Wild steelhead conservation planning in the Lower Mainland Region

# CHILLIWACK RIVER ADULT STEELHEAD SAMPLING PROGRAM

## SNORKEL COUNTS & RADIO TELEMETRY SURVEY

## SPRING 2000


prepared for the
Ministry of Water, Air and Land Protection,
Fish and Wildlife Science and Allocation
Surrey, BC

Fisheries and Environmental Services
Aquatic Resources Ltd

ARL report no. 337-4
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HABITAT CONSERVATION TRUST FUND

## SUMMARY

This data report summarises the first year of Chilliwack/Vedder River spring adult steelhead snorkel counts conducted by the *Lower Mainland Wild Steelhead Conservation* program. Similar floats have been conducted in previous years.

We identified 40 km of the 61 km Chilliwack mainstem that we considered safe to float. We conducted four surveys of various sections between February 15 and April 26, 2000. A complete survey of all sections took four days to complete, and was accomplished only once in 2000 (Float 1). After February, visibility and discharge conditions downstream of clay banks at Slesse Park precluded useful counts below this point. Sections swum during Floats 2, 3, and 4 depended on clarity and flow conditions encountered.

The total number of steelhead observed during surveys ranged from 27 (April 3) to 221 (February 15 – 18). Counts were standardised by distance surveyed: standardised counts ranged between 4.8 and 9.2 steelhead per kilometre.

We used radio-telemetry and mark-resight data to develop Peterson estimates of fish actually present, both within sections surveyed and system-wide. Estimates were highly uncertain and varied with assumptions applied. Results are snapshots at the time of each float, not total population estimates, and expanded system-wide estimates are based on the ratio of marked to unmarked fish in sections surveyed. Our results suggest that between 244 and 887 fish were present in surveyed reaches. Density estimates ranged from about 13 to 41 fish per kilometre. Estimates of the total number of steelhead at large in the Chilliwack River system ranged between about 1000 and 2800 fish.

We compared maximum count and maximum standardised count for 2000 with available data from previous years. Counts in 2000 were low relative to historical data, suggesting that Chilliwack steelhead have experienced a decline in total escapement. Historical snorkel float data are highly variable, and subject to differences in reaches surveyed and conditions encountered in each year of survey. However, juvenile assessment data and angler success records also provide evidence of reduced returns. Ocean survival information for southern coastal steelhead streams suggests that poor steelhead returns are likely to continue.

This study, in concert with available data from previous floats, indicate that snorkel counts provide a feasible indexing tool for Chilliwack River steelhead. However, further research is required to determine index accuracy relative to true escapement. In addition, we need to identify the minimum sampling effort that provides adequate precision.

## ACKNOWLEDGEMENTS

The 2000 Chilliwack River adult steelhead population survey was a combined effort involving contributions from many individuals. The program was developed by combining two existing Chilliwack River projects: snorkel floats conducted by *Aquatic Resources Limited* and radio telemetry work undertaken by *LGL environmental research associates.* Peter Caverhill, Marvin Roseanau, Ross Neuman, Ron Ptolemy and Allen Hanson, at the BC Ministry of Water, Land and Air Protection, sourced funds to combine the programs, enthusiastically followed our results, monitored contracts and provided review comments.

Snorkel counts are part of an on-going, Habitat Conservation Trust Fund (HCTF) supported program, the *Lower Mainland Wild Steelhead Conservation* project. The project is designed to develop conservation targets and long-term monitoring protocols for steelhead in selected Lower Mainland rivers.

The *Chilliwack/Vedder Steelhead Radio Telemetry* project was funded by various contributors, including the HCTF. The two year project was designed to produce distribution and behavioural data for steelhead in the system. Volunteer anglers provided fish, returned tags from killed hatchery fish and reported recaptures.

Swims were completed by Justus Benckhuysen, Leonardo Frid, Steve Latham, CEJ Mussell, Jim Rissling, Pier van Dishoeck, Andrew Walter, Patrick Williston and Chris Wulff. CEJ and Jack Mussell, Troy Nelson and Jim Rissling were responsible for telemetry surveys and swimmer support. The Mussell family provided unparalleled hospitality.

Allison Kozdron and Terry Maniwa helped compile the report. Josh Korman helped with program design and data analysis. Russ Brown at Chilliwack River Rafting guided our reconnaissance trip. Lauren Wick and Lynne Campo at Environment Canada provided the discharge data.

Thanks.

The Habitat Conservation Trust Fund was created by an act of the legislature to preserve, restore and enhance key areas of habitat for fish and wildlife throughout British Columbia. Anglers, hunters, trappers and guides contribute to the projects of the Trust Fund through license surcharges.

HABITAT CONSERVATION TRUST FUND

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# 1 INTRODUCTION

The Chilliwack/Vedder River supports the largest population of winter steelhead trout (*Oncorhynchus mykiss*) in the Lower Mainland region, and the most popular recreational steelhead fishery in British Columbia (about 48 000 angler days a year over the last decade[1]). Habitat degradation and low steelhead ocean survival have raised concerns over the long-term management of the stock. The BC Ministry Water, Land and Air Protection (MWLAP) has managed steelhead in the system as an augmented run since 1980. Augmented management refers to the release of hatchery steelhead for the purpose of providing a harvest fishery. Returns of adult hatchery fish are not intended to contribute to natural production.

Stock health concerns, coupled with heavy recreational use and the hatchery program, require that Chilliwack steelhead be actively managed. In 1997, regional steelhead biologists selected the Chilliwack as one of six Lower Mainland steelhead streams with pressing conservation management concerns. To address these concerns, the *Lower Mainland Wild Steelhead Conservation* program was undertaken, with funding from the Habitat Conservation Trust Fund.

The program is designed to establish a framework for steelhead management in the Chilliwack drainage by developing:

1. escapement targets for the system, and;
2. monitoring programs to assess performance relative to these targets.

Following Provincial protocol, escapement targets are based on estimates of system total productive capacity and provide a concrete management objective. Annual monitoring is required to determine stock status relative to the conservation goal. If returns are greater than target, the run is considered healthy. If returns fall below target, management action is required to conserve stocks.

Monitoring programs can rely on juvenile or adult counts, or a combination of the two. Juvenile density surveys provide an estimate of fry or parr standing stock. This can be used to assess utilisation of available juvenile habitat, and to predict smolt production, using survival equations. Utilisation data can be used as an index of previous adult escapement. Smolt production data can be used to predict future escapement.

[1] Average of angler days reported to the Steelhead Harvest Analysis (SHA), 1988/89 - 1998/99. Not adjusted for known SHA over-reporting bias (35 - 40%).

Adult assessments provide an index of escapement, and can be used with other data to estimate total escapement. Adult numbers are useful because conservation limits are most often defined in terms of returning fish. Snorkel counts also provide an opportunity for adaptive, in-season management, although this may be unlikely in practice. Adult results can be compared with sampled juvenile densities to assess the reliability of surveys. In establishing index techniques for the Chilliwack drainage, both fry and adult surveys have been conducted.

Various adult snorkel counts and fry density surveys have been conducted in the drainage over the past two decades. While this information provides baseline steelhead population data, further research was necessary to consolidate habitat capacity estimates and to develop robust, long-term monitoring protocols.

In 2000, two separate, complementary adult steelhead assessment projects were undertaken. Aquatic Resources Limited conducted a series of snorkel floats to:

1. assess adult steelhead returns to the Chilliwack River for 2000, using snorkel float methodology consistent with previous years of data, and;
2. assess the utility of snorkel floats as a long-term stock assessment tool for Chilliwack River steelhead.

LGL environmental research associates conducted the second and final year of adult steelhead radio telemetry work begun in 1998/99. Objectives were to:

1. establish migration and spawning behaviour patterns for Chilliwack system steelhead, and;
2. examine the impact of catch-and-release fishing regulations on steelhead in the Chilliwack River.

## 1.1 Background

Available information suggests that Chilliwack system steelhead populations have declined significantly over recent decades (van Dishoeck *et al.* 1998). These declines are likely related to decreased steelhead ocean survival (Ward 2000), changes in freshwater habitats, and may be affected by angling pressure. Evidence of these declines is available from a series of fry density surveys conducted through the 1980s and 1990s. Indices of adult abundance, including snorkel surveys (beginning in 1973; Appendix I) and the provincial Steelhead Harvest Analysis (SHA; 1968 - present) substantiate these declines.

Angling regulations and the hatchery stocking program attempt to separate wild and hatchery returns. No angling is permitted upstream of Slesse Creek, and wild fish caught below this boundary must be released. Hatchery smolts are stocked in the lower river, so as to encourage hatchery adults to return to the open section (Slaney *et al.* 1993). Although the majority of hatchery fish do spawn below Slesse Creek, the radio telemetry program has shown that some hatchery fish do spawn upstream of this point (Nelson *et al.* in prep.). Interaction between hatchery and wild fish is a significant management concern.

## 1.2 Previous work

To develop preliminary escapement objectives, we completed a map-based modelling exercise (van Dishoeck *et al.* 1998). This estimated freshwater carrying capacity for the drainage using available habitat and stock character information. Map-derived estimates can be used to develop recommendations for escapement targets ('conservation limits') and harvest levels. Further work is required to finalise the preliminary targets generated.

Chilliwack system fry density surveys were completed in September 1998, 1999 and 2000 (van Dishoeck 1999, 2000, 2001). For adults, historical snorkel float data are available for 14 years between 1973 and 1987 (Appendices I, II).

## 1.3 Snorkel floats

Snorkel floats provide an efficient adult assessment tool for Chilliwack steelhead. A large proportion of the anadromous length is safe to swim, and fish return to the river between December and June. Visibility and discharge conditions over much of this period are usually favourable for snorkel counts.

There are a number of factors that limit the utility of floats as a stock assessment tool, because they constrain the area and time over which counts are feasible. Sections of the Chilliwack River are too dangerous to float. Two large bank failures on the mainstem river, near Slesse Park, can preclude floats of sections downstream, when conditions disturb sediment. Further upstream, a major tributary, Slesse Creek, can also reduce visibility and preclude downstream floats. All sections are affected by increased flows after rainfall or snowmelt. Floats are not possible after the onset of spring freshet, so steelhead returning after this time cannot be counted. Sections of river, known to support large numbers of fish (this study, Nelson *et al.* in prep.) will be impossible to assess in some years.

Despite these limitations, favourable conditions do often prevail, and snorkel floats can provide an excellent, if incomplete, in-season assessment of adult steelhead stock health. While angler data and juvenile density surveys can provide a proxy of adult returns, only snorkel floats directly count adults. With adequate data, these counts can be used to generate total escapement estimates.

A single snorkel count provides an index of fish in the river at the time of the survey. The count is not complete, because swimmers miss some fish, and some sections of river are not floated. If multiple counts are completed over the season, counts can be compared with previous sampled years. However, we do not know what proportion of the fish seen were also present on previous floats. Additionally, the entire migration period is not assessed. Counts are an index, that, repeated consistently on an annual basis, can be used to track abundance trends over time. To generate escapement estimates, it is necessary to estimate:

1. *observer efficiency* (the proportion of fish missed in sections floated);
2. the number of fish in sections not floated;
3. *residence time* (the time a fish spends in the survey area), and;

These parameters can be estimated if a sub-sample of fish is marked with radio transmitters and external, visual tags. Observer efficiency is estimated as the number of marks seen divided by the number of marks known to be present (from transmitters). To estimate the number of fish in sections not swum, the ratio of total fish to marks, in sections swum, is applied to transmitters present in sections not swum. Residence time is determined from tracking data.

Hilborn *et al.* (1999) apply this information, plus a run-timing curve (the start and end dates of the run) to develop total escapement estimates using area under the curve methodology. The run-timing curve is generated from fish capture and radio tracking information. Korman and Ahrens (2000) applied the Hilborn *et al.* approach to generate steelhead population estimates for the Cheakamus River in 2000, based on radio telemetry work by McCubbing and Melville (2000).

Radio telemetry data for 1999 and 2000 are available for the Chilliwack River (Nelson *et al.* in prep.). No snorkel floats were conducted in 1999. We used data from 2000 snorkel floats to provide an index of escapement. Telemetry information was used to estimate observer efficiency for snorkel counts. However, the data were not sufficient to generate a robust steelhead population estimate for the Chilliwack River in 2000.

# 2 METHODS

## 2.1 Study area

A map of the Chilliwack/Vedder drainage is provided in Figure 1. River kilometres indicated are distance upstream of the Fraser River and are used throughout this report. Put-in and take-out locations for snorkel floats are indicated, as are the names of local landmarks relevant to the snorkel counts.

The Chilliwack/Vedder River system is located east of Vancouver. The mainstem river originates south of the Canada-US border, and flows north into Chilliwack Lake, and then west into the Fraser River. The watershed has a total drainage area of 1,877 $km^2$ and is largely of the Coastal Western Hemlock bio-geoclimatic zone (Northwest 1994, MoF 1992). The drainage straddles the transition between the Fraser Lowlands and the Cascade Mountains physiographic regions and about half is over 1,100 m elevation (Matthews 1986, Northwest 1994, McLean 1980).

The mainstem Chilliwack River, downstream of Chilliwack Lake, extends about 61 km to its confluence with the Fraser River. While there are numerous tributary streams, many are steep, with short anadromous reaches. The majority of steelhead spawning and rearing habitat is located in the mainstem river, and associated side channels. Slesse Creek is a major tributary, with some anadromous habitat. The creek affects discharge rates, water temperatures, and sediment levels in the mainstem Chilliwack. Downstream of Slesse Creek, the river is characterized by larger channel widths, a braided, meandering pattern and high substrate mobility. Upstream of Slesse Creek the mainstem river is more confined and channel variation between years is much lower.

In addition to wild and hatchery steelhead stocks, the Chilliwack system supports populations of nine other commercially and recreationally important salmonids, as well as other fish species (Table 1, page 7). On snorkel floats, we saw steelhead, resident rainbow trout, char, whitefish and suckers. We did not differentiate between Dolly Varden and bull trout, nor between sucker species. In most cases, anadromous steelhead and river-resident rainbow trout were easily separated, based on size and colour. However, when the distinction was more difficult, we assumed that fish smaller than 50 cm fork length were rainbow trout, while those larger were steelhead. To calibrate our judgement of size underwater, we viewed objects 50 cm in length from various distances.

**Figure 1.** Map of the Chilliwack/Vedder watershed study area, including river kilometres, put-in/take-out locations and selected local landmarks. Reaches floated are indicated by black bars below the map.

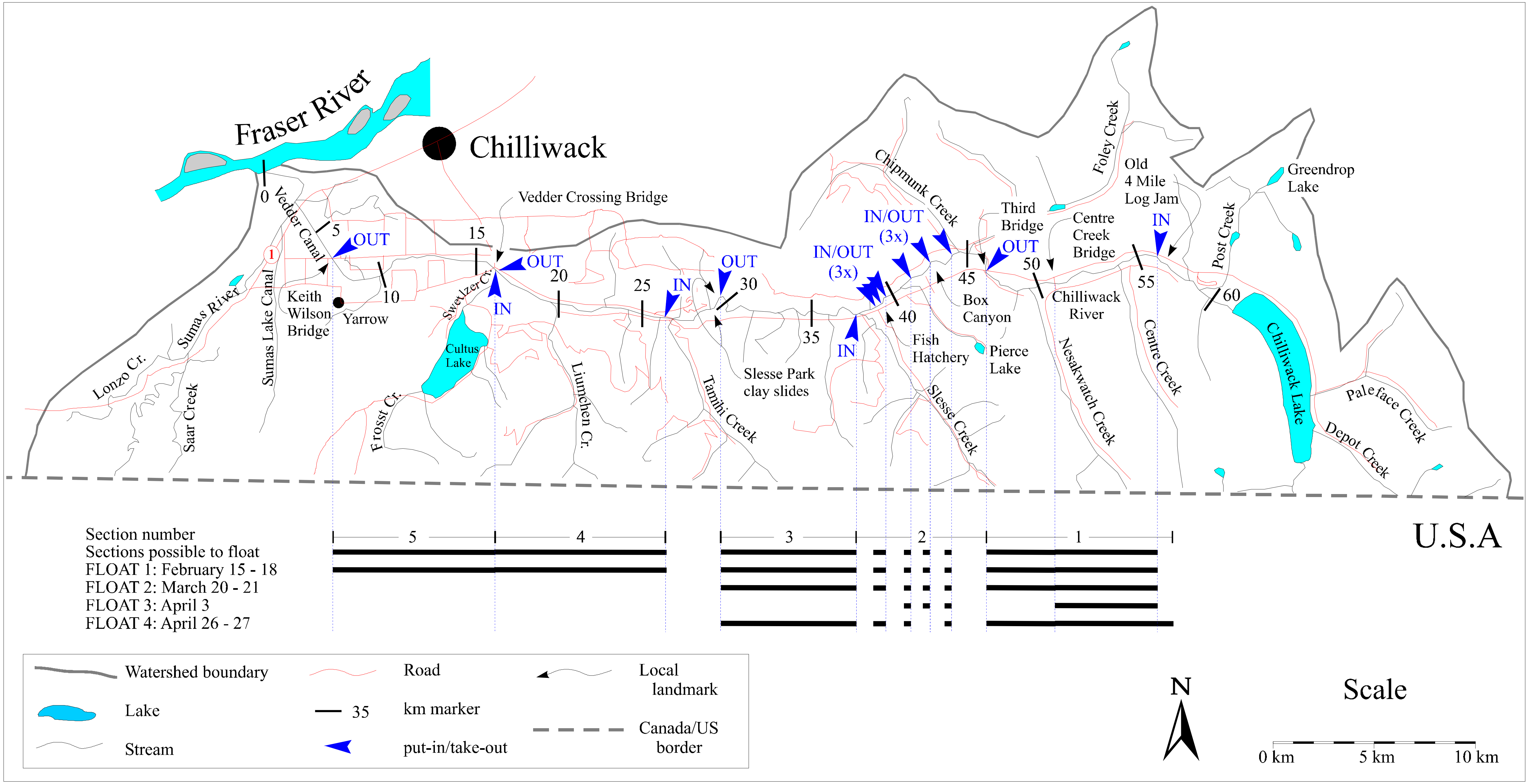


**Table 1.** Fisheries resources of the Chilliwack/Vedder River system.

| Common Name | Scientific Name |
|---|---|
| Steelhead/rainbow trout | *Oncorhynchus mykiss* |
| Coho salmon | *O. kisutch* |
| Chum salmon | *O. keta* |
| Sockeye/kokanee | *O. nerka* |
| Chinook salmon | *O. tshawytscha* |
| Pink salmon | *O. gorbuscha* |
| Cutthroat trout | *O. clarki clarki* |
| Dolly Varden char | *Salvelinus malma* |
| Bull trout | *Salvelinus confluentus* |
| Mountain whitefish | *Prosopium williamsoni* |
| Northern squawfish | *Ptycheilus oregonensis* |
| suckers | *Catostomus spp.* |
| Longnose dace | *Rhinichthys cataractae* |
| Threespine stickleback | *Gasterosteus aculeatus* |
| Coastrange sculpin | *Cottus aleuticus* |
| Prickly sculpin | *Cottus asper* |
| Pacific lamprey | *Lampetra tridentata* |
| River lamprey | *Lampetra ayresi* |
| Western Brook lamprey | *Lampetra richardsoni* |

## 2.2 Discharge data

Discharge critically affects snorkel floats. When discharge is low, the water tends to be clear. Rain and snowmelt cause higher discharge and elevated turbidity. High discharge increases whitewater, which reduces visibility. Swimmers also move more quickly, making it more difficult to search for fish. Although increased discharge did not reduce visibility in all sections, it prevented snorkel floats downstream of the Slesse Park clay slide. In addition, high discharge from Slesse Creek resulted in poor visibility. Discharge data were obtained from the Water Survey of Canada (WSC) for stations 08MH103 ("Chilliwack River above Slesse Creek") and 08MH001 ("Chilliwack River at Vedder Crossing").

## 2.3 Sampling methodology: snorkel floats

We enumerated all fish seen during snorkel floats of various sections of the Chilliwack River. Three swimmers, equipped with dry suits, split the width of the river into lanes, and attempted to maintain lanes and stay abreast (for some sections, 2 or 4 divers were used). When we became separated, we regrouped in areas where we were unlikely to miss or disturb fish.

We stopped periodically to compare counts and record numbers on waterproof slates. Data were later relayed to a shore or raft-based recorder. Total counts were determined by consensus between swimmers. Areas with concentrations of fish were often counted twice. Recounts were always recorded separately. For analyses, we used the maximum count for a section.

Measurements of flow stage (water height, in metres) were taken at the permanent WSC gauge in the Box Canyon (08MH103). Visibility was estimated by measuring the distance at which underwater features could no longer be distinguished. Weather and water temperature was also recorded for each survey. Floats conducted in previous years have used similar methods, have covered similar reaches (Appendix III), and are assumed to be comparable.

### 2.3.1 Snorkel float sections

We divided the floatable reaches of the Chilliwack River into five sections (Figure 1; Table 2), representing a total of 39.3 km. This is 64% of the 61 km total length of the mainstem river. Each section could be swum in one day. Section 2a and 2b spot checks can be added to surveys of Sections 1 and 3, respectively, and the entire system assessed in four days. Sections were delineated based on historical floats and a February 11, 2000 reconnaissance. We assessed safety considerations and float feasibility between Third Bridge (river km 46.5) and Vedder Crossing (15.5 km) using a raft. Dangerous areas, access points and section breaks were identified. No reconnaissance was conducted upstream of Third Bridge.

**Table 2.** Chilliwack River float sections. Values in brackets = river kilometre.

| | **Put-in** | | **Take-out** | **Section length (km)** |
|---|---|---|---|---|
| 1. | 4 Mile Log Jam (56.0 km) | to | Third Bridge (46.5 km) | 9.5 |
| 2a. | Three canyon spot checks (42.5, 44.0 and 44.8 km) | | | ~ 0.5 |
| 2b. | Hatchery pools spot checks (39.5, 39.0, 38.7, 38.6 and 38.4 km) | | | ~ 0.8 |
| 3. | Slesse confluence (37.9 km) | to | Slesse Park Clayslide (29.5 km) | 8.4 |
| 4. | Tamihi Bridge (26.3 km) | to | Vedder Crossing (15.5 km) | 10.8 |
| 5. | Vedder Crossing (15.5 km) | to | Keith Wilson Bridge (6.2 km) | 9.3 |

Upstream of Section 1, a narrow canyon confined the Chilliwack River. This section, between Chilliwack Lake and the 'Old 4 Mile Log Jam' (56.0 km), contained large woody debris accumulations. We judged the reach too dangerous to attempt, but steelhead are known to use this area (Nelson *et al.* in prep.) and to utilise spawning habitat at the lake outlet and in lake tributaries.

Section 1 was the 9.5 km reach between the 4-mile logjam and Third Bridge (46.5 km). Generally shallow runs, with few holding pools, characterized the reach. Substrate size was large, consisting mostly of cobbles and boulders. Some areas were dangerous and required caution during surveys. At low and moderate discharge, visibility tended to be excellent. However, higher discharge caused whitewater cascades, which significantly limited visibility.

Section 2 included the 8.6 km between Third Bridge and the confluence with Slesse Creek (37.9 km). The river descended a series of boulder cascades in this canyon section, and we considered most areas unsafe. However, three 'Box Canyon Pools' were 'spot checked', at 44.8, 44.0 and 42.5 km ('Section 2a'). Pool lengths were estimated and ranged between 60 and 350 m. Total length of the three pools was approximately 500 m. Estimated depths ranged from <1m at tailouts to >4 m. Section 1 plus the Box Canyon pools was floated in one day.

Section 2 also included a series of pools near the Chilliwack River Hatchery (38.4 km). Four or five of these pools, at 39.5, 39.0, 38.7, 38.6 and 38.4 km were spot checked ('Section 2b'). The section can also be swum in its entirety. Distance surveyed within this section varied with conditions encountered. For calculations of fish densities, section length was estimated as 800 m. The 'hatchery pools', plus Section 3, were assessed together in one day. The 500 m section between the Chilliwack Hatchery and the confluence with Slesse Creek was not surveyed in 2000, but the area should be assessed in future years.

Section 3 extended from the Slesse Creek confluence to the Slesse Park clay slide (29.5 km). Substrate through this 8.4 km section remained large, although the proportion of boulders was lower. Depth varied considerably, from very shallow riffles (<20 cm) to deep runs and pools (>4m). There were steeper gradient sections where visibility was limited by whitewater, as well as some hazards that required caution. At spring discharges, we had no difficulties navigating a raft downstream of Thurston Meadows Forest Service Recreation Site (34.6 km).

The Slesse Park clay slide at 29.5 km remained a source of severe sedimentation, despite recent efforts to stabilize the slide (the central of three clay banks). When conditions were poor, the river was totally opaque downstream of this point. However, under rare favourable conditions, the reaches downstream were clean enough to permit floats. The 3.2 km section between Slesse Park and Tamihi Bridge (26.3 km) was not swum, due to the major rapid at Tamihi (26.6 km).

Section 4 extended 10.8 km from Tamihi Bridge to Vedder Crossing Bridge (15.5 km). The section contained some hazards. However, the gradient of the river decreased and snorkel floats became safer. When sedimentation was low, float conditions were excellent, as there was little whitewater to obstruct visibility. Substrate was somewhat smaller than further upstream, and the river bottom was coated with a layer of fine clay, particularly in low velocity areas. Depth was variable, with shallow riffles, moderate depth runs, and deep pools. There were a large number of braids and side channels; where feasible, one swimmer would survey a braid, while two remained in the main channel. Not all braids and side channels were practical to survey. We used a raft to accompany floaters.

Section 5 included the 9.3 km between Vedder Crossing and Keith Wilson Bridge (6.2 km). The river in this section was very wide, and generally placid. There were many side channels and braids, so four swimmers provided more complete coverage: on our single float in this section, we used four floaters to Hydro Bridge (10.2 km) and three floaters thereafter. River depth was relatively uniform, with most areas being runs of moderate depth. There were also shallow riffles and a number of deeper, low velocity pools. Woody debris on corners and in side channels provided ideal holding cover, but was often too dangerous to assess. We undoubtedly missed many fish associated with debris accumulations. Substrate through this section was generally cobbles, and lower velocity areas were coated with fine clay sediments from the upstream bank failures.

### 2.3.2 2000 snorkel floats

We conducted four surveys between February 15 and April 26, 2000. Sections surveyed are indicated in Figure 1 and summarised in Table 3. Only on the first float were we able to sample all five sections. Thereafter, no floats were possible downstream of the Slesse Park clay slide, due to visibility conditions. This was unfortunate, given the unique opportunity provided by the radio telemetry project. However, some river sections were sampled on all four swims. Two or four swimmers floated some sections.

We swam all sections on Float 1 (February 15 – 18). On Float 2 (March 20 – 21), we did not survey downstream of the clay slide. On the third float (April 3), Slesse Creek was very dirty, and we did not survey downstream of its confluence. We also did not swim between Centre Creek Bridge and Third Bridge, due to discharge, visibility conditions and equipment failure. On Float 4 (April 26 – 27), Section 1 began 400 m upstream of previous floats, and we did not swim the Box Canyon pool at 44.0 km (which was unsafe), nor downstream of the clay slide.

**Table 3.** Sections floated - Chilliwack River steelhead snorkel surveys, 2000.

| Float | Day | Date | Reach floated from (km) | to (km) | from | to | # of floaters |
|---|---|---|---|---|---|---|---|
| 1 | 2 | Feb 16 | 55.6 | 50.6 | Old 4 Mile Log Jam | Centre Creek Bridge | 3 |
| | | | 50.6 | 46.5 | Centre Creek Bridge | Third Bridge | 2 |
| | | | | | Box Canyon Pool spot checks (42.5, 44.0 and 44.8 km) | | 2 |
| | 1 | Feb 15 | | | Hatchery pool checks (39.5, 38.7, 38.6 and 38.4 km) | | 3 |
| | | | 37.9 | 29.5 | Slesse confluence | Slesse Park clayslide | 3 |
| | 3 | Feb 17 | 26.3 | 15.5 | Tamihi Bridge | Vedder Crossing | 3 |
| | 4 | Feb 18 | 15.5 | 10.2 | Vedder Crossing | Hydro Bridge | 4 |
| | | | 10.2 | 6.2 | Hydro Bridge | Keith Wilson Bridge | 3 |
| 2 | 1 | Mar 20 | 55.6 | 50.6 | Old 4 Mile Log Jam | Centre Creek Bridge | 3 |
| | | | 50.6 | 46.5 | Centre Creek Bridge | Third Bridge | 2 |
| | | | | | Box Canyon Pool spot checks (42.5, 44.0 and 44.8 km) | | 3 |
| | 2 | Mar 21 | | | Hatchery pool checks (39.5, 39.0, 38.7, 38.6, 38.4 km) | | 3 |
| | | | 37.9 | 29.5 | Slesse confluence | Slesse Park clayslide | 3 |
| 3 | 1 | Apr 3 | 55.6 | 50.6 | Old 4 Mile Log Jam | Centre Creek Bridge | 3 |
| | | | | | Box Canyon Pool spot checks (42.5, 44.0 and 44.8 km) | | 3 |
| 4 | 1 | Apr 26 | 56.0 | 46.5 | u/s Log Jam | Third Bridge | 3 |
| | | | | | Box Canyon Pool spot checks (42.5 and 44.8 km) | | 3 |
| | 2 | Apr 27 | | | Hatchery pool checks (39.5, 39.0, 38.7, 38.6, 38.4 km) | | 3 |
| | | | 37.9 | 29.5 | Slesse confluence | Slesse Park clayslide | 3 |

Note: Float 4: Section 1: began 400 m upstream of previous surveys (56.0 km vs. 55.6 km).
Section 2: no float in Box Canyon pool at 44.0 km.

## 2.4 Sampling methodology: radio telemetry program

Radio telemetry work in 2000 continued an independent two year program begun in 1999 (Nelson *et al.* in prep.). To facilitate the integration of telemetry work and the snorkel float program, a number of small modifications were made to methods in 2000, and additional tracking was undertaken.

Steelhead for the telemetry program were captured by angling (project and volunteer anglers). Donation of hatchery steelhead (which could have been killed) was encouraged with baseball caps and a prize draw. Captured fish were held in black fabric tubes until a project technician could place oesophageal radio tags (Lotek, Newmarket, ON). No anaesthetic was used. Tagged fish were also externally marked with spaghetti tags (Floy Tag, Seattle, WA) at the dorsal fin. To facilitate analyses, six colours were used. Hatchery and wild fish, and early, middle and late run fish were differentiated (2 x 3 matrix = 6 colours). Spaghetti tags were numbered and included a 1-800 reporting telephone number. Anglers recapturing tagged fish were asked to report tag number and time and place of recapture. Anglers who killed tagged hatchery fish were asked to return the tags.

In addition to mobile telemetry surveys, four fixed stations were established to track tagged fish. In 2000, stations were established at the confluence with the Sumas River, near Tamihi Creek, at the Fish Hatchery and at the outlet of Chilliwack Lake (Figure 1). In concert with mobile tracking, these stations permitted us to locate each tagged fish at least once per week.

### 2.5 Integration of snorkel float and radio telemetry programs

Mobile telemetry surveys were co-ordinated with 2000 snorkel counts to facilitate collection of telemetry data relevant to float counts. A telemetry technician accompanied swimmers to track tags, record swim and telemetry data, and as a safety spotter. Upstream of Slesse Creek, the technician tracked fish on foot and from a vehicle, meeting the float team at pre-arranged river access points. From Slesse Creek to Thurston Meadows, the technician walked along the bank of the river. Downstream of Thurston Meadows, a 3-person rubber raft was used.

We further subdivided the Chilliwack River into short, discrete sections based on river features and access for the telemetry technician. Telemetry and snorkel data were recorded within subsections. These were kept as short as possible to improve the spatial resolution of the data (e.g. on Float 1 we divided the 39.7 km surveyed into 85 subsections). So that float and telemetry locations were unambiguous, subsection breaks were located at features unlikely to contain fish. For each subsection, we recorded location, number of fish of each species seen, number and colour of spaghetti tags seen and number of radio tags detected.

### 2.6 Analysis

We present results for 2000 by section and by float. As different reaches were covered on each of our swims, we standardised counts by the distance surveyed to generate a comparable index. To calculate the total number of steelhead observed per kilometre surveyed, we divided the total number of steelhead seen by the total length of sections swum, rather than average values across different sections. Standardised counts include results in spot check pools. We also compared counts within an index reach where survey coverage was most consistent in 2000: Sections 1, 2 and 3 on Floats 1, 2 and 4.

We calculated observer efficiency by dividing the number of tags seen by floaters by the number of tags known to be present (based on telemetry observations). Mean observer efficiency for each survey was calculated as the total number of marks seen divided by the total number of marks present. Mean observer efficiencies for the system as a whole were derived as the slope of the linear relationship between the number of tags observed and the number known to be present. However, due to variability in conditions, efficiency values for a given section and time of year are probably more meaningful than the mean value for the entire system.

We used radio and externally marked steelhead to derive mark-resight estimates of total fish present within surveyed reaches at the time of each float. Each estimate was calculated from a single resight event. Although more complex estimators are available for mark-resight studies (White 1996), the Peterson method is recommended for data gathered over two sampling periods (marking event and one resight survey; Krebs 1999). However, results must be interpreted with care. The Peterson estimator is nearly unbiased when the number of recaptures (or resightings) is 7 or more (Krebs 1999). Our 'recaptures' were very small (range = 0 to 8 tags). We assumed homogeneity of sighting probabilities within each section (i.e. all marked fish had equal chances of being observed, an assumption likely violated). We also assumed population 'closure' over the 2 - 4 day duration of each survey (i.e. no immigration or emigration during a survey).

We calculated Peterson estimates with Poisson confidence intervals (Krebs 1999) using mark-resight data. We calculated separate estimates for each section defined. For sections with no tags present, or no tags observed, we summed untagged fish seen + tags detected as a conservative estimate of total numbers present. Estimates in these sections are biased low. We summed section estimates across all reaches surveyed; we also calculated a pooled Peterson estimate using the total number of fish observed and detected.

To estimate the number of fish present in reaches not surveyed, we calculated the mark rate based on pooled Peterson estimates. We applied this mark rate estimate to the total number of radio tags at large at the time of each survey. Radio telemetry data were obtained from T. Nelson (LGL limited, pers. comm.).

We compared our results to available historical data using counts standardised to distance surveyed, as sections swum have varied considerably over time. Standardised results were also compared with other available indices of abundance, including juvenile density surveys and the Steelhead Harvest Analysis.

# 3 RESULTS

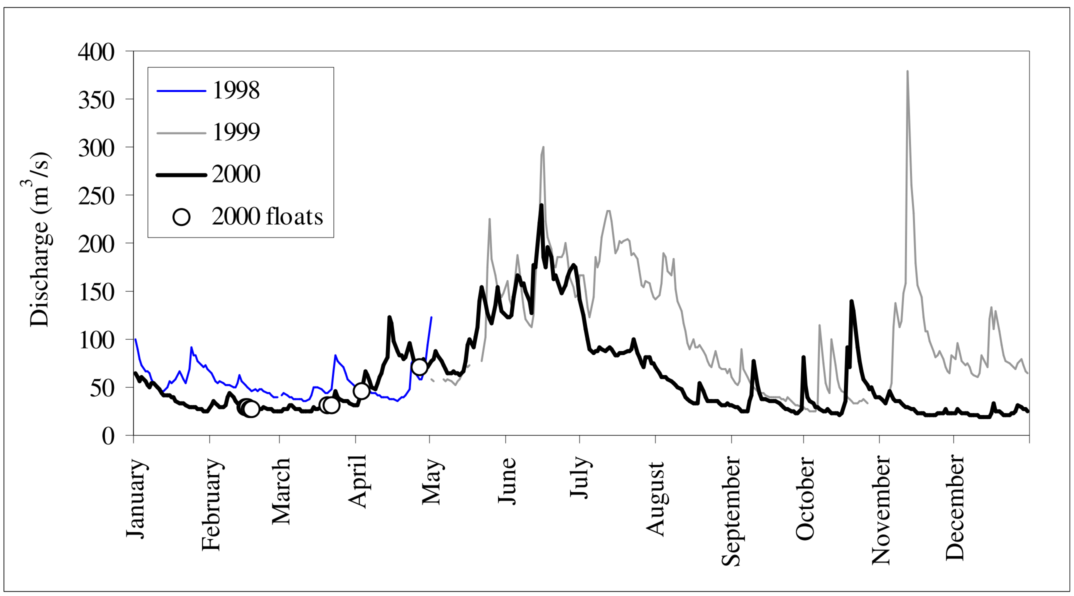
## 3.1 Discharge data

Discharge information for the Chilliwack River at Vedder Crossing (WSC gauge 08MH001) is graphed in Figure 2. The station was not functional between May 1998 and May 1999. Discharge for the Chilliwack River tends to be low and relatively stable through the winter, with a significant spring/summer freshet. Fall storm events are also clearly evident from the hydrograph.

Data for the Chilliwack River above Slesse Creek (08MH103) is presented, for the January through June period of snorkel floats, so that comparisons can be made between flows in 2000 and in the preceding two years. Discharge on float days is marked in Figure 3.

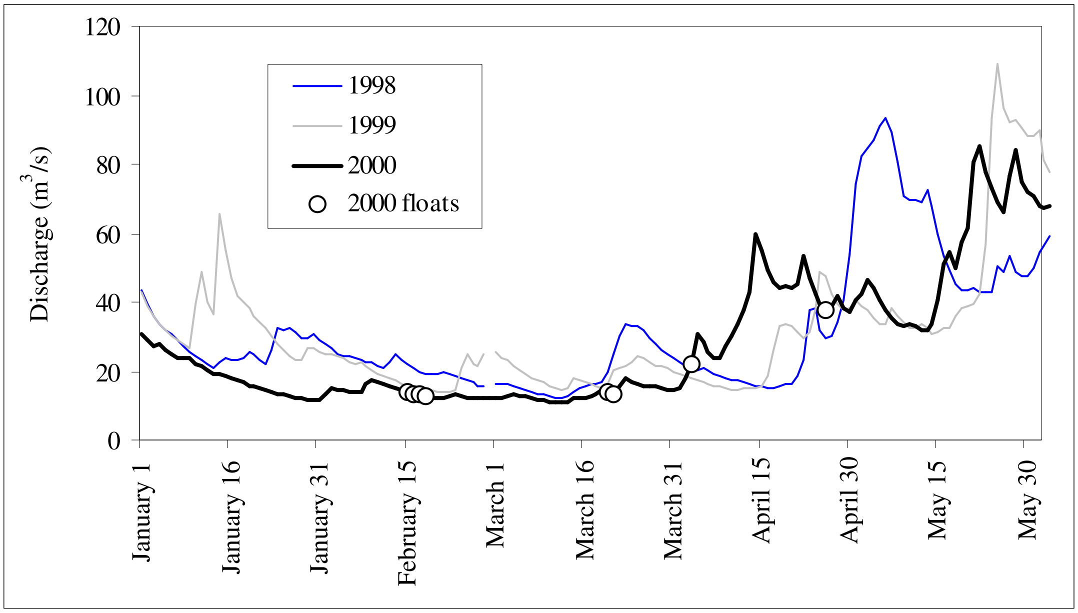
For 1998 – 2000, discharge remained relatively low and stable between late January and mid-March. Flow increased through April, with the freshet beginning in earnest sometime in May. Discharge through March 31, 2000 was lower than over the preceding two years, but high discharge in April prevented useful snorkel floats. Flows decreased for a short period in mid May, but visibility conditions did not improve and no floats were conducted at this time.

**Figure 2.** Discharge information for the Chilliwack River at Vedder Crossing (WSC gauge 08MH001), 1998, 1999 and 2000.




Float days are denoted by a circle.

**Figure 3.** Discharge information for the Chilliwack River above Slesse Creek (WSC gauge 08MH103), January – June 1998, 1999 and 2000.




Float days are denoted by a circle.

## 3.2 2000 snorkel float results

Results for Chilliwack River snorkel floats in 2000, and conditions experienced during floats are detailed in Table 4 and in Appendix IV. Both unmarked and tagged fish are included in the total steelhead count. In general, visibility in the upper river was excellent. Conditions below Slesse Creek provided good to moderate visibility, while below Slesse Park, conditions were poor on the one occasion when this reach was surveyed (Float 1). Thereafter, conditions precluded effective surveys. Visibility generally deteriorated with higher flows.

**Table 4.** Chilliwack River snorkel counts – February - April 2000.

| Date | Section | Wx | Vis. (m) | Stage (m) | Temp. (°C) | Dischrg ($m^3/s$) | km swum | SH observed | SH/km |
|---|---|---|---|---|---|---|---|---|---|
| Feb 16 | 1 | sunny | 6 - 9 | | | 28.8 | 9.1 | 3 | 0.3 |
| | 2a (canyon s/c) | | 9 | - | | | 0.5 | 4 | 8.0 |
| Feb 15 | 2b (hatchery s/c) | o/c | 7 | | 5.2 | 30.2 | 0.8 | 80 | 100.0 |
| | 3 | | 7 | | | | 8.4 | 72 | 8.6 |
| Feb 17 | 4 | sunny | 3 | | | 27.9 | 10.8 | 26 | 2.5 |
| Feb 18 | 5 | sunny | 3 | | | 26.5 | 9.3 | 36 | 3.9 |
| | | | | | | | **38.9** | **221** | **5.7** |
| Mar 20 | 1 | o/c | 6 - 7 | | 3.5 | 32.2 | 9.1 | 20 | 2.2 |
| | 2a (canyon s/c) | | 6 | 0.85 | | | 0.5 | 34 | 68.0 |
| Mar 21 | 2b (hatchery s/c) | o/c | 6 | | 5.0 | 30.4 | 0.8 | 92 | 115.0 |
| Mar 21 | 3 | | 2 – 6 | | | | 8.4 | 27 | 3.2 |
| | | | | | | | **18.8** | **173** | **9.2** |
| Apr 03 | 1 * | sunny | 5 – 6 | | 4.5 | 46.8 | 5.1 | 21 | 4.1 |
| | 2a (canyon s/c) | | 3 – 4 | 1.04 | | | 0.5 | 6 | 12.0 |
| | | | | | | | **5.6** | **27** | **4.8** |
| Apr 26 | 1 | o/c | 5+ | | 6.0 | 116 | 9.5 | 46 | 4.8 |
| | 2a* (2 of 3 pools) | o/c | 4 | 1.35 | | | 0.2 | 1 | 5.0 |
| Apr 27 | 2b (hatchery s/c) | o/c | 4+ | | | 135 | 0.8 | 22 | 27.5 |
| | 3 | | 3 - 4+ | | | | 8.4 | 38 | 4.5 |
| | | | | | | | **18.9** | **107** | **5.7** |

Notes:
1. stage measured at the staff gauge in the Box Canyon.
2. discharge data for WSC Station 08MH001, Chilliwack R. at Vedder Crossing.
3. Box Canyon (Section 2a) and Hatchery pools (2b) spot checks ('s/c') separated.
4. On April 03, only half of Section 1 was surveyed (Log Jam to Centre Creek Bridge).
5. On April 26, only two of the three Box Canyon pools were surveyed.

The highest count in 2000 was on Float 1 (221 steelhead; February 15 – 18). We encountered good visibility conditions and moderate flows, and were able to survey all five designated sections of the Chilliwack River (38.9 km; 5.7 steelhead per kilometre surveyed). Assuming uniform fish distribution throughout the drainage, this suggests that 347 fish might have been observed over a float of the 61 km total length. However, February float data indicates non-uniform distribution of fish. Very few fish were observed in the upper drainage (Section 1), and in spot checks of the Box Canyon pools (Section 2a). Spot checks of the Hatchery pools (Section 2b) produced strong counts (80 fish) suggesting that fish were holding below the canyon at the time of the float. Counts were relatively strong in Section 3, between Slesse Creek and the clay slide at Slesse Park. Visibility in Sections 4 and 5, downstream of the clay slide, was about half that upstream. Counts in these sections were moderate, and efficiency was undoubtedly affected by visibility conditions (see Table 5).

On subsequent floats, we surveyed fewer sections. On Float 2 (March 20 – 21), we saw 173 steelhead in an 18.8 km section (9.2 fish/km). This represents the highest fish count per kilometre surveyed for snorkel counts in 2000. Visibility conditions were generally good, although somewhat reduced relative to Float 1. Discharge conditions were broadly similar to the previous survey. Fish numbers in Section 1 and in the Canyon pools increased. The Hatchery pools also saw a modest increase. In Section 3 numbers were much lower than on the previous float, but visibility was reduced. Sections 4 and 5 were not assessed.

Float 3 (April 3) surveyed only the upper portion of Section 1, and the three Box Canyon pools, due to high discharge and poor visibility. Discharge was about 50% greater than on previous floats. We surveyed a 5.6 km section and saw 27 steelhead (4.8 fish/km). This represented an increase in densities for Section 1, but a reduced count for the Canyon pools. Sections 3, 4 and 5 were not assessed.

On Float 4 (April 26), discharge was substantially higher than on previous occasions, and flows increased between the two days surveyed. Reasonable visibility conditions were encountered. Densities in the upper portion of the drainage (Section 1) were the highest encountered in 2000, suggesting that fish moved in to these areas later in the season. Only one fish was encountered in the Box Canyon pools, suggesting that fish had moved out of this holding habitat. Visibility in Section 3 was about half that experienced on the first float through this section, and fish numbers were about half the Float 1 total. Densities in Section 3 were slightly higher than on the previous survey of this section (Float 2). The total for Float 4, was 107 fish over an 18.9 km section (5.7 fish/km). Sections 4 and 5 were not assessed.

Results for each survey in 2000 are summarised in Table 5. In addition to steelhead, we observed a total of 451 rainbow trout, 66 char, 1932 whitefish and 216 suckers. Suckers were seen in Section 5 only, downstream of Vedder Crossing. Observations of fish species other than steelhead are detailed in Appendix I.

**Table 5.** Summary of Chilliwack River snorkel counts 2000.

| Dates | Sections | Vis. (m) | Stage (m) | Avg. dischrg ($m^3/s$) | km swum | SH | SH/ km | RB | Char | WF | Sucker |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Feb 15-18 | 1, 2, 3, 4, 5 | 3 - 9 | - | 28.4 | 38.9 | 221 | 5.7 | 48 | 22 | 730 | 216 |
| Mar 20-21 | 1, 2, 3 | 2 - 7 | 0.85 | 31.3 | 18.8 | 173 | 9.2 | 205 | 31 | 354 | 0 |
| Apr 03 | 1*, 2 | 3 - 6 | 1.04 | 46.8 | 5.6 | 27 | 4.8 | 35 | 1 | 14 | 0 |
| Apr 26-27 | 1, 2*, 3 | 3 - 5 | 1.35 | 125.5 | 18.9 | 107 | 5.7 | 163 | 12 | 834 | 0 |

## 3.3 Observer efficiency and total fish present

Table 6 details radio tag detections and spaghetti tag observations, in addition to steelhead data, for each section swum. Number of fish present and confidence intervals are derived from mark-resight data using the Peterson estimator and Poisson confidence intervals. Observed and estimated numbers of steelhead present per kilometre of stream surveyed are also indicated in the table.

We experienced high variability in observer efficiency. In some sections, floaters saw none of the tags present, while 100% of marks were seen in other sections. The number of tags available in a section ranged between 0 and 17. Although the data set for comparisons is limited, observer efficiency was generally higher on February and March floats, when discharge and visibility conditions were more favourable. However, data correlation between efficiency and discharge/visibility is weak ($r^2$~0.15; data on file).

For Section 1, tags were present on two floats only, and few marks were available. All three tags were missed on Float 3, and one of seven marks (14%) was seen on Float 4.

Efficiency in the Box Canyon pools (Section 2a) was expected to be high, as fish are readily observed in these holding areas. Tags were present on one occasion only, and all marks were seen. Turbulence in the Hatchery pools (Section 2b) may affect observations, but these holding areas were also predicted to afford good efficiency. Marks were available on all three floats completed. On Floats 1 and 2, reasonable numbers of marks were present, and efficiency was similar (around 50%). On Float 4, only four tags were present, and all were missed.

In Section 3, reasonable numbers of marks were present on Floats 1 and 4, and efficiency was similar (around 12%). On Float 2, none of the nine tags present were seen.

**Table 6.** Observer efficiency and Peterson total fish present estimates, Chilliwack River snorkel counts – February - April 2000.

| Date | Section | km swum | # of untagged SH seen | # of tagged SH seen | # of tags detected | Obs. Eff. (%) | Estimated number of SH present | Lower 95% CI | Upper 95% CI | Peterson mark rate (%) | Steelhead per kilometre Obs. | Steelhead per kilometre Est. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Feb 16 | 1 4-mi. Log Jam to Third Br. | 9.1 | 3 | 0 | 0 | - | *3* | | | - | 0.3 | - |
| Feb 16 | 2 Box Canyon pools (spot checks) | 0.5 | 4 | 0 | 0 | - | *4* | | | - | 8.0 | - |
| Feb 15 | 3 Hatchery pools (spot checks) | 0.8 | 75 | 5 | 10 | 50.0 | 148 | 72 | 299 | 6.8 | 100.0 | 184.4 |
| Feb 15 | 4 Slesse confl. to Slesse Park clayslide | 8.4 | 70 | 2 | 16 | 12.5 | 413 | 160 | 915 | 3.9 | 8.6 | 49.1 |
| Feb 17 | 5 Below Tamihi to Vedder Crossing | 10.8 | 25 | 1 | 14 | 7.1 | 202 | 63 | 384 | 6.9 | 2.4 | 18.7 |
| Feb 18 | 6 Vedder Xing to Keith Wilson Br. | 9.3 | 32 | 4 | 11 | 36.4 | 88 | 41 | 187 | 12.5 | 3.9 | 9.4 |
| **Summed total** | | **38.9** | **209** | **12** | **51** | **23.5** | **856** | | | **6.0** | **5.7** | **22.0** |
| **Pooled total** | | | | | | | **887** | **540** | **1501** | **5.7** | | **22.8** |
| | | | | | | | | | | | | |
| Mar 20 | 1 4-mi. Log Jam to Third Br. | 9.1 | 20 | 0 | 0 | - | *20* | | | - | 2.2 | - |
| Mar 20 | 2 Box Canyon Pools | 0.5 | 32 | 2 | 2 | 100 | 34 | 13 | 76 | 5.9 | 68.0 | 68.0 |
| Mar 21 | 3 Hatchery pools (spot checks) | 0.8 | 84 | 8 | 14 | 57.1 | 154 | 87 | 325 | 9.1 | 115.0 | 192.5 |
| Mar 21 | 4 Slesse confl. to Slesse Park clayslide | 8.4 | 27 | 0 | 9 | 0 | *36* | | | - | 3.2 | - |
| **Summed total** | | **18.8** | **163** | **10** | **25** | **40.0** | **244** | | | **10.2** | **9.2** | **13.0** |
| **Pooled total** | | | | | | | **410** | **242** | **714** | **6.1** | | **21.8** |
| | | | | | | | | | | | | |
| Apr 03 | 1 4-mi. Log Jam to Centre Creek Br. | 5.1 | 21 | 0 | 3 | 0 | *24* | | | 12.5 | 4.1 | - |
| Apr 03 | 2 Box Canyon Pools | 0.5 | 6 | 0 | 0 | - | *6* | | | | 12.0 | - |
| **Summed total** | | **5.6** | **27** | **0** | **3** | **0** | ***30*** | | | | **4.8** | **5.4** |
| | | | | | | | | | | | | |
| Apr 26 | 1 Upper Log Jam to Third Br. | 9.5 | 45 | 1 | 7 | 14.3 | 187 | 58 | 357 | 3.7 | 4.8 | 19.7 |
| Apr 26 | 2 2 of 3 Box Canyon Pools | 0.2 | 1 | 0 | 0 | - | *1* | | | | 5.0 | - |
| Apr 27 | 3 Hatchery pools (spot checks) | 0.8 | 22 | 0 | 4 | 0 | *26* | | | | 27.5 | - |
| Apr 27 | 4 Slesse confl. to Slesse Park clayslide | 8.4 | 36 | 2 | 17 | 11.8 | 233 | 90 | 517 | 7.3 | 4.5 | 27.7 |
| **Summed total** | | **18.9** | **104** | **3** | **28** | **10.7** | **447** | | | **6.3** | **5.7** | **23.7** |
| **Pooled total** | | | | | | | **782** | **343** | **1722** | **3.6** | | **41.4** |

Notes:
1. mean observer efficiency for a given survey calculated as total number of tags seen / total number of tags detected.
2. total steelhead per kilometre values calculated as total steelhead / total km.
3. italics indicate no Peterson estimate (total fish estimates calculated as untagged + tagged + detected fish).

Surveys below the Slesse Park clay slide (Sections 4 and 5) were conducted during Float 1 only. Reasonable numbers of tags were available, and efficiency ranged between 7 and 36%. Floats of these sections in future years are unlikely, due to the visibility conditions downstream of the clay banks.

Confidence intervals for estimates of total fish present in sections surveyed were extremely large, due to sample size and low observer efficiency. No mark-resight estimate was derived for Float 3, because only three tags were available in the survey area, and none were observed. Summed estimates are biased low, because we were conservative in sections with no marks available (total fish present = total observed). Similarly, for sections in which none of the available tags were seen (observer efficiency = zero), we used the minimum number of fish known to be present (those observed + tags detected). As a result, pooled estimates are larger than the sum of section estimates.

Estimated of total numbers of fish present based on pooled mark-resight data suggest that around 22 fish per kilometre may have been present in surveyed reaches during Floats 1 and 2. By Float 4, densities may have risen to about 40 fish per kilometre, although confidence in these estimates is weak.

We used data from radio tags in sections not surveyed to estimate total steelhead numbers in the Chilliwack River at the time of Floats 1, 2 and 4. Estimates were derived using mark rate from pooled Peterson data. Results are summarised in Table 7. Note that these are estimates of the number of fish present in the river at the time of floats, rather than total population estimates.

**Table 7.** Estimated total number of steelhead present, Chilliwack River 2000.

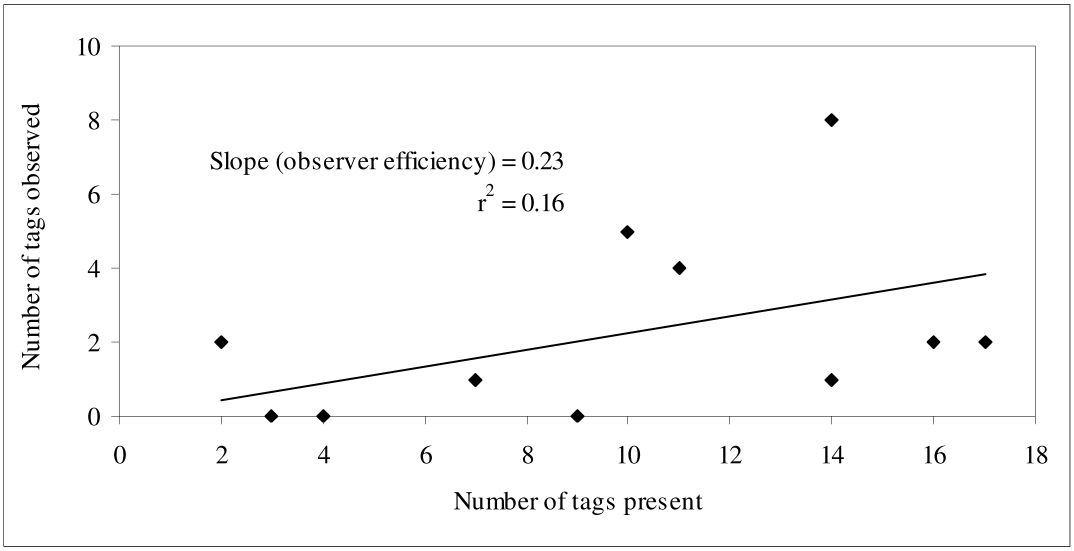
| Float | Dates | Pooled Peterson mark rate | Tags at large | Total steelhead |
|---|---|---|---|---|
| 1 | February 15 – 18 | 5.7 | 60 | 1044 |
| 2 | March 20 – 21 | 6.1 | 69 | 1132 |
| 4 | April 26 – 27 | 3.6 | 100 | 2793 |
| *4** | *April 26 – 27* | *6.3* | *100* | *1596* |

Data from tagged fish suggest that the total number of steelhead present in the Chilliwack River rose from around 1000 fish in February 2000 to about 2800 fish in April 2000. Confidence intervals were not developed for these data, but estimates are highly uncertain due to small recapture sample size and variability in visibility conditions and observer efficiency. For example, the Float 4 estimate is affected by poor conditions in Section 3. If the summed mark rate (6.3%;

Float 4*, Table 7) is applied, total steelhead numbers at the time of that survey drop to about 1600 fish.

Mean observer efficiency for 2000 Chilliwack River snorkel floats was 23% (Figure 4). However, efficiency is clearly section and condition dependent, so this broad average value, across varying sections, conditions and times of year, is probably of limited utility.

**Figure 4.** Relationship between tags observed and present, all sections, all floats.




# 4 DISCUSSION

Results from 2000, and from previous years, suggest that snorkel floats of sections of the Chilliwack River can provide a useful index of steelhead abundance. Float counts represent a relative index in sections surveyed. Repeated surveys over the course of the run provide information on different arrival components. Additionally, multiple surveys help address variability in conditions between sampling events. Consistently timed, annual surveys of selected sections should provide a time-series index to track steelhead abundance.

Snorkel float index sensitivity is limited by discharge and visibility conditions. Floats do not detect all fish present. As conditions are so variable, efficiency will change between surveys and between years. Variable efficiency may reduce the ability of the index to detect changes in population status that are meaningful in a conservation framework. The snorkel float index should be compared with other available measures of Chilliwack River steelhead abundance to determine whether it provides adequate sensitivity for management application.

In the upper Chilliwack River, upstream of a clay slide at Slesse Park, extensive sections can safely be assessed using the snorkel float technique, and conditions are often suitable during the steelhead spawning migration. Repeatable surveys are expected to be possible on an annual basis. However, visibility and discharge remain the most important constraints on float effectiveness.

Section 1 is generally shallow, with limited holding habitat. Visibility tends to be limited by bubbles rather than by sediment. Although repeated floats are important, 2000 data suggest that surveys may be less crucial in the early season, when fish may hold lower in the system. On February 16, we saw three fish in Section 1. By March 20, 20 fish had moved into the area, and the April l3 count was 21, although only 5.1 km of the usual 9.1 km were surveyed. On the final float, April 26, there were 45 fish in the upper river. Historical records and future data should be examined to determine ideal timing for floats of this section.

Section 2 contains critical holding habitat, and key pools can be assessed under most conditions. The section should be included on each survey conducted.

Section 3 provides substantial steelhead habitat, holds large concentrations of fish, is safe to float, and enjoys good water clarity. Sediment inputs from Slesse Creek and a number of smaller tributaries can be problematic. Unless prevented by visibility conditions, this section should be included on each sampling occasion.

Downstream of the Slesse Park clay slide, repeatable annual surveys are unlikely due to visibility constraints. Early season floats may be possible, but as conditions deteriorate, the number of fish entering the lower river will likely remain unknown. About half of the length of the river is downstream of this point, and significant areas of steelhead holding and spawning habitat exist. Use of these areas is documented by the radio telemetry study (Nelson *et al.* in prep.). Application of index counts to assess steelhead population status should acknowledge that some fish bearing reaches are not surveyed.

## 4.1 Observer efficiency

Observer efficiency in sections that are surveyed is determined by visibility and discharge conditions, as well as by fish behaviour and crew skill. Floaters may not detect fish hidden in deep pools or behind cover elements, or may not see fish in very turbulent sections. Large groups of fish holding in a single pool are more easily assessed than an equal number of fish distributed throughout shallow, turbulent, complex habitats. As the river is divided into swimming lanes, sections ‘between’ lanes may be inadequately assessed. Conversely, double counting of fish between lanes may introduce a positive bias to counts.

Observer efficiency varied widely between sections and between floats. Floaters detected all available tags in some sections, and missed all tags in other sections. The number of tags available was also highly variable. In general, higher efficiency was associated with lower, cleaner water conditions early in the season. Efficiency also tended to be better in pools, where steelhead were concentrated, than in shallow areas where fish were dispersed. Observer efficiency is crew dependent, and may change over time as a crew becomes more proficient.

We estimated the number of fish actually present, both within sections surveyed and system-wide, based on mark-resight data. We used the Peterson estimator, rather than raw observer efficiency results. Estimates were highly uncertain and varied considerably with assumptions applied. Total fish estimates apply for the time period of each float, within sections surveyed. Expanded system-wide estimates further assume ratios of marked to unmarked fish in sections not surveyed. Results are not total population estimates, because immigration and emigration over the course of the migration are not considered. Available data are not sufficient to calculate a robust total population estimate.

Total fish present estimates based on mark-resight data suggest that between 244 and 887 fish were present in surveyed reaches during 2000 floats. Density estimates for surveyed reaches ranged from about 13 to 41 fish per kilometre. Estimates of the total number of steelhead at large in the Chilliwack River system at the time of 2000 surveys ranged between about 1000 and 2800 fish.

### 4.2 2000 results - index reach

Snorkel results for Floats 1, 2 and 4, within Sections 1, 2 and 3, are compared in Table 8. For these three floats, coverage of the three sections was almost complete (one pool in the Box Canyon was not surveyed on Float 3). Count results in this index reach show a pattern of upstream movement between surveys. Observed steelhead numbers in Section 1, furthest upstream, increased over the course of counts. Between Floats 1 and 2, fish numbers in Section 2 increased, with more fish holding in this pool habitat. However, by Float 4, numbers decreased. Radio telemetry data confirmed upstream movement from holding locations to spawning locations (Nelson *et al.* in prep.). In Section 3, numbers decreased dramatically between Floats 1 and 2, and recovered modestly on Float 4. Variability in Section 3 counts may be related to decreased efficiency in this section after Float 1 (see Table 6).

**Table 8.** Chilliwack River snorkel counts – index reach.

| Float | Dates | Section | km swum | SH observed | Obs, SH/km | Pooled est. total SH | Lower 95% CI | Upper 95% CI | Est. SH/km |
|---|---|---|---|---|---|---|---|---|---|
| 1 | Feb. 15 – 18 | 1 | 9.1 | 3 | 0.3 | | | | |
| | | 2a | 0.5 | 4 | 8.0 | | | | |
| | | 2b | 0.8 | 80 | 93.8 | | | | |
| | | 3 | 8.4 | 72 | 8.3 | | | | |
| | | | **18.8** | **159** | **8.5** | **539** | **292** | **1007** | **28.7** |
| 2 | Mar. 20 - 21 | 1 | 9.1 | 20 | 2.2 | | | | |
| | | 2a | 0.5 | 34 | 64.0 | | | | |
| | | 2b | 0.8 | 92 | 105 | | | | |
| | | 3 | 8.4 | 27 | 3.2 | | | | |
| | | | **18.8** | **173** | **9.2** | **410** | **242** | **714** | **21.8** |
| 4 | April 26 - 27 | 1 | 9.5 | 46 | 4.7 | | | | |
| | | 2a* | 0.2 | 1 | 5.0 | | | | |
| | | 2b | 0.8 | 22 | 27.5 | | | | |
| | | 3 | 8.4 | 38 | 4.3 | | | | |
| | | | **18.9** | **107** | **5.7** | **782** | **343** | **1722** | **41.4** |

The number of fish observed within the index reach increased on Float 2, and decreased on Float 4. This may reflect a pattern of fish arrival (Float 2), and then dispersal into areas where floats are not conducted or efficiency is reduced (Float 4). Efficiency in pool habitats, where large numbers of steelhead held during early surveys, was generally much better than in shallower, more turbulent areas where fish were found on the final float. Conversely, the change in index reach counts may have been caused only by changes in sampling conditions.

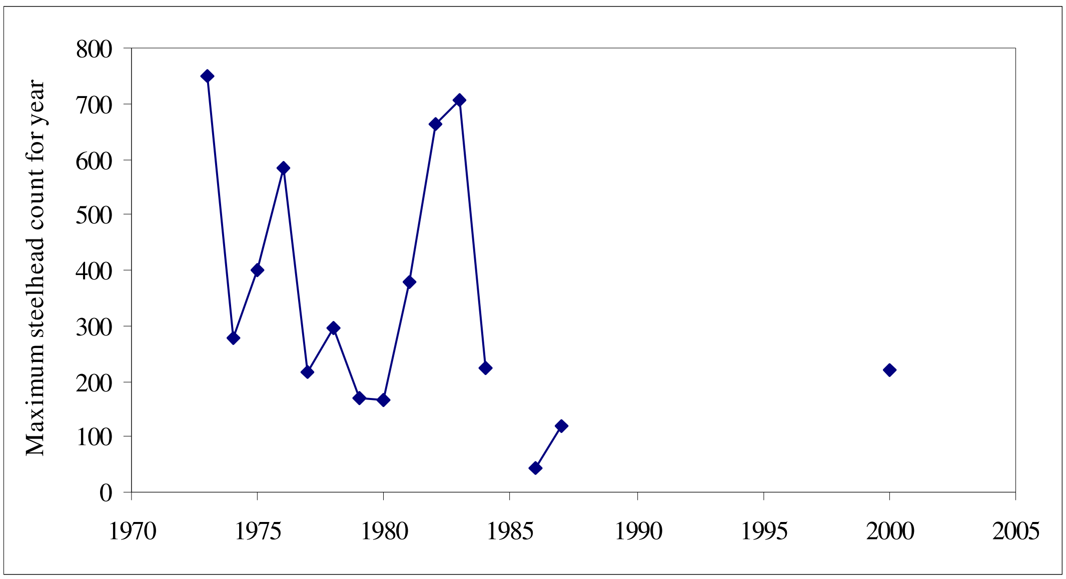
Estimates of fish present, based on mark-resight data pooled across index sections, suggest that numbers actually decreased on Float 2 and then increased substantially on Float 4 (Table 8). Upstream of Slesse Creek (Sections 1 and 2), pooled mark-resight estimates increased consistently between Floats 1, 2 and 4 (data on file).

## 4.3 Comparison with previous snorkel float results

Twenty five snorkel floats were conducted on the Chilliwack River between 1973 and 1987. The results of these surveys have been extremely variable, with a range of total counts between 751 (February 8, 1973) and 27 fish (April 3, 1987). Much of this variability is due to wide disparity in sections surveyed and timing of swims. Detailed information for all Chilliwack River floats is provided in Appendix II, with sections surveyed in each year identified in Appendix III. Data is summarised in Appendix I and graphed in Appendix V.

The maximum snorkel float result for each year sampled is graphed in Figure 5. No attempt is made to account for differences in float timing or sections surveyed. Despite high variability, and limited recent data, the overall trend and 2000 results suggest a dramatic reduction in steelhead recruitment. Evidence for population declines is also provided by angling results (see Section 4.4) and by juvenile density surveys (van Dishoeck 1999, 2000, 2001).

**Figure 5.** Maximum snorkel counts for years sampled: 1973 through 2000.

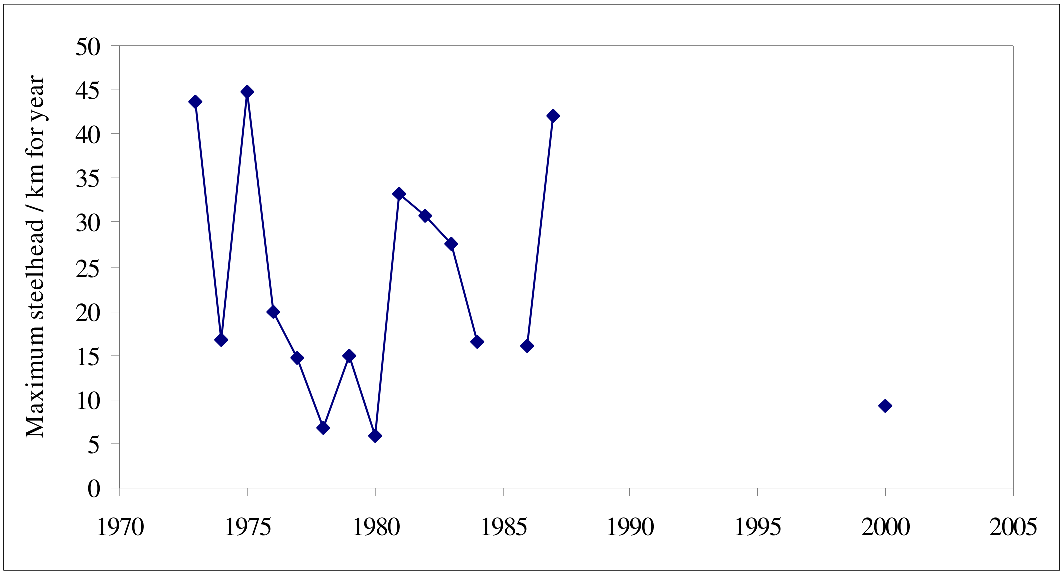



4.3.1 Steelhead per kilometre of stream surveyed

Standardised results are extremely variable over time. This reflects real steelhead recruitment, but is also affected by sampling conditions and sections surveyed. Steelhead distribution varies considerably, and surveys in some years assessed very short sections of high quality holding habitat. These 'spot checks' of selected pools often result in high counts over short sections, and a very high fish per kilometre index. For example, floats on March 8 and April 11, 1975 checked known holding pools, counting 120 and 39 fish in less than a kilometre of river.

Figure 6 graphs maximum steelhead per kilometre results for each year sampled. Results from 1975 spot checks are not included. Due to omissions from data records, lengths of reaches surveyed on February 16 and April 1, 1979 and on March 11, 1981 were estimated. For February 16, 1979, only the section upstream of Slesse Creek was included. Results for all floats conducted to date are presented in Appendix VI, with values tabulated in Appendix IV.

**Figure 6.** Maximum number of steelhead observed per kilometre surveyed.




Does not include 1975 spot checks. Distance surveyed est. for 79/02/16, 79/04/01, and 81/03/11.

Standardised results for 2000 were similar to counts in some previous years. However, despite variability, 2000 results suggest a decline in steelhead numbers relative to previous surveys. Counts through the early 1980s reflect a period of high steelhead oceanic survival (Ward 2000). No winter floats were conducted between 1988 and 1999; comparisons are not possible through this period.

## 4.4 Correlation with Steelhead Harvest Analysis (SHA)

The provincial Steelhead Harvest Analysis (SHA) provides an index of angler use and success, and a relative measure of adult steelhead returns. However, angler use is affected by factors such as perceived run size, success, weather and regulations. Angler success is affected by skill and catchability. In addition, the SHA index is imperfect. Reporting bias is known to inflate estimates, and the SHA is affected by changes in recreational fishing rules. Catch and release regulations for Chilliwack steelhead have been in place since 1979/80 (Table 9). When steelhead are released, recaptured fish may be reported to the SHA more than once, so results probably overestimate wild steelhead abundance. The SHA is based on the fiscal year (April 1, 1999 through March 31, 2000), so reported catch is split across two return years. April 1999 catch (*1999 return year*) and March 2000 catch (*2000 return year*) are reported together.

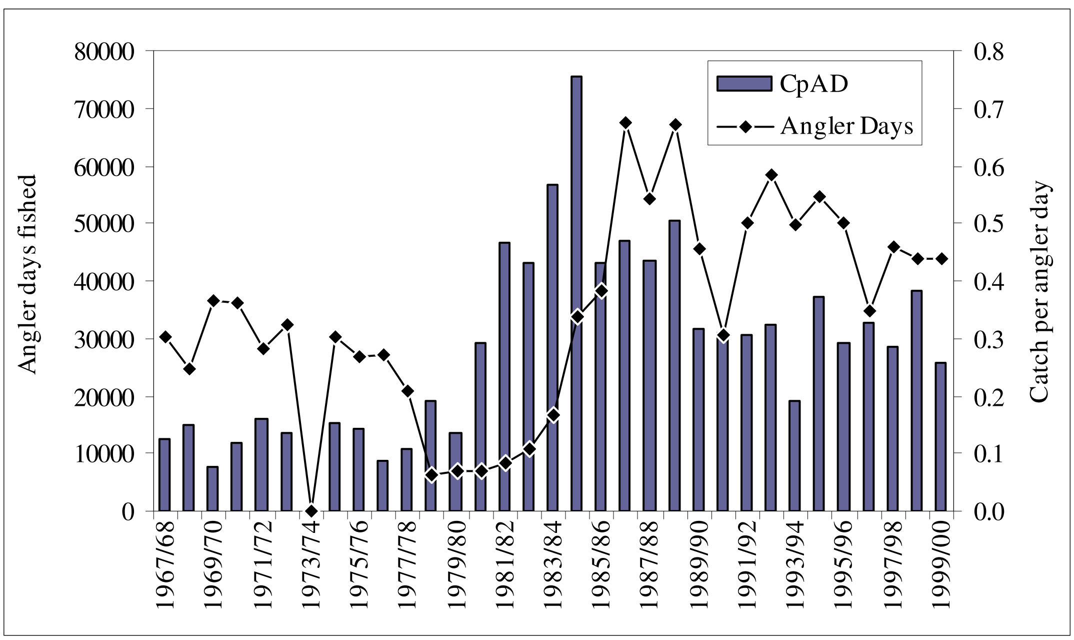
**Table 9.** Steelhead fishing regulations on the Chilliwack River, 1979-2001.

| **Seasons in force:** | **Regulation:** | **Applicable to:** |
|---|---|---|
| 1979/80 | Release steelhead 12/01 to 03/15 | Chilliwack River |
| 1980/81 – 1981/82 | Release wild steelhead 12/01 to 04/14 | Chilliwack River |
| 1982/83 – 1984/85 | Release wild steelhead 12/01 to 04/30 | Selected Reg. II MUs* |
| 1985/86 – present | Quota daily wild steelhead = ZERO | Region II |

* including the Chilliwack River. From Billings (1988) and P. Caverhill (MELP, pers. comm.).

Steelhead Harvest Analysis data for 1967/68 through 1999/00, are presented in Figure 7. Note that these results include both hatchery and wild steelhead. Despite regulation changes, early data are included because snorkel counts are available for comparison. Patterns of angler use and success after 1984/85 are considered to be less variable and the relationship between actual abundance and catch per unit effort is probably more consistent.

**Figure 7.** Steelhead Harvest Analysis results. Chilliwack River, 1967/68–1999/00.



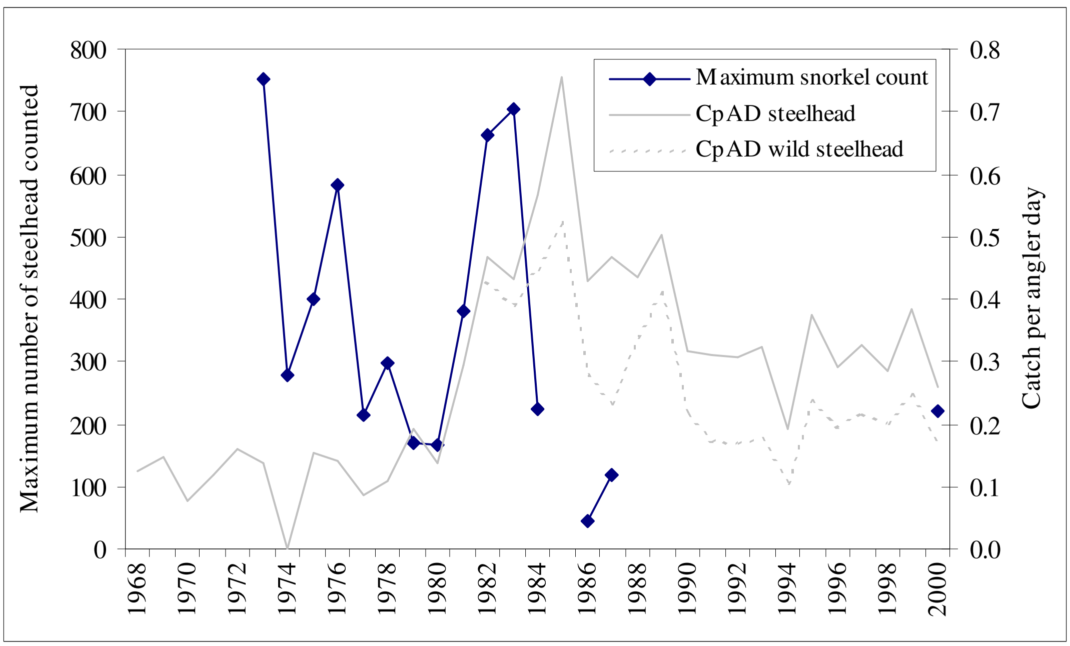

Not adjusted for the known SHA overestimation bias.

Angler effort has varied considerably over the period of record, but generally elevated effort since 1984/85 is apparent. Catch per angler day increased to peak levels during the mid-1980s period of high ocean survival for steelhead, and has generally declined since.

We assumed that most fish captured in the Chilliwack system are caught prior to March 31, and compared 2000 snorkel float results with the 1999/2000 SHA. Although some fish are caught after the beginning of April, most Chilliwack system snorkel floats have been completed prior to March 31. Of the 15 years with data, only six include swims after March 31. In three years, the maximum count occurred after this date (although in 1986, only one float was conducted, and this was after March 31).

SHA results for all steelhead (hatchery + wild), and for wild steelhead, are compared against available maximum snorkel counts in Figure 8. Changes in regulations and angler habits are ignored, and no attempt was been made to adjust for timing of floats and variability in sections surveyed.

**Figure 8.** Snorkel float results and Steelhead Harvest Analysis data for the Chilliwack/Vedder River, 1968 - 2000.

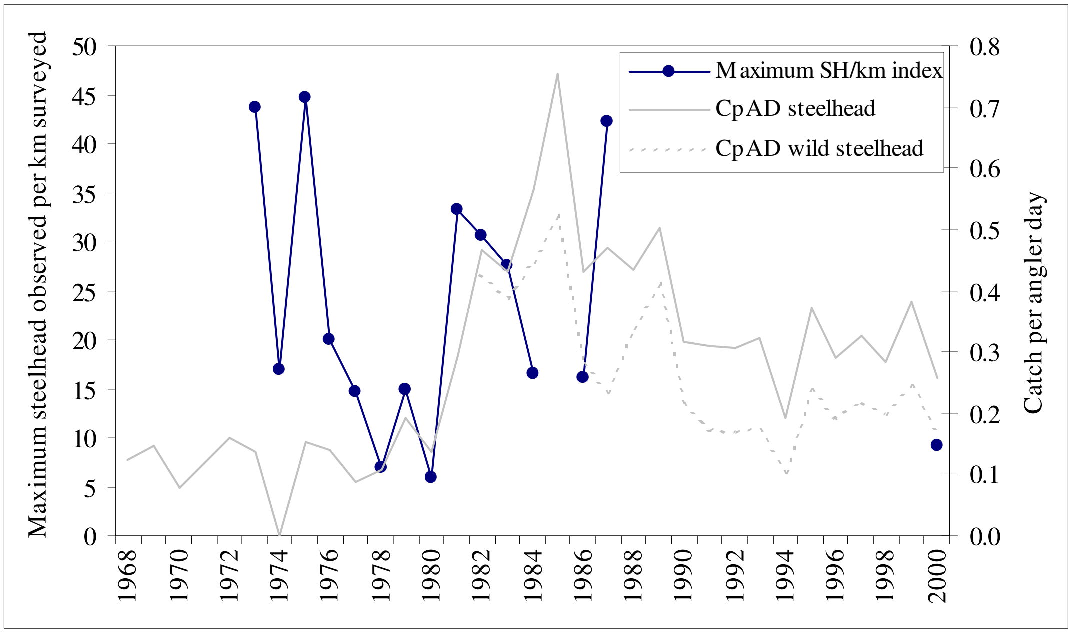



Sections floated in each year not identical. '1968' = 1967/68 SHA and 1968 snorkel float.

Maximum snorkel count and SHA catch indices of abundance follow similar trends of increase or decreases for many of the years compared. Correlation in magnitude of changes is poor, and may be related variability in timing and location of floats, and to changes in angler habits, conditions and regulations.

Maximum steelhead snorkel counts, standardised by distance surveyed, are compared with SHA results in Figure 9. Again, for most years compared, trends in the two indices are similar, although correlation in magnitude of changes is poor. In most years, an increase in the standardised steelhead count is reflected by an increase in the SHA index. Exceptions are 1978, 1982, and 1984.

**Figure 9.** Maximum steelhead count per kilometre and Steelhead Harvest Analysis data for the Chilliwack/Vedder River, 1968 - 2000.

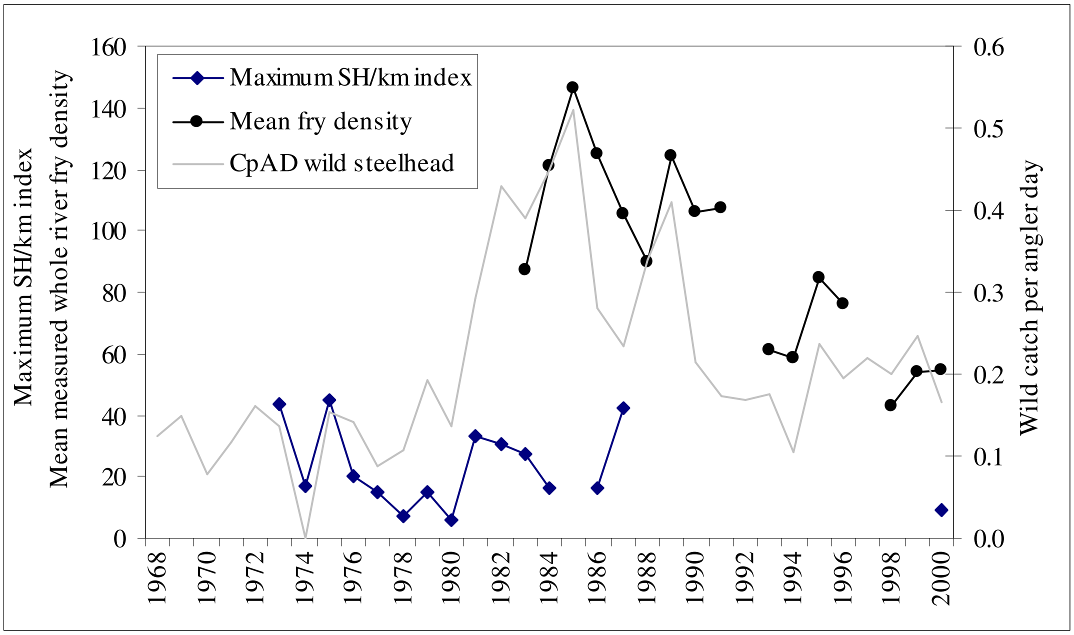



Does not include 1975 spot checks. Distance surveyed est. for 79/02/16, 79/04/01, and 81/03/11.

## 4.5 Correlation with juvenile density surveys

Fall juvenile steelhead density surveys have been conducted on the Chilliwack/Vedder River in most years since 1983. Results can be used as an index of adult escapement in the preceding spring. In Figure 10, mean measured fry densities for a given year are compared with maximum standardised snorkel counts and wild steelhead SHA results. Wild fish results are presented because juvenile surveys assess wild densities only. For fry results, lower and upper river sites (upstream and downstream of Slesse Creek) are pooled. Depth/velocity adjustment data is not applied.

**Figure 10.** Maximum standardised snorkel counts, mean fry densities and Steelhead Harvest Analysis results for the Chilliwack/Vedder River, 1968 - 2000.




Juvenile results appear to track changes in the SHA index relatively well. However, there are only five years for which both snorkel float and juvenile density surveys data are available. Based on this limited information, correlation is poor. As the true abundance of Chilliwack River steelhead is not known, it is difficult to assess the relative performance of the three available indices.

## 5 CONCLUSIONS

Snorkel floats appear to provide a useful index of steelhead abundance for the Chilliwack River. Based on our experience in 2000, and on review of historical information, effective surveys of about two thirds of the anadromous reach can be conducted under usual spring discharge and visibility conditions. Surveys downstream of the clay slide at Slesse Park are unlikely in most years, although extensive steelhead use of this section is known.

We conducted four snorkel surveys of varying sections of the Chilliwack River in 2000. We used a sample of externally marked and radio tagged fish to estimate observer efficiency within surveyed sections. For three of the four surveys, mark-resight data were used to calculate Peterson estimates of total fish present within sampled reaches. We applied pooled Peterson mark rates to radio tags in reaches not surveyed to estimate total fish numbers present throughout the system.

Our maximum count in 2000 occurred on Float 1, when all five designated sections were surveyed. We observed 221 fish over four days, between February 15 and 18. The float covered 38.9 km that we considered safe (64% of the 61 km total length of the mainstem Chilliwack River) and represents 5.7 fish per kilometre surveyed. Observer efficiency ranged between 7 and 50% (mean = 23.5%). Based on mark-resight data, we estimated that between 856 and 887 steelhead were present in the surveyed section. Based on radio tags at large and mark rate assumptions applied, we estimated that the total number of steelhead present in the river at the time of Float 1 was about 1000.

On Float 2 (March 20-21), we saw 173 steelhead in a shorter, 18.8 km section (9.2 fish/km). Observer efficiency ranged between 0 and 100% (mean = 40%). Mark-resight data suggested that between 244 and 410 fish were present in surveyed sections. Estimated total number of fish in the river increased to about 1100, although no information on deaths or emigration was applied.

A short float on April 3 suggested movement of fish into the upper river; 27 fish were counted in 5.6 km (4.8 fish/km). Efficiency and total fish present estimates were not calculated for Float 3. Only three marks were available in surveyed sections, and none were observed.

On Float 4 (April 26 – 27), the section surveyed was very similar to Float 2. We observed 107 fish over 18.9 km (5.7 steelhead/km). Results, corroborated by telemetry data, indicated an upstream movement of fish from holding locations to areas near spawning habitats. Observer efficiency was likely reduced by this change in habitat, and ranged between 0 and 14% (mean = 10.7%). Based on mark-resight data, we estimated that between 447 and 782 steelhead were present in the surveyed section. Variable efficiency strongly affected estimates of total fish numbers, but between 1600 and 2800 steelhead were likely present.

Snorkel floats repeated at various times over the course of the steelhead return are necessary to characterise run timing and to ensure that the peak of the steelhead return is assessed. Steelhead management requires an estimate of the total annual escapement, or an index thereof. At present, no data suggests that a single annual float on a particular date can provide this index.

The Chilliwack River steelhead stock appears to have faced significant declines since snorkel floats were first conducted in the 1970s. However, count results are highly variable, as are counts standardised by distance surveyed. This may reflect uncertainties inherent in the methodology, or actual changes in abundance.

Complementary data from juvenile density surveys and angler success records suggests that declines have occurred, and that conservation management of Chilliwack stocks must assume poor recruitment. Continued snorkel floats and juvenile surveys will be used to refine the available indices and to more accurately characterise stock status.

## 5.1 Recommendations

- ***repeat annual steelhead snorkel counts.***

  A robust method to derive total escapement from steelhead counts is not yet available, although floats provide a demonstrated index of abundance. Continued floats within the context of the Wild Steelhead Conservation Program will permit comparisons between snorkel float and juvenile assessment data. In addition, baseline snorkel float data through the 1980s is available for comparison if this index is repeated.

- ***establish representative index section.***

  An index section should be established so that each survey event can be completed in one or two days. Once established, the index section could be assessed several times annually on a repeatable, affordable basis. Establishment of an index section will require an intensive float program over four to five years.

- ***continue juvenile assessment study.***

  Juvenile densities also provide an index, rather than a direct estimate, of adult escapement. However, continued surveys will provide a numerical basis for the analysis of minimum data requirements. Comparison of juvenile and adult results should support development of a cost effective annual program that provides data adequate for management objectives.

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| Date | Total SH | Total km floated | SH per km floated | Notes |
|---|---|---|---|---|
| February 08, 1973 | 751 | 17.2 | 43.7 | |
| February 15, 1973 | 291 | 29.9 | 9.7 | |
| February 21, 1974 | 278 | 16.5 | 16.8 | |
| January 08, 1975 | 174 | 4.8 | 36.3 | |
| February 05, 1975 | 400 | 24.7 | 16.2 | |
| March 08, 1975 | 120 | 1 | 120.0 | spot checks |
| March 27, 1975 | 135 | 17.4 | 7.8 | |
| April 09, 1975 | 398 | 8.9 | 44.7 | |
| April 11, 1975 | 39 | 0.3 | 130.0 | spot checks |
| February 11, 1976 | 252 | 21.7 | 11.6 | |
| March 20, 1976 | 584 | 29.3 | 19.9 | |
| January 09, 1977 | 148 | 24.5 | 6.0 | |
| February 02, 1977 | 216 | 14.6 | 14.8 | |
| February 16, 1978 | 297 | 43.4 | 6.8 | |
| February 16, 1979 | 69 | 11.4 | 6.1 | |
| April 01, 1979 | 169 | 11.4 | 14.8 | |
| February 15, 1980 | 167 | 31.7 | 5.3 | |
| April 03, 1980 | 132 | 22.5 | 5.9 | |
| March 11, 1981 | 380 | 11.4 | 33.3 | |
| March 11, 1982 | 663 | 21.6 | 30.7 | |
| February 08, 1983 | 270 | 20.1 | 13.4 | |
| April 06, 1983 | 705 | 25.6 | 27.5 | |
| March 13, 1984 | 223 | 13.5 | 16.5 | |
| 1985 | | | | no survey |
| May 12, 1986 | 45 | 2.8 | 16.1 | |
| March 25, 1987 | 118 | 2.8 | 42.1 | |
| 1988 | | | | no survey |
| 1989 | | | | no survey |
| 1990 | | | | no survey |
| 1991 | | | | no survey |
| 1992 | | | | no survey |
| 1993 | | | | no survey |
| 1994 | | | | no survey |
| February 16, 2000 | 221 | 38.9 | 5.7 | |
| March 20, 2000 | 173 | 18.8 | 9.2 | |
| April 03, 2000 | 27 | 5.6 | 4.8 | |
| April 26, 2000 | 104 | 18.9 | 5.7 | |

| Date | For | Visibility | TOTAL # of steelhead | # of sections | # of crew | Source | Section 1 | Section 2 | Section 3 | Section 4 | Section 5 | Section 6 | Section 7 | Section 8 | Section 9 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| February 8, 1973 | adults | low flow & clear | | 6 | 40 | MoE Surrey file | 4 mi. log jam to Centre Ck. Camp | Centre Ck. Camp to Rearing Pond | Rearing Pond to 3rd Bridge | 3rd Bridge to Box Canyon | Box Canyon to sandbar camp | Sandbar camp to Wells Ranch Br. | | | |
| # Fish Observed | | | **751** | | | | 19 | 36 | 177 | 314 | 37 | 168 | | | |
| February 15, 1973 | adults | | | 6 | 20 BCIT | MoE Surrey file | Slesse Creek to Thurston Camp | Thurston Camp to Tamihi Bridge | Tamihi Bridge to Edwards Road | Edwards Road to Vedder Bridge | Vedder Bridge to Lickman Road | Lickman Road to Vedder Canal | | | |
| # Fish Observed | | | **291** | | | | 86 | 89 | 25 | 9 | 20 | 62 | | | |
| March 21, 1973 | Slesse Creek floated by 5 divers but NO fish were sighted, despite excellent conditions. | | | | | | | | | | | | | | |
| February 21, 1974 | adults | exc. | | 8 | 20 BCIT | MoE Surrey file | Post Ck. to Centre Ck. Br. | Centre Ck. Br. to Centre Ck. Camp | Centre Ck. Camp to Rearing Pond | Rearing Pond to Old Bridge | Old Bridge to 3rd Bridge | Ford Camp to Box Canyon | Box Canyon Pool to Sand Bar | Sand Bar to Slesse Creek | |
| Sect. length (km) | | | | | | | 1.93 | 1.93 | 2.09 | 2.25 | 2.25 | 2.74 | 2.58 | 1.77 | |
| # Fish Observed | | | **278** | | | | 13 | 8 | 33 | 13 | 96 | 81 | 22 | 12 | |
| August 30, 1974 | Spot checks and short swims through Allison Pools to Slesse Park. No SH sighted but 12 RBT > 8" and 157 RBT < 8" (150 fingerlings) sighted. | | | | | | | | | | | | | | |
| January 8, 1975 | adults - tagged fish | exc. | | 4 | | MoE Surrey file | Old Bridge abutment to 3rd Bridge | 3rd Bridge to Reco Br. | Box Canyon spot check | Camp Site Pool spot check | | | | | |
| # Fish Observed | noted. | | **174** | | | | 116 | 31 | 23 | 4 | | | | | |
| January 23, 1975 | Slesse Creek floated by 3 divers. Poor water conditions (visibility=1-2m) prevailed and NO SH were sighted. | | | | | | | | | | | | | | |
| February 5, 1975 | adults | exc. u/s Slesse Park | | 11 & spot checks | 30 (BCIT) | MoE Surrey file, Bech (1986) | Post Ck. hole & 4 mi. log jam to Centre Creek Br. | Centre Ck. Bridge to Centre Ck. Camp | Centre Ck. Camp to Rearing Pond | Rearing Pond to Old Bridge | Old Bridge to 3rd Bridge | Reco Bridge to Box Canyon | Slesse Creek to Borden Creek | Nursery Run to top of Allison Pool | Allison Pool to Slesse Park Store |
| Sect. length (km) | | poor d/s | | | | | 1.61 | 1.29 | 1.93 | 1.77 | 2.25 | 2.59 | 2.90 | 3.54 | 4.83 |
| # Fish Observed | | | **400** | | | | 1 | 3 | 16 | 2 | 73 | 95 | 14 | 91 | 65 |

| Date | For | Visibility | TOTAL # of steelhead | # of sections | # of crew | Source | Section 1 | Section 2 | Section 3 | Section 4 | Section 5 | Section 6 | Section 7 | Section 8 | Section 9 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| February 5, 1975 | same float as above | | | | | | Slesse Park Store to Tamihi Pool (10) | Boulder Hole to Osbourne Road (11) | Post Ck., Ford Camp and Wells Ranch | | | | | | |
| Sect. length (km) | (cont.) | | | | | | 1.93 | 2.58 | spot checks | | | | | | |
| # Fish Observed | | | | | | | 3 | 7 | 30 | | | | | | |
| February 7, 1975 | Attempt to float from Osbourne Road to the dyke at Yarrow failed due to poor water conditions. | | | | | | | | | | | | | | |
| March 8, 1975 | adults | clear | | 7 | 6 + tenders | MoE Surrey file | Middle Ck. Br. abutment (spot check) | Road Run on Middle Ck. (spot check) | Main Br. (Middle Ck.) (spot check) | Reco Bridge (spot check) | Box Canyon (spot check) | Limits Hole (spot check) | Bedrock Run to Allison | | |
| # Fish Observed | | low flow | **120** | | | | 25 | 20 | 20 | 4 | 15 | 1 | 35 | | |
| March 27 & 28, 1975 | adults | ~9m | | 7 | 5 | MoE Surrey file | Boom Sticks (Vedder X) to Hopedale | Hopedale Road to Wilson Road | Wilson Road to d/s Meat Hole | d/s Meat Hole to Power line | Schellers Br. to u/s J. Little's | J. Little's to High bank | High bank to Vedder Crossing Br. | | |
| # Fish Observed | | | **135** | | 2 days | | 47 | 19 | 26 | 6 | 13 | 14 | 10 | | |
| April 9 & 10, 1975 | adults | ~10m | | 9 | 4 | MoE Surrey file | Vedder Crossing to Pump House | Pump House to Log Jam (d/s Peach Pool) | Log Jam (Peach Pool) to Lickman Road | Lickman Road to Hopedale Road | Hopedale Road to BCE Bridge | BCE Bridge to Wilson Road | Wilson Road to Meat Hole | Meat Hole to top of Canal | Top of Canal to 400m u/s Power line |
| # Fish Observed | | | **398** | | 2 days | | 35 | 151 | 48 | 11 | 15 | 14 | 4 | 116 | 4 |
| April 11, 1975 | adults | <10m | | 3 | 3 | MoE Surrey file | Run d/s Meat Hole | Cutbank run d/s Meat Hole | Meat Hole | | | | | | |
| # Fish Observed | | | **39** | | | | 37 | 1 | 1 | | | | | | |
| April 16, 1975 | 4 divers floated the lower ~8km of the Little Chilliwack R. (Dolly Varden Ck.). A helicopter was required for drops. Excellent water conditions but no SH adults, juveniles or evidence of spawning. Good habitat. | | | | | | | | | | | | | | |

| **Date** | **For** | **Visibility** | **TOTAL # of steelhead** | **# of sections** | **# of crew** | **Source** | **Section 1** | **Section 2** | **Section 3** | **Section 4** | **Section 5** | **Section 6** | **Section 7** | **Section 8** | **Section 9** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| February 11, 1976 | adults | good (20') | | 12 | 37 | MoE Surrey file | Campsite pool, Wells Ranch & 4 mi log jam spotchecks | 4 mi. log jam to Centre Ck. Br. | Centre Ck. Bridge to Centre Ck. Camp | Centre Ck. Camp to Rearing Pond | Rearing Pond to Middle Ck. Br. abutment | Middle Ck. Br. abutment to 3rd Bridge | 3rd Br. to Reco Br. | Box Canyon | Slesse Ck. Confluence to Borden Ck. |
| Sect. length (km) | | | | | | | | 1.93 | 1.93 | 1.93 | 2.25 | 2.25 | 1.21 | | 2.90 |
| # Fish Observed | | | **252** | | | | 7 | 18 | 3 | 6 | 43 | 99 | 21 | 8 | 5 |
| February 11, 1976 | same float as above | | | | | | Butterfly to Anderson Ck. (10) | Anderson Ck. to Slesse Park Store (11) | Slesse Park Store to Tamihi Bridge (12) | | | | | | |
| Sect. length (km) | (cont.) | | | | | | 3.54 | | | | | | | | |
| # Fish Observed | | | | | | | 15 | 27 | 0 | | | | | | |
| March 20 & April 4, 1976 | adults | ~8m u/s Slesse Pk. <1m d/s. | | 9 | 8 | MoE Surrey file | Post Ck. to Centre Ck. Br. | Centre Ck. Br. to Rearing Pond | Rearing Pond to 3rd Br. | 3rd Br. to Box Canyon | Wellhead (?) to Slesse Ck. | Slesse Ck. to Borden Ck. | Borden Ck. to Allison Railing | Allison to Slesse Park Store | J. Little's to Vedder Crossing |
| # Fish Observed | | | **584** | | 2 days | | 2 | 87 | 233 | 98 | 32 | 27 | 71 | 2 | 32 |
| January 9, 1977 | adults | | | | | MoE Surrey file | Allison to Yarrow | | | | | | | | |
| # Fish Observed | | | **148** | | | | 148 | | | | | | | | |
| February 2, 3 & 4, 1977 | adults & res. RBT | exc. | | 3.5 °C | | MoE Surrey file | 4 mi. log jam (spot check) | Centre Ck. to F.S. Campsite | Middle Ck. abutment to 3rd Bridge | 3rd Bridge to Peter's (?) Bridge | Box Canyon (spot check) | Sandbar Campsite (spot check) | Slesse Creek to Borden Creek | Borden Ck. to Anderson Ck. | |
| # Fish Observed | | low flow | **216** | | | | 0 | 12 | 62 | 39 | 50-75 (?) | 0 | 3 | 50 | |

| Date | For | Visibility | TOTAL # of steelhead | # of sections | # of crew | Source | Section 1 | Section 2 | Section 3 | Section 4 | Section 5 | Section 6 | Section 7 | Section 8 | Section 9 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| February 16, 1978 | adults | | | 18 | 43 | MoE Surrey file | 4 mi. log jam to Centre Creek Bridge | Centre Ck. Bridge to Centre Ck. Camp | Centre Ck. Camp to Riverside Camp | Riverside Camp to Middle Ck. abutment | Middle Ck. abutment to 3rd Bridge | 3rd Bridge to Reco Bridge | Upper Box Canyon to Lower Box Canyon | Sandbar Campsite to Borden Ck. (?) | Borden Ck. to Anderson Ck. |
| # Fish Observed | | | **297** | | | | 9 | 5 | 13 | 7 | 42 | 6 | 53 | 45 | 2 |
| February 16, 1978 | (cont.) | | | | | | Anderson Ck. to Slesse Pk. Store (10) | Slesse Pk. Store to Tamihi Br. (11) | Tamihi Br. to Osbourne Rd. (12) | Osbourne Rd. to J. Little's (13) | J. Little's to Vedder Crossing (14) | Vedder Crossing to Peach Road (15) | Peach Road to Log Jam (16) | Log Jam to Meat Hole (17) | Meat Hole to head of Vedder Canal (18) |
| # Fish Observed | | | | | | | 2 | 11 | 1 | 16 | 5 | 18 | 12 | 17 | 33 |
| February 16, 1979 | adults | | | | | Bech (1986) | Down-stream of Slesse Crk | Upstream of Slesse Creek | | | | | | | |
| # Fish Observed | | | **99** | | | | 30 | 69 | | | | | | | |
| April, 1979 | adults | | | | | Bech (1986) | Upstream of Slesse Creek | | | | | | | | |
| # Fish Observed | | | **169** | | | | 169 | | | | | | | | |
| February 15, 1980 | adults | > 10 m | | 11 | 42 | MoE Surrey file | Chilliwack Lk. to Centre Ck. Br. | Centre Ck. Bridge to Centre Ck. Camp | Centre Ck. Camp to Riverside Camp | Riverside Camp to Middle Ck. abutment | Middle Ck. abutment to 3rd Bridge | 3rd Bridge to Reco Bridge | Reco Br. to Lower Box Canyon | Lower Box Canyon to Slesse Creek | Slesse Creek to Borden Creek |
| # Fish Observed | | | **167** | | | | 11 | 1 | 0 | 3 | 32 | 17 | 40 | 17 | 2 |
| February 15, 1980 | (cont.) | | | | | | Borden Creek to Anderson Culvert (10) | Anderson Culvert to Slesse Park Store (11) | | | | | | | |
| # Fish Observed | | | | | | | 26 | 18 | | | | | | | |
| February 15, 1980 | | Slesse Creek floated from Box Canyon (?) to confluence with the Chilliwack River. One report says no steelhead, another says one steelhead sighted. | | | | | | | | | | | | | |

| Date | For | Visibility | TOTAL # of steelhead | # of sections | # of crew | Source | Section 1 | Section 2 | Section 3 | Section 4 | Section 5 | Section 6 | Section 7 | Section 8 | Section 9 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| April 3 & 16, 1980 | adults | ~3m | | 4 | 8 | MoE Surrey file | Post Ck. [Hole] | 4 mi. log jam to Centre Ck. Bridge | Centre Ck. Bridge to Centre Ck. Camp | Left Channel Middle Creek | Riverside Campsite to 3rd Bridge | 3rd Bridge to Reco Bridge | Reco Bridge to Slesse Confluence | Slesse conf. to Butterfly Falls | Butterfly Falls to Slesse Park |
| # Fish Observed | | | **132** | | | | 1 | 11 | 13 | 2 | 27 | 3 | 32 | 19 | 24 |
| March 11, 1981 | adults | | | | | Bech (1986) | Upstream of Slesse Creek | | | | | | | | |
| # Fish Observed | | | **380** | | | | 380 | | | | | | | | |
| March 11, 16, 17, 24, 26 & 31, 1982 | adults | | | 11 | | MoE Surrey file | 4 mi. log jam to Centre Creek Bridge | Centre Ck. Bridge to Centre Ck. Camp | Centre Ck. Camp to Riverside Camp | Riverside Camp to Middle Ck. abutment | Middle Ck. abutment to 3rd Bridge | 3rd Bridge to Reco Bridge | Upper Box Canyon to Lower Box Canyon | Sandbar Campsite to Thermo-graph | Thermo-graph Hole & Run |
| # Fish Observed | | | **663** | | | | 48 | 23 | 32 | 15 | 166 | 75 | 72 | 3 | 50 |
| March 11, 16, 17, 24, 26 & 31, 1982 | (cont.) | | | | | | Chilliwack Hatchery to Thurston Camp (10) | Thurston Camp to Slesse Park (11) | | | | | | | |
| # Fish Observed | | | | | | | 120 | 59 | | | | | | | |
| February 8, 10 & 14, 1983 | adults; | 7.5m u/s Slesse; 3-4 m d/s | | 11 | 3 | MoE Surrey file | Post Ck. hole & 4 mi. log jam to Centre Creek Br. | Centre Ck. Bridge to Centre Ck. Camp | Centre Ck. Camp to Riverside Campsite | Riverside Camp to Middle Ck. Br. abutment | Middle Ck. Br. abutment to 3rd Br. | 3rd Br. to Reco Br. | Upper & Lower Box Canyon | Sandbar Campsite to Slesse Confluence | Slesse Ck. to Borden Ck. |
| # Fish Observed | | | **270** | | 4 days | | 20 | 12 | 32 | 10 | 28 | 8 | 22 & 22 | 45 | 26 |
| February 8, 10 & 14, 1983 | (cont.) | | | | | | Borden Creek to Thurston Camp (10) | Thurston Camp to Allison Pool (11) | | | | | | | |
| # Fish Observed | | | | | | | 43 | 2 | | | | | | | |

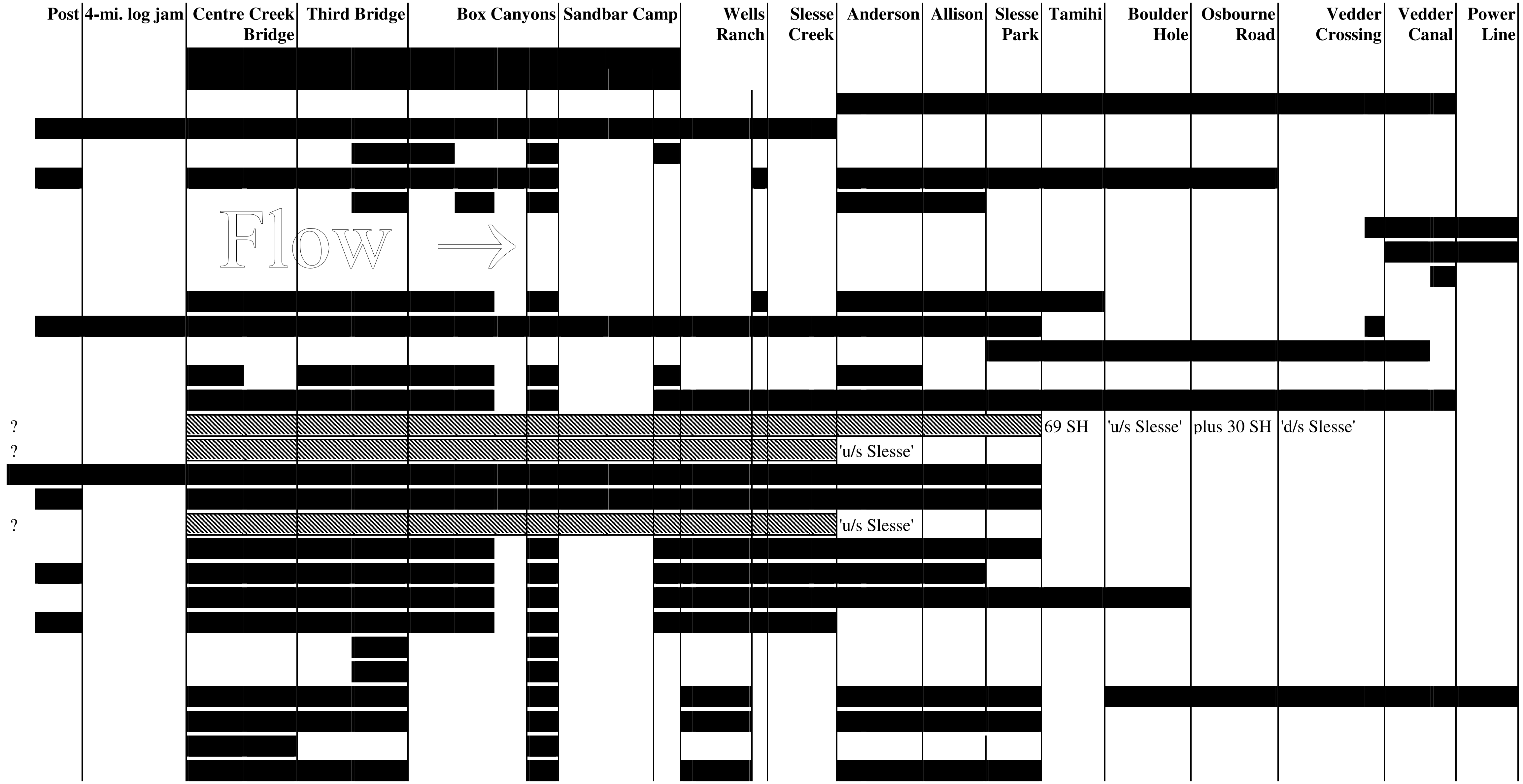
| Date | For | Visibility | TOTAL # of steelhead | # of sections | # of crew | Source | Section 1 | Section 2 | Section 3 | Section 4 | Section 5 | Section 6 | Section 7 | Section 8 | Section 9 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| February ??, 1983 | Slesse Creek floated from release site to confluence with the Chilliwack River. No steelhead were sighted. | | | | | | | | | | | | | | |
| April 6, 8, 13 & 14, 1983 | adults: Lower R. float | >5m | | 13 | 3 | MoE Surrey file | 4 mi. log jam to Centre Creek Br. | Centre Ck. Bridge to Centre Ck. Camp | Centre Ck. Camp to Riverside Campsite | Riverside Camp to Middle Ck. Br. Abutment | Middle Ck. Br. Abutment to 3rd Br. | 3rd Br. To Reco Br. | Upper & Lower Box Canyon | Sandbar Campsite to Slesse Confluence | Slesse Ck. To Borden Ck. |
| # Fish Observed | float | | **705** | | 4 days | | 40 | 46 | 57 | 70 | 65 | 30 | 56 | 68 | 60 |
| April 6, 8, 13 & 14, 1983 | (cont.) | | | | | | Borden Creek to Thurston Camp (10) | Thurston Camp to Anderson Creek (11) | Anderson Creek to Slesse Park Store (12) | Slesse Park Store to Boulder Hold (13) | | | | | |
| # Fish Observed | | | | | | | 106 | 29 | 64 | 14 | | | | | |
| March 13 & 15, 1984 | adults | | | 8 | 9 | MoE Surrey file | Post Ck. Hole & 4 mi. log jam to Centre Creek Br. | Centre Ck. Bridge to Centre Ck. Camp | Centre Ck. Camp to Riverside Campsite | Riverside Camp to Middle Ck. Br. Abutment | Middle Ck. Br. Abutment to 3rd Br. | 3rd Br. To Reco Br. | Upper & Lower Box Canyon | Sandbar Campsite to Slesse Confluence | |
| # Fish Observed | | | **223** | | | | 2 & 9 = 11 | 13 | 13 | 26 | 41 | 13 | 22 & 48 = 70 | 36 | |
| May 12, 1986 Note: Latest (spring) float on record | adults | ~3m, low flow | | 3 | 3 | MoE Surrey file | Abutment to 3rd Bridge | Lower Box Canyon | Upper Box Canyon | | | | | | |
| # Fish Observed | | | **45** | | | | 25 | 18 | 2 | | | | | | |
| March 25, 1987 | adults; late | exc. to OK | | 3 | 3 | MoE Surrey file | Abutment to 3rd Bridge | Upper Box Canyon | Lower Box Canyon (thermo-graph) | Recommends that future floats spot check Upper & Lower Box Canyons w/out floating the middle section ("as no fish are ever seen there"). | | | | | |
| # Fish Observed | | | **118** | | | | 77 | 20 | 21 | | | | | | |

| Date | For | Visibility | TOTAL # of rainbow trout | # of sections | # of crew | Source | Section 1 | Section 2 |
|---|---|---|---|---|---|---|---|---|
| August 25, 1988 | adult resident **RBT** | 35-50% of fish thought to be seen | | 2 | 3 | MoE file | 4 mi. log jam | Middle Ck. Br. abutment to 3rd Bridge |
| Sect. length (km) | | | | 2.6 | | | 0.7 | 1.9 |
| # Fish Observed | | | **51 RBT** | | | | 8 RBT 30cm+, 11 RBT 40cm+ | 11 RBT 30cm+, 21 RBT 40cm+ |
| September 1, 1989 | adult resident **RBT** | 4m | | 2 | 3 | MoE file | 4 mi. log jam | Middle Ck. Br. abutment to 3rd Bridge |
| Sect. length (km) | | | | 3.1 | | | 0.7 | 1.9 |
| # Fish Observed | | low flow | **42 RBT** | | | | 2 RBT 30cm+ | 18 RBT 30cm+, 19 RBT 40cm+, 3 RBT 50cm+ |
| September 27, 1990 | adult resident **RBT** | 4m | | 2 | 3 | MoE Surrey file | Middle Ck. Br. abutment to 3rd Bridge | 3rd Bridge to Foley Creek |
| Sect. length (km) | | $12^{o}$ C | | 3.1 | | | 1.9 | 1.2 |
| # Fish Observed | | low flow | **67 RBT** | | | | 17 RBT 20cm+, 15 RBT 30cm+, 10 RBT 40cm+ | 12 RBT 20cm+, 9 RBT 30cm+, 4 RBT 40cm+ |
| September 23, 1991 | adult resident **RBT** | 6m | | 2 | 3 | MoE Surrey file | Middle Ck. Br. abutment to 3rd Bridge | 3rd Bridge to Foley Creek |
| Sect. length (km) | | $11^{o}$ C | | 3.1 | | | 1.9 | 1.2 |
| # Fish Observed | | | **62 RBT** | | | | 20 RBT 20cm+, 13 RBT 30cm+, 1 RBT 40cm+ | 21 RBT 20cm+, 6 RBT 30cm+, 1 RBT 40cm+ |
| October 13, 1992 | adult resident **RBT** | 4m | | 2 | 3 | MoE Surrey file | Middle Ck. Br. abutment to 3rd Bridge | 3rd Bridge to Foley Creek |
| Sect. length (km) | | $13^{o}$ C | | 3.1 | | | 1.9 | 1.2 |
| # Fish Observed | | | **93 RBT** | | | | 11 RBT 20cm+, 21 RBT 30cm+, 5 RBT 40cm+ | 28 RBT 20cm+, 20 RBT 30cm+, 8 RBT 40cm+ |

| Date | For | Visibility | TOTAL # of steelhead | # of sections | # of crew | Source | Section 1 | Section 2 | Section 3 | Section 4 | Section 5 | Section 6 | Section 7 | Section 8 | Section 9 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| February 16, 17, 18, 19, 2000 | adults | 3 – 9 m | | 18 | 3 4 days | ARL floats | Old 4 Mile Log Jam to Centre Creek Prison | Centre Creek Prison to Centre Creek Br. | Centre Creek Br. to Upper side channel | Upper side channel to 3rd Br. Pool | Old Bridge Crossing | Upper Box Canyon Pools | Cable Car Box Canyon Pool | Hatchery Intake to Hatchery Hole | Slesse Creek to Borden Creek |
| Sect. length (km) | | | | | | | 2.8 | 2.2 | 2.2 | 1.9 | spot check | spot check | spot check | spot check | 1.9 |
| # Fish Observed | | | **221** | | | | 0 | 0 | 2 | 1 | 1 | 3 | 0 | 80 | 13 |
| February 16, 17, 18, 19, 2000 | same float as above | | | | | | Borden Creek to Thurston Camp (10) | Thurston Camp to Allison Pool (11) | Allison Pool to Slesse Park clayslide (12) | d/s Tamihi Br. to culvert u/s Sheller's Br. (13) | culvert u/s Sheller's Br. to Way's Field (14) | Way's Field to Liumchen Creek (15) | Liumchen Creek to Vedder Crossing (16) | Vedder Crossing to Lickman Road (17) | Lickman Road to Keith Wilson Bridge (18) |
| Sect. length (km) | (cont.) | | | | | | 2.4 | 2.6 | 1.5 | 1.5 | 2.4 | 2.6 | 4.3 | 3.1 | 6.2 |
| # Fish Observed | | | | | | | 37 | 18 | 4 | 2 | 6 | 6 | 12 | 12 | 24 |
| March 20, 21, 2000 | adults | 2 – 7 m | | 12 | 3 2 days | ARL floats | Old 4 Mile Log Jam to Centre Creek Prison | Centre Creek Prison to Centre Creek Br. | Centre Creek Br. to Middle Creek turn around | Middle Creek turn around to 3rd Bridge Pool | Old Bridge Crossing | Upper Box Canyon Pools | Cable Car Box Canyon Pool | Hatchery Intake to Hatchery Hole | Slesse Creek to Borden Creek |
| Sect. length (km) | | | | | | | 2.8 | 2.2 | 2.6 | 1.5 | spot check | spot check | spot check | spot check | 1.9 |
| # Fish Observed | | | **173** | | | | 4 | 3 | 6 | 7 | 4 | 5 | 25 | 92 | 9 |
| March 20, 21, 2000 | same float as above | | | | | | Borden Creek to Thurston Camp (10) | Thurston Camp to Allison Pool (11) | Allison Pool to Slesse Park clayslide (12) | d/s Tamihi Br. to culvert u/s Sheller's Br. (13) | culvert u/s Sheller's Br. to Way's Field (14) | Way's Field to Liumchen Creek (15) | Liumchen Creek to Vedder Crossing (16) | Vedder Crossing to Lickman Road (17) | Lickman Road to Keith Wilson Bridge (18) |
| Sect. length (km) | (cont.) | | | | | | 2.4 | 2.6 | 1.5 | 1.5 | 2.4 | 2.6 | 4.3 | 3.1 | 6.2 |
| # Fish Observed | | | | | | | 10 | 8 | 0 | not floated | not floated | not floated | not floated | not floated | not floated |

| Date | For | Visibility | TOTAL # of steelhead | # of sections | # of crew | Source | Section 1 | Section 2 | Section 3 | Section 4 | Section 5 | Section 6 | Section 7 | Section 8 | Section 9 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| April 3, 2000 | adults | 3 – 6 m | | 12 | 3 | ARL floats | Old 4 Mile Log Jam to Old Ford | Old Ford to Upper Centre Ck. outside bend | Upper Centre Ck. bend to Centre Ck. WRP in | Centre Ck. WRP intake to Centre Ck. overflow | Centre Ck. overflow to Lower Centre Ck. prison | Lower Centre Ck. prison to Centre Ck. camp spot | Centre Ck. camping spot to Centre Ck. WRP out | Centre Ck. WRP outlet to Centre Ck. trail | Centre Ck. trail to Centre Ck. bridge |
| Sect. length (km) | | | | | 1 day | | 1 | 0.9 | 0.3 | 0.4 | 0.5 | 0.5 | 0.3 | 0.7 | 0.5 |
| # Fish Observed | | | **27** | | | | 4 | 4 | 0 | 1 | 4 | 5 | 0 | 1 | 2 |
| April 3, 2000 | same float as above | | | | | | Centre Ck. Bridge to 3rd Bridge (10) | Old Bridge Crossing (11) | Upper Box Canyon Pools (12) | Cable Car Box Canyon Pool (13) | Hatchery Intake to Hatchery Hole | Slesse Creek to Slesse Park clayslide | d/s Tamihi Bridge to Vedder Crossing | Vedder Crossing to Keith Wilson Br. | |
| Sect. length (km) | (cont.) | | | | | | 4.1 | spot check | spot check | spot check | | | | | |
| # Fish Observed | | | | | | | not floated | 0 | 1 | 5 | not floated | not floated | not floated | not floated | |
| April 26, 27, 2000 | adults | 3 – 5+ m | | 17 | 3 | ARL floats | Upper Log Jam to Old 4 Mile Log Jam | Old 4 Mile Log Jam to Centre Ck. WRP in | Centre Ck. WRP in to Centre Ck. WRP overflow | Centre Ck. overflow to Centre Ck. camping spot | Centre Ck. camping spot to Centre Ck. WRP out | Centre Ck. WRP outlet to Centre Ck. trail | Centre Ck. trail to Centre Ck. Bridge | Centre Ck. Bridge to Middle Ck. turn around | Middle Ck. turn around to 3rd Bridge Pool |
| Sect. length (km) | | | | | 2 days | | 0.5 | 2.2 | 0.4 | 1.0 | 0.3 | 0.3 | 0.5 | 2.6 | 1.5 |
| # Fish Observed | | | **107** | | | | 9 | 5 | 0 | 4 | 1 | 2 | 6 | 12 | 7 |
| April 26, 27, 2000 | same float as above | | | | | | Old Bridge Crossing (10) | Upper Box Canyon Pools (11) | Cable Car Box Canyon Pool (12) | Hatchery Intake (13) | Hatchery Storage Area to Hatchery Hole (14) | Slesse Creek to Borden Creek (15) | Borden Creek to Thurston Camp (16) | Thurston Camp to Allison Pool (17) | Allison Pool to Slesse Park clayslide (18) |
| Sect. length (km) | (cont.) | | | | | | spot check | | spot check | spot check | 0.6 | 1.9 | 2.4 | 2.6 | 1.5 |
| # Fish Observed | | (Tamihi Br. to Keith Wilson Br. not floated) | | | | | 0 | not floated | 1 | 5 | 17 | 15 | 8 | 6 | 9 |

| Date | Total SH | Total km | SH/km | |
|---|---|---|---|---|
| Feb. 8, 1973 | 751 | 17.2 | 43.7 | |
| Feb. 15, 1973 | 291 | 29.9 | 9.7 | |
| Feb. 21, 1974 | 278 | 16.5 | 16.8 | |
| Jan. 8, 1975 | 174 | 4.8 | 36.3 | |
| Feb. 5, 1975 | 400 | 24.7 | 16.2 | |
| Mar. 8, 1975 | 120 | 1 | 120.0 | |
| Mar. 27, 1975 | 135 | 17.4 | 7.8 | |
| Apr. 9, 1975 | 398 | 8.9 | 44.7 | |
| Apr. 11, 1975 | 39 | 0.3 | 130.0 | |
| Feb. 11, 1976 | 252 | 21.7 | 11.6 | |
| Mar. 20, 1976 | 584 | 29.3 | 19.9 | |
| Jan. 9, 1977 | 148 | 24.5 | 6.0 | |
| Feb. 2, 1977 | 216 | 14.6 | 14.8 | |
| Feb. 16, 1978 | 297 | 43.4 | 6.8 | |
| Feb. 16, 1979 | 69 | *11.4* | 6.1 | ? |
| Apr., 1979 | 169 | *11.4* | 14.8 | ? |
| Feb. 15, 1980 | 167 | 31.7 | 5.3 | |
| Apr. 3, 1980 | 132 | 22.5 | 5.9 | |
| Mar. 11, 1981 | 380 | *11.4* | 33.3 | ? |
| Mar. 11, 1982 | 663 | 21.6 | 30.7 | |
| Feb. 8, 1983 | 270 | 20.1 | 13.4 | |
| Apr. 6, 1983 | 705 | 25.6 | 27.5 | |
| Mar. 13, 1984 | 223 | 13.5 | 16.5 | |
| May 12, 1986 | 45 | 2.8 | 16.1 | |
| Mar. 25, 1987 | 118 | 2.8 | 42.1 | |
| Feb. 16, 2000 | 221 | 38.9 | 5.7 | |
| Mar. 20, 2000 | 173 | 18.8 | 9.2 | |
| Apr. 3, 2000 | 27 | 5.6 | 4.8 | |
| Apr. 26, 2000 | 107 | 18.9 | 5.7 | |




Note: Schematic diagram approximate, and *not to scale*, and relies on file records of reaches floated (see Appendix II).
Some records sum counts over large sections, and do not indicate whether all reaches were floated, or if some dangerous portions were walked.
Spot checks indicated by short bars (Box Canyons, Sandbar Camp and Wells Ranch). Reaches of uncertain length indicated with striped bars.
February 16, 1979 = 69 SH ‘u/s Slesse Creek’ (11.4 km estimated section length) plus 30 SH ‘d/s Slesse Creek’ (no section length estimated).

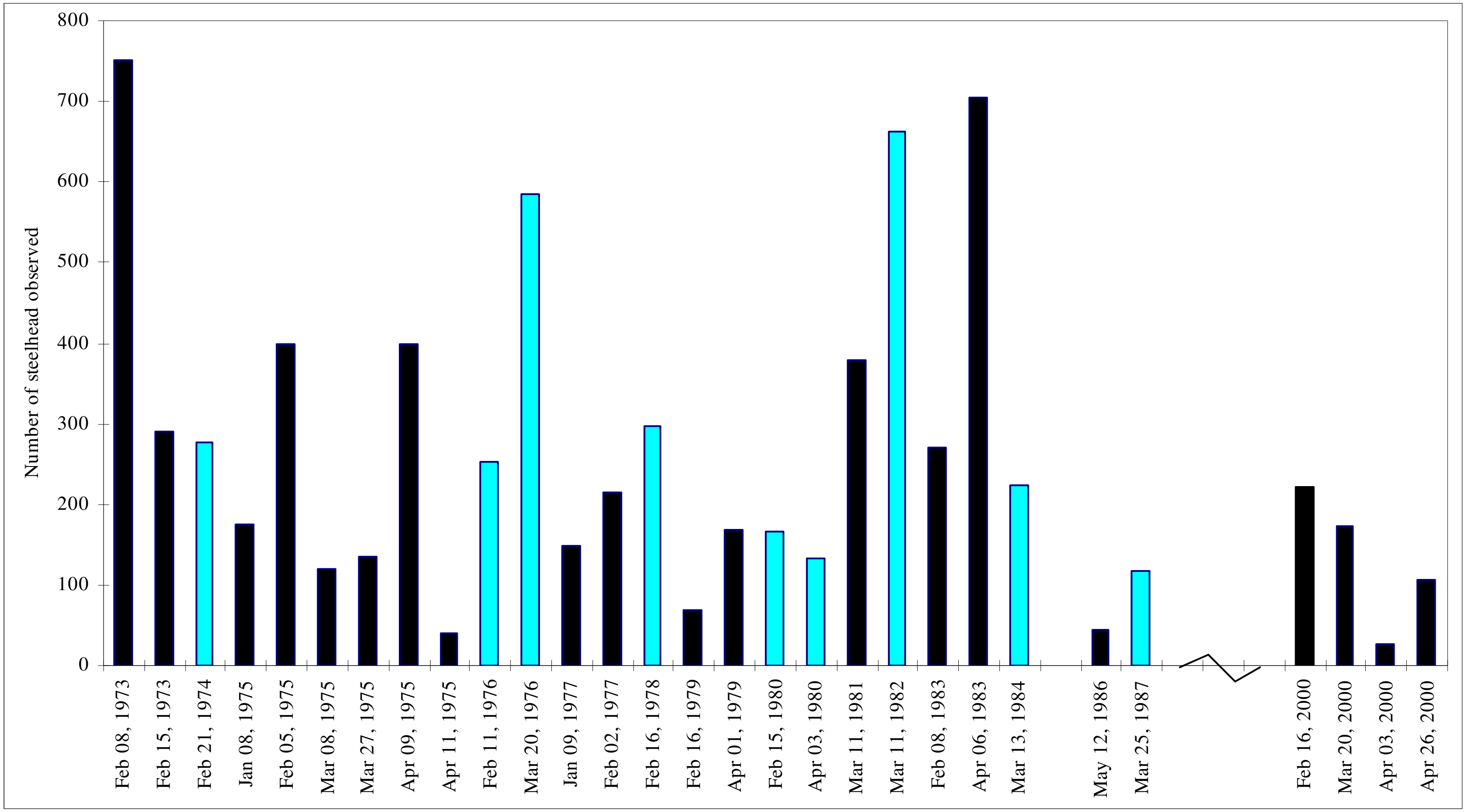
| **Float 1** | | | # of | # of | # of | No. other species observed | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | River | untagged | tagged SH | tags | RB | char | WF | SU |
| Date | Local Name | km | SH obs. | observed | detected | | | | |
| 16-Feb-00 | Old 4 Mile Log Jam to Centre Crk Prison | 55.6 to 52.8 | 0 | | | 4 | | | |
| 16-Feb-00 | Centre Crk Prison to Centre Crk Bridge | 52.8 to 50.6 | 0 | | | 13 | | 3 | |
| 16-Feb-00 | Centre Crk Bridge to Upper Sidechannel Jct | 50.6 to 48.4 | 2 | | | 6 | 1 | 7 | |
| 16-Feb-00 | Upper Sidechannel Jct to 3rd Bridge Pool | 48.4 to 46.5 | 1 | | | 2 | 3 | 3 | |
| 16-Feb-00 | Cable Car Box Canyon Pool | 42.5 | 0 | | | | | 13 | |
| 16-Feb-00 | Upper Box Canyon Pools | 44 | 3 | | | 6 | | 1 | |
| 16-Feb-00 | Old Bridge Crossing | 44.8 | 1 | | | 2 | | | |
| 15-Feb-00 | Station 6 | 39.5 | 9 | | | 2 | | 1 | |
| 15-Feb-00 | 2nd Intake Hole | 38.7 | 5 | | | | 4 | | |
| 15-Feb-00 | Upper Hatchery Hole | 38.6 | 14 | | 1 | 4 | | | |
| 15-Feb-00 | Hatchery Hole | 38.4 | 47 | 5 | 9 | | | | |
| 15-Feb-00 | Limits Hole | 37.9 | 1 | | 1 | | | | |
| 15-Feb-00 | Below Limits Hole | 37.7 | 1 | | 2 | | | | |
| 15-Feb-00 | Pool Above Ranger Run | 37.4 | 0 | | 1 | | | | |
| 15-Feb-00 | Glide Above Ranger Run | 37.1 | 1 | | 1 | | | | |
| 15-Feb-00 | Ranger Run | 36.7 | 9 | | 2 | 1 | 6 | 100 | |
| 15-Feb-00 | Lower Ranger Run | 36.4 | 1 | | | | 1 | | |
| 15-Feb-00 | Borden Crk Split | 36 | 0 | | | | 1 | | |
| 15-Feb-00 | Lower Borden Waterfall | 35.2 | 0 | | | | | 1 | |
| 15-Feb-00 | Butterfly Run | 34.8 | 0 | | | | | 30 | |
| 15-Feb-00 | Upper Thurston Glide | 34.2 | 4 | | 1 | | 1 | 19 | |
| 15-Feb-00 | Upper Thurston Pool | 33.8 | 4 | | | 3 | | 7 | |
| 15-Feb-00 | Thurston Prison Camp | 33.6 | 27 | 2 | 3 | | | | |
| 15-Feb-00 | Lower Thurston Prison Camp | 33.4 | 5 | | | | | 13 | |
| 15-Feb-00 | 2nd Lower Thurston Prison Camp | 33.2 | 1 | | | | | | |
| 15-Feb-00 | 3rd Lower Thurston Prison Camp | 32.9 | 2 | | 1 | | | | |
| 15-Feb-00 | Cedars | 32.7 | 3 | | 2 | | | 82 | |
| 15-Feb-00 | Above 1st Washout | 32.6 | 0 | | | | | 16 | |
| 15-Feb-00 | 1st Washout | 32.5 | 2 | | | | 3 | 35 | |
| 15-Feb-00 | Pool Below 1st Washout | 32 | 0 | | | | | | |
| 15-Feb-00 | 2nd Pool Above Allison Pool | 31.7 | 0 | | | | | | |
| 15-Feb-00 | 1st Pool Above Allison Pool | 31.5 | 2 | | | | | | |
| 15-Feb-00 | Allison Pool | 31.3 | 1 | | | | | | |
| 15-Feb-00 | Lower Allison Pool | 31.1 | 0 | | | 1 | | | |
| 15-Feb-00 | Allison Tailout | 31 | 2 | | | | | | |
| 15-Feb-00 | South Split of Channel | 30.5 | 0 | | | | | | |
| 15-Feb-00 | Pool Above Nick's | 29.9 | 1 | | | | | | |
| 15-Feb-00 | Run at Nick's | 29.7 | 3 | | 1 | | | 5 | |
| 15-Feb-00 | Slesse Park clay slide | 29.5 | 0 | | 1 | | 1 | 45 | |
| 17-Feb-00 | Below Tamihi Bridge | 26.3 | 0 | | | | | | |
| 17-Feb-00 | Boulder Hole | 25.8 | 0 | | | | | 25 | |
| 17-Feb-00 | Station 3 Run | 25.5 | 0 | | | | | | |
| 17-Feb-00 | Shelf Below Bourne Rd | 25.3 | 0 | | 2 | 1 | | | |

| **Float 1** | | | # of | # of | # of | No. other species observed | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | River | untagged | tagged SH | tags | RB | char | WF | SU |
| Date | Local Name | km | SH obs. | observed | detected | | | | |
| 17-Feb-00 | Culvert Above Sheller's Bridge | 24.8 | 2 | | 1 | | | | |
| 17-Feb-00 | Run Above Sheller's Island | 24.5 | 0 | | | | | 1 | |
| 17-Feb-00 | North Split Above Sheller's | 24 | 1 | | 1 | | | | |
| 17-Feb-00 | Upper Sheller's Bridge Run | 23.7 | 1 | | | | | | |
| 17-Feb-00 | Lower Sheller's Tailout | 23.4 | 3 | | | | | 1 | |
| 17-Feb-00 | Top of Way's Field Rapids | 23 | 1 | | | | | 15 | |
| 17-Feb-00 | Top of Way's Field Pool | 22.4 | 0 | | | | | 1 | |
| 17-Feb-00 | Pool Below Way's Corner | 22.2 | 0 | | 1 | | | | |
| 17-Feb-00 | Outside Bend of Way's Field | 21.7 | (1) - dead: | | 1 | | | 1 | |
| 17-Feb-00 | Glide Above Twin Cedars | 21.2 | 0 | | | | | 1 | |
| 17-Feb-00 | Twin Cedars | 20.7 | 0 | | | | | 12 | |
| 17-Feb-00 | Liumcheen Crk | 19.8 | 5 | 1 | 2 | | | 28 | |
| 17-Feb-00 | Above Swoolie Dike | 19 | 0 | | 2 | | | 14 | |
| 17-Feb-00 | Riffle Before Swoolie Dike | 18.9 | 3 | | | | | 6 | |
| 17-Feb-00 | Top of Swoolie Pool | 18.4 | 8 | | 1 | | | 3 | |
| 17-Feb-00 | Above Swoolie Cedars | 17.1 | 0 | | 1 | | | | |
| 17-Feb-00 | Swoolie Cedars Log Jam | 16.9 | 0 | | 2 | | | 25 | |
| 17-Feb-00 | Below Stella's Rock | 16.5 | 0 | | | | | 15 | |
| 17-Feb-00 | Teskey Rock | 15.7 | 1 | | | | | | |
| 18-Feb-00 | Vedder Crossing | 15.5 | 1 | | | 1 | | 33 | |
| 18-Feb-00 | Above Rock Quarry | 14.7 | 4 | 2 | 2 | | | | |
| 18-Feb-00 | Above Peach Rd | 14.2 | 0 | | | | | | 18 |
| 18-Feb-00 | Peach Rd | 13.9 | 1 | | | | | 2 | |
| 18-Feb-00 | Below Peach Rd | 13.6 | 1 | | | | | | |
| 18-Feb-00 | Above Lickman Rd | 13.2 | 1 | | | | | | |
| 18-Feb-00 | Above Ernie's Hole | 12.6 | 1 | | | | | 7 | |
| 18-Feb-00 | Lickman Rd | 12.4 | 1 | | | | | 4 | 1 |
| 18-Feb-00 | Lower Lickman | 12.3 | 0 | | | | | | 3 |
| 18-Feb-00 | Upper Brown Rd | 12.1 | 2 | | | | | | 3 |
| 18-Feb-00 | Brown Rd | 11.8 | 17 | 1 | 6 | | | 150 | 40 |
| 18-Feb-00 | Tom's Tailout | 11.3 | 1 | 1 | 1 | | | | 1 |
| 18-Feb-00 | Above Hydro Bridge | 10.2 | 0 | | 1 | | | | 3 |
| 18-Feb-00 | Wilson Rd | 9.3 | 0 | | | | | | 3 |
| 18-Feb-00 | Six Fish Run | 9.1 | 0 | | | | 1 | | |
| 18-Feb-00 | VTV Spot | 8.7 | 0 | | | | | | 11 |
| 18-Feb-00 | Above Sawween | 8.4 | 0 | | | | | | 18 |
| 18-Feb-00 | Sawween | 8.3 | 1 | | | | | 1 | 6 |
| 18-Feb-00 | Below Sawween | 8.1 | 0 | | | | | 3 | 70 |
| 18-Feb-00 | Ernie's Corner | 8 | 0 | | | 1 | | 1 | 12 |
| 18-Feb-00 | Vedder Canal | 7 | 0 | | 1 | | | | 25 |
| 18-Feb-00 | Above Keith Wilson Bridge | 6.4 | 1 | | | | | | 2 |
| 18-Feb-00 | Keith Wilson Bridge | 6.2 | 0 | | | 1 | | | |
| | **Total this float:** | **38.9** | **209** | **12** | **51** | **48** | **22** | **730** | **216** |

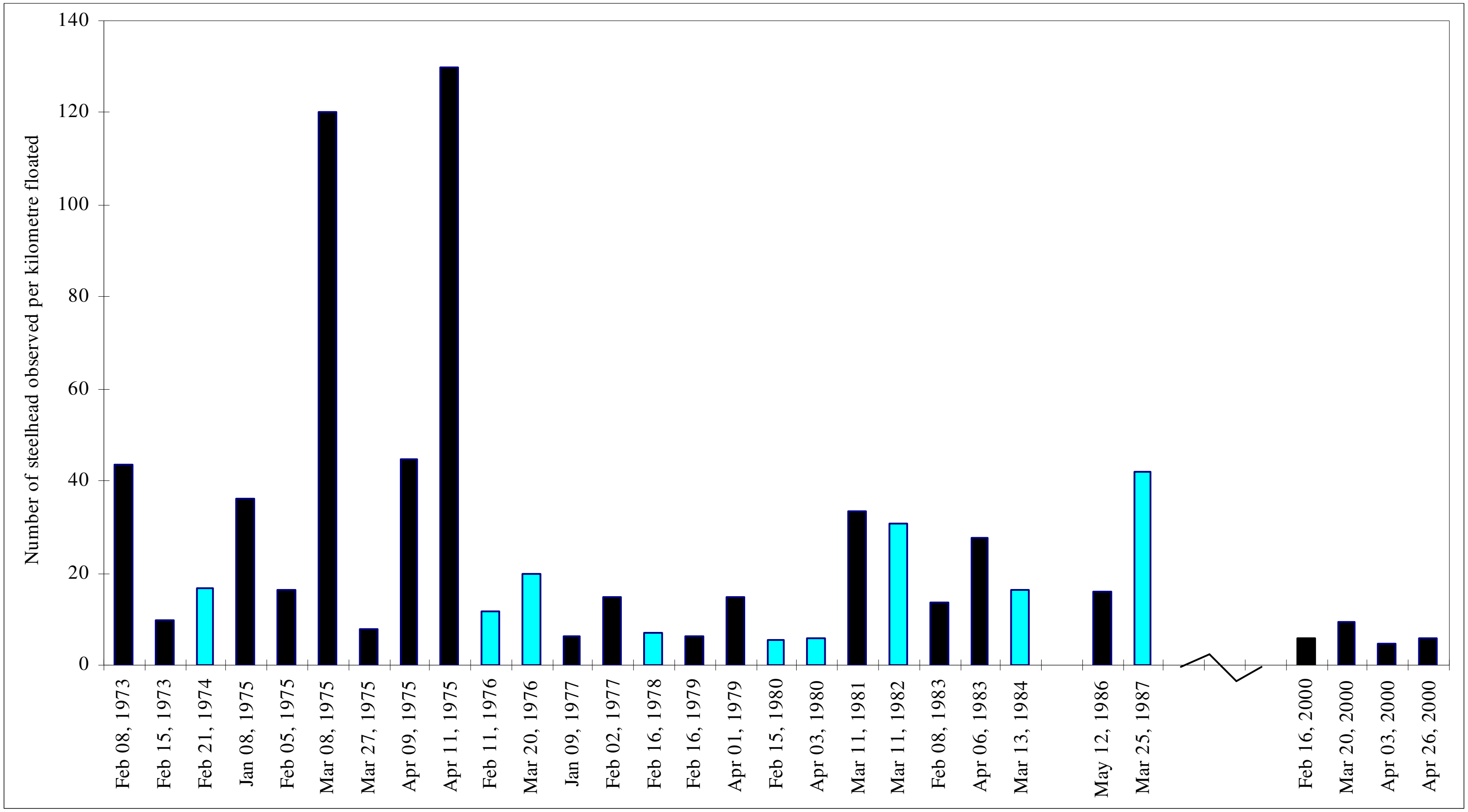
| Float 2 | | | # of | # of | # of | No. other species observed | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | River | untagged | tagged SH | tags | RB | char | WF | SU |
| Date | Local Name | km | SH obs. | observed | detected | | | | |
| 20-Mar-00 | Old 4 Mile Log Jam | 55.6 | 1 | | | | | | |
| 20-Mar-00 | Old 4 Mile Log Jam to Centre Crk Prison | 55.5 to 52.8 | 3 | | | 11 | 1 | | |
| 20-Mar-00 | Centre Crk Prison to Centre Crk Bridge | 52.8 to 50.6 | 3 | | | 17 | | 1 | |
| 20-Mar-00 | Centre Crk Br. to Middle Creek turnaround | 50.6 to 48.0 | 6 | | | 10 | | 1 | |
| 20-Mar-00 | Middle Creek turn around to 3rd Bridge Pool | 48.0 to 46.5 | 7 | | | 16 | 2 | 7 | |
| 20-Mar-00 | Cable Car Box Canyon Pool | 42.5 | 23 | 2 | | 26 | 1 | 4 | |
| 20-Mar-00 | Old Bridge Crossing | 44.8 | 4 | | | 13 | | | |
| 20-Mar-00 | First Upper Box Canyon Pool | 44.2 | 1 | | | | | | |
| 20-Mar-00 | Second Upper Box Canyon Pool | 44.1 | 0 | | | | | | |
| 20-Mar-00 | Third Upper Box Canyon Pool | 44.0 | 4 | | | 3 | | 7 | |
| 21-Mar-00 | Station 6 | 39.5 | 5 | | 1 | 21 | | 5 | |
| 21-Mar-00 | Hatchery storage area | 39.0 | 5 | | 1 | 6 | | 2 | |
| 21-Mar-00 | 2nd Intake Hole | 38.7 | 1 | | 1 | 9 | 1 | | |
| 21-Mar-00 | Upper Hatchery Hole | 38.6 | 11 | 1 | 1 | 15 | 1 | 4 | |
| 21-Mar-00 | Hatchery Hole | 38.4 | 62 | 7 | 11 | 20 | | | |
| 21-Mar-00 | Limits Hole | 37.9 | 1 | | 1 | | | | |
| 21-Mar-00 | Below Limits Hole | 37.7 | 2 | | | 2 | | 2 | |
| 21-Mar-00 | Pool Above Ranger Run | 37.4 | 1 | | | 2 | 5 | 15 | |
| 21-Mar-00 | Glide Above Ranger Run | 37.1 | 1 | | | 3 | 1 | 5 | |
| 21-Mar-00 | Ranger Run | 36.7 | 3 | | 1 | 8 | 11 | 60 | |
| 21-Mar-00 | Lower Ranger Run | 36.4 | 0 | | | 2 | | 8 | |
| 21-Mar-00 | Borden Crk Split | 36.0 | 1 | | | 3 | | 15 | |
| 21-Mar-00 | Lower Borden Waterfall | 35.2 | 2 | | | | 1 | 3 | |
| 21-Mar-00 | Upper Butterfly | 35.0 | 1 | | | 1 | | 5 | |
| 21-Mar-00 | Butterfly Run | 34.8 | 0 | | | 2 | | 15 | |
| 21-Mar-00 | Upper Thurston Glide | 34.2 | 1 | | | 9 | 2 | 65 | |
| 21-Mar-00 | Upper Thurston Pool | 33.8 | 3 | | 1 | | | 16 | |
| 21-Mar-00 | Thurston Prison Camp | 33.6 | 3 | | 1 | 2 | | 27 | |
| 21-Mar-00 | Lower Thurston Prison Camp | 33.4 | 0 | | | 3 | 5 | 9 | |
| 21-Mar-00 | 2nd Lower Thurston Prison Camp | 33.2 | 0 | | | | | | |
| 21-Mar-00 | 3rd Lower Thurston Prison Camp | 32.9 | 0 | | 1 | | | | |
| 21-Mar-00 | Cedars | 32.7 | 0 | | | | | 10 | |
| 21-Mar-00 | Above 1st Washout | 32.6 | 0 | | 2 | | | 1 | |
| 21-Mar-00 | 1st Washout | 32.5 | 1 | | | 1 | | 10 | |
| 21-Mar-00 | Pool Below 1st Washout | 32.0 | 1 | | | | | 16 | |
| 21-Mar-00 | 2nd Pool Above Allison Pool | 31.7 | 1 | | 1 | | | 4 | |
| 21-Mar-00 | 1st Pool Above Allison Pool | 31.5 | 1 | | 1 | | | 4 | |
| 21-Mar-00 | Allison Pool | 31.3 | 3 | | | | | 2 | |
| 21-Mar-00 | Lower Allison Pool | 31.1 | 0 | | | | | 8 | |
| 21-Mar-00 | Allison Tailout | 31.0 | 1 | | | | | 4 | |
| 21-Mar-00 | South Split of Channel | 30.5 | 0 | | | | | | |
| 21-Mar-00 | Pool Above Nick's | 29.9 | 0 | | | | | 5 | |
| 21-Mar-00 | Run at Nick's | 29.7 | 0 | | | | | 11 | |
| 21-Mar-00 | Slesse Park Clayslide | 29.5 | 0 | | | | | 3 | |
| | **Total this float:** | **18.8** | **163** | **10** | **24** | **205** | **31** | **354** | **0** |

| Float 3 | | | # of | # of | # of | No. other species observed | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | River | untagged | tagged SH | tags | RB | char | WF | SU |
| Date | Local Name | km | SH obs. | observed | detected | | | | |
| 03-Apr-00 | Old 4 Mile Log Jam | 55.6 | | | | 1 | | 1 | |
| 03-Apr-00 | Old 4 Mile Log Jam to Old Ford | 55.5 to 54.6 | 4 | | | 2 | | | |
| 03-Apr-00 | Old Ford to Upper Centre Crk outside bend | 54.6 to 53.7 | 4 | | | 2 | | | |
| 03-Apr-00 | Outside bend to Centre Ck WRP intake | 53.7 to 53.4 | | | | 2 | | 1 | |
| 03-Apr-00 | WRP intake to Centre Crk overflow | 53.4 to 53.0 | 1 | | 1 | 1 | | | |
| 03-Apr-00 | Overflow to Lower Centre Crk prison | 53.0 to 52.5 | 4 | | | 3 | | 1 | |
| 03-Apr-00 | Prison to Centre Crk camping spot | 52.5 to 52.0 | 5 | | 1 | 5 | 1 | 1 | |
| 03-Apr-00 | Camping spot to Centre Crk WRP outlet | 52.0 to 51.7 | | | | 7 | | | |
| 03-Apr-00 | Centre Crk WRP outlet to Centre Crk trail | 51.7 to 51.0 | 1 | | | 5 | | 1 | |
| 03-Apr-00 | Centre Crk trail to Centre Crk bridge | 51.0 to 50.5 | 2 | | 1 | 1 | | | |
| 03-Apr-00 | Cable Car Box Canyon Pool | 42.5 | 5 | | | 2 | | 2 | |
| 03-Apr-00 | First Upper Box Canyon Pool | 44.2 | | | | | | 2 | |
| 03-Apr-00 | Second Upper Box Canyon Pool | 44.1 | | | | | | | |
| 03-Apr-00 | Third Upper Box Canyon Pool | 44.0 | 1 | | | 3 | | | |
| 03-Apr-00 | Old Bridge Crossing | 44.8 | | | | 1 | | 5 | |
| | **Total this float:** | **5.6** | **27** | **0** | **3** | **35** | **1** | **14** | **0** |

| **Float 4** | | | # of | # of | # of | No. other species observed | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | River | untagged | tagged SH | tags | RB | char | WF | SU |
| Date | Local Name | km | SH obs. | observed | detected | | | | |
| 26-Apr-00 | Upper Log Jam to Old 4 Mile Log Jam | 56.0 to 55.5 | 9 | | 2 | 19 | 4 | 2 | |
| 26-Apr-00 | Old 4 Mile Log Jam | 55.6 | 0 | | | | | | |
| 26-Apr-00 | Log Jam to Centre Crk WRP intake | 55.5 to 53.4 | 5 | | 2 | 9 | 3 | 8 | |
| 26-Apr-00 | WRP intake to Centre Crk overflow | 53.4 to 53.0 | 0 | | | 2 | | 1 | |
| 26-Apr-00 | Overflow to Centre Crk camping spot | 53.0 to 52.0 | 3 | 1 | 3 | 5 | | 7 | |
| 26-Apr-00 | Camping spot to Centre Crk WRP outlet | 52.0 to 51.7 | 1 | | | 1 | | 1 | |
| 26-Apr-00 | Centre Crk WRP outlet to Centre Crk trail | 51.7 to 51.0 | 2 | | | 1 | | 2 | |
| 26-Apr-00 | Centre Crk trail to Centre Crk bridge | 51.0 to 50.5 | 6 | | | 5 | | 3 | |
| 26-Apr-00 | Bridge to Middle Creek turnaround | 50.6 to 48.0 | 12 | | | 28 | | 32 | |
| 26-Apr-00 | Middle Creek turn around to 3rd Bridge Pool | 48.0 to 46.5 | 7 | | | 10 | 1 | 34 | |
| 26-Apr-00 | Old Bridge Crossing | 44.8 | 0 | | | 5 | | 2 | |
| 26-Apr-00 | Cable Car Box Canyon Pool | 42.5 | 1 | | | 4 | | 29 | |
| 27-Apr-00 | Station 6 | 39.5 | 5 | | 1 | 8 | | 7 | |
| 27-Apr-00 | Hatchery storage area to 2nd intake hole | 39.0 to 38.7 | 5 | | 3 | 20 | | 33 | |
| 27-Apr-00 | Upper Hatchery Hole | 38.6 | 3 | | | 10 | 1 | 7 | |
| 27-Apr-00 | Hatchery Hole | 38.4 | 9 | | | 6 | | 13 | |
| 27-Apr-00 | Limits Hole to Below Limits Hole | 37.9 to 37.7 | 6 | | 2 | 7 | | 29 | |
| 27-Apr-00 | Pool to glide above Ranger Run | 37.4 to 37.1 | 8 | | | 4 | | 43 | |
| 27-Apr-00 | Ranger Run | 36.7 | 1 | | 3 | 2 | | 51 | |
| 27-Apr-00 | Lower Ranger Run | 36.4 | 0 | | 1 | | 1 | 23 | |
| 27-Apr-00 | Borden Crk Split | 36.0 | 0 | | 2 | 1 | | 24 | |
| 27-Apr-00 | Lower Borden Waterfall | 35.2 | 0 | | | 1 | | 15 | |
| 27-Apr-00 | Upper Butterfly | 35.0 | 2 | | | 1 | | 19 | |
| 27-Apr-00 | Butterfly Run | 34.8 | 0 | | | 3 | 1 | 34 | |
| 27-Apr-00 | Upper Thurston Glide | 34.2 | 4 | | 2 | 1 | | 29 | |
| 27-Apr-00 | Upper Thurston Pool | 33.8 | 0 | | | 2 | | 26 | |
| 27-Apr-00 | Thurston Prison Camp | 33.6 | 1 | 1 | 2 | 1 | | 13 | |
| 27-Apr-00 | Lower Thurston Prison Camp | 33.4 | 0 | | | 1 | | 32 | |
| 27-Apr-00 | 2nd to 3rd Lower Thurston Prison Camp | 33.2 to 32.9 | 0 | | | | | 4 | |
| 27-Apr-00 | Cedars | 32.7 | 3 | | | 1 | 1 | 81 | |
| 27-Apr-00 | Above 1st Washout | 32.6 | 0 | | | | | | |
| 27-Apr-00 | 1st Washout | 32.5 | 0 | | 1 | 1 | | 22 | |
| 27-Apr-00 | Pool Below 1st Washout | 32.0 | 0 | | | | | 14 | |
| 27-Apr-00 | 2nd to 1st pool above Allison Pool | 31.7 to 31.5 | 1 | | 2 | 1 | | 38 | |
| 27-Apr-00 | Allison Pool | 31.3 | 2 | | | | | 42 | |
| 27-Apr-00 | Lower Allison Pool to Allison Tailout | 31.1 to 31.0 | 1 | | | | | 5 | |
| 27-Apr-00 | South Split of Channel | 30.5 | 6 | | 1 | 2 | | 101 | |
| 27-Apr-00 | Pool Above Nick's to Run at Nick's | 29.9 to 29.7 | | | | 1 | | 8 | |
| 27-Apr-00 | Slesse Park Clayslide | 29.5 | 1 | 1 | 1 | | | | |
| | **Total this float:** | **18.9** | **104** | **3** | **28** | **163** | **12** | **834** | **0** |




Note: adjacent bars of the same colour indicate swims completed in the same year (*i.e.* there were two swims in 1973).
See Appendix II for full details, Appendix III for reaches floated each survey, and Appendix IV for summary of data included.




Notes: March 8 and March 11, 1975 were spot checks of good holding areas.
The reach length surveyed is estimated for February 16 and April 1, 1979 and for March 11, 1981.