**Fishery Data Series No. 00-16**

# Southeast Alaska Steelhead Studies, 1999: Situk River Weir and Surveys of Regional Index Streams

**by**

**Robert E. Johnson**

**and**

**J. Douglas Jones**

**September 2000**

**Alaska Department of Fish and Game** **Division of Sport Fish**

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**Weights and measures (metric)**

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

**Weights and measures (English)**

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

Spell out acre and ton.

**Time and temperature**

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

Spell out year, month, and week.

**Physics and chemistry**

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

**General**

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

**Mathematics, statistics, fisheries**

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

*FISHERY DATA SERIES NO. 00-16*

# SOUTHEAST ALASKA STEELHEAD STUDIES, 1999: SITUK RIVER WEIR AND SURVEYS OF REGIONAL INDEX STREAMS

by

Robert E. Johnson
*Division of Sport Fish, Yakutat*
and
J. Douglas Jones
*Division of Sport Fish, Douglas*

Alaska Department of Fish and Game
Division of Sport Fish
P. O. Box 240020
Douglas, AK 99824-0020

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*Robert E. Johnson*
*Alaska Department of Fish and Game, Division of Sport Fish, Region I*
*P. O. Box 49, Yakutat, AK 99689-0049, USA*

*J. Douglas Jones*
*Alaska Department of Fish and Game, Division of Sport Fish, Region I*
*P. O. Box 240020, Douglas, AK 99824-0020, USA*

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# ABSTRACT

Regionwide monitoring of trends in steelhead *Oncorhynchus mykiss* spawning abundance in 12 index streams in Southeast Alaska was continued in 1999. Each of these index streams was surveyed for steelhead abundance by a two- or three-person team using snorkel gear during April and May 1999. Peak steelhead counts in these 12 systems totaled 1,005 which was similar to the 1998 total (998) but 34% less than in 1997 (1,505). Due to high spring water levels in 1999, survey conditions were generally poor and some streams could not be surveyed as frequently as planned. It is therefore likely that the 1999 counts were negatively biased by these factors.

The Situk River produces the largest run of steelhead in Southeast Alaska. Between 9 May and 6 August 1999, 9,204 steelhead were counted as they emigrated downstream through a weir located about 2 km upstream of the Lower Landing on the Situk River. This count was an increase of 59% from the steelhead escapement in 1998 and also was the largest count since the 1950's. Float surveys on the Situk River downstream of Nine Mile bridge counted a maximum of 3,778 steelhead, 41% of the total counted at the weir.

The average total lengths of female and male steelhead from the Situk River were 792 mm (SE = 3) and 799 mm (SE = 4), respectively. Of the 697 fish sampled, 17 or 2% were ≥36 inches (914 mm) in total length; 7 of these were female and 10 were male.



Key words: steelhead, *Oncorhynchus mykiss*, emigration, abundance, Situk River, Eagle Creek, Harris River, Humpback Creek, Ketchikan Creek, McDonald Lake, White River, Marten Creek, Petersburg Creek, Sitkoh Creek, Ford Arm Creek, Peterson Creek, Pleasant Bay Creek, weir, timing, sex, length, abundance indices, snorkel survey, index stream.


# INTRODUCTION

Southeast Alaska has 331 identified steelhead *Oncorhynchus mykiss* populations, most of which are believed to contain 200 or fewer spawning adults. Major sport fisheries occur on larger systems such as the Naha, Karta, and Thorne rivers near Ketchikan, which support up to 1,000 spawning steelhead, and on the Situk River, which supports annual returns of 3,000 to 8,000 or more steelhead. Steelhead harvests in Southeast Alaska generally increased from the late 1970s through 1989, but then began to decline (Mills 1993). As fishery managers and participants reported lower escapements, an emergency order prohibiting steelhead harvests in the Situk River was enacted in 1991. In 1992, harvests were prohibited by emergency order in 24 popular systems, and in 1993 the Situk and 47 other systems were closed to steelhead harvest. In 1994, the Alaska Board of Fisheries enacted conservative regulations for steelhead in Southeast Alaska, and since 1994, anglers have been limited regionwide to a harvest of 2 steelhead per year with a minimum size limit of 36 inches (914 mm).

Intensive research on steelhead stocks in Southeast Alaska has largely been limited to Petersburg Creek (Jones 1972–1976, 1983) and the Situk River (Johnson 1990, 1991, 1996; Didier and Marshall 1991; Johnson and Marshall 1991; Glynn 1992; Glynn and Elliott 1993). Estimates of migratory timing, abundance, and age composition have also been made in a few other systems (Harding and Jones 1990, 1991, 1992; Jones et al. 1991; Yanusz 1997). Creel surveys of steelhead fisheries have also been conducted (Freeman and Hoffman 1989, 1990, 1991; Hubartt 1989, 1990; Hoffman et al. 1990; Harding and Jones 1991, 1993, 1994; Schmidt 1992), and enhancement has been studied in one system (Freeman 1992, 1995).

Although a few counts of steelhead in selected systems had been made for many years, in 1994, systematic foot surveys were initiated to monitor annual trends in peak escapement in 17 streams. Since then, survey methodology has evolved, and the streams and reaches selected to survey have changed as observers gained experience with each system (Johnson and Jones 1998, 1999). The 12 steelhead streams picked for survey in 1999 were dispersed across Southeast Alaska (Figure 1).

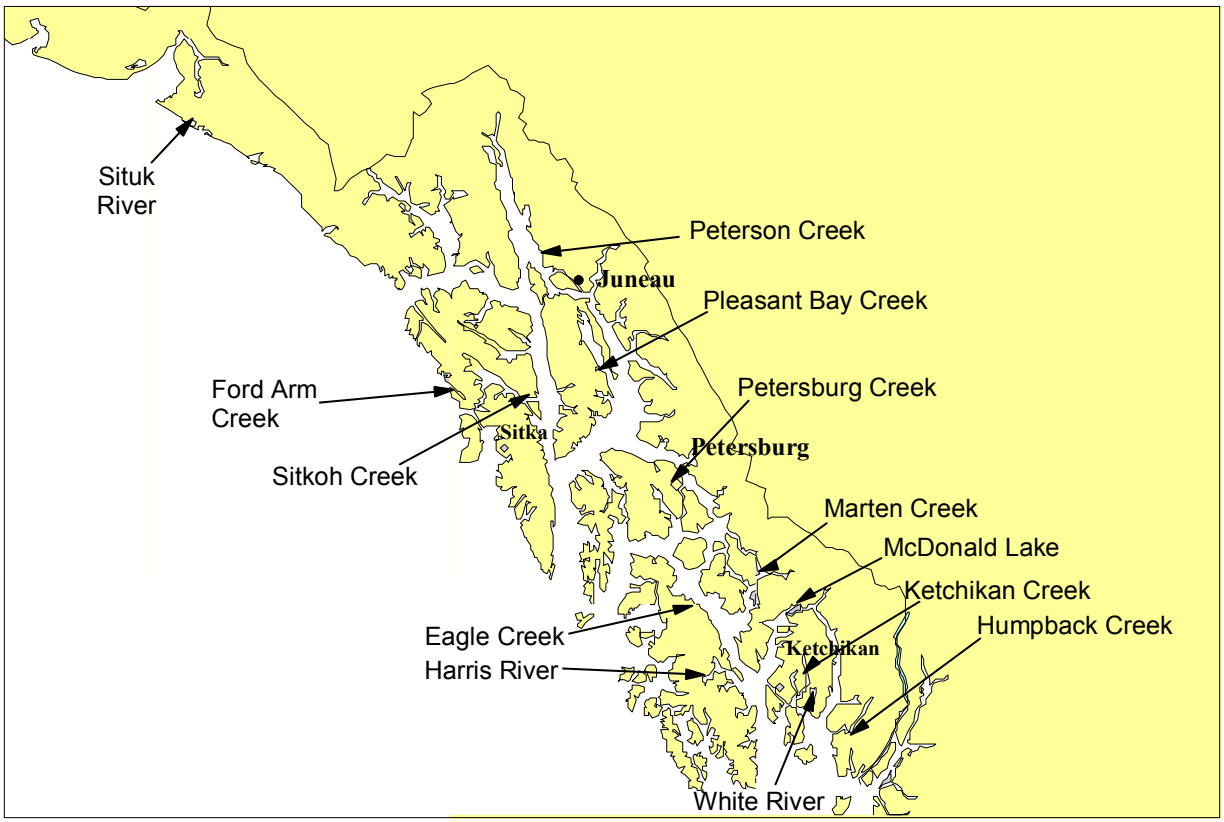


**Figure 1.–Steelhead index systems in Southeast Alaska surveyed in 1999.**

Substantial changes in survey methods were instituted in 1997 to increase the proportion of steelhead observed in index streams and to better identify dates of peak instream abundance (Johnson and Jones 1998). Shardlow et al. (1987) found that among the most common survey methods, snorkel surveys by experienced observers yield the highest counts. During late April through May 1999, the primary objective of the steelhead survey project was to count by weekly snorkel surveys the number of steelhead in standardized sections of these 12 index streams.

As noted above, the Situk River has the largest steelhead run in Southeast Alaska, and studies were intensified in 1994 to provide consistent long-term assessment of this stock (Johnson 1996; Johnson and Jones 1998, 1999). Located east of Yakutat, the Situk River is 35.2 km long and drains 2 lakes with a combined surface area of about 397 ha (Figure 2). Prior to 1993, counts of Situk River steelhead were recorded incidentally at a weir installed 1.9 km (river mile1.2) upstream of Lower Landing for the purpose of counting sockeye *O. nerka* and chinook salmon *O. tshawytscha* (Figure 2). These counts of steelhead were considered incomplete counts of total abundance, as the migratory timing of the target salmon species only partially overlapped that of the emigrating steelhead. Sonar was also used to count Situk River steelhead immigrants in 1989 and 1990 but was too labor-intensive to be readily implemented on an annual basis (Johnson 1990, 1991).

A weir was installed specifically to count emigrant steelhead in 1993, but spring floods washed out the weir and prevented a complete count. Annual weir counts have since been complete, primarily because in 1995, a resistance

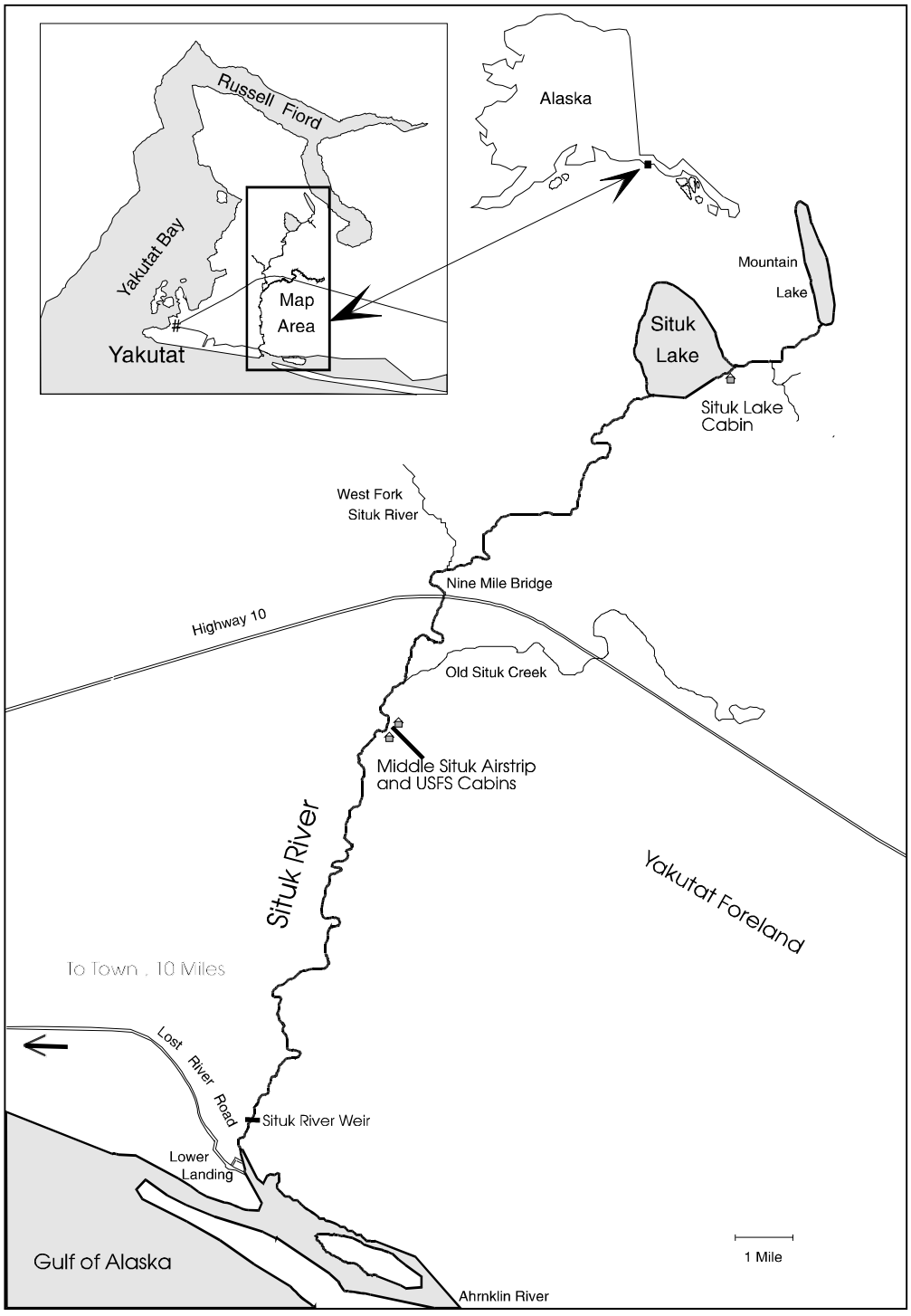


**Figure 2.–Location of weir used to count emigrating steelhead from the Situk River drainage, Southeast Alaska, 1999.**

board weir was installed which withstands most flooding events.

Because the Situk River is relatively wide and shallow, steelhead kelts are not easily captured at the weir. Furthermore, capturing all emigrants at the Situk River weir without affecting run timing and mortality while staying within budgetary constraints does not appear to be possible. However, significant hardware modifications improving capture and holding capabilities were implemented in 1997–1998 (Johnson and Jones 1998, 1999). On three occasions during each of those 2 years, all (or most) emigrating steelhead were sampled in discrete batches over an entire evening's emigration. Differences were noted between those fish emigrating during the early evening and the late part of the evening. In general, large fish, exhibiting fungal growth and darker coloration, were the first fish to pass through the weir during these "total" sample events. More importantly, there were substantial differences in sex composition between the 2 time periods early in the season. These differences would lead to biased estimates for the season if corrective procedures were not implemented. As a result, fish from both the early evening and late evening portions of the emigration were sampled to estimate sex and length composition objectives. We also wanted to determine what proportion of fish had obtained the minimum legal size for harvest (36 inches).

The Situk River portion of this study thus had three objectives: (1) count emigrant steelhead past a weir; (2) estimate the proportion of emigrant steelhead ≥36 inches in total length; and (3) estimate the sex and length composition of emigrant steelhead.

Long-term data for Situk steelhead escapements also include indices of abundance obtained from float survey counts. Overall, float surveys of the entire river, under favorable conditions, count about 70% of the kelt emigration (Johnson and Jones 1999).

Although affected by generally high water levels and access restrictions on the upper river due to deep snow in 1999, we were able to make 2 lower river float counts for comparison with weir counts of emigrant steelhead. These data will help estimate an expansion factor and associated variance for estimating steelhead abundance if weir counts of the total run are unavailable.

# METHODS

## SOUTHEAST ALASKA SNORKEL SURVEYS

Snorkel surveys were scheduled to provide indices of peak steelhead abundance for 12 streams in Southeast Alaska in 1999 (Figure 1). These streams had all been surveyed for steelhead in 1997 and 1998 (Johnson and Jones 1998, 1999). As in 1997 and 1998, index streams were surveyed weekly, up to 4 times (depending on the stream), from late April through May when instream abundance was expected to peak. If the peak count occurred during the last survey, an additional survey was scheduled. If a survey was missed because of unsuitable weather, the missed survey was performed as soon as conditions permitted, and the survey schedule was adjusted as possible so that a near-weekly counting interval was maintained. Snorkel surveys of Steelhead Creek and 12-Mile Creek on Prince of Wales Island, and Starrigavan Creek near Sitka were also conducted to evaluate their potential use as index systems.

Surveys were conducted by at least 2 employees wearing dry suits and snorkel gear. One surveyor was always a senior, trained observer. Data from each survey in each stream were recorded by discrete sections (reaches) of the river. If a shoreside (third) party was available, counts were verbally conveyed to them, and they tabulated and then recorded the counts by reach as the survey progressed. When a shoreside party was not available, one or both snorkelers recorded the counts by reach with a waterproof (wax-based) marker on a small plastic diver's slate until it could be transcribed to conventional data forms.

Observers, as a team, counted all steelhead observed during the survey. The surveyors attempted to stay abreast of each other in the stream and coordinated their observations to obtain maximum coverage. When passing through high concentrations of steelhead, both observers counted the number of steelhead in their area of responsibility before consulting with each other on their counts. If either or both surveyors felt that a questionable count was made in a particular

pool or stretch of river, the area was recounted. Since steelhead were often not too disturbed, recounts of a pool or run were usually possible.

The level of surface illumination, subsurface light transmission at a depth of 0.5 meters, surface water temperature in degrees Celsius (°C), and weather conditions (cloud cover, wind, and precipitation) were recorded at the beginning of the survey. Surface illumination and subsurface light transmission were recorded using a Sekonic L-188WH light meter protected by a waterproof underwater housing. The meter was set to an ASA value of 100, and the EV (exposure value) scale at the bottom of the light meter was recorded. On each index system, water levels were recorded at a permanent benchmark established in 1997. This benchmark was either a permanent mark on a bridge abutment, a USGS gauging station, or a mark carved in bedrock.

## SITUK RIVER WEIR STUDIES

A bipod and picket weir with a center "resistance board" section about 40 ft wide was installed on the Situk River 1.2 mi (1.9 km) upstream of the Lower Landing (Figure 2) and made "fish tight" on the evening of 9 May. Each day, steelhead were counted as they passed downstream through an opening in the resistance board section. On designated days, steelhead were to be sampled for biological information in a downstream weir trap.

In general, steelhead emigrated through the weir during the darkest hours (i.e., the highest rate of fish passage occurred between 2200 and 0200 hours). The low ambient light during these hours was supplemented by artificial light from three 300-watt electric lights hung from a cable spanning the river about 20 ft above normal water level. The lights illuminated the width of the trap opening in a band about 20 ft wide. Light intensity was kept at a low level, allowing observation of fish while minimizing behavioral changes in emigrating steelhead.

Emigrant kelts were funneled through a 7 ft wide weir opening into a three section trap downstream of the weir. The primary trap below the weir opening was 8 ft wide and 16 ft long. Two adjoining 8 ft × 8 ft holding pens interconnected via sliding "guillotine" type doors. Steelhead entered the trap from upstream through a "V" shaped chute equipped with a manually operated trap door. The three-section trap design allowed segregation of discrete groups of fish captured during a single night.

To satisfy precision levels established for the project, 612 steelhead were to be sampled for scales, length, and sex over the entire emigration (Cochran 1977). To reach that goal, samples were to be collected twice a week (Monday and Thursday). A sampling goal for the week was to be estimated each Monday from current weir counts and the average cumulative proportions sampled over the past 4 years at a similar point in the emigration. Technicians were to attempt collection of 50% of the weekly sample during the early portion of the daily emigration (on Monday night) and 50% during the late portion of the daily emigration (on Thursday night). If less than 25% of the goal for the week (50% for the day) was obtained during the first early or late portion sampling day, then the emigration was to be sampled on the following night. When emigration rates were very low (as in the first and last several weeks when daily rates were only a few fish per night), all of the emigrants that could easily be trapped were to be sampled. On Monday evenings, an "early" sample was to be collected by sampling the first fish to enter the trap (minus the weak fish that accumulated during the day above the weir) prior to opening the weir. On Thursday, the "late" portion of the evening emigration was to be sampled.

High water levels, however, were a dominant environmental factor on the Situk River prior to mid-June. When water levels finally dropped, fish suddenly began emigrating in large numbers. As a result, we modified our sampling design to include sampling each day (instead of Monday and Thursday). This plan was similar to 1998 sampling, with the exception that we sampled the early and late portions of the evening emigration on alternating evenings. The trap was left open as long as possible during each of these portions of the evening to insure that the largest possible fraction of the daily emigration was sampled. Because most (93%) of the samples were collected in a relatively short time period (14 days), all biological data were pooled for analysis.

Biological measurements taken from each fish included sex, total length (TL) to nearest 5 mm, and color classification. Color classifications included bright, medium, or dark. Presence or absence of fungus was also noted on each fish, and any wounds or scars were also noted and classified to general type. Four scales were taken from the "preferred" area on both sides of the fish (Welander 1940).

The sex composition of emigrants was estimated:

$$\hat{p}_a = \frac{n_a}{n} \tag{1}$$

$$\mathrm{var}(\hat{p}_a) = \left(1 - \frac{n}{N}\right) \frac{\hat{p}_a(1-\hat{p}_a)}{n-1} \tag{2}$$

where $p_a$ = proportion of the population with estimated sex $a$, $n_a$ = number sampled fish with estimated sex $a$, $n$ = number of fish sampled for sex, and $N$ = number of fish counted at the weir. Because all (or most) emigrants were enumerated, an fpc (finite population correction) = (1-$n/N$) was included in the estimator. The standard error of $p_a$ is $\mathrm{var}(\hat{p}_a)^{1/2}$.

The mean length (y) of emigrants was estimated:

$$\bar{y} = \frac{1}{n}\sum_i y_i \tag{3}$$

$$\mathrm{var}(\bar{y}) = \left(1 - \frac{n}{N}\right) \frac{\sum_i (y_i - \bar{y})^2}{n(n-1)} \tag{4}$$

where $i$ denotes an individual fish. An fpc was again used since all fish were counted at the weir. The standard error $se(\bar{y}) = \mathrm{var}(\bar{y})^{1/2}$. Another statistic, the standard deviation $sd(y)$ was also calculated as a measure of the dispersion of the $y$ values:

$$sd(y) = \left(\sum (y_i - \bar{y})^2 / (n-1)\right)^{1/2} \tag{5}$$

### SITUK RIVER FLOAT COUNTS

Deep snow and high water conditions during the spring of 1999 prevented a complete float survey (Situk Lake downstream to the Lower Landing), and only 2 float surveys of the lower river (Nine Mile bridge to the Lower Landing) were completed. Survey timing was based on peak steelhead counts obtained during past float surveys. To further study steelhead distribution during float counts, the Situk River was divided into 22 sections: 9 in the upper river and 13 in the lower river (see Appendix A2 of Johnson and Jones 1998). The beginning and end of each section was based on prominent, easily distinguished features. The length in miles of each section was measured from aerial photographs. Float survey procedures are presented in Johnson and Jones (1998).

## RESULTS

### SOUTHEAST ALASKA SNORKEL SURVEYS

Thirty-two snorkel surveys were conducted on the twelve index streams during April and May, 1999 (Table 1 and Appendix A1). Peak steelhead counts ranged from 4 in Humpback Creek to 192 in Harris River. The number of surveys made on index systems ranged from 1 in White River to 5 on Eagle Creek. Only 2 counts or less were made on 5 of the 12 streams, which was less than the 3 or 4 minimum desired. This was due to high water conditions which were a result of heavier than normal snow levels and a warm and wet spring. Safety of the snorkeling crew was a primary concern so many surveys had to be cancelled for safety concerns.

In addition, snorkel counts were made in 3 other systems which were candidates for the index in the future. Twenty steelhead were recorded on 30 April in 12-Mile Creek and 53 in Steelhead Creek on 9 May (Appendix A1). Foot or foot/snorkel surveys on 5 May and 13 May yielded counts of 11 and 18 steelhead, respectively, in Starrigavan Creek. Only Steelhead Creek on Prince of Wales Island appeared to be a good candidate for future inclusion as a steelhead index stream. Starrigavan Creek has been logged extensively, and there is considerable blow-down in the stream, making snorkel counts almost impossible. Dark and slow-moving water in 12-Mile Creek made this creek unsuitable as an index system because fish were very difficult to

**Table 1.–Index streams for steelhead surveyed along with dates of peak counts and peak numbers of steelhead counted, 1999.**

| STREAM NAME | NO. OF SURVEYS | PEAK COUNT DATE | PEAK COUNT OF STEELHEAD | GENERAL LOCATION |
|---|---|---|---|---|
| Eagle Creek | 5 | 8 May | 118 | Prince of Wales I. |
| Harris River | 3 | 28 April | 192 | Prince of Wales I. |
| Ketchikan Creek | 3 | 18 May | 19 | Revillagigedo I. |
| White River | 1 | 13 May | 60 | Revillagigedo I. |
| Humpback Creek | 2 | 28 April | 4 | Southern mainland |
| McDonald Lake | 2 | 11 May | 100 | Southern mainland |
| Marten Creek | 2 | 19 May | 18 | Southern mainland |
| Petersburg Creek | 3 | 11 May | 115 | Kupreanof Island |
| Pleasant Bay Creek | 3 | 18 May | 132 | Admiralty Island |
| Ford Arm Creek | 3 | 18 May | 89 | Chichagof Island |
| Sitkoh Creek | 2 | 19 May | 120 | Chichagof Island |
| Peterson Creek | 3 | 17 May | 38 | Northern mainland |

observe. Actively swimming snorkelers (in slow-moving water) usually spook steelhead before they can be accurately counted.

## SITUK RIVER WEIR AND FLOAT COUNTS

Between 9 May and 6 August, 9,204 steelhead were counted at the weir as they emigrated from the Situk River (Figure 3; Appendix A2). Peak emigration occurred 9 June, when 1,362 steelhead were counted downstream through the weir.

Float counts were conducted on 2 occasions, 10 May and 8 June (Table 2 and Appendix A3). Detailed environmental conditions measured during the float counts are listed in Appendix A4. The highest count of 3,778 steelhead occurred in the lower river when conditions were fair to good. In general, fish were concentrated within the lower river from the weir (about river mile 1.2) to river mile 4.4 (Figure 4) at the time of the peak survey. The high density of steelhead holding in the vicinity of the weir undoubtedly reduced counting accuracy in that area.

## SITUK RIVER STEELHEAD BIOLOGICAL SAMPLING

We sampled a total of 697 steelhead for biological characteristics in 1999. Scales have yet to be aged from this study, so no ages are available. The daily proportion of steelhead sampled is presented in Figure 3. We noted no significant differences in sex or length over the 2 week period in which most samples were taken so all data were pooled.

Sixty-four percent (64%) of the fish sampled were females averaging 792 mm (SE = 3 mm) in length (Table 3). Females ranged in length from 575 mm to 945 mm. The average total length of male steelhead was 799 mm (SE = 4 mm), from a range of 640 mm to 965 mm. Generally, dark fish tended to be longer in length than bright fish regardless of sex (Table 4). Males were also generally much darker in color than females.

Of the 697 steelhead sampled during the 1999 emigration, 352 (51%) exhibited at least 1 wound or scar, 67 exhibited at least 2 different types of wounds, and 10 carried 3 distinctly different types of wounds or scars. One-hundred-forty-seven (147) of the (once) wounded fish had fishhook related (carrying hooks or torn mouth parts or mouth puncture) injuries and 4 fish were gillnet scarred. Of the 697 steelhead sampled, 17 or 2.4% (SE = 0.6%) were at least 36 inches in total length. Based on this sample and the number of emigrants counted at the Situk River weir, an estimated 224 (SE = 54) fish were eligible for harvest.

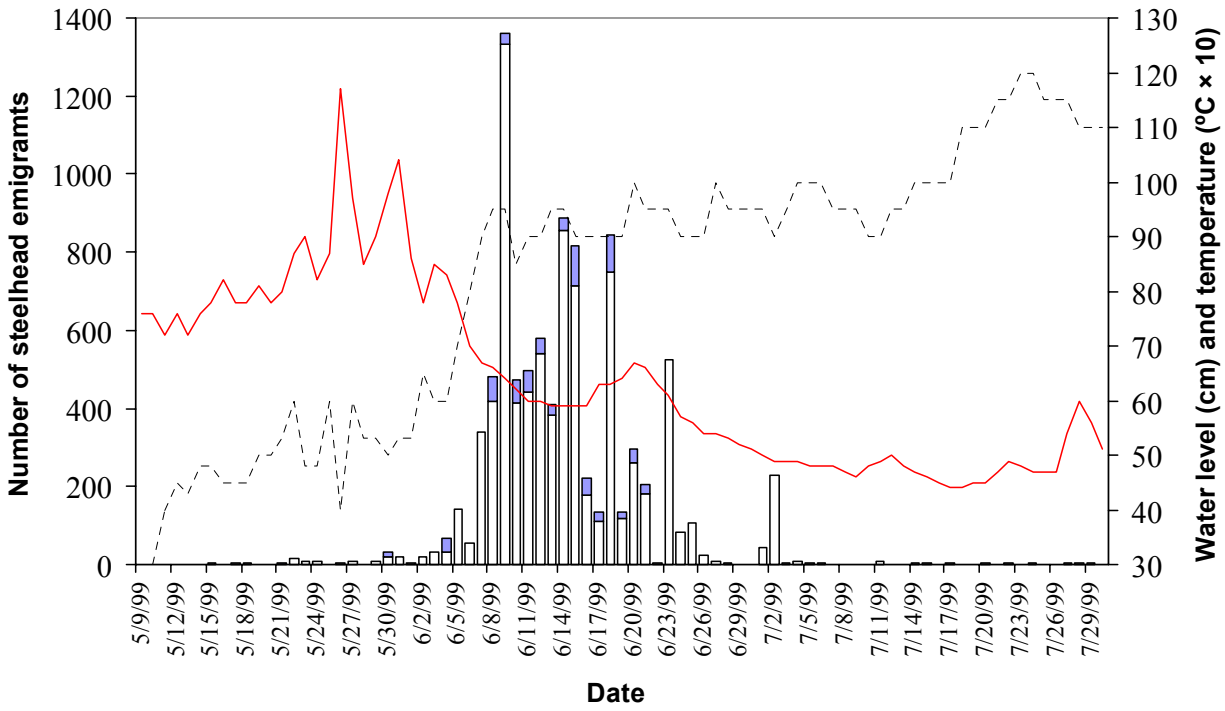


**Figure 3.–Daily counts of emigrant steelhead** (bars)**, daily sampled steelhead** (dark portion of bars)**, water level readings** (solid line)**, and water temperature** (dashed line)**, at the Situk River weir, 1999.**

**Table 2.–Numbers of steelhead counted by date, location, and observer during Situk River float surveys in 1999.**

| Survey date | Steelhead count | River section [a] | Observers | Subjective viewing conditions |
|---|---|---|---|---|
| 10 May | 1,645 | Lower | Mike Tracy, Larry Derby | Fair |
| 8 June | 3,778 | Lower | Robert Johnson, Laura Rollins | Good |

[a] Lower = Nine Mile bridge to Lower Landing.

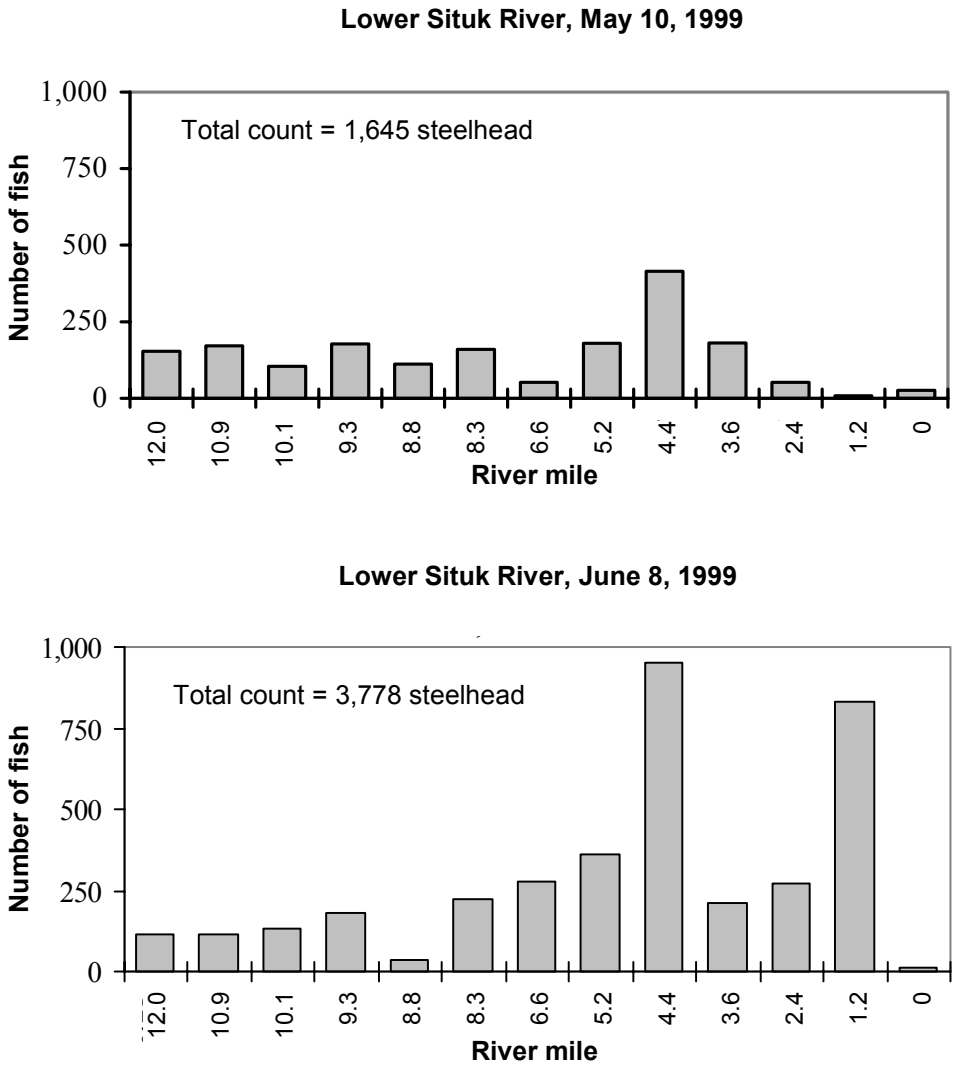


**Figure 4.–Steelhead density per mile, Situk River float surveys, 1999.**

**Table 3.–Biological statistics by sex for all steelhead sampled randomly, 1999.**

| | M | F | All |
|---|---|---|---|
| **Sample size** | 254 | 443 | 697 |
| % by sex | 36 | 64 | 100 |
| SE % by sex | 2 | 2 | – |
| **Mean length** (mm) | 799 | 792 | 794 |
| SD (length) | 71 | 56 | 62 |
| SE (mean length) | 4 | 3 | 2 |
| Number of fish ≥36" | 10 | 7 | 17 |
| % of fish ≥36" | 3.9 | 1.6 | 2.4 |
| SE % of fish ≥36" | 1.2 | 0.6 | 0.5 |
| Bright | 78 | 435 | 513 |
| Medium | 95 | 8 | 103 |
| Dark | 81 | 0 | 81 |
| With fungus | 86 | 2 | 88 |
| Without fungus | 168 | 441 | 609 |

**Table 4.–Average total length (mm) for male and female steelhead, by color classification, in the Situk River, 1999.**

| SEX | STATISTIC | BRIGHT | MEDIUM | DARK |
|---|---|---|---|---|
| Male | Sample size | 78 | 95 | 81 |
| | Mean length | 742 | 805 | 844 |
| | SD | 27 | 29 | 29 |
| | SE | 3 | 3 | 3 |
| Female | Sample size | 435 | 8 | 0 |
| | Mean length | 791 | 851 | – |
| | SD | 55 | 31 | – |
| | SE | 3 | 11 | – |

A total of 24 steelhead mortalities washed up on the weir during 1999; 4 were female and 20 were male. With the exception of 1 medium-colored male, all males were dark in coloration. Two of the females were bright and 1 was medium. The other female mortality was the only dark female encountered during sampling this season. Eighteen of the males and 1 of the females exhibited external fungal growth. The average total length of these steelhead mortalities was 835 mm, which was larger than the average size of the other sampled kelts (794 mm).

# DISCUSSION

In 1999, for only the third time, all steelhead surveys were snorkel surveys (other than the Situk River). Snorkel surveys record a much higher percentage of the fish in streams than do foot surveys (Shardlow et al. 1987). Consequently, the 1999 surveys were directly comparable only to surveys from 1997 and 1998 (Table 5), not to surveys conducted by foot prior to 1997. Summing the peak surveys for the 12 index streams monitored results in a total count of 1,505 steelhead in 1997, 998 in 1998 and 1,005 in 1999. Counts in 1999 were below 1998 counts in 6 (50%) of the index streams and above 1998 levels in the other 6 streams.

The total count in 1999 was 8 fish higher than in 1998, but spring stream conditions were far more challenging in 1999, and we think the counts would have been higher had conditions been similar to the prior 2 years. Because of safety concerns about the high-water hazard, many of the

**Table 5.–Peak steelhead survey counts for index systems monitored in 1997, 1998, and 1999.**

| STREAM | 1997 | 1998 | 1999 |
|---|---|---|---|
| Peterson Creek | 26 | 29 | 38 |
| Pleasant Bay | 155 | 81 | 132 |
| Humpback Creek | 91 | 24 | 4 |
| Ketchikan Creek | 48 | 47 | 19 |
| McDonald Lake | 145 | 86 | 100 |
| White River | 84 | 93 | 60 |
| Marten Creek | 14 | 17 | 18 |
| Petersburg Creek | 123 | 152 | 115 |
| Eagle Creek | 90 | 56 | 118 |
| Harris River | 104 | 156 | 192 |
| Ford Arm Creek | 296 | 103 | 89 |
| Sitkoh Creek | 329 | 154 | 120 |
| Totals | 1,505 | 998 | 1,005 |

surveys were not done, so the peak of abundance was not bracketed in some of the streams.

In 2 streams where we first tested snorkel survey techniques, Peterson Creek and Pleasant Bay, we now have 4 years of snorkel data. Steelhead counts in Peterson Creek were 36, 26, and 29, and 38 respectively, in 1996, 1997, 1998, and 1999. At Pleasant Bay, counts were 168, 155, 81 and 132 for the same 4-year period. These counts fail to show an obvious trend in abundance for these 2 systems.

We decided to drop 2 streams, Marten and Humpback creeks, from the steelhead index for future years. Surveys at Marten Creek will be discontinued because of very low (8 to 17) steelhead counts in that system over the past 6 years. Humpback Creek should also be dropped from the index, at least temporarily, because of inexplicably high variations in counts (20, 91, 24, 4) over the last 4 years. However, the Management Biologist in Ketchikan will continue to count steelhead in Humpback Creek with an intent to determine the cause of high variations in annual snorkel counts

Emigration timing of steelhead in the Situk River was about 2 weeks later than in the previous 4 years (Figure 5). This very late timing was probably due to an above average snow pack which reduced water temperatures and delayed spawning. Water temperature at the weir on 27 May 1999 was only 6°C, and <1% of emigration was completed at this time (Appendix A2). By comparison, in 1997 the temperature on 27 May was 12°C and 63% of emigration was completed; comparable statistics for 1998 were 10°C and 26% completed on 27 May.

Weir data indicated that the 1999 return was 59% higher than in 1998 and the highest ever in recent history (Table 6). The highest known escapement occurred in 1952 when a (roughly) estimated

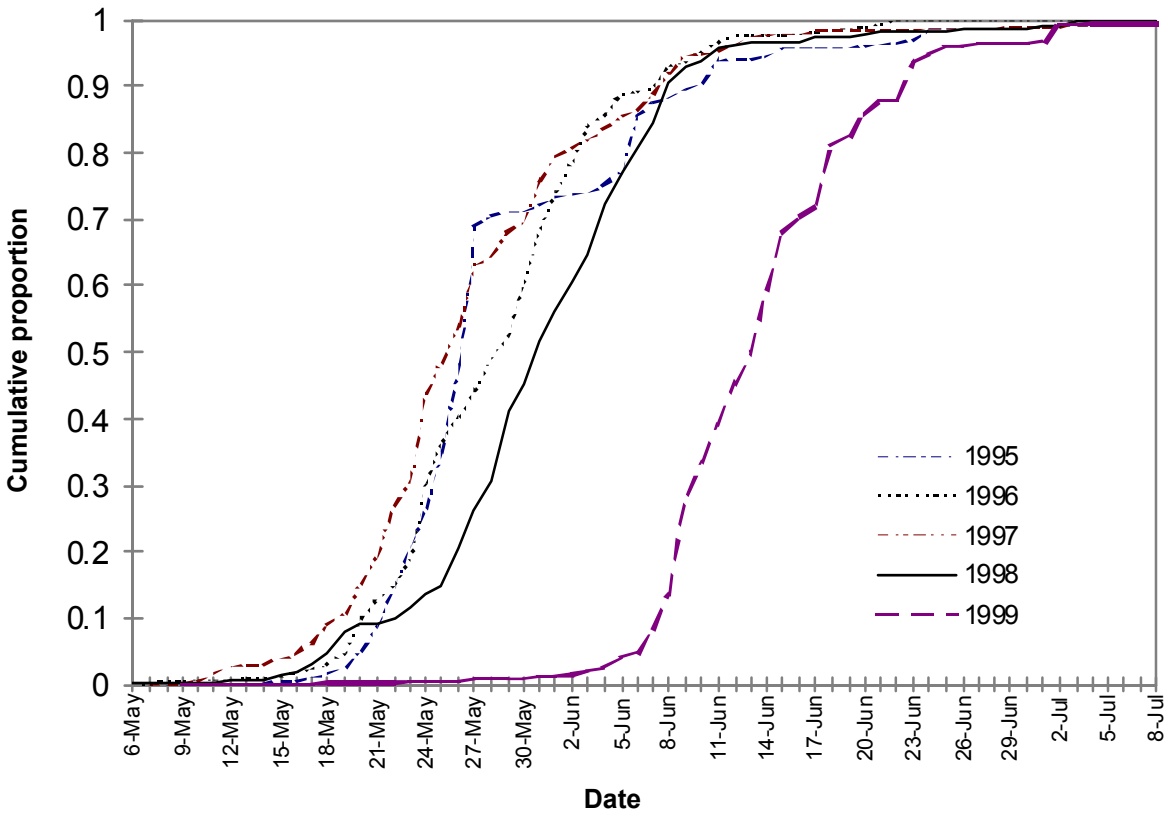


**Figure 5.–Cumulative proportions of Situk River weir daily steelhead counts, 1995–1999.**

**Table 6.–Weir count, peak float count, percent of total steelhead observed, and subjective survey conditions during 6 years of both weir operation and standardized float surveys for entire river and lower river, 1994–1999.**

| | | ENTIRE RIVER | | LOWER RIVER | | | |
|---|---|---|---|---|---|---|---|
| | | | | | | SUBJECTIVE SURVEY CONDITIONS | |
| YEAR | WEIR COUNT | Peak float count | Proportion observed | Peak float count | Proportion Observed | Entire river (upper [a] / lower [b]) | Lower river [b] |
| 1994 | 7,854 | 4,702 | 0.60 | 4,383 | 0.56 | v. good / good | good |
| 1995 | 6,608 | 6,235 | 0.94 | 5,189 | 0.78 | exc. / exc. | excellent |
| 1996 | 8,510 | 5,934 | 0.70 | 5,867 | 0.69 | exc. / fair | fair |
| 1997 | 7,328 | 4,943 | 0.67 | 4,377 | 0.60 | good / good-exc. | good-exc. |
| 1998 | 5,786 | N/A | N/A | 3,282 | 0.57 | not counted | excellent |
| 1999 | 9,204 | N/A | N/A | 3,778 | 0.41 | not counted | fair |
| Mean | 7,548 | 5,454 [c] | 0.73 [c] | 4,479 | 0.60 | | |
| SE | 510 | 373 | 0.15 | 382 | 0.13 | | |

[a] From Situk Lake to Nine Mile bridge.
[b] From Nine Mile bridge to Lower Landing.
[c] Does not include 1998 or 1999.

25,000–30,000 steelhead emigrated (Knapp 1952). Even though the 1999 emigration count was very high, the growing incidence of wounded fish is cause for concern. It is obvious that a high proportion of these fish are being caught and released. As a result, an angling closure of a spawning area upstream of the Nine Mile Bridge during the peak of the spawning season was established by the Alaska Board of Fisheries in March, 2000 to provide protection for the most vulnerable spawners in the Situk River system. Continued public education regarding proper catch and release techniques is also suggested.

Because of the short, intense emigration in 1999, biological samples were collected every day, rather than on only 2 days each week. Sampling both early and late evening periods on an alternating daily basis was thus used to obtain a representative sample of the emigration. An estimated 224 fish exceeded the 36-inch minimum size limit during 1999 which was similar to the 194 estimated during 1998. The percentage (2.4%) of steelhead ≥36 inches was statistically the same as 1998 (3%, $p = 0.32$) but different than observed in 1997 (6%, $p = 0.001$). Male steelhead averaged 799 mm during 1999, compared with 745 mm during 1998, and 797 mm during 1997. Female steelhead averaged 792 mm during 1999, compared with 776 mm during 1998, and 787 mm during 1997.

Situk River float count data for the lower river would have grossly underestimated 1999 run strength as only 41% of the run was counted (Table 6). This was due to both the late emigration and fair float count conditions (subsurface visibility was poor, many fish had not yet immigrated, and fish were probably concentrated above the Nine Mile bridge). As in previous years, float timing, river water depth, and the ability of the observers to accurately count large groups of fish passing the boat (during late season surveys up to 7,000 steelhead can be concentrated in a small section of the lower river), also affected steelhead counting accuracy. Recent increases in angler and boat densities during the peak of the steelhead season continue to degrade subsurface visibility in the river. This was particularly noticeable during 1999 when water levels were generally marginal.

We recommend that float surveys continue. Additional data will improve estimates of the proportion of the total Situk River steelhead

**Table 7.–Date, location, and peak counts of steelhead during Situk River float surveys, 1987–1999.**

| Year | Upper river | Date | Lower river | Date | Total |
|---|---|---|---|---|---|
| 1987 | 1,123 | 5/11 | 2,083 | 5/12 | 3,206 |
| 1988 | 430 | 5/15 | 2,165 | 5/25 | 2,595 |
| 1989 | 1,016 | 5/20 | 1,235 | 5/21 | 2,251 |
| 1990 | 502 | 5/16 | 1,138 | 5/17 | 1,640 |
| 1991 | 386 | 5/14 | 593 | 5/12 | 979 |
| 1992 | 220 | 5/16 | 663 | 5/16 | 883 |
| 1993 | 369 | 5/19 | 3,130 | 5/18 | 3,499 |
| 1994 | 319 | 5/21 | 4,383 | 5/21 | 4,702 |
| 1995 | 1,406 | 5/8 | 4,829 | 5/9 | 6,235 |
| 1996 | 566 | 5/21 | 5,368 | 5/21 | 5,934 |
| 1997 | 848 | 5/4 | 4,095 | 5/5 | 4,943 |
| 1998 | N/A | N/A | 3,282 | 5/27 | 3,282 |
| 1999 | N/A | N/A | 3,778 | 6/9 | 3,778 |

population observed during float surveys. The long-term database of observations since 1987 (Table 7) should be maintained. These data, in conjunction with data from Table 6, will be valuable if the weir is removed in the future and also can be used to estimate past run sizes.

Johnson and Jones (1999) provide a more detailed discussion of comparisons of float counts with weir counts of steelhead escapement in the Situk River.

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# APPENDIX A

**Appendix A1.– Counts of steelhead from 1999 snorkel surveys by stream, date, and reach of stream along with measured habitat variables.** (Abbreviations: S = snorkel, S/F = snorkel and foot combined, C = clear, O = overcast, R = rain, RW = rain/wind, CT = cutthroat trout, DV = Dolly Varden, SH = steelhead, RB = rainbow trout). (Light levels are EV values from a light meter calibrated to ASA 100).

| Stream name | Date | Reach | Distance surveyed (miles) | Survey type | # Live | # Redds | Weather codes | Observers[a] | Surface light | Light trans | Surface temp. (°C) | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 12-Mile | 30-Apr | | 3.5 | S | 20 | 3 | O | BC,TQ | 7.5 | 7.0 | 5.0 | |
| Ford Arm Creek | 4-May | 1 | Length | S | 6 | | R | TB,DJ,KK | | | | Low water excellent visibility |
| Ford Arm Creek | 4-May | 2 | Length | S | 23 | | R | TB,DJ,KK | | | | Low water excellent visibility |
| Ford Arm Creek | 11-May | 1 | Length | S | 30 | | C | TB,RH,JW | | | 3.8 | Guided fishing party of three. |
| Ford Arm Creek | 11-May | 2 | Length | S | 30 | | C | TB,RH,JW | | | 3.8 | Guided fishing party of three. |
| Ford Arm Creek | 18-May | 1 | Length | S | 44 | | O/R | TB,TT,RH | | | 4.5 | Water level 37.9" About 80% dark fish |
| Ford Arm Creek | 18-May | 2 | Length | S | 45 | | O/R | TB,TT,RH | | | 4.5 | |
| Harris River | 21-Apr | 1 | Length | S | 0 | 0 | O | BC, TQ | 10.5 | 11.6 | 5.0 | Water level 4" |
| Harris River | 21-Apr | 2 | Length | S | 10 | 3 | O | BC, TQ | 10.5 | 11.6 | 5.0 | |
| Harris River | 21-Apr | 3 | Length | S | 35 | 0 | O | BC, TQ | 10.5 | 11.6 | 5.0 | |
| Harris River | 21-Apr | 4 | Length | S | 75 | 0 | O | BC, TQ | 10.5 | 11.6 | 5.0 | |
| Harris River | 21-Apr | 5 | Length | S | 11 | 0 | O | BC, TQ | 10.5 | 11.6 | 5.0 | |
| Harris River | 28-Apr | 1 | Length | S | 0 | 0 | O | SH,SK | | | 4.0 | Water level 4.5" |
| Harris River | 28-Apr | 2 | Length | S | 20 | 4 | O | SH,SK | | | 4.0 | Water level 4.5" |
| Harris River | 28-Apr | 3 | Length | S | 41 | 11 | O | SH,SK | | | 4.0 | Water level 4.5" |
| Harris River | 28-Apr | 4 | Length | S | 115 | 13 | O | SH,SK | | | 4.0 | Water level 4.5" |
| Harris River | 28-Apr | 5 | Length | S | 16 | 0 | O | SH,SK | | | 4.0 | Water level 4.5" |
| Harris River | 7-May | 1 | Length | S | 1 | 0 | O | BC, TQ | | | 4.0 | Light meter out |
| Harris River | 7-May | 2 | Length | S | 12 | 4 | O/R | BC, TQ | | | 4.0 | |
| Harris River | 7-May | 3 | Length | S | 55 | 12 | R | BC, TQ | | | 4.0 | 1 CT |
| Harris River | 7-May | 4 | Length | S | 50 | 21 | R | BC, TQ | | | 4.0 | Most SH dark <10% bright |
| Harris River | 7-May | 5 | Length | S | 4 | 0 | R | BC, TQ | | | 4.0 | |
| Humpback Creek | 28-Apr | 1 | 0.3 | S/F | 1 | 2 | C | GF,NZ,SH | | | | Light meter failed "good" visib. |
| Humpback Creek | 28-Apr | 2 | 0.3 | S/F | 3 | 0 | C | GF,NZ,SH | | | | Light meter failed "good" visib. |
| Humpback Creek | 28-Apr | 3 | 0.4 | S/F | 0 | 36 | C | GF,NZ,SH | | | | Light meter failed "good" visib. |

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**Appendix A1.–Page 2 of 4.**

| Stream name | Date | Reach | Distance surveyed (miles) | Survey type | # Live | # Redds | Weather codes | Observers[a] | Surface light | Light trans | Surface temp. (°C) | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Humpback Creek | 28-Apr | 4 | 1.0 | S/F | 0 | 16 | C | GF,NZ,SH | | | | Light meter failed "good" visib. |
| Humpback Creek | 9-May | 1 | 0.3 | S/F | 1 | 2 | O/C | GF,MW,SH | | 12.0 | 4.0 | |
| Humpback Creek | 9-May | 2 | 0.3 | S/F | 0 | 24 | C | GF,MW,SH | | 12.0 | 4.0 | Older Redds |
| Humpback Creek | 9-May | 3 | 0.4 | S/F | 0 | 0 | C | GF,MW,SH | | 12.0 | 4.0 | |
| Humpback Creek | 9-May | 4 | 1.0 | S/F | 0 | 0 | C | GF,MW,SH | | 12.0 | 4.0 | |
| Karta River | 19-Feb | Lower | | F | 2 | | O | SH | | | 1.0 | |
| Karta River | 19-Feb | Lower | | S | 2 | 0 | O | BC,MW,GF | | | 1.0 | |
| Karta River | 30-Mar | Lower | | Angling | 18 | 0 | C | MW, SH | | | 3.0 | Fished 3.5 hours caught 18 |
| Ketchikan Creek | 30-Apr | 1 | | S | 0 | 0 | O/R | GF,SH | | 9.0 | 6.0 | 100 RB |
| Ketchikan Creek | 30-Apr | 2 | | S | 0 | 0 | O/R | GF,SH | | 9.0 | 6.0 | Water level. 3.5 ft @ gauge |
| Ketchikan Creek | 30-Apr | 3 | | S | 8 | 0 | O/R | GF,SH | | 9.0 | 6.0 | New fish |
| Ketchikan Creek | 10-May | 1 | | S | 3 | 0 | O | GF,SH | | 11.0 | 6.0 | |
| Ketchikan Creek | 10-May | 2 | | S | 4 | 2 | O | GF,SH | | 11.0 | 6.0 | Water level 4.0 ft @ gauge |
| Ketchikan Creek | 10-May | 3 | | S | 5 | 0 | O | GF,SH | | 11.0 | 6.0 | |
| Ketchikan Creek | 18-May | 1 | | S | 10 | | O | SH,MW | 13.0 | 11.0 | 5.0 | Water level 3.5 ft @ gauge |
| Ketchikan Creek | 18-May | 2 | | S | 8 | 2 | O | SH,MW | 13.0 | 11.0 | 5.0 | Water level 3.5 ft @ gauge |
| Ketchikan Creek | 18-May | 3 | | S | 1 | | O | SH,MW | 13.0 | 11.0 | 5.0 | Water level 3.5 ft @ gauge |
| Luck Lake/Eagle Cr. | 25-Feb | 3 | | S | 2 | 0 | O | BC, MW | 9.5 | 9.5 | 1.0 | Water level 3 ft @ gauge |
| Luck Lake/Eagle Cr. | 12-Apr | 3 | | S | 16 | 0 | | RH, BC | | | 4.0 | Water level 7" |
| Luck Lake/Eagle Cr. | 12-Apr | 4 | | S | 6 | 0 | | RH, BC | | | 4.0 | |
| Luck Lake/Eagle Cr. | 28-Apr | 1 | | S | 0 | 0 | O | BC,TQ | 9.0 | 10.0 | 5.0 | |
| Luck Lake/Eagle Cr. | 28-Apr | 2 | | S | 17 | 0 | O | BC,TQ | 9.0 | 10.0 | 5.0 | 2 CT |
| Luck Lake/Eagle Cr. | 28-Apr | 3 | | S | 33 | 0 | O | BC,TQ | 9.0 | 10.0 | 6.0 | 150+DV |
| Luck Lake/Eagle Cr. | 28-Apr | 4 | | S | 0 | 0 | O | BC,TQ | 9.0 | 10.0 | 6.0 | 200+DV |
| Luck Lake/Eagle Cr. | 1-May | 1 | | S | 6 | 0 | O/R | BC, TQ | 8.0 | 7.0 | 5.0 | |

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**Appendix A1.–Page 3 of 4.**

| Stream name | Date | Reach | Distance surveyed (miles) | Survey type | # Live | # Redds | Weather codes | Observers[a] | Surface light | Light trans | Surface temp. (°C) | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Luck Lake/Eagle Cr. | 1-May | 2 | | S | 23 | 7 | O/R | BC, TQ | 8.0 | 7.0 | 5.0 | 1 CT |
| Luck Lake/Eagle Cr. | 1-May | 3 | | S | 30 | 3 | O/R | BC, TQ | 8.0 | 7.0 | 5.0 | |
| Luck Lake/Eagle Cr. | 1-May | 4 | | S | 9 | 0 | O/R | BC, TQ | 8.0 | 7.0 | 5.0 | 100+DV |
| Luck Lake/Eagle Cr. | 8-May | 1 | | S | 6 | 2 | C/O | BC, TQ | | | 5.0 | 5CT, 1RT, 2DV |
| Luck Lake/Eagle Cr. | 8-May | 2 | | S | 64 | 13 | C/O | BC, TQ | | | 5.0 | 12CT, 5RT, 12DV |
| Luck Lake/Eagle Cr. | 8-May | 3 | | S | 37 | 26 | C/O | BC, TQ | | | 6.5 | 6CT, 1RT, 200+DV |
| Luck Lake/Eagle Cr. | 8-May | 4 | | S | 11 | 0 | C/O | BC, TQ | | | 6.5 | 23CT, 2RT, 200+DV |
| Marten Creek | 10-May | 1 | | S | 14 | 0 | O | VG,ST | | 8.0 | 6.0 | Depth 12.2" |
| Marten Creek | 10-May | 2 | | S | 0 | 0 | O | VG,ST | | | | |
| Marten Creek | 19-May | 1 | | S | 18 | 6 | O | DB,VG | | 10.5 | 7.0 | Depth 9" |
| Marten Creek | 19-May | 2 | | S | 0 | 0 | O | DB,VG | | | | |
| McDonald Lake | 3-May | 1 | | S | 8 | 0 | C/O | GF,NZ | | 11.0 | 3.5 | Fall SH |
| McDonald Lake | 3-May | 2 | | S | 22 | 4 | C/O | GF,NZ | | 11.0 | 3.5 | Fall SH |
| McDonald Lake | 3-May | 3 | | S | 18 | 0 | C/O | GF,NZ | | 11.0 | 3.5 | Mix spring & fall SH |
| McDonald Lake | 3-May | 4 | | S | 4 | 0 | C/O | GF,NZ | | 11.0 | 3.5 | Mix spring & fall SH |
| McDonald Lake | 11-May | 1 | | S | 43 | 2 | O/R | GF,NZ | 12.0 | | 5.0 | Lg rock exposed 2" |
| McDonald Lake | 11-May | 2 | | S | 18 | 10 | O/R | GF,NZ | 12.0 | | 5.0 | 60% bright SH |
| McDonald Lake | 11-May | 3 | | S | 15 | 1 | O | GF,NZ | 12.0 | | 5.0 | |
| McDonald Lake | 11-May | 4 | | S | 24 | 2 | O | GF,NZ | 12.0 | | 5.0 | Mostly new SH |
| Petersburg Creek | 7-May | 1 | | S | 11 | 3 | O | VG,ST | | 10.0 | 5.0 | Depth 27" |
| Petersburg Creek | 7-May | 2 | | S | 15 | 0 | O | VG,ST | | | | Stopped at camp tent |
| Petersburg Creek | 7-May | 3 | | S | - | - | O | VG,ST | | | | 1/2 mile above cabins |
| Petersburg Creek | 11-May | 1 | | S | 37 | 3 | O | DB,VG,ST | | | | Depth 30" |
| Petersburg Creek | 11-May | 2 | | S | 76 | 9 | O | DB,VG,ST | | | | |
| Petersburg Creek | 11-May | 3 | | S | 2 | 0 | O | DB,VG,ST | | | | |
| Petersburg Creek | 18-May | 1 | | S | 49 | 6 | O | DB,JM,VG | | 9.5 | 7.0 | Depth 33" |
| Petersburg Creek | 18-May | 2 | | S | 47 | 10 | O | DB,JM,VG | | 9.5 | 7.0 | |

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**Appendix A1.–Page 4 of 4.**

| Stream name | Date | Reach | Distance surveyed (miles) | Survey type | # Live | # Redds | Weather codes | Observers[a] | Surface light | Light trans | Surface temp. (°C) | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Petersburg Creek | 18-May | 3 | | S | 0 | 0 | O | DB,JM,VG | | 9.5 | 7.0 | Snorkeled 100yds estuary |
| Peterson Creek | 3-May | 1 | Length | S | 17 | | O | MS, BG | na | na | na | Water level -12" |
| Peterson Creek | 10-May | 1 | Length | S | 23 | | O | MS, BG | 11.5 | 8.9 | 4.0 | Water level -10" |
| Peterson Creek | 17-May | 1 | Length | S | 38 | | O | MS, BG | 11.3 | 9.5 | 4.5 | Water level -8.5" |
| Pleasant Bay Creek | 4-May | 1 | Length | S | 55 | | O | MS,BG,PS | 11.0 | 9.5 | 3.3 | |
| Pleasant Bay Creek | 4-May | 2 | Length | S | 30 | | O | MS,BG,PS | | | | Water level -13.6" |
| Pleasant Bay Creek | 4-May | 3 | Length | S | 0 | | O | MS,BG,PS | | | | |
| Pleasant Bay Creek | 11-May | 1 | Length | S | 80 | | O/R | MS,BG,BF | 11.0 | 9.0 | 3.6 | |
| Pleasant Bay Creek | 11-May | 2 | Length | S | 37 | | O/R | MS,BG,BF | | | | Water level -12.2" |
| Pleasant Bay Creek | 11-May | 3 | Length | S | 3 | | O/R | MS,BG,BF | | | | |
| Pleasant Bay Creek | 18-May | 1 | Length | S | 75 | | | BG,DJ,KK | 11.0 | 6.5 | 4.4 | Water Level -12.6" |
| Pleasant Bay Creek | 18-May | 2 | Length | S | 55 | | | BG,DJ,KK | 11.0 | 6.5 | 4.4 | |
| Pleasant Bay Creek | 18-May | 3 | Length | S | 2 | | | BG,DJ,KK | 11.0 | 6.5 | 4.4 | |
| Sitkoh Creek | 12-May | 1 | Length | S | 5 | | O | TB,DM,RH | | | 3.0 | Guided 2, Non-guided 3 total=5 |
| Sitkoh Creek | 12-May | 2 | Length | S | 52 | | O | TB,DM,RH | | | 3.0 | |
| Sitkoh Creek | 12-May | 3 | Length | S | 52 | | O | TB,DM,RH | | | 3.0 | |
| Sitkoh Creek | 19-May | 1 | Length | S | 14 | | O/R | TB, TT, RH | | | 3.5 | Most bright Depth 24.5" |
| Sitkoh Creek | 19-May | 2 | Length | S | 53 | | O/R | TB, TT, RH | | | 3.5 | |
| Sitkoh Creek | 19-May | 3 | Length | S | 53 | | O/R | TB, TT, RH | | | 3.5 | |
| Situk River | 29-Jul | | | Weir | 9,200 | | | RJ | | | | |
| Starrigavan Creek | 5-May | | Length | Foot | 11 | | O | TB,DJ,KK | | | | Low water |
| Starrigavan Creek | 13-May | | Length | S/F | 18 | 6 | C | TB,DM | | | 2.0 | 3 SH below survey area |
| Steelhead Creek | 9-May | | Lower | S | 24 | 12 | C | BC, TQ | | | 5.0 | |
| Steelhead Creek | 9-May | | Upper | S | 29 | 0 | C | BC, TQ | | | 5.0 | |
| White River | 13-May | 1 | 1.3 | S | 30 | 10 | O/C | GF,SH | 12.0 | | 2.0 | Water 4" above Bridge abutment |
| White River | 13-May | 2 | 1.0 | S | 13 | 12 | O | GF,SH | 12.0 | | 2.0 | Water 4" above Bridge abutment |
| White River | 13-May | 3 | 1.0 | S | 17 | 17 | O | GF,SH | 12.0 | | 2.0 | Water 4" above Bridge abutment |

[a] Primary observer(s) initials: MS (Mark Schwan), BG (Brian Glynn), KK (Kurt Kondzela), RH (Roger Harding), DJ (Doug Jones), AS (Art Schmidt), MW (Mike Wood), BC (Bob Chadwick), GF (Glenn Freeman), TB (Tom Brookover), AP (Andy Piston), VG (Vera Goudima), DB (Dean Beers), TQ (Todd Qualls), DM (Dave Magnus).

**Appendix A2.–Daily steelhead emigration count, steelhead biological samples taken, and water level and temperature data, Situk River Weir, 1999.**

| Date | Steelhead down | Morts (incl.) | Cumulative proportion | Number sampled | Not sampled | Cumulative % sampled | Water level (cm) | Water temp. (°C) |
|---|---|---|---|---|---|---|---|---|
| 5/9/99 | 0 | 0 | 0.000 | 0 | 0 | 0 | 76 | 2.5 |
| 5/10/99 | 0 | 0 | 0.000 | 0 | 0 | 0 | 76 | 3 |
| 5/11/99 | 0 | 0 | 0.000 | 0 | 0 | 0 | 72 | 4 |
| 5/12/99 | 0 | 0 | 0.000 | 0 | 0 | 0 | 76 | 4.5 |
| 5/13/99 | 0 | 0 | 0.000 | 0 | 0 | 0 | 72 | 4.3 |
| 5/14/99 | 0 | 0 | 0.000 | 0 | 0 | 0 | 76 | 4.8 |
| 5/15/99 | 5 | 0 | 0.001 | 0 | 5 | 0 | 78 | 4.8 |
| 5/16/99 | 0 | 0 | 0.001 | 0 | 0 | 0 | 82 | 4.5 |
| 5/17/99 | 3 | 0 | 0.001 | 0 | 3 | 0 | 78 | 4.5 |
| 5/18/99 | 3 | 0 | 0.001 | 0 | 3 | 0 | 78 | 4.5 |
| 5/19/99 | 0 | 0 | 0.001 | 0 | 0 | 0 | 81 | 5 |
| 5/20/99 | 0 | 0 | 0.001 | 0 | 0 | 0 | 78 | 5 |
| 5/21/99 | 2 | 0 | 0.001 | 1 | 1 | 8 | 80 | 5.3 |
| 5/22/99 | 16 | 1 | 0.003 | 0 | 16 | 3 | 87 | 6 |
| 5/23/99 | 6 | 0 | 0.004 | 0 | 6 | 3 | 90 | 4.8 |
| 5/24/99 | 7 | 0 | 0.005 | 0 | 7 | 2 | 82 | 4.8 |
| 5/25/99 | 0 | 0 | 0.005 | 0 | 0 | 2 | 87 | 6 |
| 5/26/99 | 4 | 0 | 0.005 | 0 | 4 | 2 | 117 | 4 |
| 5/27/99 | 9 | 0 | 0.006 | 0 | 9 | 2 | 97 | 6 |
| 5/28/99 | 0 | 0 | 0.006 | 0 | 0 | 2 | 85 | 5.3 |
| 5/29/99 | 7 | 0 | 0.007 | 0 | 7 | 2 | 90 | 5.3 |
| 5/30/99 | 31 | 0 | 0.010 | 10 | 21 | 12 | 98 | 5 |
| 5/31/99 | 20 | 0 | 0.012 | 2 | 18 | 12 | 104 | 5.3 |
| 6/1/99 | 3 | 0 | 0.013 | 0 | 3 | 11 | 86 | 5.3 |
| 6/2/99 | 20 | 0 | 0.015 | 0 | 20 | 10 | 78 | 6.5 |
| 6/3/99 | 31 | 0 | 0.018 | 0 | 31 | 8 | 85 | 6 |
| 6/4/99 | 69 | 0 | 0.026 | 36 | 33 | 21 | 83 | 6 |
| 6/5/99 | 143 | 0 | 0.041 | 0 | 143 | 13 | 78 | 7 |
| 6/6/99 | 55 | 0 | 0.047 | 0 | 55 | 11 | 70 | 8 |
| 6/7/99 | 339 | 4 | 0.084 | 0 | 339 | 6 | 67 | 9 |
| 6/8/99 | 480 | 2 | 0.136 | 60 | 420 | 9 | 66 | 9.5 |
| 6/9/99 | 1362 | 3 | 0.284 | 30 | 1332 | 5 | 64 | 9.5 |
| 6/10/99 | 475 | 1 | 0.336 | 60 | 415 | 6 | 62 | 8.5 |
| 6/11/99 | 497 | 0 | 0.390 | 55 | 442 | 7 | 60 | 9 |
| 6/12/99 | 581 | 1 | 0.453 | 42 | 539 | 7 | 60 | 9 |
| 6/13/99 | 409 | 3 | 0.497 | 25 | 384 | 7 | 59 | 9.5 |
| 6/14/99 | 887 | 2 | 0.594 | 30 | 857 | 6 | 59 | 9.5 |
| 6/15/99 | 816 | 1 | 0.682 | 104 | 712 | 7 | 59 | 9 |
| 6/16/99 | 222 | 2 | 0.706 | 46 | 176 | 8 | 59 | 9 |
| 6/17/99 | 136 | 0 | 0.721 | 25 | 111 | 8 | 63 | 9 |
| 6/18/99 | 845 | 0 | 0.813 | 97 | 748 | 8 | 63 | 9 |
| 6/19/99 | 134 | 1 | 0.828 | 14 | 120 | 8 | 64 | 9 |
| 6/20/99 | 295 | 2 | 0.860 | 35 | 260 | 8 | 67 | 10 |
| 6/21/99 | 207 | 0 | 0.882 | 25 | 182 | 9 | 66 | 9.5 |
| 6/22/99 | 2 | 0 | 0.882 | 0 | 2 | 9 | 63 | 9.5 |
| 6/23/99 | 525 | 0 | 0.939 | 0 | 525 | 8 | 61 | 9.5 |

-continued-

**Appendix A2.–Page 2 of 2.**

| Date | Steelhead down | Morts (incl.) | Cumulative proportion | Number sampled | Not sampled | Cumulative % sampled | Water level (cm) | Water temp. (°C) |
|---|---|---|---|---|---|---|---|---|
| 6/24/99 | 84 | 0 | 0.949 | 0 | 84 | 8 | 57 | 9 |
| 6/25/99 | 108 | 0 | 0.960 | 0 | 108 | 8 | 56 | 9 |
| 6/26/99 | 23 | 0 | 0.963 | 0 | 23 | 8 | 54 | 9 |
| 6/27/99 | 6 | 0 | 0.963 | 0 | 6 | 8 | 54 | 10 |
| 6/28/99 | 3 | 0 | 0.964 | 0 | 3 | 8 | 53 | 9.5 |
| 6/29/99 | 1 | 0 | 0.964 | 0 | 1 | 8 | 52 | 9.5 |
| 6/30/99 | 0 | 0 | 0.964 | 0 | 0 | 8 | 51 | 9.5 |
| 7/1/99 | 42 | 0 | 0.968 | 0 | 42 | 8 | 50 | 9.5 |
| 7/2/99 | 227 | 0 | 0.993 | 0 | 227 | 8 | 49 | 9 |
| 7/3/99 | 3 | 0 | 0.993 | 0 | 3 | 8 | 49 | 9.5 |
| 7/4/99 | 9 | 0 | 0.994 | 0 | 9 | 8 | 49 | 10 |
| 7/5/99 | 5 | 0 | 0.995 | 0 | 5 | 8 | 48 | 10 |
| 7/6/99 | 4 | 0 | 0.995 | 0 | 4 | 8 | 48 | 10 |
| 7/7/99 | 0 | 0 | 0.995 | 0 | 0 | 8 | 48 | 9.5 |
| 7/8/99 | 0 | 0 | 0.995 | 0 | 0 | 8 | 47 | 9.5 |
| 7/9/99 | 0 | 0 | 0.995 | 0 | 0 | 8 | 46 | 9.5 |
| 7/10/99 | 1 | 0 | 0.995 | 0 | 1 | 8 | 48 | 9 |
| 7/11/99 | 6 | 0 | 0.996 | 0 | 6 | 8 | 49 | 9 |
| 7/12/99 | 0 | 0 | 0.996 | 0 | 0 | 8 | 50 | 9.5 |
| 7/13/99 | 1 | 0 | 0.996 | 0 | 1 | 8 | 48 | 9.5 |
| 7/14/99 | 5 | 0 | 0.997 | 0 | 5 | 8 | 47 | 10 |
| 7/15/99 | 3 | 0 | 0.997 | 0 | 3 | 8 | 46 | 10 |
| 7/16/99 | 0 | 0 | 0.997 | 0 | 0 | 8 | 45 | 10 |
| 7/17/99 | 2 | 0 | 0.997 | 0 | 2 | 8 | 44 | 10 |
| 7/18/99 | 0 | 0 | 0.997 | 0 | 0 | 8 | 44 | 11 |
| 7/19/99 | 1 | 0 | 0.997 | 0 | 1 | 8 | 45 | 11 |
| 7/20/99 | 2 | 0 | 0.998 | 0 | 2 | 8 | 45 | 11 |
| 7/21/99 | 0 | 0 | 0.998 | 0 | 0 | 8 | 47 | 11.5 |
| 7/22/99 | 3 | 0 | 0.998 | 0 | 3 | 8 | 49 | 11.5 |
| 7/23/99 | 0 | 0 | 0.998 | 0 | 0 | 8 | 48 | 12 |
| 7/24/99 | 3 | 0 | 0.998 | 0 | 3 | 8 | 47 | 12 |
| 7/25/99 | 0 | 0 | 0.998 | 0 | 0 | 8 | 47 | 11.5 |
| 7/26/99 | 0 | 0 | 0.998 | 0 | 0 | 8 | 47 | 11.5 |
| 7/27/99 | 5 | 0 | 0.999 | 0 | 5 | 8 | 54 | 11.5 |
| 7/28/99 | 4 | 0 | 0.999 | 0 | 4 | 8 | 60 | 11 |
| 7/29/99 | 3 | 0 | 1.000 | 0 | 3 | 8 | 56 | 11 |
| 7/30/99 | 0 | 0 | 1.000 | 0 | 0 | 8 | 51 | 11 |
| 7/31/99 | 0 | 0 | 1.000 | 0 | 0 | 8 | 50 | 10.5 |
| 8/1/99 | 0 | 0 | 1.000 | 0 | 0 | 8 | 48 | 11.5 |
| 8/2/99 | 0 | 0 | 1.000 | 0 | 0 | 8 | 47 | 12 |
| 8/3/99 | 0 | 0 | 1.000 | 0 | 0 | 8 | 46 | 13 |
| 8/4/99 | 0 | 0 | 1.000 | 0 | 0 | 8 | 45 | 12.5 |
| 8/5/99 | 0 | 0 | 1.000 | 0 | 0 | 8 | 44 | 13 |
| 8/6/99 | 4 | 0 | 1.000 | 0 | 4 | 8 | 43 | 12.5 |

**Appendix A3.–Situk River steelhead index float survey data, 1999.**

| Date & reach surveyed | Sections | River mile | Cumulative number counted | LENGTH OF SECTION | | DENSITY | |
|---|---|---|---|---|---|---|---|
| | | | | Km | Miles | SH/km | SH/mi |
| **MAY 10** | 9 Mile bridge | 13.1 | | Begin | | | |
| **LOWER** | | 12.0 | 168 | 1.7 | 1.1 | 99 | 153 |
| **RIVER** | Old Situk | | | | | | |
| | airstrip | 10.9 | 374 | 1.9 | 1.2 | 108 | 172 |
| | | 10.1 | 457 | 1.3 | 0.8 | 64 | 104 |
| | | 9.3 | 599 | 1.3 | 0.8 | 109 | 178 |
| | | 8.8 | 655 | 0.8 | 0.5 | 70 | 112 |
| | | 8.3 | 735 | 0.8 | 0.5 | 100 | 160 |
| | | 6.6 | 818 | 2.6 | 1.6 | 32 | 52 |
| | | 5.2 | 1,068 | 2.3 | 1.4 | 109 | 179 |
| | | 4.4 | 1,400 | 1.3 | 0.8 | 255 | 415 |
| | | 3.6 | 1,544 | 1.3 | 0.8 | 111 | 180 |
| | | 2.4 | 1,606 | 2.0 | 1.2 | 31 | 52 |
| | Weir | 1.2 | 1,614 | 1.8 | 1.1 | 4 | 7 |
| | Lower Landing | 0.0 | 1,645 | 2.0 | 1.2 | 16 | 26 |
| | Reach total | | 1,645 | 21.1 | 13.1 | | |
| **JUNE 8** | 9 Mile bridge | 13.1 | | Begin | | - | - |
| **LOWER** | | 12.0 | 124 | 1.70 | 1.1 | 73 | 113 |
| **RIVER** | Old Situk | | | | | | |
| | airstrip | 10.9 | 264 | 1.90 | 1.2 | 74 | 117 |
| | | 10.1 | 368 | 1.30 | 0.8 | 80 | 130 |
| | | 9.3 | 512 | 1.30 | 0.8 | 111 | 180 |
| | | 8.8 | 530 | 0.80 | 0.5 | 23 | 36 |
| | | 8.3 | 640 | 0.80 | 0.5 | 138 | 220 |
| | | 6.6 | 1,088 | 2.60 | 1.6 | 172 | 280 |
| | | 5.2 | 1,592 | 2.30 | 1.4 | 219 | 360 |
| | | 4.4 | 2,352 | 1.30 | 0.8 | 585 | 950 |
| | | 3.6 | 2,520 | 1.30 | 0.8 | 129 | 210 |
| | | 2.4 | 2,846 | 2.00 | 1.2 | 163 | 272 |
| | Weir | 1.2 | 3,760 | 1.80 | 1.1 | 508 | 831 |
| | Lower Landing | 0.0 | 3,778 | 2.00 | 1.2 | 9 | 15 |
| | Reach total | | 3,778 | 21.1 | 13.1 | | |

**Appendix A4.–Environmental conditions during Situk River steelhead float surveys, 1999.**

| Situk River Float Survey Conditions, 1999 | | | | | Luminosity [c] | | Cloud Cover | | | | Wind | | | | Precipitation | | | | Turbidity/Color | | | | Overall Conditions Could not see well into - | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Date | Section [a] | Time | Water Height [b] | Water Temp. (°C) | Air | Water | Complete Overcast | Mostly Overcast | Partly Overcast | No Clouds | Constant | Frequent | Occaisional | None | Constant | Frequent | Occaisional | None | Very Heavy | Heavy | Slight | None | Average Pools | Deep Pools | Deepest Pools | No reduction in Vis. | Subjective Visibility |
| 5/10/99 | 2 | 11:10 | 40.3 | 4.5 | 15.9 | 10.8 | | X | | | | X | | | | | | X | | | X | | X | | | | Fair |
| 5/10/99 | 3 | 13:37 | - | 4.5 | 15.5 | 9.9 | | X | | | | | X | | | | | X | | | X | | X | | | | Fair |
| 6/8/99 | 2 | 10:45 | 41.0 | 10.0 | 14.5 | 14.5 | | | | X | | | X | | | | | X | | | X | | | | X | | Good |
| 6/8/99 | 3 | 13:40 | - | 10.0 | 15.5 | 9.6 | | X | | | | X | | | | | | X | | | X | | | | X | | Fair |

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

[b] Measured from the Nine Mile bridge support concrete seam, down to the water surface, in inches.

[c] ISO 100, see text.