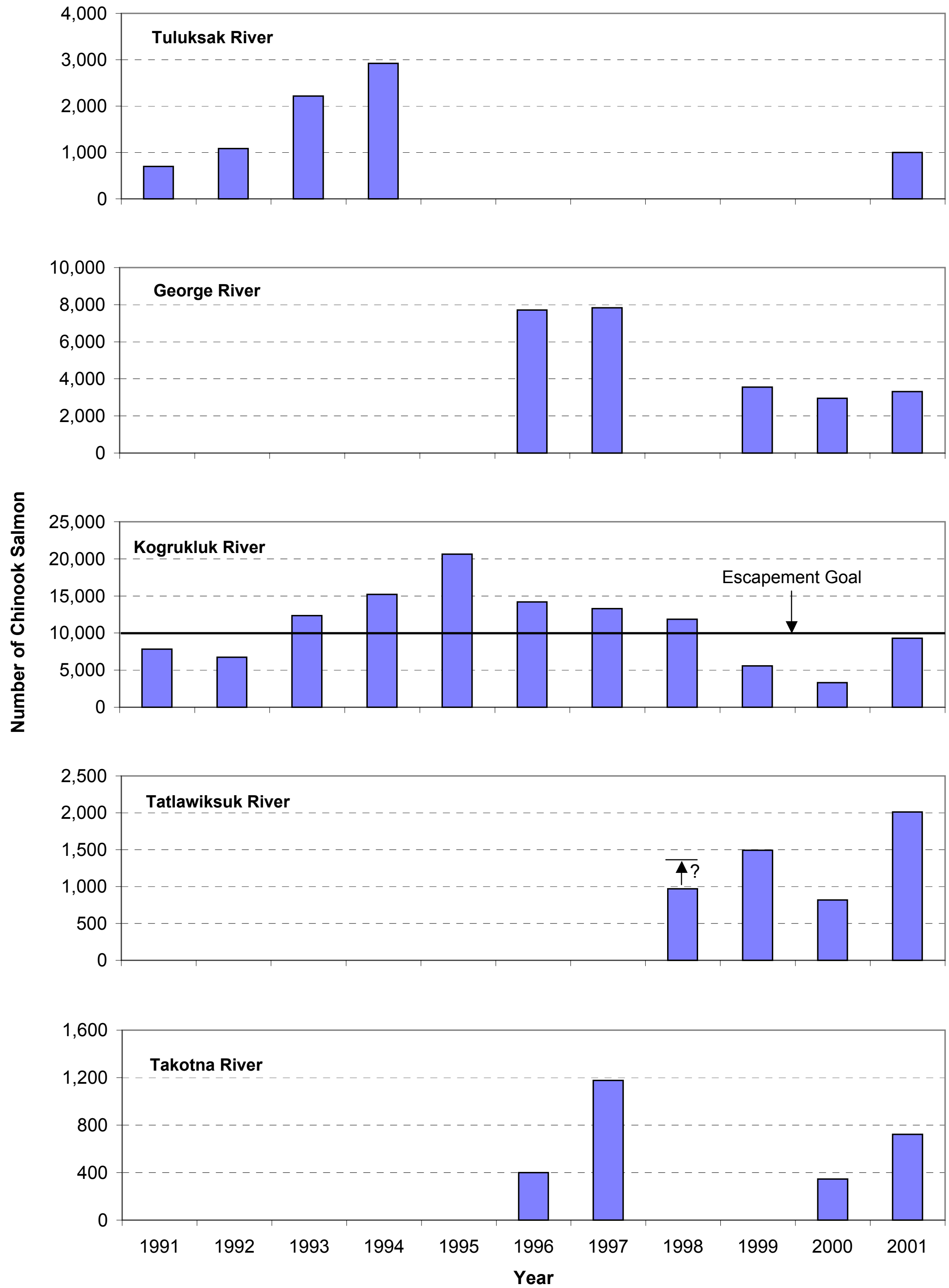

Figure 5. Chinook salmon escapement into five Kuskokwim River tributaries, 1991 - 2001.

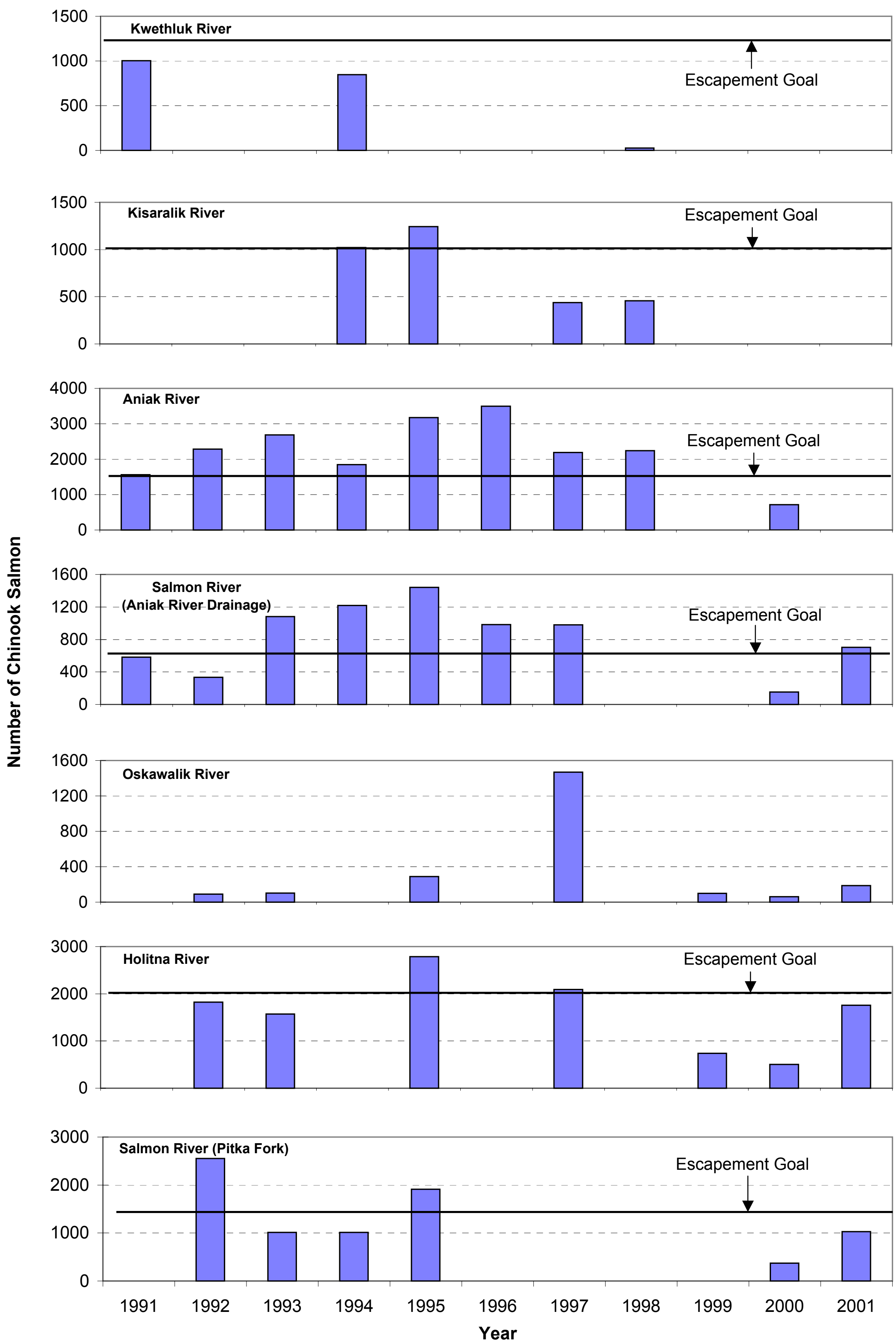

Figure 6. Aerial survey counts of chinook salmon in seven Kuskokwim River tributaries, 1991 - 2001.

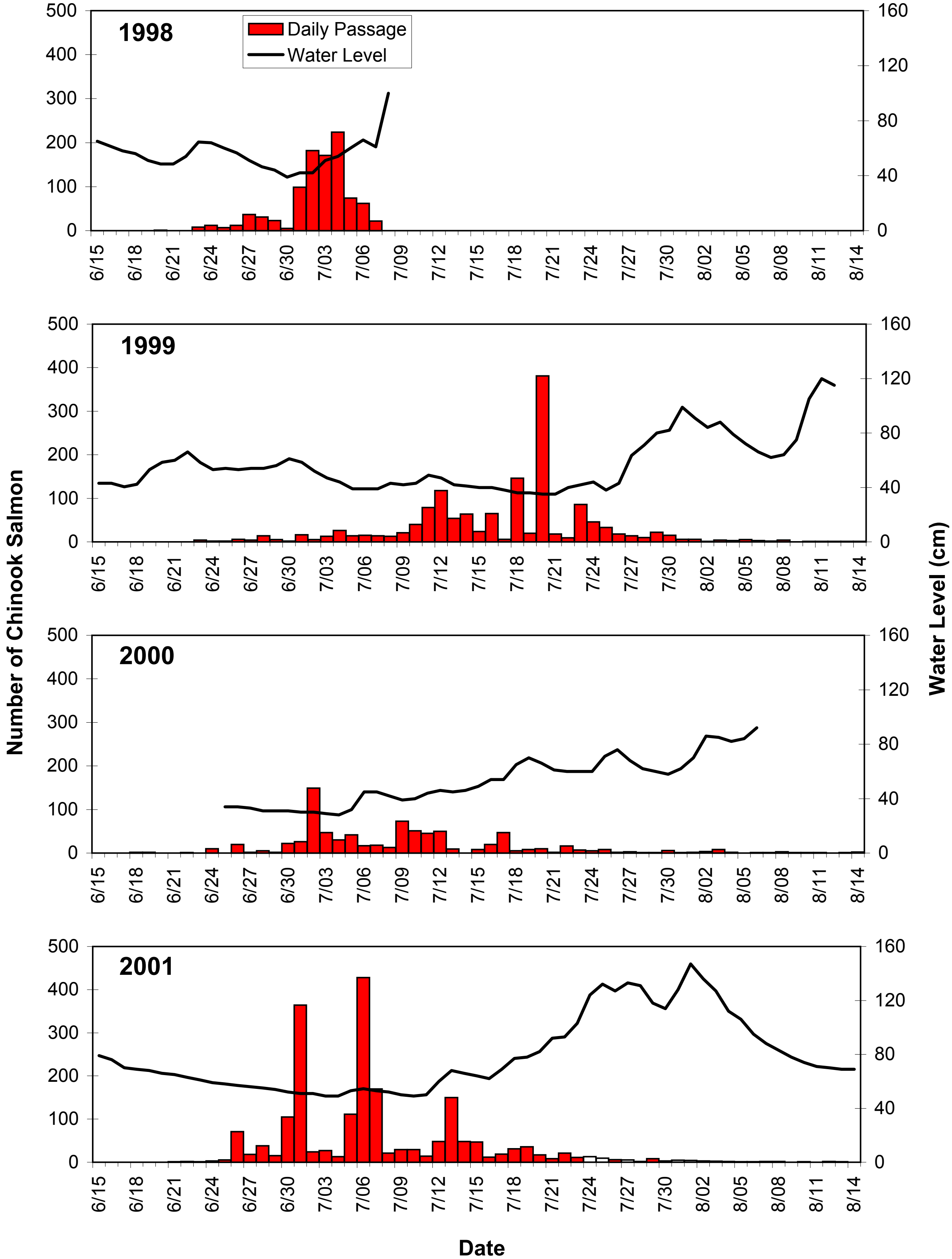

Figure 7. Daily chinook salmon passage relative to daily water level at the Tatlawiksuk River weir, 1998 - 2001. (Solid bars represent observed passage, open bars represent estimated passage.)

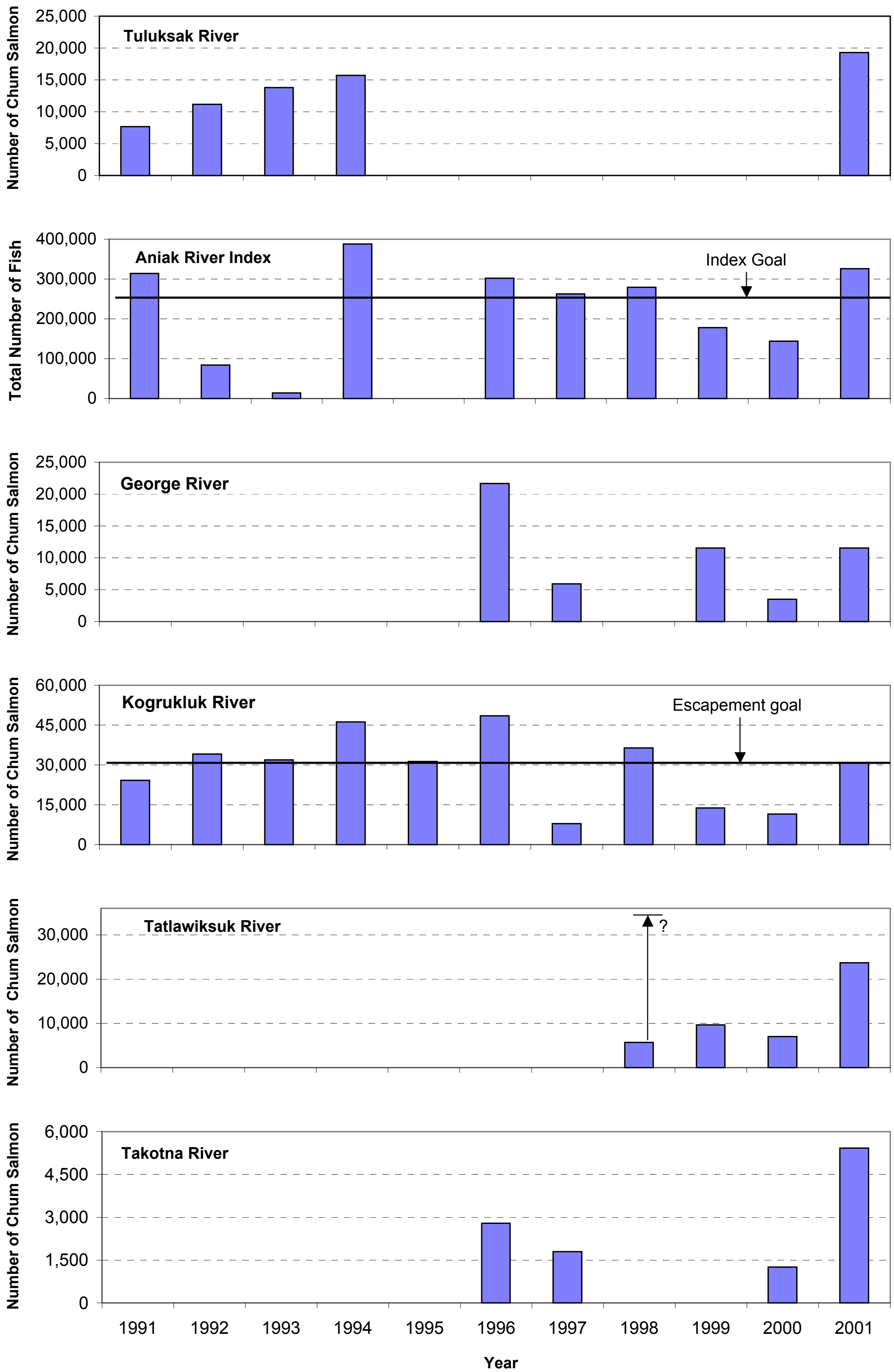

Figure 8. Chum salmon escapement into six Kuskokwim River tributaries, 1991 - 2001.

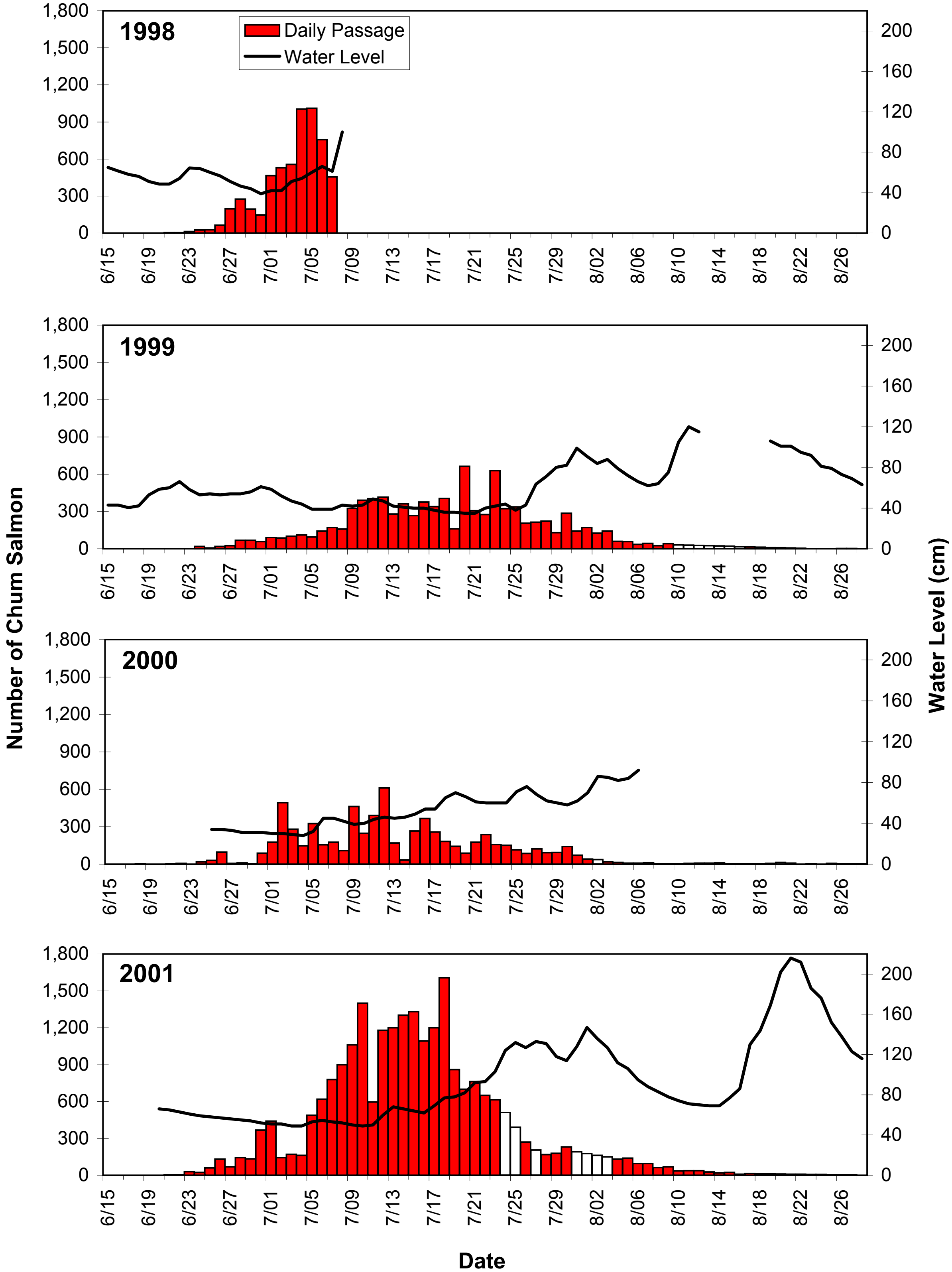

Figure 9. Daily chum salmon passage relative to daily water level at the Tatlawiksuk River weir, 1998 - 2001. (Solid bars represent observed passage, open bars represent estimated passage.)

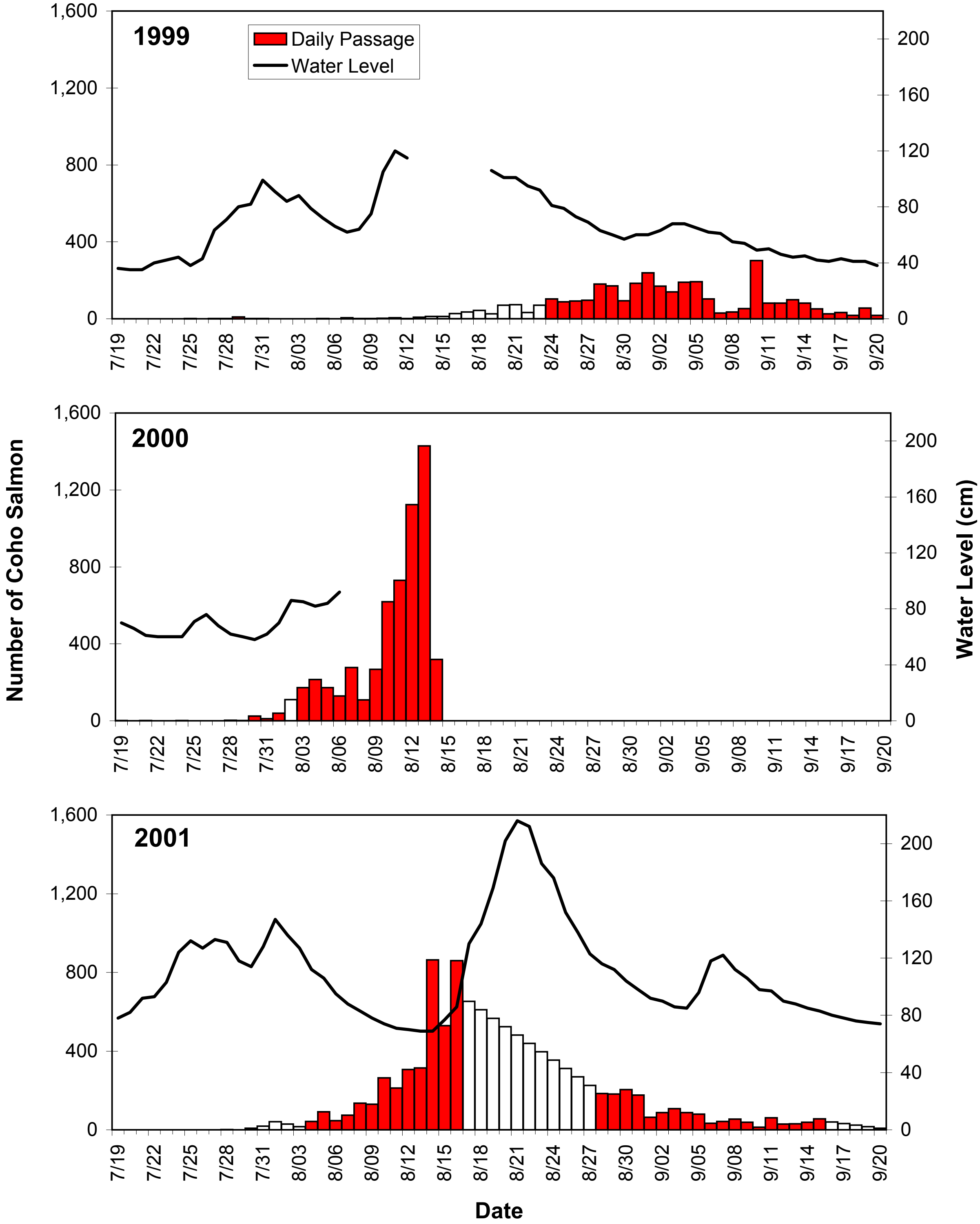

Figure 10. Daily coho salmon passage relative to daily water level at the Tatlawiksuk River weir, 1999 - 2001. (Solid bars represent observed passage, open bars represent estimated passage.)

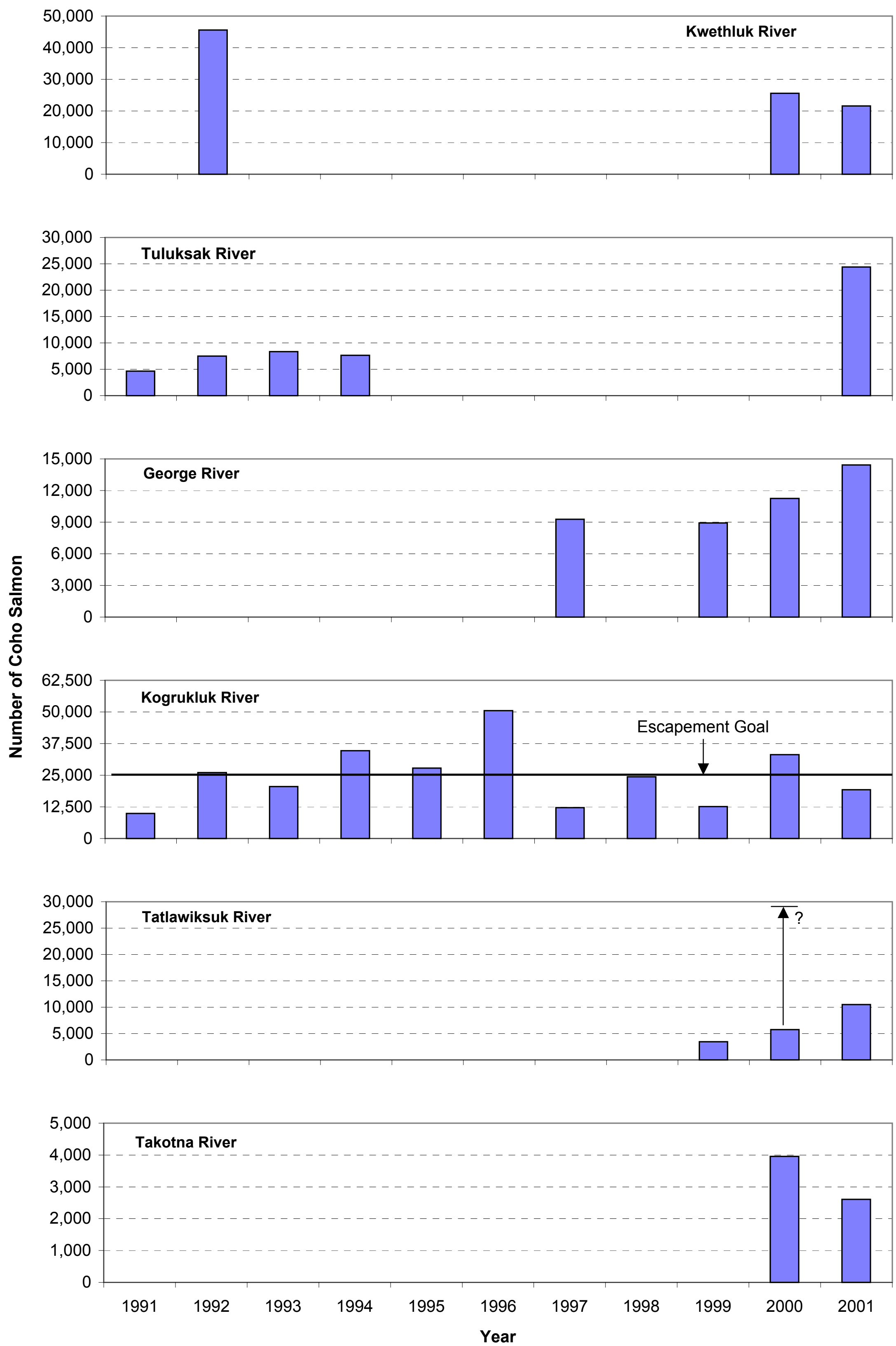

Figure 11. Coho salmon escapement into six Kuskokwim River tributaries, 1991 - 2001.

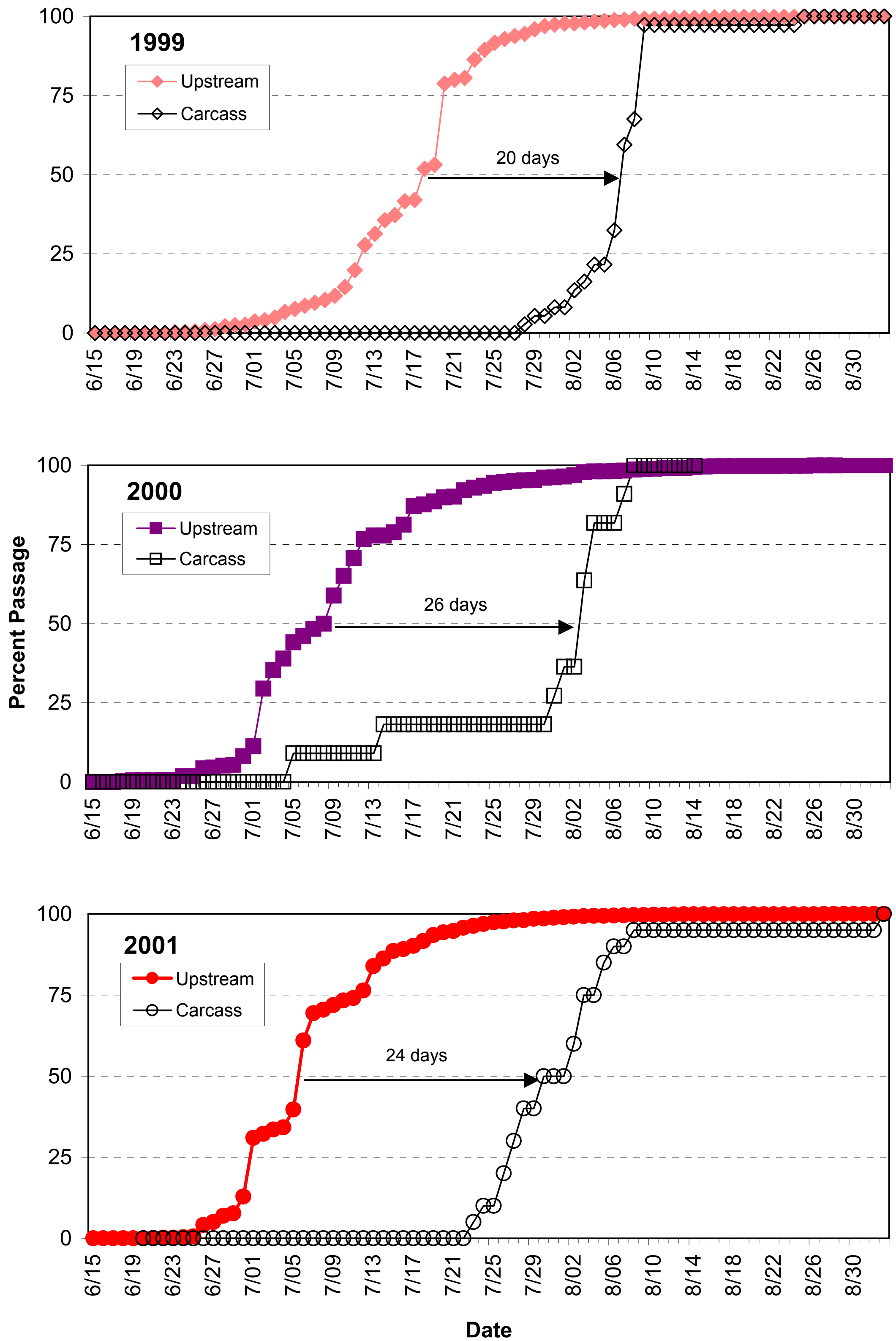

Figure 12. Comparison of percent upstream chinook salmon passage and percent downstream chinook carcass passage at the Tatlawiksuk River weir, 1999 - 2001.

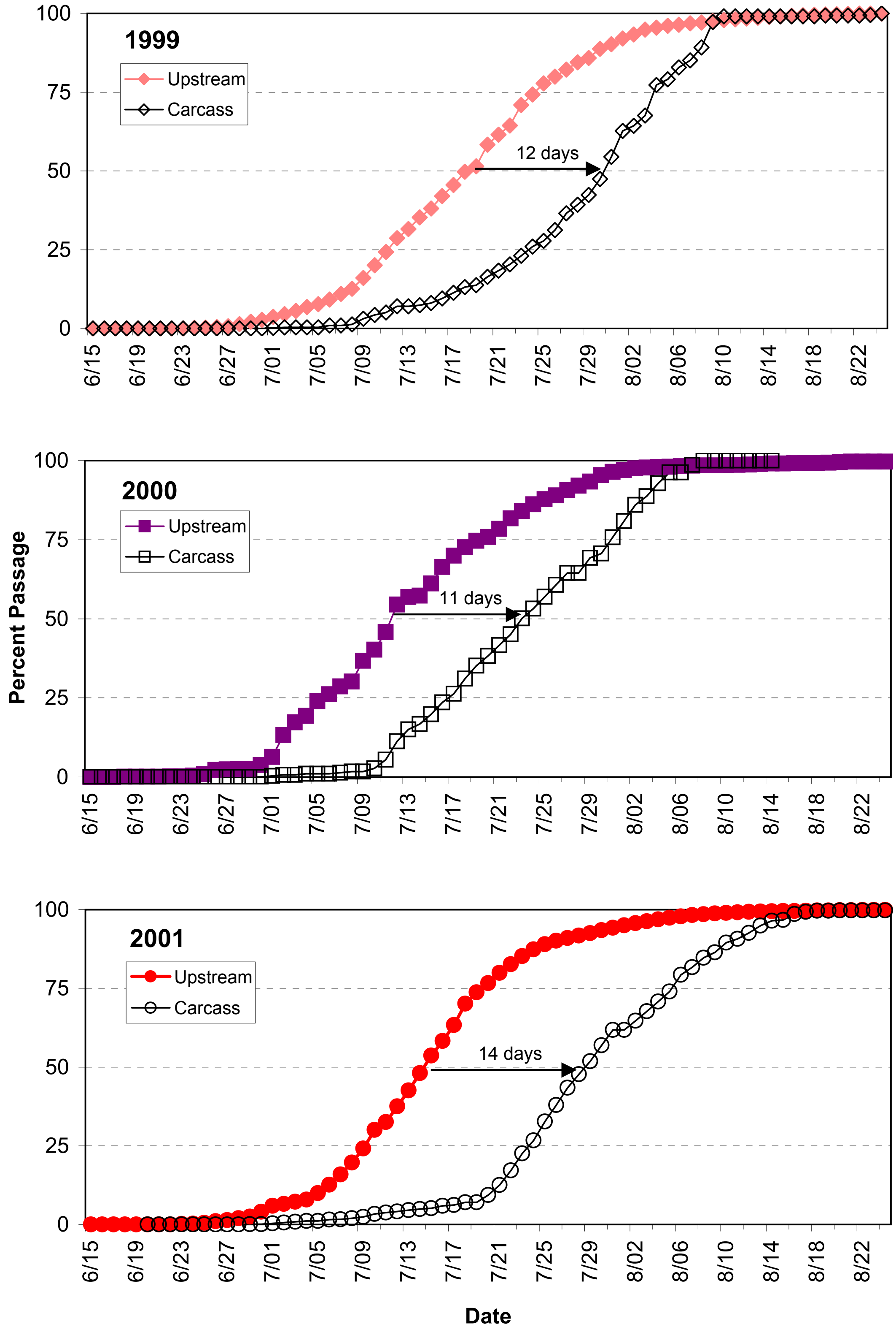

Figure 13. Comparison of percent upstream chum salmon passage and percent downstream chum carcass passage at the Tatlawiksuk River weir, 1999 - 2001.

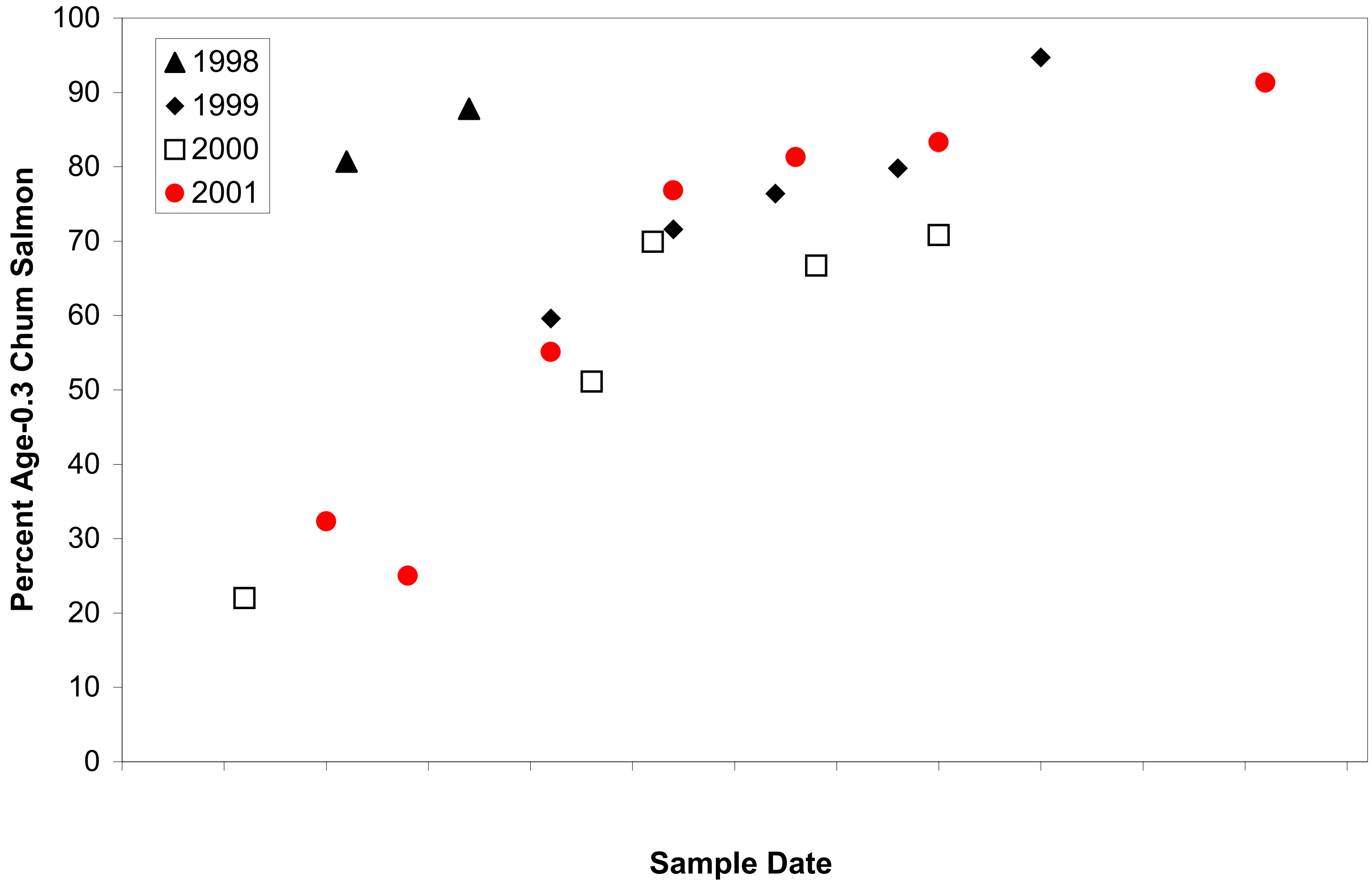

Figure 14. Percentage of age-0.3 chum salmon by sample date at the Tatlawiksuk River weir, 1998 - 2001.

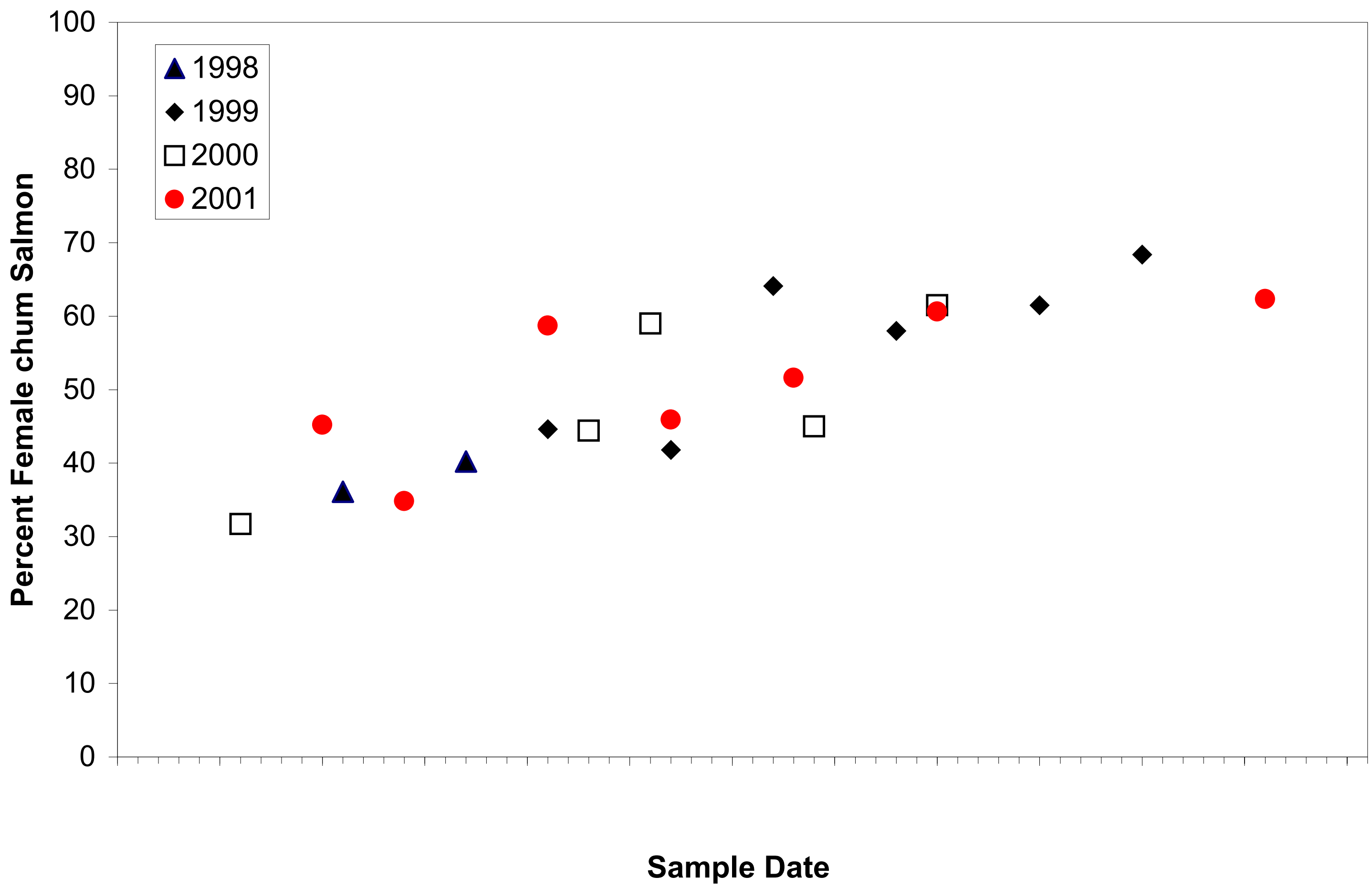

Figure 15. Percentage of female chum salmon by sample date at the Tatlawiksuk River weir, 1998 - 2001.

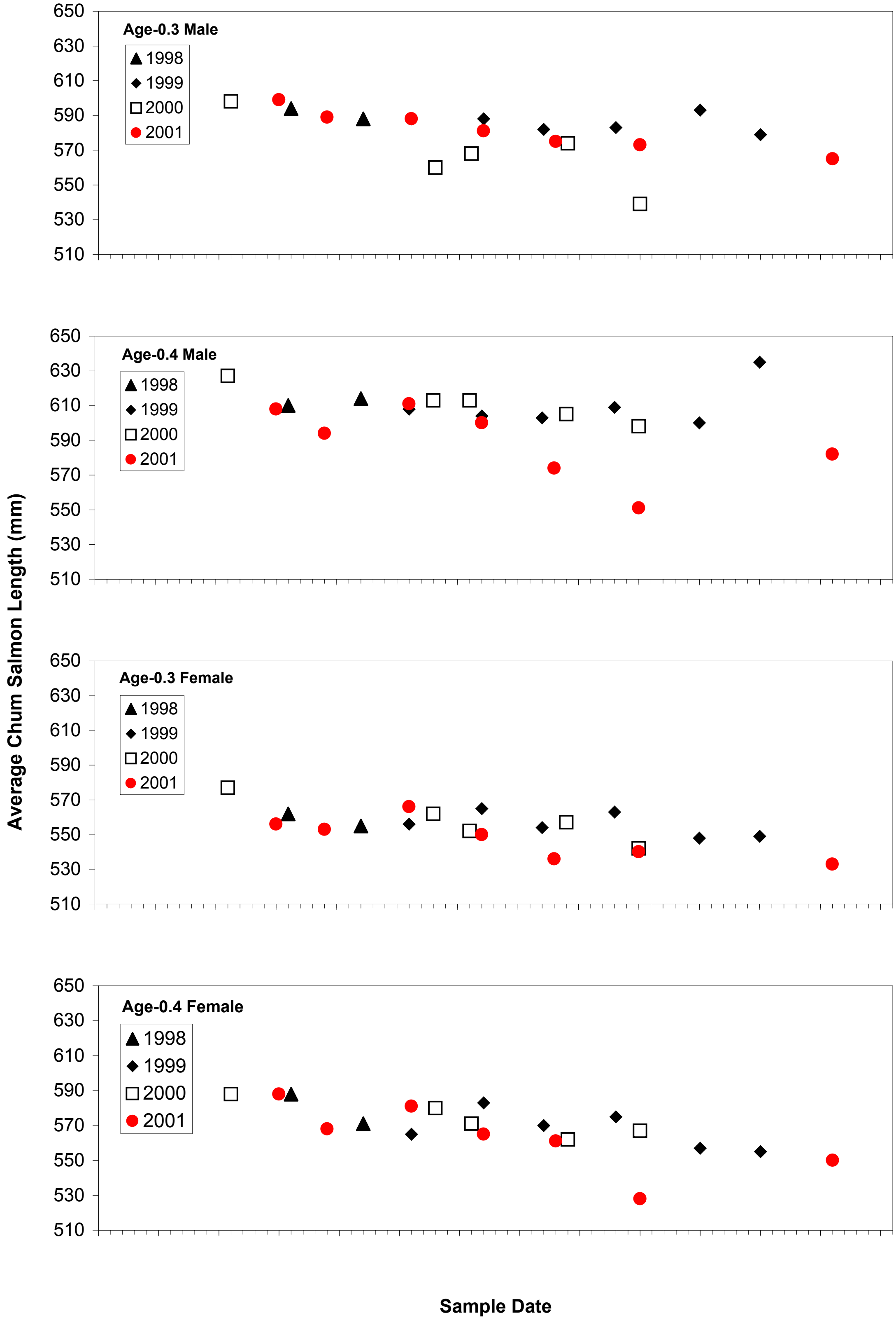

Figure 16. Average length (mm) at age of chum salmon by sample date at the Tatlawiksuk River weir, 1998 - 2001.

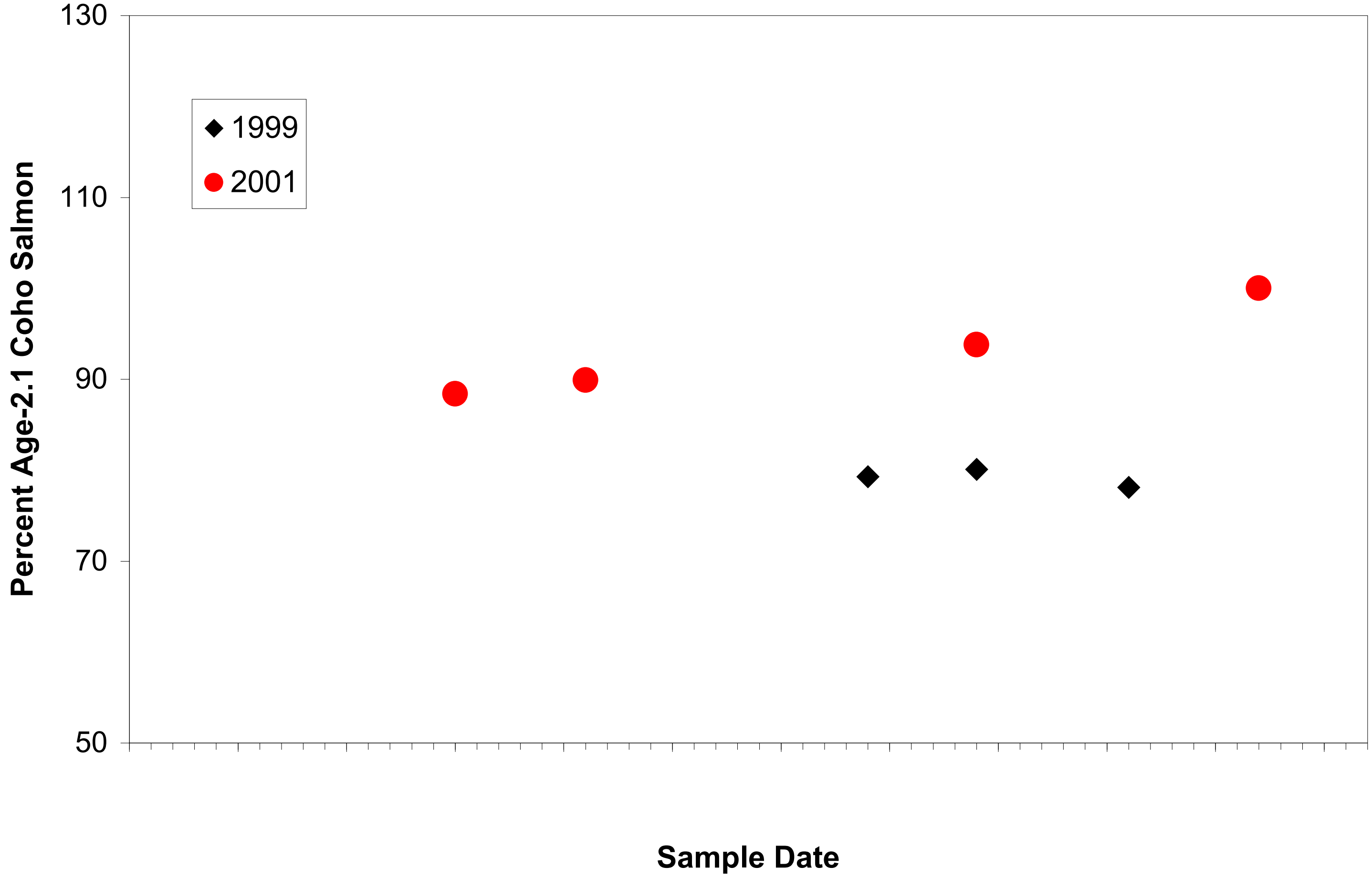

Figure 17. Percentage of age-2.1 coho salmon by sample date at the Tatlawiksuk River weir, 1999 and 2001.

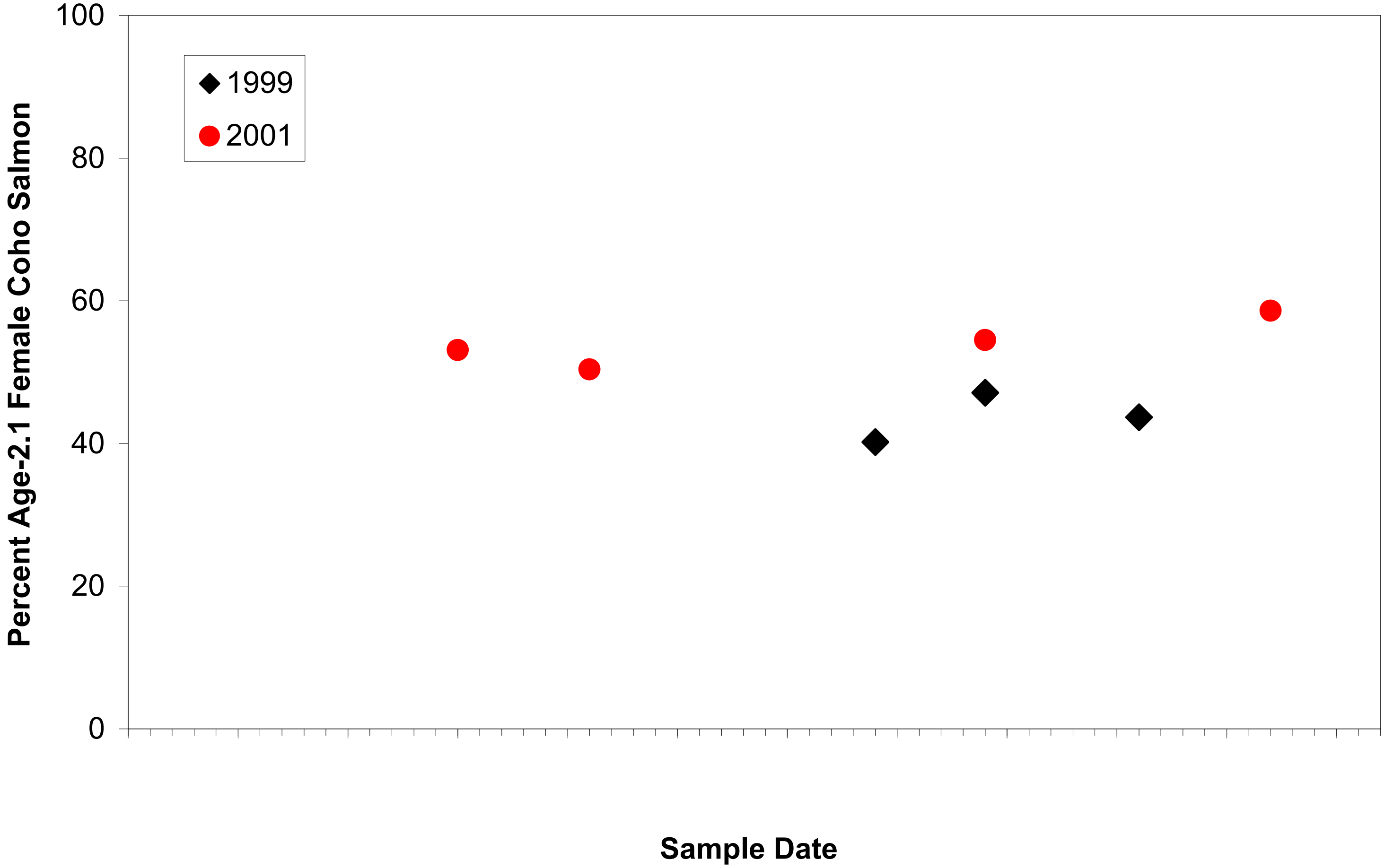

Figure 18. Percentage of age-2.1 female coho salmon by sample date at the Tatlawiksuk River weir, 1999 and 2001.

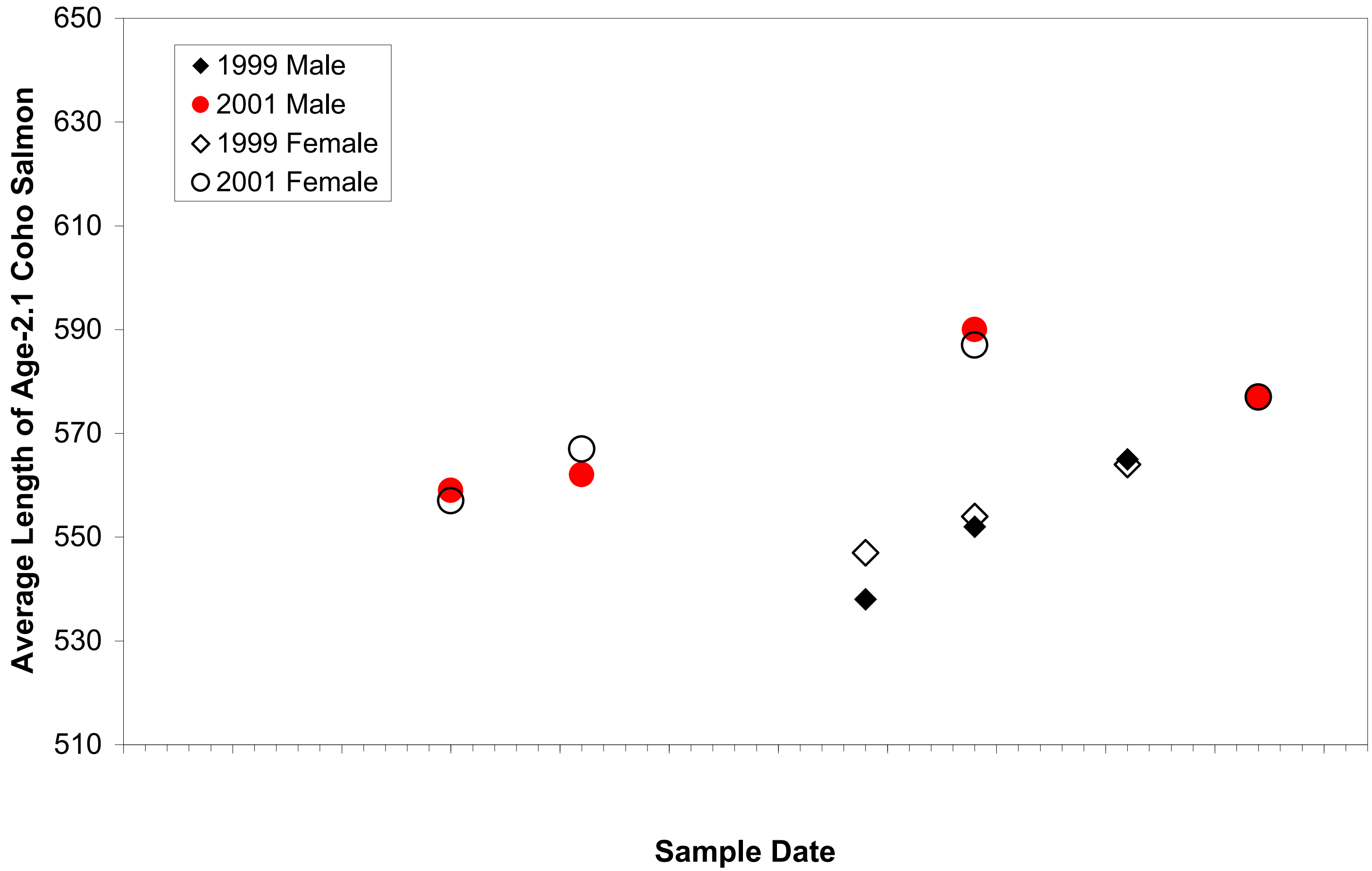

Figure 19. Average length (mm) of age-2.1 coho salmon by sample date at the Tatlawiksuk River weir, 1999 and 2001.

APPENDIX

APPENDIX A:
AERIAL SPAWNING GROUND SURVEY DATA FROM KUSKOKWIM RIVER TRIBUTARIES

Appendix A.1. Peak aerial survey counts of chinook salmon in indexed Kuskokwim River spawning tributaries, 1975 - 2001[a].

Year	Eek	Kwethluk Canyon C.	Kisaralik	Tuluksak	Aniak	Kipchuk (Aniak)	Salmon (Aniak)	Holokuk	Oskawalik	Holitna	Kogrukluk Weir	Cheeneetnuk	Salmon Pitka
1975			118			94		17	71	1,114			
1976				139		177		126	204	2,571	5,579	1,197	1,146
1977		2,290		291			562	60	276			1,399	1,978
1978	1,613	1,732	2,417	403			289			2,766	13,667	267	1,127
1979		911						113			11,338		699
1980	2,378			725			1,186	250	123				1,177
1981		1,783	672		9,074		894				16,655		1,474
1982	230				2,645		185	42	120	521	10,993		419
1983	188	471	731	129	1,909		231	33	52	1,069		243	586
1984		273	157	93	1,409					299	4,926	1,177	577
1985	1,118	629		135				135	61		4,619	1,002	625
1986					909		336	100		850	5,038	381	
1987	1,739	975		60		193	516	208	193	813		317	
1988	2,255	766	840	188	945		244	57	80		8,506		501
1989	1,042	1,157	152		1,880	994	631				11,940		446
1990	1,983	1,295	631	166	1,255	537	596	143	113		10,218		
1991	1,312	1,002		342	1,564	885	583				7,850		
1992					2,284	670	335	64	91	1,822	6,755	1,050	2,555
1993					2,687	1,248	1,082	114	103	1,573	12,332	678	1,012
1994		848	1,021		1,848	1,520	1,218				15,227	1,206	1,010
1995			1,243		3,174	1,215	1,442	181	289	2,787	20,630	1,565	1,911
1996					3,496		983	85			14,199		
1997			439	173	2,187	855	980	165	1,470	2,093	13,280	345	
1998		27	457		2,239	353							
1999								18	98	741	5,570		
2000					714	182	152	42	62	501	3,181		374
2001							703	51	186	1,760	9,294		1,029
BEG[b]		1,200	1,000	400	1,500		600			2,000	10,000		1,300
Median[c]	1,460					670		107	108			1,002	

[a] Estimates are from "peak" aerial surveys conducted between 20 and 31 July under fair, good, or excellent viewing conditions.

[b] From Buklis (1993).

[c] Median of years 1975 through 1994.

Appendix A.2. History of aerial spawnig ground surveys of the Tatlawiksuk River drainage with surveyor comments (Burkey and Salomone 1999).

Date of Survey	Observer	Survey Conditions	Species			Comments
			Chinook	Chum	Coho	
30 July 1997	Tom Cappiello	Poor	415	1,896	0	
28 July 1995	Charlie Burkey	Fair	249	976	0	15 miles along the middle river; water very brown, deep pools obscured. Chum count is low, could only survey top 4 miles of 101 due to dark water. Dark water and cloud cover hampered survey.
31 July 1994	Charlie Burkey	Fair	424	5,219	0	25 miles of middle and lower river; dark brown river bottom and water color. Overcast for part of survey. All decrease ability to see fish. Carcass count is a low estimate. 20-30 king redds without fish on them. Stopped survey 5 air miles from mouth due to dark water color.
28 July 1992	Charlie Burkey	Fair	235	2,400	0	30 miles of middle and lower river; water very dark with tannic acid; not a good river for aerial survey due to dark water
26 July 1987	Dan Scheiderhan	Poor	0	0	0	3 miles; too stained and turbid for survey; suveyed five miles in upper valley. North tributary about five miles from mouth is in similar condition
27 July 1982	Dan Scheiderhan	Poor				water high and muddy
07 August 1981	Dan Scheiderhan	Poor	35	48		40 miles of middle and lower river; foothills to 1,465 foot peak
20 July 1980	Rae Baxter					too stained; thousands of chum in tributary creek on south river
29 July 1978	Dan Scheiderhan	Poor	86	38	0	35 miles of middle and lower river; foothills to 1,465 foot peak; water with high dissolved organic material; dark coffee color makes visibility low
22 July 1977	Gary Schaefer	Poor	191	6,430	0	35 miles of middle and lower river; foothills to 1,465 foot peak lower 5 miles too turbid to survey; difficult to survey - very twisted and brown stained; counts minimal.
30 September 1976	Gary Schaefer	Fair	0	0	31	80 miles; Pete Shepards cabin to mouth
24 July 1976	Gary Schaefer	Fair	212	5,600	31	80 miles; Pete Shepards cabin to mouth
24 July 1968	Rae Baxter	Poor	58	3,000	0	35 miles; little good gravel

APPENDIX B:
ADF&G MEMORANDUM REGARDING THE 1997 WEIR SITE SURVEY OF THE TATLAWIKSUK RIVER

APPENDIX C:
DATA FORMS USED FOR THE TATLAWIKSUK RIVER WEIR PROJECT