Angler Effort and Catch in the 1998 Sport Fisheries of Five Lower Fraser River Tributaries

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TABLE OF CONTENTS

TABLE OF CONTENTS (cont'd)

TABLE OF CONTENTS (cont'd)

Page

LIST OF FIGURES

LIST OF TABLES

LIST OF APPENDICES

Appendix

LIST OF APPENDICES (cont'd)

Appendix **Page**

ABSTRACT

Palermo, V. and A.S. Thompson. 2000. Angler effort and catch in the 1998 sport fisheries of five lower Fraser River tributaries. Can. Manuscr. Fish. Aquat. Sci. 2530: 55 p.

The lower Harrison River recreational fishery was assessed from September 1 to November 30, 1998, using an access point and overflight survey design. The Chehalis River and the Nicomen Slough and Norrish Creek sport fisheries were assessed from September 1 to December 14, 1998, using combined roving and instantaneous effort count study designs. The lower Stave River was assessed from September 1 to December 14, 1998, using an access point, roving and instantaneous effort count survey design. Finally, the Vedder-Chilliwack River sport fishery was assessed from September 1 to November 30, 1998, using a roving and overflight survey design. The studies focused on angler effort and the harvest and release of coho (*Oncorhynchus kisutch*), chum (*O. keta*), sockeye (*O. nerka*) and chinook (*O. tshawytscha*) salmon.

Over the course of the five studies, a total of 19,808 angler interviews and 106 instantaneous effort counts were conducted. Total angler effort was estimated at 423,369 hours. Total harvests of coho and chum salmon were estimated at 11,075 and 6,329; harvests of sockeye and chinook salmon were estimated at 1,733 and 12,852. Total releases of coho and chum salmon were estimated at 13,992 and 37,796; releases of sockeye and chinook salmon were estimated at 2,559 and 19,703.

Key Words: Chehalis River, Vedder-Chilliwack River, Harrison River, Nicomen Slough, Norrish Creek, lower Stave River, lower Fraser River, sport fishery, chinook salmon, sockeye salmon, coho salmon, chum salmon, angler effort, catch, harvest, release.

RÉSUMÉ

Palermo, V. and A.S. Thompson. 2000. Angler effort and catch in the 1998 sport fisheries of five lower Fraser River tributaries. Can. Manuscr. Fish. Aquat. Sci. 2530: 55 p.

Nous avons évalué la pêche sportive sur le cours inférieur de la Harrison du 1er septembre au 30 novembre 1998, par enquête au point d'accès et survol aérien. Pour la Chehalis, le bras Nicomen et le crique Norrish, nous avons mené l'étude du 1er septembre au 14 décembre 1998, en combinant l'enquête itinérante et les recensements instantanés de l'effort de pêche. Pour le cours inférieur de la Stave, nous avons mené l'étude du 1er septembre au 14 décembre 1998, par enquête au point d'accès, enquête itinérante et recensements instantanés de l'effort. Enfin, dans la Vedder-Chilliwack, la pêche sportive a été évaluée du 1er septembre au 30 novembre 1998 par enquête itinérante et survol aérien. Les enquêtes étaient axées sur l'effort de pêche et sur la capture avec remise à l'eau du coho (*Oncorhynchus kisutch*), du kéta (*O. keta*), du saumon rouge (*O. nerka*) et du quinnat (*O. tshawytscha*).

Au cours des cinq enquêtes, nous avons réalisé au total 19 808 entrevues et 106 recensements instantanés de l'effort. L'effort total de pêche sportive a été estimé à 423 369 heures. Les prélèvements totaux de coho et de kéta ont été estimés à 11 075 et 6 329; les prélèvements de saumon rouge et de quinnat ont été estimés à 1 733 et 12 852. Les remises à l'eau totales de coho et de kéta ont été estimées à 13 992 et 37 796; les remises à l'eau de saumon rouge et de quinnat ont été estimées à 2 559 et 19 703.

Mots clés : Chehalis, Vedder-Chilliwack, Harrison, bras Nicomen, crique Norrish, cours inférieur de la Stave, cours inférieur du Fraser, pêche sportive, quinnat, saumon rouge, coho, kéta, effort de pêche sportive, capture, prélèvement, remise à l'eau.

INTRODUCTION

Norrish Creek, Nicomen Slough, and the Harrison, Chehalis and lower Stave rivers are all tributaries to the lower Fraser River that support year-round sport fisheries. In 1998, each of these rivers was studied to assess angler effort and catch during the autumn sport-fishing season. The Harrison River was studied using an access point and overflight survey design, while the Chehalis River study design combined roving and instantaneous effort count survey methods. Nicomen Slough and Norrish Creek were combined and surveyed as one homogeneous study area, also using both roving and instantaneous effort count survey methods, while the lower Stave River was surveyed using roving and access point interviews and instantaneous effort counts. The studies of these tributaries all focused on angler effort and catch of coho (*Oncorhynchus kisutch*), chum (*O. keta*), sockeye (*O. nerka*) and chinook (*O. tshawytscha*) salmon.

The Vedder-Chilliwack River, another tributary to the lower Fraser River, supports one of British Columbia's largest nontidal sport fisheries (Hickey et al., 1987). The autumn sport fisheries for coho and chinook (*O. tshawytscha*) salmon were first assessed by a preliminary study in 1984 (DPA Group Inc. MS 1985); more detailed studies were conducted in 1985, 1986, and 1988 (Hickey et al., 1987; Whyte et al., 1987; Whyte and Schubert, 1990). In 1998, the autumn Vedder-Chilliwack River recreational fishery was again studied by creel survey, using a combination of roving and overflight survey methods. As in past years, the survey focused on angler effort and catch of coho and chinook salmon.

This report describes the methods and procedures of the 1998 sport fishery surveys of selected lower Fraser River tributaries; it details the total angler effort and catch per unit effort (CPUE), including harvest per unit effort (HPUE) and release per unit effort (RPUE), for the Chehalis, Vedder-Chilliwack, Harrison and lower Stave rivers, as well as Nicomen Slough and Norrish Creek, from September 1 to December 14, 1998. Finally, recommendations are made for future surveys and management of the recreational fisheries on lower Fraser River tributaries.

STUDY AREA

The Fraser River is the largest river in British Columbia, draining most of the southern half of the province. From its headwaters in the Rocky Mountains, the Fraser River flows 1,350 km through the central interior, entering the Strait of Georgia near Vancouver, BC.

The final 150 km stretch of the Fraser River below Hope flows through the alluvial floodplain of the Fraser Valley, bounded to the north by the Coast Mountains and to the south by the Cascade Range. The tributaries surveyed in this study all enter the lower Fraser River between 76 and 116 kilometres upstream from the Strait of Georgia (Figure 1).

HARRISON RIVER

The Harrison River originates at Harrison Lake and flows southwest for 16.5 km, entering the Fraser River 116 km upstream from the Strait of Georgia (Figure 2). The mainstem of the Harrison River is a wide low-gradient channel with depths up to 5 m and sand to gravel substrate. The Harrison River also has number of natural and artificially constructed low-gradient side channels, with depths up to 0.5 m and gravel substrate. In 1998 the river had an annual mean daily flow rate of 437.0 m^3/s (Water Survey of Canada, pers. comm.).

The Harrison River study area extended from the CPR bridge a short distance upstream from the mouth of the river, upstream to the outlet of Harrison Lake. Most anglers accessed the Harrison River by boat, launching at Kilby Beach (Figure 2) and at Englebrich Bar (Figure 1). Both launch areas were used as access point survey sites. Approximately 70% of interviews took place at Kilby Beach, while 30% were at Englebrich Bar which, while not located directly on the Harrison River, is the main boat launch for anglers wanting to access the river from south bank of the Fraser River.

CHEHALIS RIVER

Originating at Chehalis Lake, the Chehalis River flows southeast for 19 km, entering the Harrison River approximately 6 km upstream of the Harrison's confluence with the Fraser River (Figure 2). Where the Chehalis enters the Harrison River, its main and side channels are characterized by moderate to low gradients, depths up to 1 m and gravel substrate. Upstream of the Chehalis-Harrison confluence the main channel has a moderate gradient, depths up to 2.5 m and a gravel and boulder substrate. Side channels, including the one terminating in a fish capture trap for the Chehalis River Hatchery, have smaller substrates than the main channel. The river had annual mean daily flow rates of 36.9 m^3/s in 1996 and 54.2 m^3/s in 1997 (Water Survey of Canada, pers. comm.). Flow rate data are not available for 1998 because the flow meter on the Chehalis River was damaged by vandalism.

The Chehalis River study area extended from the mouth of the river to the bottom of the canyon upstream of the Chehalis River Fish Hatchery, a total distance of 4 km.

NICOMEN SLOUGH - NORRISH CREEK

Nicomen Slough is a former side channel of the Fraser River, on the north side of Nicomen Island (Figure 3). It flows for 14 km in a broad diked channel through agricultural land before entering the Fraser River approximately 90 km upstream from the Strait of Georgia. Norrish Creek originates at a small lake north of the Fraser River and flows in a southerly direction for 21.5 km, entering Nicomen Slough 4 km upstream of its confluence with the Fraser River. In 1998 Norrish Creek had an annual mean daily flow rate of 10.2 m^3/s (Water Survey of Canada, pers. comm.).

The Nicomen Slough-Norrish Creek study area extended from the mouth of Nicomen Slough to its confluence with Norrish Creek and up Norrish Creek to a point approximately 200 metres upstream of the railway bridge. Because of the high gradient of Norrish Creek further upstream, this essentially represents the upper fishing boundary.

LOWER STAVE RIVER

The lower Stave River originates at the Ruskin Dam, at the outlet of Hayward Lake, and flows in a southerly direction for 3 km, entering the Fraser River 76 km upstream from the Strait of Georgia (Figure 4). In 1998 the upper Stave River (upstream of Stave Lake) had an annual mean daily flow rate of 33.2 m^3/s (Water Survey of Canada, pers. comm.). Discharge data are not available for the lower Stave River. The lower Stave River study area extended from the CPR bridge near the mouth of the river, upstream to Ruskin Dam. Over 95% of anglers fished from shore in the 1 km stretch of river immediately downstream of the dam. A small number of anglers fished from boats near the mouth of the river.

VEDDER-CHILLIWACK RIVER

The Vedder-Chilliwack River originates in the Cascade Mountains of Washington State. It flows north into Chilliwack Lake in British Columbia, then continues in a westerly direction for 61 km, entering the Sumas River and then the Fraser River near Chilliwack, BC (Figure 5). The Chilliwack River at Vedder Crossing had annual mean daily flow rates of 60.3 m^3/s in 1996 and 84.2 m^3/s in 1997 (Water Survey of Canada, pers. comm.). Flow rate data are not available for 1998 because the flow meter at Vedder Crossing was damaged by vandalism.

The Vedder-Chilliwack River study area extended from its confluence with the Fraser River upstream to Slesse Creek. The Chilliwack River upstream of Slesse Creek is closed to angling year-round and therefore was not surveyed. For the purposes of sampling, the study area was divided into 3 sections. Section 1 included the Vedder-Chilliwack and Sumas rivers from the bridge at Vedder Crossing downstream to the Fraser River confluence. From the Sumas River to Vedder Crossing, the river is diked to provide flood control and channel stability; roads running along the dikes provide anglers with direct river access through most of this section. The 5-km stretch of the Vedder-Chilliwack River upstream of the Sumas River confluence is narrow and straightened; this section is known locally as the Vedder

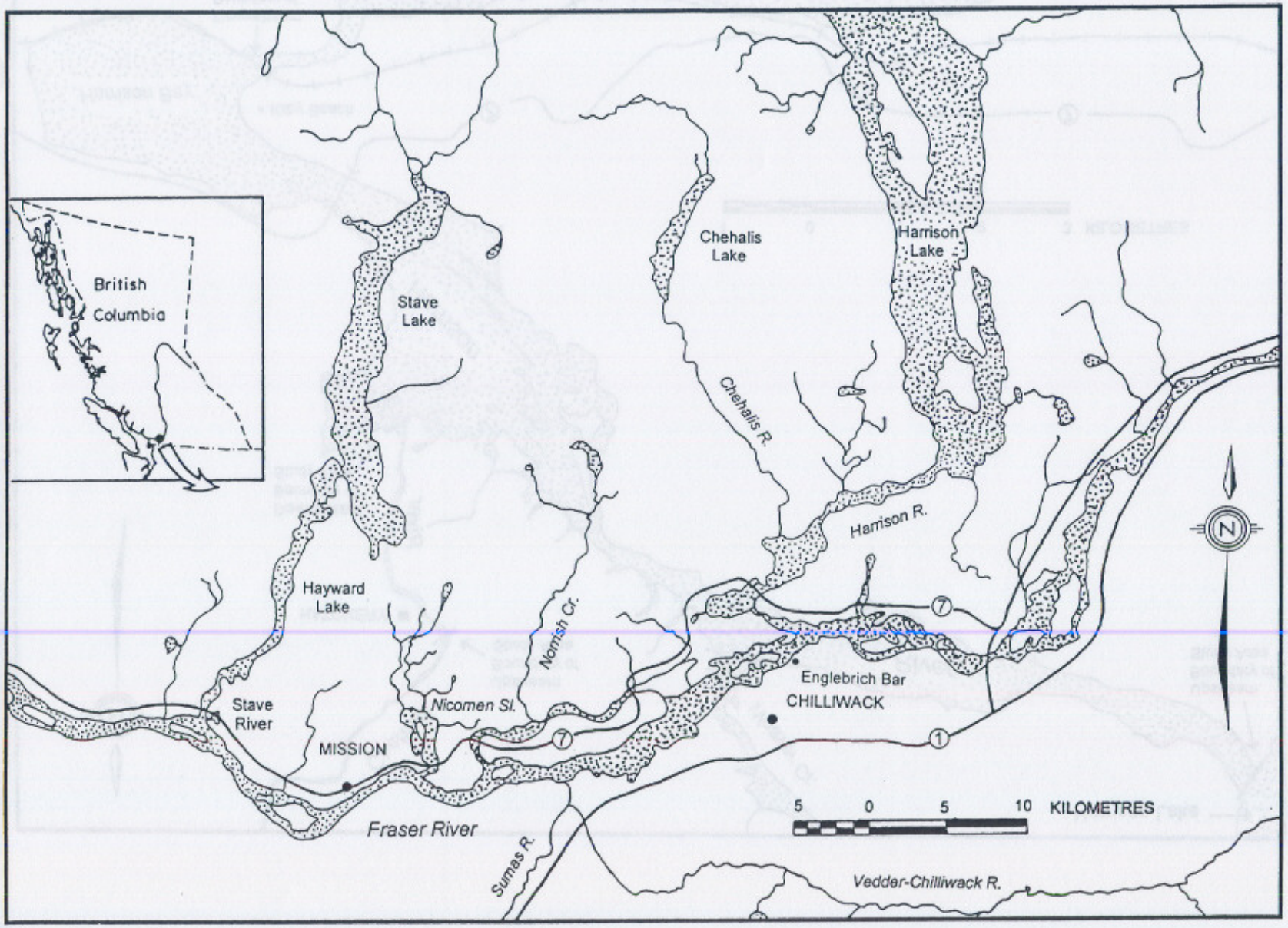

Figure 1. Lower Fraser River tributaries study area overview map.

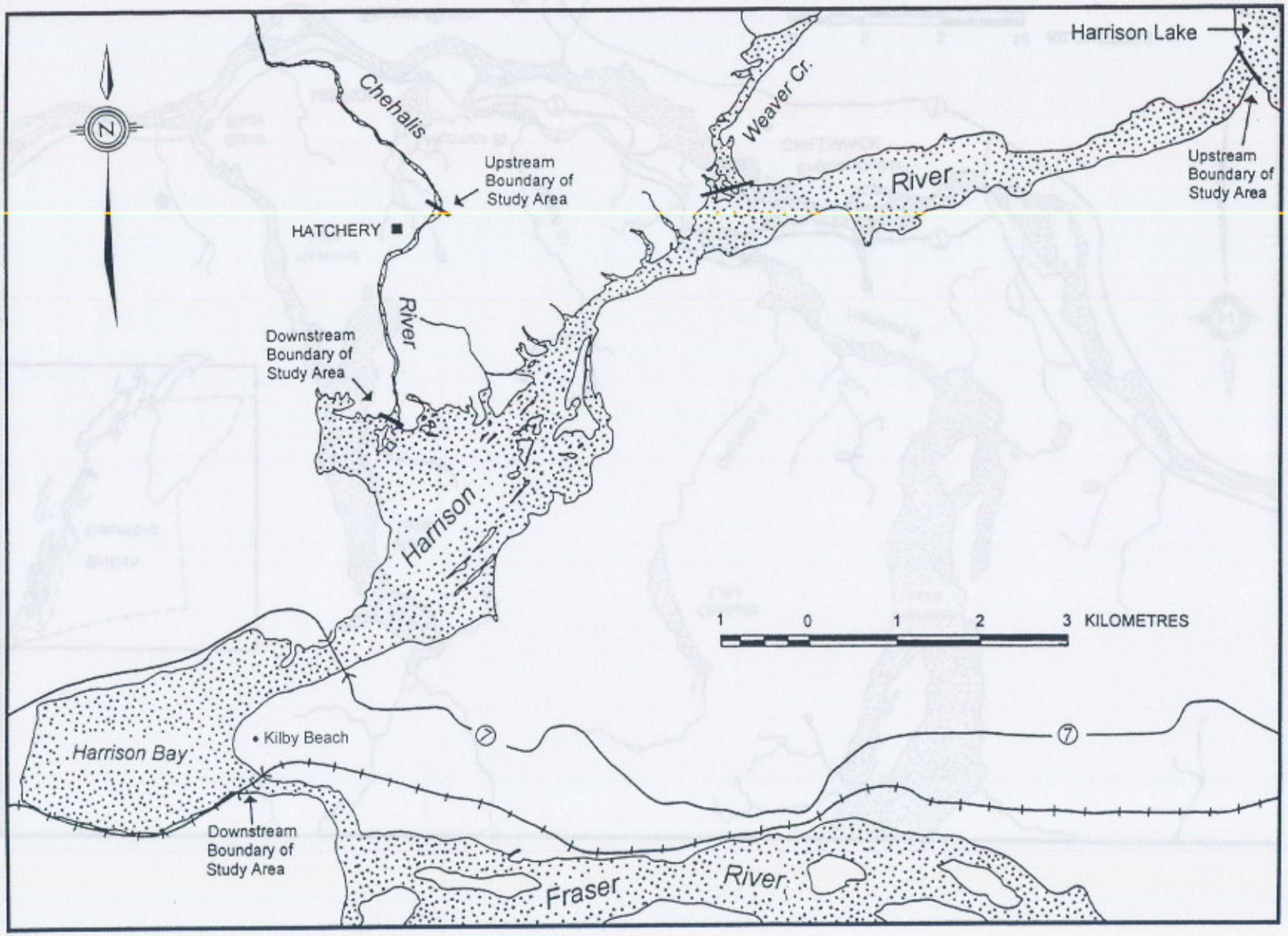

Figure 2. Harrison River and Chehalis River study areas location map.

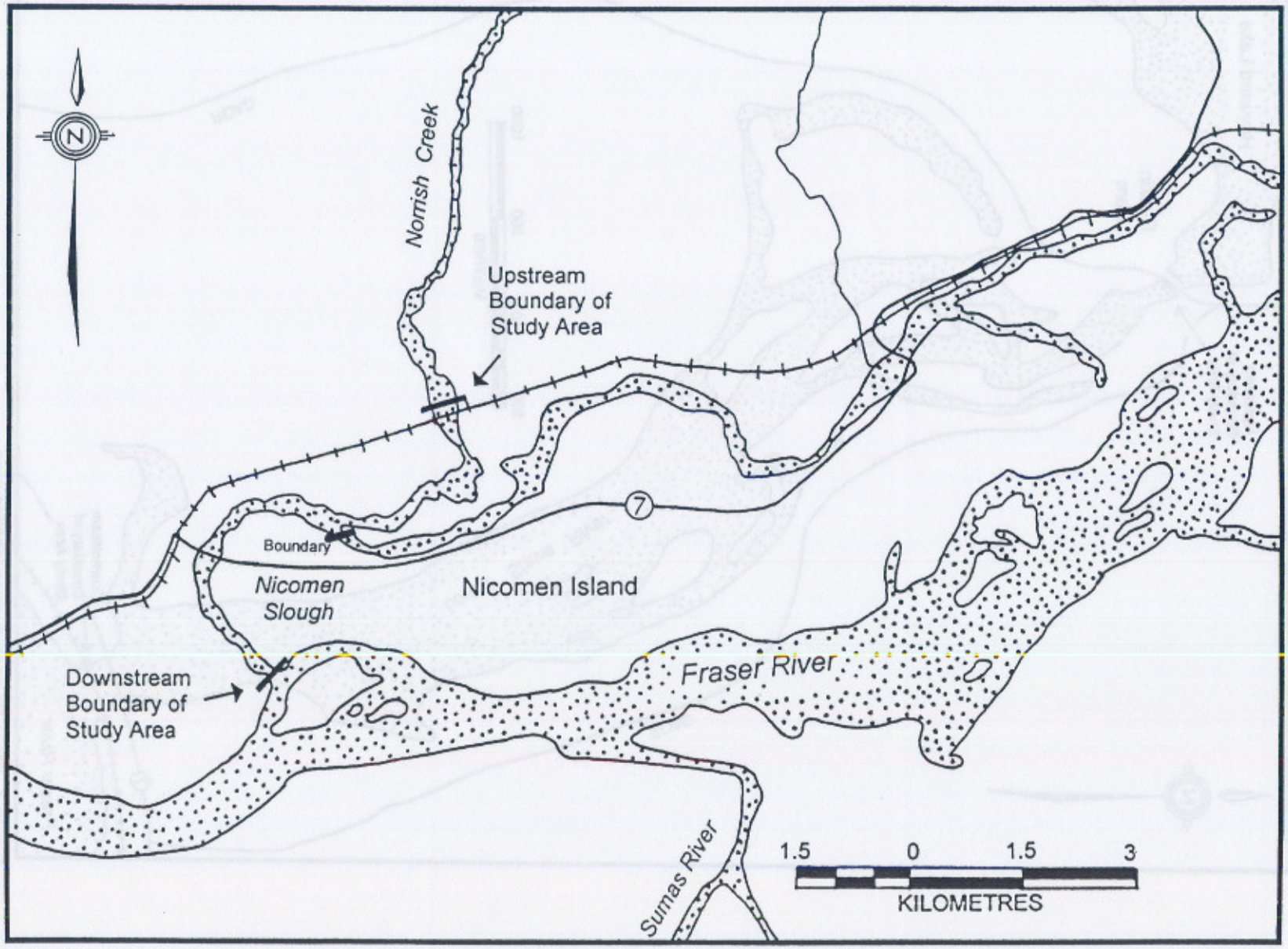

Figure 3. Nicomen Slough and Norrish Creek study area location map.

Figure 4. Stave River study area location map.

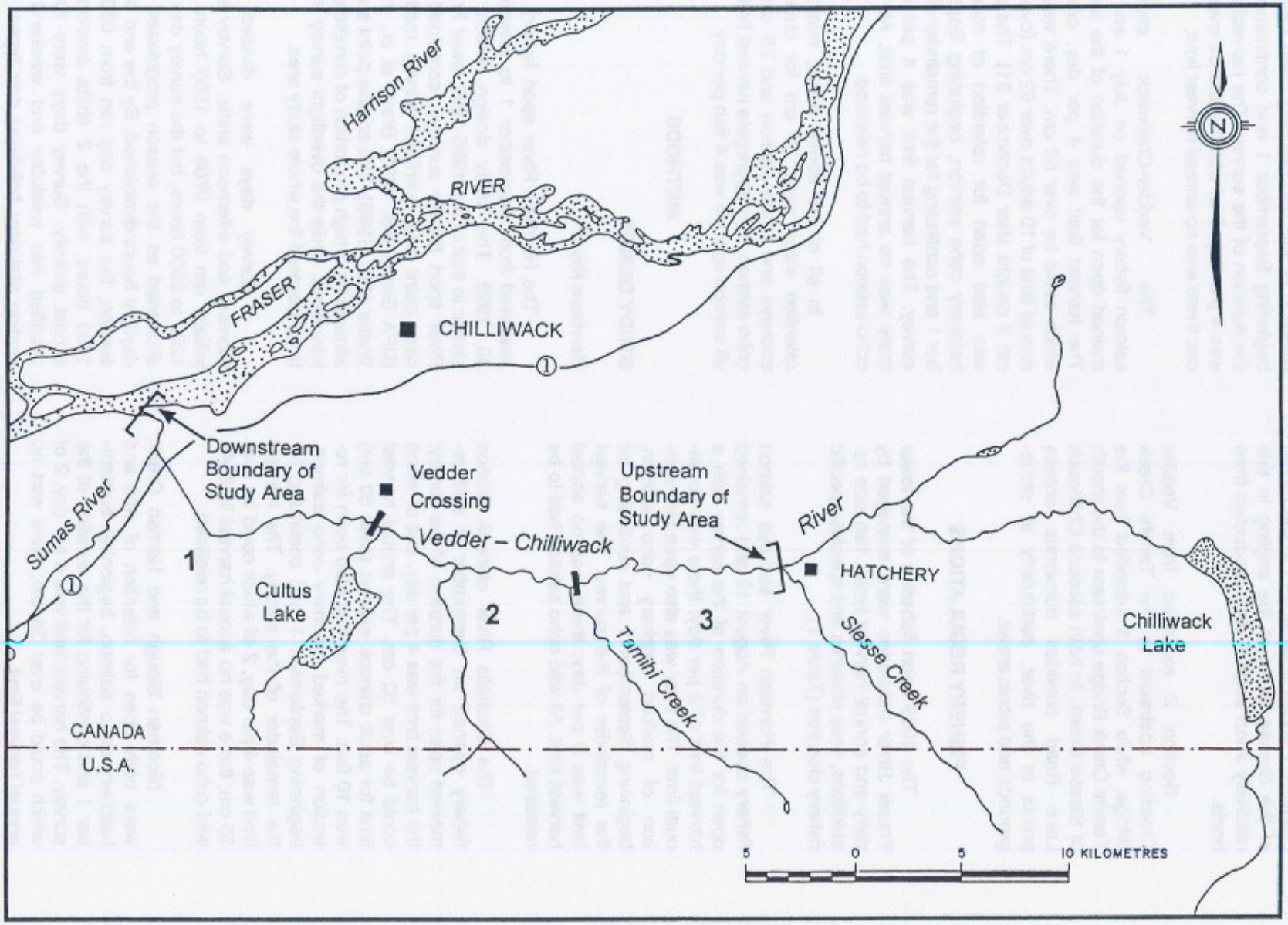

Figure 5. Vedder-Chilliwack River study area location map.

Canal. Shore access is limited from the Highway 1 bridge downstream to the mouth of the Sumas; most of the angling in this relatively short section was conducted from boats.

Section 2 extended from Vedder Crossing upstream to the Tamihi Creek Bridge, while Section 3 extended from the Tamihi Creek Bridge upstream to the mouth of Slesse Creek. In both sections Chilliwack Lake Road provides numerous access points to the river, particularly at campgrounds and picnic areas.

FISHERY REGULATIONS

The 1998 sport fisheries of the lower Fraser River tributaries were managed by daily and annual harvest limits, fish size restrictions, area closures and species-specific fishery closures (Table 1).

The Harrison River sockeye salmon fishery opened on August 10 and remained open for the duration of the survey with a harvest limit of 2 per day; there was no annual limit. The river was also open for retention of marked hatchery coho salmon, beginning September 1 and continuing for the remainder of the survey. The harvest limit was 2 per day; there was no annual harvest limit. All wild coho salmon had to be released.

The Chehalis River chinook salmon fishery opened on September 2 and remained open for the duration of the survey; the harvest limit was 4 per day, one of which could be over 62 cm. The annual harvest limit for adult chinook salmon (over 50 cm) was 10 fish. The river was also open for retention of marked hatchery coho salmon, beginning September 1 and continuing for the remainder of the survey. The harvest limit was 4 per day, 2 of which could be over 35 cm; there was no annual harvest limit. All wild coho salmon had to be released.

Nicomen Slough and Norrish Creek were both open for retention of wild and hatchery coho salmon, beginning September 1 and continuing for the duration of the survey. The harvest limit was 4 per day, 2 of which could be over 35 cm; there was no annual harvest limit.

The lower Stave River was open for retention of wild and hatchery coho salmon, beginning September 1 and continuing for the duration of the survey. The harvest limit was 4 per day, 2 of which could be over 35 cm; there was no annual harvest limit.

The Vedder-Chilliwack chinook salmon fishery opened on July 1 and remained open for the duration of the study. The harvest limit was 4 per day, one of which could be over 62 cm. There was an annual limit of 10 adults over 62 cm (over 50 cm if caught after December 31). The river was also open for retention of marked hatchery coho salmon, beginning September 1 and continuing for the remainder of the survey. The harvest limit was 4 per day; there was no annual harvest limit. All wild coho salmon had to be released.

In all of the above rivers, minimum retention sizes were 30 cm for chinook, sockeye and chum salmon and 25 cm for coho salmon. The aggregate harvest limit for all salmon species was 4 fish per day.

METHODS

STUDY DESIGN

Harrison River

The Harrison River sport fishery was assessed from September 1 to November 30, 1998. The study design, which was similar to that of the 1995-1997 lower Fraser River sport fishery surveys, combined access point and overflight survey methods (DPA Group MS, 1985; Bratty et al., 1998; Walter et al., 1998). The access point survey allowed for a high proportion of complete trip interviews, while the overflight survey effectively covered the whole study area.

Survey days were divided into morning and afternoon shifts. Survey shifts initially ran from 0700 to 1500 hours and 1200 to 2000 hours, but the survey day was shortened as the season progressed and daylight hours diminished. By the end of the season, the survey day ran from 0800 to 1700 hours, with the 2 shifts overlapping almost entirely. Survey days were further stratified into weekday and weekend (including statutory holidays) day types. One

Table 1. Non-tidal salmon fishery regulations for the Harrison, Chehalis, lower Stave and Vedder-Chilliwack rivers, Norrish Creek and Nicomen Slough, during the 1998 sport fishery surveys of lower Fraser River tributaries.

River	Location	Species	Openings	Daily Harvest Limits	Annual Harvest Limits
Harrison River	CPR bridge to mouth of Harrison Lake	Hatchery Coho	Sept 1 – Dec 31	2 ≥ 25 cm	-
		Sockeye	Aug 10 – Dec 31	2 > 30 cm	-
		Pink	Aug 1 – Dec 31	4 > 30 cm	-
		Chum	Aug 1 – Dec 31	1 > 30 cm	-
Chehalis River	Harrison River to logging bridge	Chinook	Sept 2 _ Dec 31	4 ≥ 30 cm, incl. 1 > 62 cm	10 adults > 50 cm
		Hatchery Coho	Sept 1 – Mar 31	4 ≥ 25 cm, incl. 2 > 35 cm	-
		Chum	June 1 – Mar 31	1 > 30 cm	-
Nicomen Slough	Fraser River to confluence of Siddle Creek	Coho	Sept 1 – Mar 31	4 ≥ 25 cm, incl. 2 > 35 cm	-
Norrish Creek	Entire length of the creek	Coho	Sept 1 – Mar 31	4 ≥ 25 cm, incl. 2 > 35 cm	-
Stave River	CPR Bridge to Ruskin Dam	Coho	Sept 1 – Mar 31	4 ≥ 25 cm, incl. 2 > 35 cm	-
		Chum	Apr 1 – Mar 31	1 > 30 cm	-
Vedder-Chilliwack River	Fraser River to Slesse Creek confluence	Chinook	July 1 – Mar 31	4 ≥ 30 cm, incl. 1 > 62 cm	10 adults > 62 cm
		Hatchery Coho	Sept 1 – Mar 31	4 ≥ 25 cm	-
		Chum	July 1 – Mar 31	1 > 30 cm	-

- No annual harvest limit was set for this species

surveyor was stationed at each access point until November 15, when decreasing angler activity at Englebrich bar prompted the removal of its surveyor. Between the two sites, survey shifts took place on all but 2 weekend days and on an average of 3 weekdays per week. Each shift started with the interviewer asking anglers to take part in the survey at the end of their fishing trip. Hourly rod counts were then conducted to build effort profiles and all anglers exiting the site were interviewed. Interview questions included: number of anglers in the party, completed or intended length of fishing trip, time blocks fished, target species, fishing gear used, total harvested marked or unmarked fish, by species, and total released fish, also by species. With the anglers' permission, any harvested fish were inspected by the interviewer to verify species and identify marks. At the end of the shift an 'incomplete trip' interview was conducted on all anglers that were still fishing at the interview site. Total complete and incomplete interviews were then tallied for the day on an angler count summary form.

An average of two overflights per

week (one on weekends and one on weekdays) was scheduled for the duration of the survey. Overflights were conducted primarily with a Cessna 182 traveling 30 m above the water, at an average speed of 130 kph. All surveys began between 1000 and 1400 hours and took approximately 1 hour to complete. When conducting overflights, two observers were seated on the same side of the plane. Rod counts and flight times were recorded on a study area map of the Harrison River. These maps were then compiled to build angler effort profiles and to provide mean daily rod counts for the study area.

A total of 2,037 angler interviews and 23 overflights were conducted between September 1 and November 30, 1998 in the Harrison River fishery survey (Table 2).

Chehalis River

The Chehalis River sport fishery was assessed from September 1 to December 14, 1998. The study design combined roving and instantaneous effort count survey methods (Hoenig et al., 1997), which allowed surveyors to effectively cover the whole study area. Survey days were divided into morning and afternoon shifts; one of the two surveyors worked during a shift. The shifts initially ran from 0700 to 1500 hours and 1200 to 2000 hours, but the survey day was shortened as the season progressed and daylight hours diminished. By the end of the season, the survey day ran from 0800 to 1700 hours, with the 2 shifts overlapping almost entirely. Survey days were further stratified into weekday and weekend (including statutory holidays) day types. Survey shifts took place on all but 3 weekend days and on an average of 4 weekdays per week.

The surveyors traveled a predetermined route by car, with a randomly selected start point and direction of travel. The surveyor's rate of travel through the study area was standardized to ensure that an entire circuit was completed. Anglers were approached on foot to be interviewed. Interview questions included: number of anglers in the party, completed or intended length of fishing trip, time blocks fished, target species, fishing gear used, total harvested marked or unmarked fish, by species, and total released fish, also by species. With the anglers' permission, the interviewer inspected any harvested fish to verify species and identify marks. At the end of the shift, total complete and incomplete interviews were tallied on an angler count summary form.

Instantaneous effort counts were made by one observer who drove the length of the study area and counted all the anglers fishing in it. Rod counts were recorded on a study area map of the Chehalis River. These maps were then compiled to build angler effort profiles and to provide mean daily rod counts for the study area. Effort counts began at 1100 hours and took about an hour to complete. Four instantaneous effort counts were performed in September, with 8 conducted in each of October and November and 3 in December.

A total of 3,676 angler interviews and 23 instantaneous effort counts were conducted between September 1 and December 14, 1998 in the Chehalis River fishery survey (Table 2).

Nicomen Slough - Norrish Creek

The combined Nicomen Slough - Norrish Creek sport fishery was assessed from September 1 to December 14, 1998. The study design was essentially the same as described above for the Chehalis River. Survey shifts took place on all but 7 weekend days and on an average of 3 weekdays per week.

Instantaneous effort counts began at 1100 hours and generally took half an hour to complete. Three instantaneous effort counts were performed in September, while 6 took place in October, 4 in November and 5 in December.

A total of 2,105 angler interviews and 18 instantaneous effort counts were conducted between September 1 and December 14, 1998 in the Nicomen Slough - Norrish Creek fishery survey (Table 2).

Stave River

The combined Stave River sport fishery was assessed from September 1 to De-

cember 14, 1998. The study design was essentially the same as described above for the Chehalis River, except that both roving and access point interviews were conducted. Survey shifts took place on all but 6 weekend days and on an average of 4 weekdays per week.

Instantaneous effort counts began at 1100 hours and generally took half an hour to complete. Instantaneous effort counts were performed on 2 days in September, on 5 days in October, 7 in November and 5 in December.

A total of 3,131 angler interviews and 19 instantaneous effort counts were conducted between September 1 and December 14, 1998 in the Stave River fishery survey (Table 2).

Vedder-Chilliwack River

The Vedder-Chilliwack River sport fishery was assessed from September 1 to November 30, 1998 and combined roving and overflight survey methods (Hoenig et al., 1997), allowing surveyors to effectively cover the whole study area. Survey days were divided into morning and afternoon shifts, with one surveyor in each section working one of the two shifts. The shifts initially ran from 0700 to 1500 hours and 1200 to 2000 hours, but the survey day was shortened as the season progressed and daylight hours diminished. By the end of the season, the survey day ran from 0800 to 1700 hours, with the 2 shifts overlapping almost entirely. Survey days were further stratified into weekday and weekend (including statutory holidays) day types. Survey shifts took place on all weekend days and on an average of over 4 weekdays per week. Data were recorded by section of angler encounter. However, for the purpose of making catch estimates, all data were pooled because the highly mobile nature of the anglers precluded making unbiased effort and catch per unit effort estimates by section.

Within their respective sections, the surveyors traveled a pre-determined route by car, with a randomly selected start point and direction of travel. The surveyor's rate of travel through the study area was standardized to ensure that an entire circuit was completed. Anglers were approached on foot to be interviewed. Interview questions included: number of anglers in the party, completed or intended length of fishing trip, time blocks fished, target species, fishing gear used, total harvested marked or unmarked fish, by species, and total released fish, also by species. With the anglers' permission, the interviewer inspected any harvested fish to verify species and identify marks. At the end of the shift, total complete and incomplete interviews were tallied on an angler count summary form.

An average of two overflights per week (one on weekends and one on weekdays) was scheduled for the duration of the survey. Overflights were conducted with a Bell Jet Ranger 206 traveling 30 m above the water, at speeds ranging from 0 to 50 kph. Most surveys began between 1130 and 1230 hours and took about 1 hour to complete. All overflights covered Sections 1 to 3. When conducting overflights, two observers were seated on the same side of the helicopter. Rod counts and flight times were recorded on study area maps. These maps were then compiled to build angler effort profiles and to provide mean daily rod counts for the study areas.

A total of 8,859 angler interviews and 23 overflights were conducted between September 1 and November 30, 1998 in the Vedder-Chilliwack River fishery survey (Table 2).

DATA MANAGEMENT

Data management procedures were the same as for the 1998 lower Fraser River creel survey and are described in detail in Palermo and Thompson (1999b).

DATA ANALYSIS

Harrison River

Before the analysis algorithms were performed, data were stratified according to site, month, day type, hour and stint. Days were divided into three stints: the period of overlap between the a.m. and p.m. shifts, and the a.m. and p.m. shifts outside the overlap period. Stratification allowed the

appropriate weighting of interview and instantaneous effort count data.

Angler Effort

Angler effort profiles were generated from hourly rod counts at the survey sites. Effort information from outside the survey shifts (prior to 0700 and after 2200 hours, for example) was reconstructed from the interview data and used to adjust the daily angler effort profile. Hourly effort was also weighted to compensate for the sampling imbalances resulting from overlapping survey shifts. Mean sample day effort for each stratum (month and day type) was the ratio of the mean instantaneous effort count to the proportion of daily effort occurring during the instantaneous effort count time block. Total angler effort was the product of the mean daily angler effort and the number of days in the stratum. The mathematical relationships are reported below, with variance calculations detailed in Schubert and Whyte (1992).

1) Estimated total rods fishing by hour j and day type h:

$$\hat{R}_{hj} = \sum_i N_h / n_{hij} \sum_k r_{hijk}$$

2) Estimated proportion of the daily angler effort occurring during the instantaneous effort count time block, by day type:

$$\overline{P}_{hj^*} = \frac{\hat{R}_{hj^*}}{\sum_j \hat{R}_{hj}}$$

3) Estimated mean rod count during the instantaneous effort count time block, by day type:

$$\overline{y}_{hj^*} = \sum_k \frac{y_{hj^*k}}{n_{hj^*}}$$

4) Estimated angler effort by day type, in hours:

$$E_h = N_h \frac{\overline{y}_{hj^*}}{P_{hj^*}}$$

5) Estimated study period angler effort, in hours:

$$E = \sum_h E_h$$

where:

N_h = total study period days of day type h (weekday or weekend);

n_{hij} = number of interview sample days on day type h at site i during hour j;

r_{hijk} = rod count on day type h at site i at hour j on day k;

$\hat{R}_{hj^*}$ = estimated total effort (hours) on day type h during the instantaneous count time j^*

y_{hj^*k} = instantaneous effort count on day type h on day k;

n_{hj^*} = number of instantaneous effort counts on day type h;

Catch per Unit Effort

CPUE was calculated by day type for each species and mark group, using a total ratio estimator (Von Geldern, Jr. and Thomlinson, 1973; Malvestuto, 1983), i.e., the total estimated catch was divided by the total estimated effort (to time of interview). Estimates were derived from interview data weighted by the proportion of stints that were surveyed. CPUE was calculated separately for harvested (HPUE) and released (RPUE) fish. The mathematical relationships are reported below.

6) Estimated monthly catch to time of interview at the survey sites by day type:

$$\hat{X}_h = \sum_i \sum_l \frac{1}{a_{hil}} \sum_f \sum_q \sum_u \frac{x_{hilfqu}}{a_{hilfq}}$$

7) Estimated monthly angler hours to time of interview at the survey sites by day type:

$$\hat{T}_h = \sum_i \sum_l \frac{1}{a_{hil}} \sum_f \sum_q \sum_u \frac{t_{hilfqu}}{a_{hilfq}}$$

8) Estimated catch per angler hour at the survey sites by day type:

$$\bar{c}_h = \frac{\hat{X}_h}{\hat{T}_h}$$

where:

a_{hil} = proportion of monthly stints of type *l* for site *i* on day type *h* which were surveyed;

a_{hilfq} = proportion of anglers leaving in time block *q* on stint *f* of stint type *l* at site *i* on day type *h* who were interviewed;

x_{hilfqu} = catch to time of interview by angler *u* leaving in time block *q* on stint *f* of stint type *l* at site *i* on day type *h*;

t_{hilfqu} = hours fished to time of interview by angler *u* leaving in time block *q* on stint *f* of stint type *l* at site *i* on day type *h*.

Before calculating CPUE, however, the raw interview data were tested for significant differences in CPUE estimates calculated from all interviews and complete trip interviews only. The test used, from Cochran (1977) was:

9) Estimated variance of the difference between two ratios $Var(\bar{c}_c - \bar{c}_t)$:

$$Var(\bar{c}_c - \bar{c}_t) = Var(\bar{c}_c) + Var(\bar{c}_t)$$

where:

$Var(\bar{c}_c)$ = variance of CPUE from complete trip interviews:

$$\frac{1}{n(n-1)\bar{t}^2}(\sum x_u^2 - 2\bar{c}_c \sum x_u t_u + \bar{c}_u^2 \sum t_u^2)$$

$Var(\bar{c}_t)$ = variance of CPUE from all interviews, calculated as above.

$\bar{t}$ = mean time to interview.

If $(\bar{c}_c - \bar{c}_t) \pm$ (t-table, 0.95) $Var(\bar{c}_c - \bar{c}_t)$ did not include zero, the difference was significant. In that case, incomplete trip interviews were excluded from the analysis for that site. In the 1998 Harrison River survey, 12.5% of the interviews were incomplete; all of these were excluded from analysis.

Harvest and Release

Monthly harvest and release, estimated by species and mark group, are the sum of the weekday and weekend strata estimates. For each stratum, harvest and release was the product of stratum effort and the corresponding value of HPUE or RPUE.

10) Total study period catch (*C*):

$$C = \sum_h \bar{c}_h E_h$$

Angler Characteristics

Several unweighted angler attributes, including mean angler day length, preferred species and gear type, were also summarized by month (Appendix 1a).

Chehalis River

Before the analysis algorithms were performed, data were stratified according to month, day type, hour and stint. Days were divided into three stints: the period of overlap between the a.m. and p.m. shifts, and the a.m. and p.m. shifts outside the overlap period. Stratification allowed the appropriate weighting of interview and instantaneous effort count data.

Angler Effort

Angler effort profiles were generated from rod counts at the survey sites and 'time fishing' data from interviews. Effort information from outside the survey shifts (prior to 0700 and after 1800 hours, for example) was reconstructed from the interview data and used to adjust the daily angler effort profile. Hourly effort was also weighted to compensate for the sampling imbalances resulting from overlapping survey shifts. Mean sample day effort for each stratum

(month and day type) was the ratio of the mean instantaneous rod count to the proportion of daily effort occurring during the instantaneous effort count time block. Total angler effort was the product of the mean daily angler effort and the number of days in the stratum. The mathematical relationships are reported below, with variance calculations detailed in Schubert and Whyte (1992).

11) Estimated total rods fishing by hour *j* and day type *h*:

$$\hat{R}_{hj} = N_h / n_{hj} \sum_k r_{hjk}$$

12) Estimated proportion of the daily angler effort occurring during the instantaneous rod count time block, by day type:

$$\overline{P}_{hj^*} = \frac{\hat{R}_{hj^*}}{\sum_j \hat{R}_{hj}}$$

13) Estimated mean rod count during the instantaneous rod count time block, by day type:

$$\overline{y}_{hj^*} = \sum_k \frac{y_{hj^*k}}{n_{hj^*}}$$

14) Estimated angler effort by day type, in hours:

$$E_h = N_h \frac{\overline{y}_{hj^*}}{\overline{p}_{hj^*}}$$

15) Estimated study period angler effort, in hours:

$$E = \sum_h E_h$$

where:

N_h = total study period days of day type *h* (weekday or weekend);

n_{hj} = number of interview sample days on day type *h* during hour *j*;

r_{hjk} = rod count on day type *h* at hour *j* on day *k*;

$\hat{R}_{hj^*}$ = estimated total effort (hours) on day type *h* during the instantaneous count time *j**

y_{hj^*k} = instantaneous rod count on day type *h* on day *k*;

n_{hj^*} = number of instantaneous rod counts on day type *h*;

Catch per Unit Effort

CPUE was calculated by day type for each species and mark group, using a mean of ratios estimator (Von Geldern, Jr. and Thomlinson, 1973; Malvestuto, 1983; Hoenig et al., 1997), i.e., the sum of all the daily ratios of estimated catch to estimated effort (to time of interview) was divided by the total number of anglers interviewed. Estimates were derived from interview data weighted by the proportion of stints that were surveyed. CPUE was calculated separately for harvested (HPUE) and released (RPUE) fish. The mathematical relationships are reported below.

16) Estimated catch per angler hour for angler *u*:

$$\hat{X}_u = \frac{x_u}{t_u}$$

17) Estimated cumulative catch per angler hour by day type:

$$\hat{c}_h = \sum_l \frac{1}{a_{hl}} \sum_f \sum_q \sum_u \frac{\hat{X}_u}{a_{hlfq}}$$

18) Estimated catch per angler hour by day type:

$$\overline{c}_h = \frac{\hat{c}_h}{n_h}$$

where:

a_{hl} = proportion of monthly stints of type *l* on day type *h* which were surveyed;

a_{hlfq} = proportion of anglers fishing in time block q on stint f of stint type l on day type h who were interviewed;

x_u = catch to time of interview by angler u;

t_u = hours fished to time of interview by angler u;

n_h = total number of anglers interviewed on day type h.

However, before calculating CPUE, the raw interview data were tested for significant differences in CPUE estimates calculated from all interviews and complete trip interviews only, using Equation 9. In the 1998 Chehalis River survey, 30% of the interviews were incomplete; none of these were excluded from analysis.

Harvest and Release

Monthly harvest and release, estimated by species and mark group, are the sum of the weekday and weekend strata estimates. For each stratum, harvest and release was the product of stratum effort and the corresponding value of HPUE or RPUE, calculated as in Equation 10.

Angler Characteristics

Several unweighted angler attributes, including mean angler day length, preferred species and gear type, were also summarized by month (Appendix 1b).

Nicomen Slough - Norrish Creek

Data from this survey were analyzed using the methodology described above for the Chehalis River. In the 1998 Nicomen-Norrish survey, 32% of the interviews were incomplete; none of these were excluded from analysis. Unweighted angler attributes are summarized by month in Appendix 1c.

Stave River

Data from this survey were analyzed using the access point methodology described above for the Harrison River. Although the Stave River survey incorporated both access point and roving interviews, the fishery's effort profile indicated the data were best suited to analysis using the ratio of means estimator. In the 1998 Stave River survey, 58% of the interviews were incomplete; none of these were excluded from analysis. Unweighted angler attributes are summarized by month in Appendix 1d.

Vedder-Chilliwack River

Data from this survey were analyzed using the methodology described above for the Chehalis River. In the 1998 Vedder-Chilliwack River survey, 80% of the interviews were incomplete; none of these were excluded from analysis. Unweighted angler attributes are summarized by month in Appendix 1e.

RESULTS

Angler effort and harvest and release by species are summarized for the 1998 Harrison, Chehalis, Nicomen-Norrish, Stave and Vedder-Chilliwack sport fisheries in Table 2. A summary of angler interview responses for each of the five study areas is presented in Table 3.

HARRISON RIVER

The 1998 Harrison River sport fishery survey was conducted between September 1 and November 30, 1998. Catches during the survey period included coho, chum, sockeye, chinook and pink salmon, as well as sturgeon and several trout species. Survey effort, total angler effort, CPUE, HPUE and RPUE estimates by species, along with total catch and release estimates by species, are detailed below.

Survey Effort

The study period included 62 weekdays and 29 weekend days; 66% of weekdays and 93% of weekend days were sampled.

Eight overflights were conducted over the Harrison River in September, 7 were conducted in October and 8 in November. Overflight rod counts ranged from 0 to 84 on weekdays and from 2 to 162 on weekends

Table 2. Angler effort, survey effort, and harvest and release by species in the 1998 Harrison, Chehalis, Nicomen-Norrish, Stave and Vedder-Chilliwack sport fisheries.

	Harrison River	Chehalis River	Nicomen-Norrish	Stave River	Vedder-Chilliwack River
Dates surveyed	Sept 1 - Nov 30	Sept 1 - Dec 14	Sept 1 - Dec 14	Sept 1 - Dec 14	Sept 1 - Nov 30
# of interviews	2,037	3,676	2,105	3,131	8,859
Angler effort (hours)	44,288	41,430	14,748	31,876	291,027
Angler effort (days)	9,544	9,961	3,208	10,446	51,303
Average angler day (hours)	4.6	4.2	4.6	3.1	5.7
TOTAL HARVEST					
Chinook	36	0	5	0	8,196
Jack Chinook	0	81	4	5	4,525
Coho	564	3,099	941	320	6,151
Chum	485	533	14	970	4,327
Pink	4	0	0	0	0
Sockeye	1,711	0	0	22	0
Steelhead	0	152	0	0	3
Trout	104	35	3	36	24
Sturgeon	0	0	0	0	0
Other	39	0	4	0	0
TOTAL RELEASE					
Chinook	528	175	3	7	13,740
Jack Chinook	117	79	16	5	5,033
Coho	1,545	3,544	243	849	7,811
Chum	2,787	18,974	364	2,827	12,844
Pink	1	24	0	0	3
Sockeye	2,334	0	0	42	183
Steelhead	17	124	0	0	69
Trout	801	216	114	414	317
Sturgeon	1,230	0	92	0	108
Other	469	90	3	26	275

Table 3. Angler characteristics (from interview responses) in the 1998 Harrison, Chehalis, Nicomen-Norrish, Stave and Vedder-Chilliwack sport fisheries.

	Harrison River	Chehalis River	Nicomen-Norrish	Stave River	Vedder-Chilliwack River
TARGET SPECIES (%)					
None	3.2	3.2	2.0	13.1	3.7
Chinook	1.1	0.0	0.0	0.0	0.8
Jack Chinook	0.0	0.0	0.0	0.0	0.0
Coho	47.8	94.2	95.1	68.6	87.9
Chum	2.2	0.6	0.0	11.1	0.1
Pink	0.0	0.0	0.0	0.0	0.0
Sockeye	24.9	0.1	0.0	0.1	0.1
Steelhead	1.1	1.0	0.0	0.1	0.0
Trout	8.6	0.9	1.5	7.0	0.5
Sturgeon	10.5	0.0	1.3	0.0	0.1
Other	0.6	0.0	0.0	0.0	6.8
GEAR TYPE (%)					
Bait	14.5	18.1	30.7	18.9	8.0
Lure	55.5	70.6	62.9	61.5	52.0
Bait and Lure	8.9	7.9	3.8	4.4	39.1
Fly	21.1	3.4	2.6	15.2	0.9

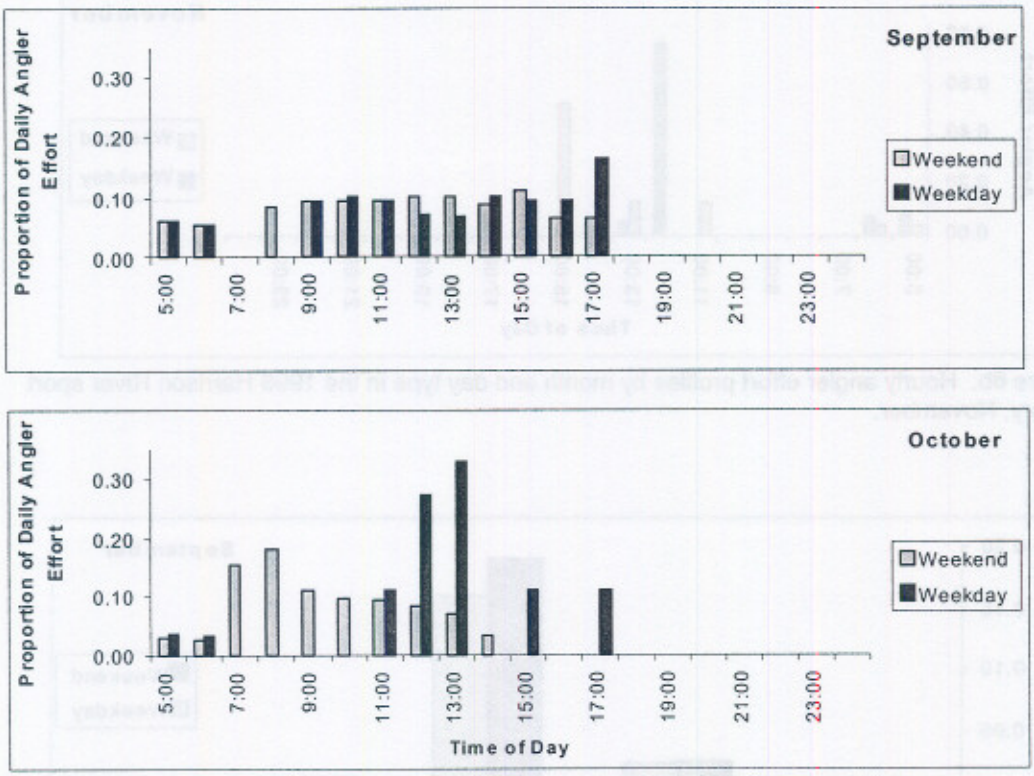

Figure 6a. Hourly angler effort profiles by month and day type in the 1998 Harrison River sport fishery, September and October.

(Appendix 2a). The peak rod count for the study area occurred on September 26.

Angler Effort

Daily Profile

Anglers generally fished between 0500 and 1700 hours, with peaks in effort occurring around noon (Figure 6).

Total Angler Effort

Total estimated angler effort for September through November was 44,288 hours or 9,544 angler days. Angling effort decreased from September (17,743 hours) to November (10,971 hours). Forty-five percent of the angling effort took place on weekdays. Angler effort totals by month are presented in Appendix 4a.

Catch per Unit Effort

CPUEs for coho, chum, sockeye and chinook salmon are presented in Figure 7 and, along with HPUEs and RPUEs, in Appendix 5a. Peak and average CPUEs are described below by month and day type. The proportion of harvested fish to total catch is also described.

CPUEs, HPUEs and RPUEs for all other species caught in the study area during the survey are detailed in Appendix 5a. Following coho and sockeye salmon, sturgeon and trout were the main targets and had average weekday CPUEs for September through November of 0.0277 and 0.0198.

Average weekend and weekday CPUEs for coho salmon were 0.0422 and 0.0654. Approximately one quarter of the catch was harvested; weekend and weekday HPUEs averaged 0.0109 and 0.0178. The peak weekend and weekday CPUEs both occurred in November (0.0630 and 0.0963).

Average weekend and weekday CPUEs for chum salmon were 0.0934 and 0.0650. Approximately one seventh of the

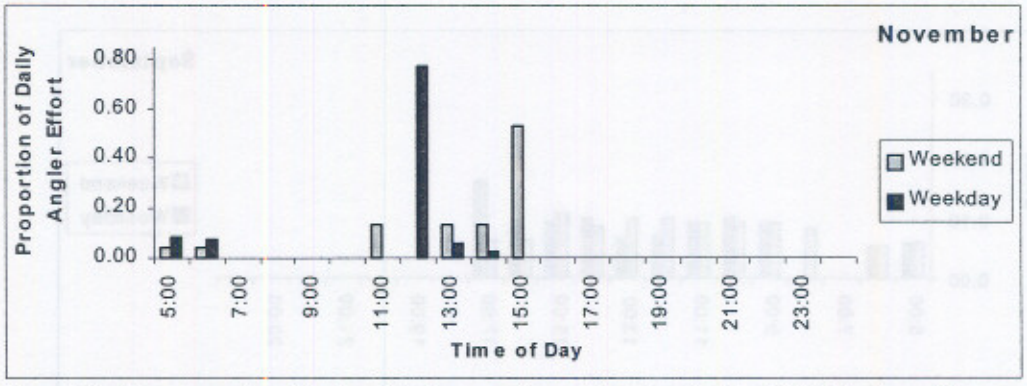

Figure 6b. Hourly angler effort profiles by month and day type in the 1998 Harrison River sport fishery, November.

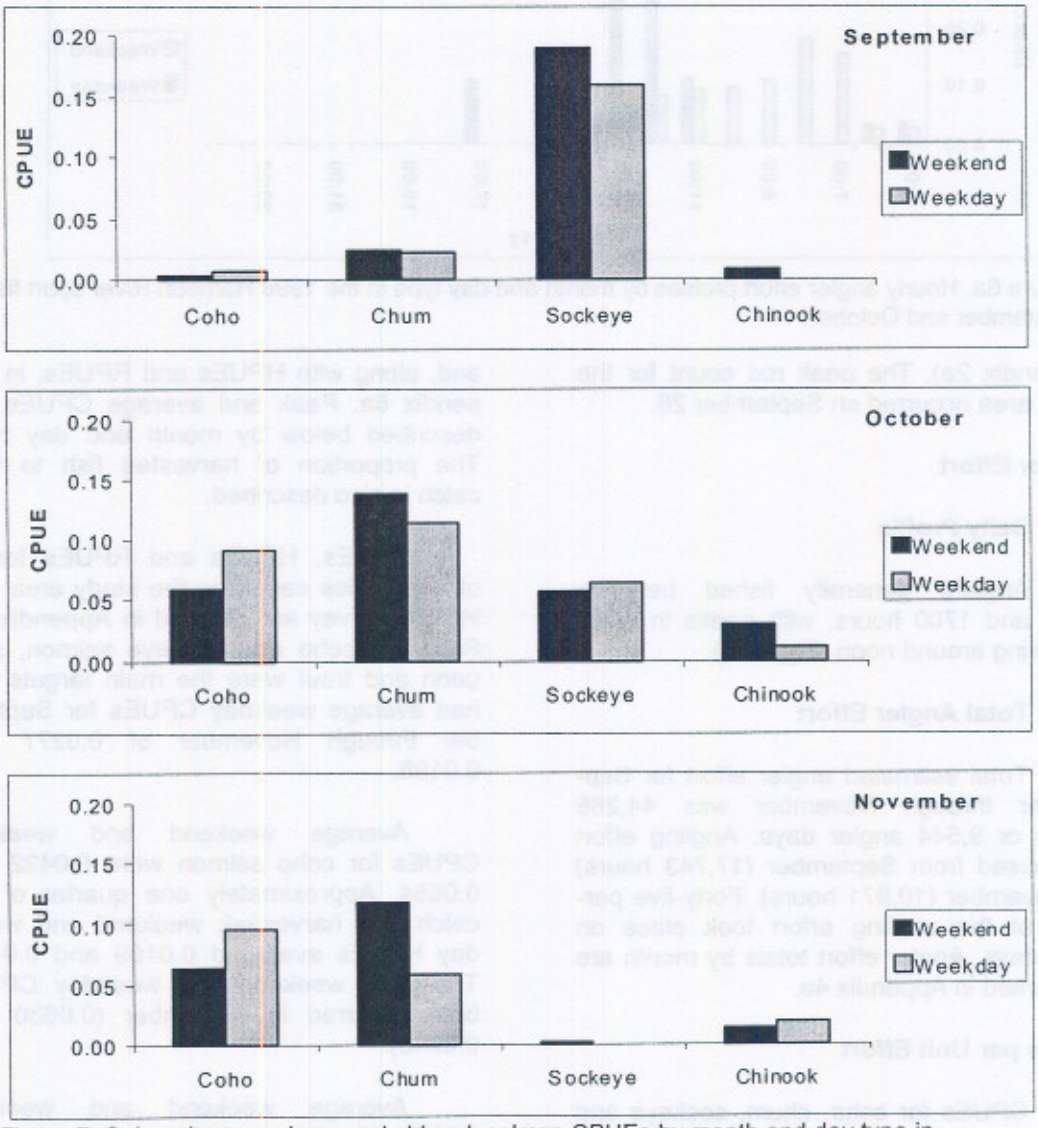

Figure 7. Coho, chum, sockeye and chinook salmon CPUEs by month and day type in the 1998 Harrison River sport fishery.

catch was harvested; weekend and weekday HPUEs averaged 0.0120 and 0.0092. The peak weekend and weekday CPUEs both occurred in October (0.1376 and 0.1143).

Average weekend and weekday CPUEs for sockeye salmon were 0.0828 and 0.0749. Less than one half of the catch was harvested; weekend and weekday HPUEs averaged 0.0368 and 0.0278. The peak weekend and weekday CPUEs both occurred in September (0.1908 and 0.1602).

Average weekend and weekday CPUEs for chinook salmon were 0.0174 and 0.0097. A small proportion of the catch was harvested; weekend and weekday HPUEs averaged 0.0010 and 0.0002. The peak weekend and weekday CPUEs occurred in October (0.0302) and November (0.0186).

Total Catch

Catches of 2,109 coho, 3,272 chum, 4,045 sockeye and 681 chinook salmon, representing 79% of the total sport catch, were estimated for the Harrison River study area from September through November. Monthly harvest and release totals for all species are presented in Appendix 4a.

Coho, chum, sockeye and chinook salmon were caught throughout the study period. Coho and chum salmon catches peaked during October, when 49% of the coho and 63% of the chum salmon were caught. In total, 27% of coho and 15% of chum salmon caught were harvested. Sockeye salmon catches peaked in September, when 77% of the catch occurred. Forty-two percent of the sockeye salmon catch was harvested. Chinook salmon catches peaked in October, when 60% of the catch took place; 5% of the total chinook salmon catch was harvested.

Marked Catch

Ninety percent of the coho salmon harvested during the study were recorded as marked. Marked harvest estimates are presented by species and month in Table 4. Interview staff did not record mark data for released fish, as angler mark recognition was not considered reliable.

Table 4. Estimated harvested marked fish by species and month in the 1998 Harrison River sport fishery.

	Sept.	Oct.	Nov.	Total
Chinook	8	0	0	8
Jack Chinook	0	0	0	0
Coho	0	221	285	506
Chum	14	1	0	15
Pink	0	0	0	0
Sockeye	0	0	0	0
Steelhead	0	0	0	0
Trout	17	43	9	69

Angler Characteristics

Angler characteristics are summarized by month in Appendix 1a. Anglers changed their target species in accordance with changes in species composition and abundance. Seventy-three percent of the anglers interviewed targeted either coho (48%) or sockeye (25%) salmon, while 9% targeted trout and 10% targeted sturgeon. During September, when sockeye salmon were abundant in the river, they were targeted by 69% of anglers. In October, as coho salmon entered the river, interest in sockeye salmon dropped, with only 9% of anglers targeting them and 64% targeting coho salmon. In November, the proportion of anglers targeting sockeye salmon dropped even lower to 1% and 72% of anglers targeted coho salmon. Over the course of the survey, only 2% of the anglers interviewed were targeting chum salmon.

Fifty-six percent of the anglers interviewed used lures as their gear type, with the remainder using flies (21%), bait (14%), or bait and lure combinations (9%). Mean angler trip length over the study period was 4.6 hours; angler trips were shortest in September (3.4 hours) and longest in October (6.2 hours).

CHEHALIS RIVER

The 1998 Chehalis River sport fishery survey was conducted between September 1 and December 14, 1998. Catches during

the 3-month study included coho, chum, chinook and pink salmon, as well as several trout species. Survey effort, total angler effort, CPUE, HPUE and RPUE estimates by species, along with total catch and release estimates by species, are detailed below.

Survey Effort

The study period included 72 weekdays and 33 weekend days; 88% of weekdays and 91% of weekend days were sampled.

Four instantaneous effort counts were conducted on the Chehalis River in September, with 8 conducted in each of October and November and 3 in December. Rod counts ranged from 2 to 81 on weekdays and from 0 to 67 on weekends (Appendix 2b). The peak rod count for the study area occurred on October 23 and again on November 5.

Angler Effort

Daily Profile

Anglers fished between 0500 and 1700 hours, with peaks in effort occurring around 0500 hours and between 0800 and 1200 hours (Figure 8).

Total Angler Effort

Total estimated angler effort for September 1 to December 14 was 41,430 hours or 9,961 angler days. Angling effort increased from September (1,700 hours) to October (21,191 hours) and then decreased again through November (13,230 hours) and December (5,309 hours). Seventy-one percent of the angling effort took place on weekdays. Angler effort totals by month are presented in Appendix 4b.

Catch per Unit Effort

CPUEs for coho and chum salmon are presented in Figure 9 and, along with HPUEs and RPUEs, in Appendix 5b. Peak and average CPUEs are described below by month and day type. The proportion of harvested fish to total catch is also described.

CPUEs, HPUEs and RPUEs for all other species caught in the study area during the survey are detailed in Appendix 5a. Following coho salmon, steelhead trout and other trout species were the main targets and had average weekday CPUEs from September through December of 0.0020 and 0.0218.

Average weekend and weekday CPUEs for coho salmon were 0.1252 and 0.1777. Less than half of the catch was harvested; weekend and weekday HPUEs averaged 0.0582 and 0.0503. The peak weekend and weekday CPUEs both occurred in December (0.2381 and 0.2944).

Average weekend and weekday CPUEs for chum salmon were 0.2879 and 0.3519. A very small proportion of the catch was harvested; weekend and weekday HPUEs averaged 0.0074 and 0.0106. The peak weekend and weekday CPUEs both occurred in November (0.9217 and 0.9168).

Total Catch

Catches of 6,643 coho 19,507 chum and 335 chinook salmon, representing 98% of the total sport catch, were estimated for the Chehalis River study area for September 1 through December 14. Monthly harvest and release totals for all species are detailed in Appendix 4b.

Coho salmon were caught from October through December. Chum and chinook salmon were both caught from September through November. Coho and chinook salmon catches both peaked during October (55% and 84% of the total catch), while chum salmon catches peaked during November (62% of the total catch). In total, 47% of coho, 3% of chum and 24% of chinook salmon caught were harvested.

Marked Catch

Over 99% of the coho salmon harvested during the study were recorded as marked. Marked harvest estimates are presented by species and month in Table 5. Interview staff did not record mark data for released fish, as angler mark recognition was not considered reliable.

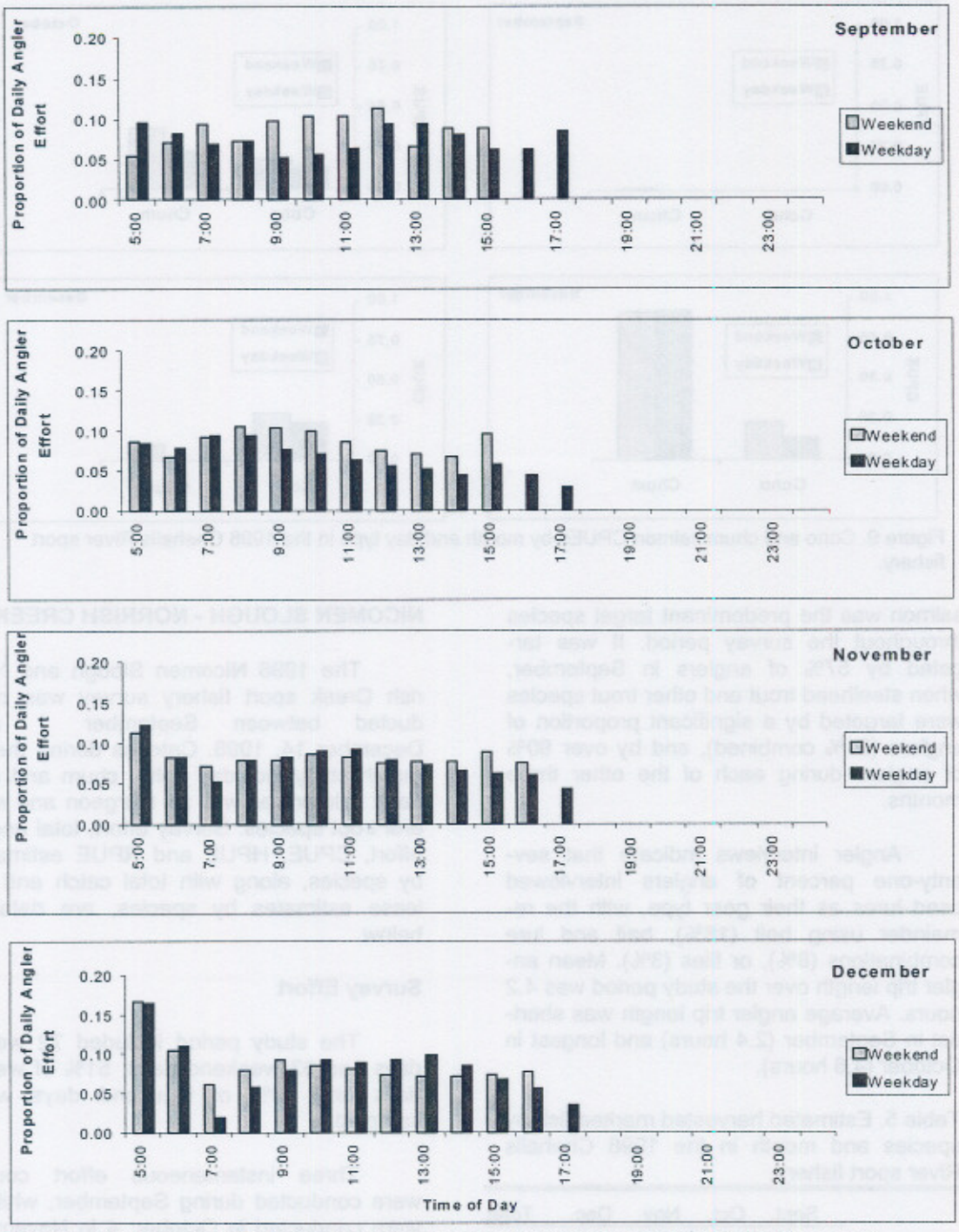

Figure 8. Hourly angler effort profiles by month and day type in the 1998 Chehalis River sport fishery.

Angler Characteristics

Angler characteristics are summarized by month in Appendix 1b. Anglers changed their target species in accordance with changes in species composition and abundance. Ninety-four percent of the anglers interviewed were targeting coho salmon. Three percent were not targeting any particular species and less than 1% targeted each of steelhead trout, other trout species and chum and sockeye salmon. Coho

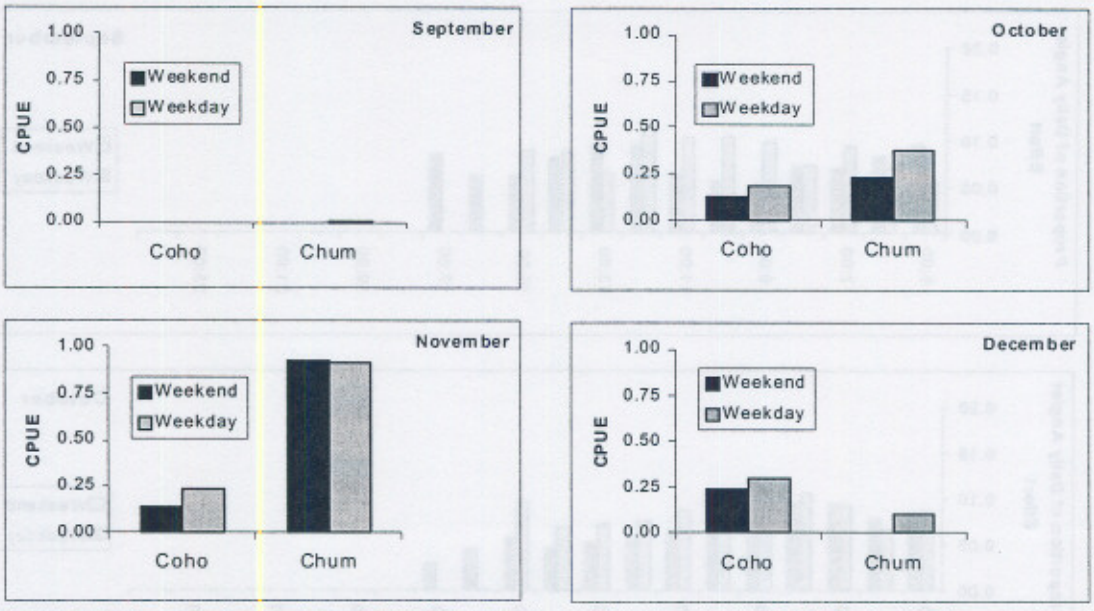

Figure 9. Coho and chum salmon CPUEs by month and day type in the 1998 Chehalis River sport fishery.

salmon was the predominant target species throughout the survey period. It was targeted by 57% of anglers in September, when steelhead trout and other trout species were targeted by a significant proportion of anglers (21% combined), and by over 90% of anglers during each of the other three months.

Angler interviews indicate that seventy-one percent of anglers interviewed used lures as their gear type, with the remainder using bait (18%), bait and lure combinations (8%), or flies (3%). Mean angler trip length over the study period was 4.2 hours. Average angler trip length was shortest in September (2.4 hours) and longest in October (4.6 hours).

Table 5. Estimated harvested marked fish by species and month in the 1998 Chehalis River sport fishery.

	Sept.	Oct.	Nov.	Dec.	Total
Chinook	0	0	0	0	0
Jack Chinook	0	16	0	0	16
Coho	0	1,695	1,041	353	3,089
Chum	0	0	0	0	0
Pink	0	0	0	0	0
Sockeye	0	0	0	0	0
Steelhead	0	152	0	0	152
Trout	0	8	7	17	32

NICOMEN SLOUGH - NORRISH CREEK

The 1998 Nicomen Slough and Norrish Creek sport fishery survey was conducted between September 1 and December 14, 1998. Catches during the 3-month study included coho, chum and chinook salmon, as well as sturgeon and several trout species. Survey effort, total angler effort, CPUE, HPUE and RPUE estimates by species, along with total catch and release estimates by species, are detailed below.

Survey Effort

The study period included 72 weekdays and 33 weekend days; 51% of weekdays and 79% of weekend days were sampled.

Three instantaneous effort counts were conducted during September, while 6 were conducted in October, 4 in November and 5 in December. Instantaneous effort counts ranged from 0 to 39 on weekdays and from 4 to 55 on weekends (Appendix 2c). The peak rod count for the study area occurred on November 1.

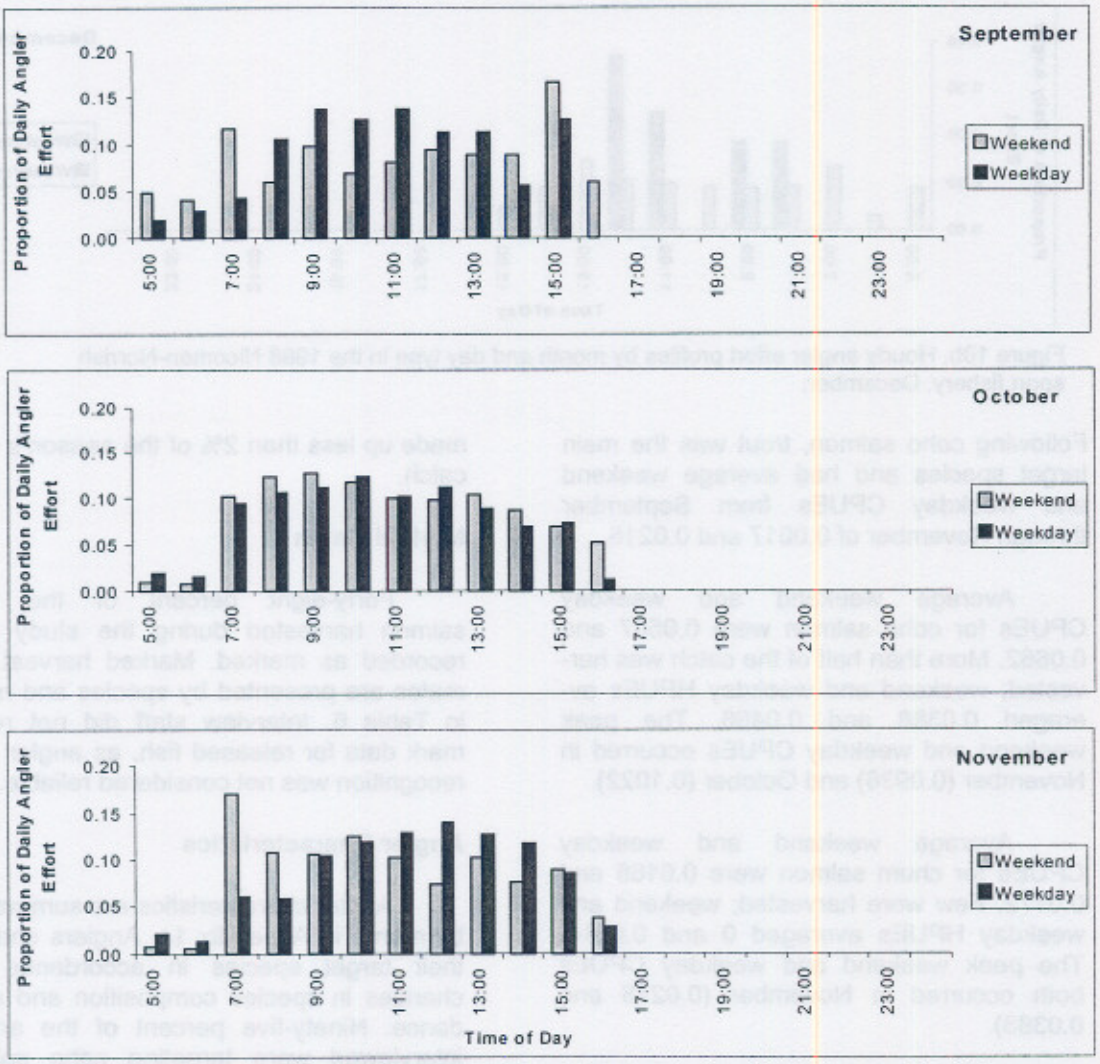

Figure 10a. Hourly angler effort profiles by month and day type in the 1998 Nicomen-Norrish sport fishery, September through November.

Angler Effort

Daily Profile

Anglers generally fished between 0500 and 1600 hours; the timing of effort peaks changed between months (Figure 10).

Total Angler Effort

Total estimated angler effort for September 1 to December 14 was 14,748 hours or 3,208 angler days. Angling effort increased from September (1,380 hours) to October (8,097 hours) and then decreased again through November (5,019 hours) and December (252 hours). Sixty percent of the angling effort took place on weekdays. Angler effort totals by month are presented in Appendix 4c.

Catch per Unit Effort

CPUEs for coho and chum salmon are presented in Figure 11 and, along with HPUEs and RPUEs, in Appendix 5c. Peak and average CPUEs are described below by month and day type. The proportion of harvested fish to total catch is also described.

CPUEs, HPUEs and RPUEs for all other species caught in the study area during the survey are detailed in Appendix 5c.

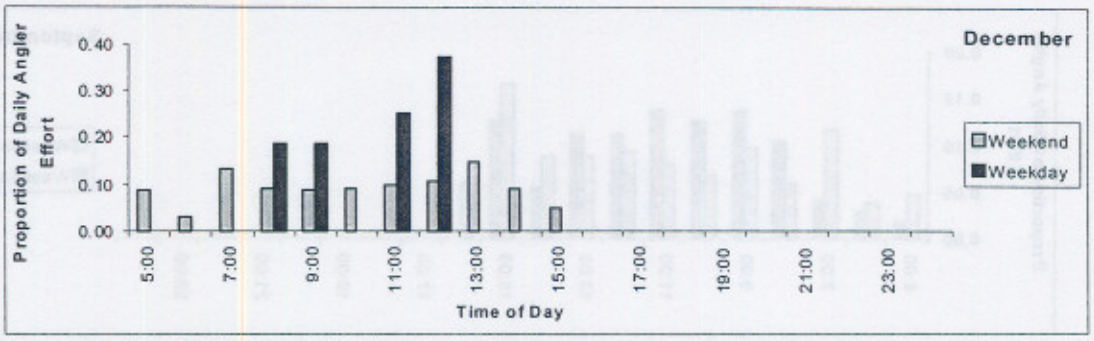

Figure 10b. Hourly angler effort profiles by month and day type in the 1998 Nicomen-Norrish sport fishery, December.

Following coho salmon, trout was the main target species and had average weekend and weekday CPUEs from September through November of 0.0017 and 0.0215.

Average weekend and weekday CPUEs for coho salmon were 0.0507 and 0.0662. More than half of the catch was harvested; weekend and weekday HPUEs averaged 0.0388 and 0.0466. The peak weekend and weekday CPUEs occurred in November (0.0936) and October (0.1022).

Average weekend and weekday CPUEs for chum salmon were 0.0166 and 0.0172. Few were harvested; weekend and weekday HPUEs averaged 0 and 0.0014. The peak weekend and weekday CPUEs both occurred in November (0.0278 and 0.0383).

Total Catch

Catches of 1,184 coho, 378 chum and 28 chinook salmon, representing 88% of the total sport catch, were estimated for the Nicomen-Norrish study area for September 1 through December 14. Monthly harvest and release totals for all species are detailed in Appendix 4c.

Coho salmon were caught throughout the study period, while chum salmon were caught from September through November. Catches of both species peaked during October, when 69% of the coho and 58% of the chum salmon were caught. In total, 79% of coho and 4% of chum salmon caught were harvested. Chinook salmon were caught only during October and November, and made up less than 2% of the season's sport catch.

Marked Catch

Forty-eight percent of the coho salmon harvested during the study were recorded as marked. Marked harvest estimates are presented by species and month in Table 6. Interview staff did not record mark data for released fish, as angler mark recognition was not considered reliable.

Angler Characteristics

Angler characteristics are summarized by month in Appendix 1c. Anglers changed their target species in accordance with changes in species composition and abundance. Ninety-five percent of the anglers interviewed were targeting coho salmon. Two percent were not targeting any particular species, while 1% targeted each of sturgeon and trout. Coho salmon was the predominant target species throughout the survey period. It was targeted by 70% of anglers in September, when trout and sturgeon were targeted by a significant proportion of anglers (18% combined), by over 90% of anglers during October and November and by all anglers in December.

Sixty-three percent of anglers interviewed used lures as their gear type, with the remainder using bait (31%), bait and lure combinations (4%) or flies (2%). Mean angler trip length over the study period was 4.6 hours. Average angler trip length was shortest in December (2.3 hours) and longest in November (6.9 hours).

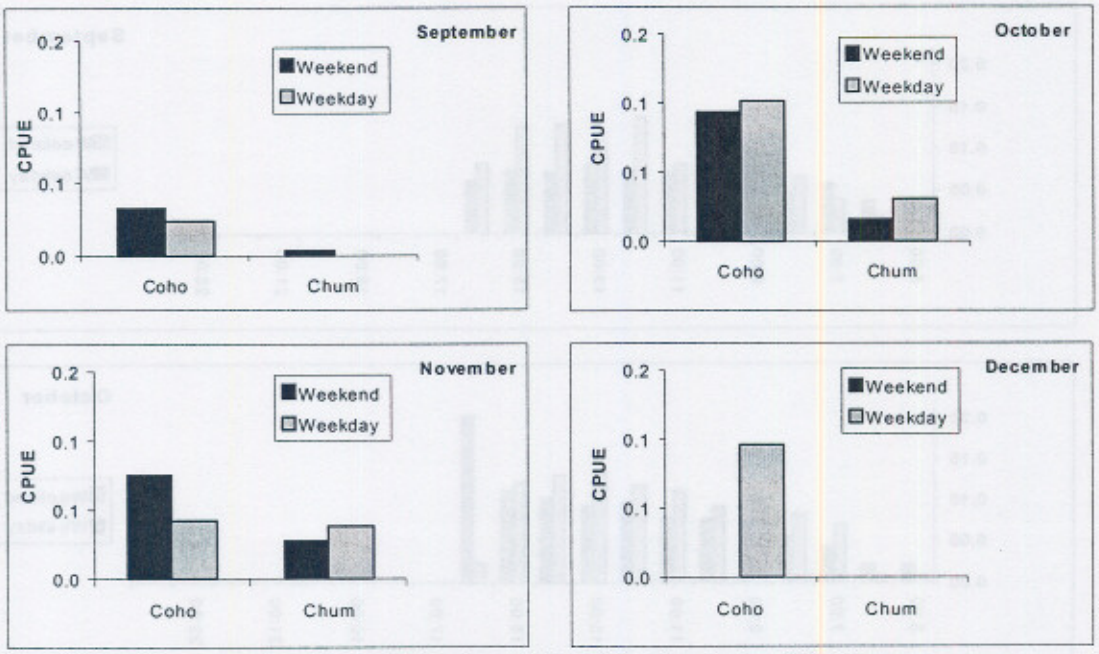

Figure 11. Coho and chum salmon CPUEs by month and day type in the 1998 Nicomen-Norrish sport fishery.

Table 6. Estimated harvested marked fish by species and month in the 1998 Nicomen-Norrish sport fishery.

	Sept.	Oct.	Nov.	Dec.	Total
Chinook	0	0	0	0	0
Jack Chinook	0	0	0	0	0
Coho	6	356	87	2	451
Chum	0	0	0	0	0
Pink	0	0	0	0	0
Sockeye	0	0	0	0	0
Steelhead	0	0	0	0	0
Trout	0	2	0	0	2

STAVE RIVER

The 1998 lower Stave River sport fishery survey was conducted between September 1 and December 14, 1998. Catches during the 3-month study included coho, chum, sockeye and chinook salmon, as well as several trout species. Survey effort, total angler effort, CPUE, HPUE and RPUE estimates by species, along with total catch and release estimates by species, are detailed below.

Survey Effort

The study period included 72 weekdays and 33 weekend days; 64% of weekdays and 82% of weekend days were sampled.

Two instantaneous effort counts were conducted during September, while 5 were conducted in each of October and December and 7 took place in November. Instantaneous effort counts ranged from 1 to 80 on weekdays and from 0 to 87 on weekends (Appendix 2d). The peak rod count for the study area (87 rods) occurred on October 24.

Angler Effort

Daily Profile

Anglers generally fished between 0500 and 1600 hours, with peaks in effort occurring between 1200 and 1500 hours (Figure 12).

Total Angler Effort

Total estimated angler effort for September 1 to December 14 was 31,876 hours or 10,446 angler days. Angling effort increased from September (6,619 hours) to October (17,819 hours) and then decreased again through November (6,474 hours) and

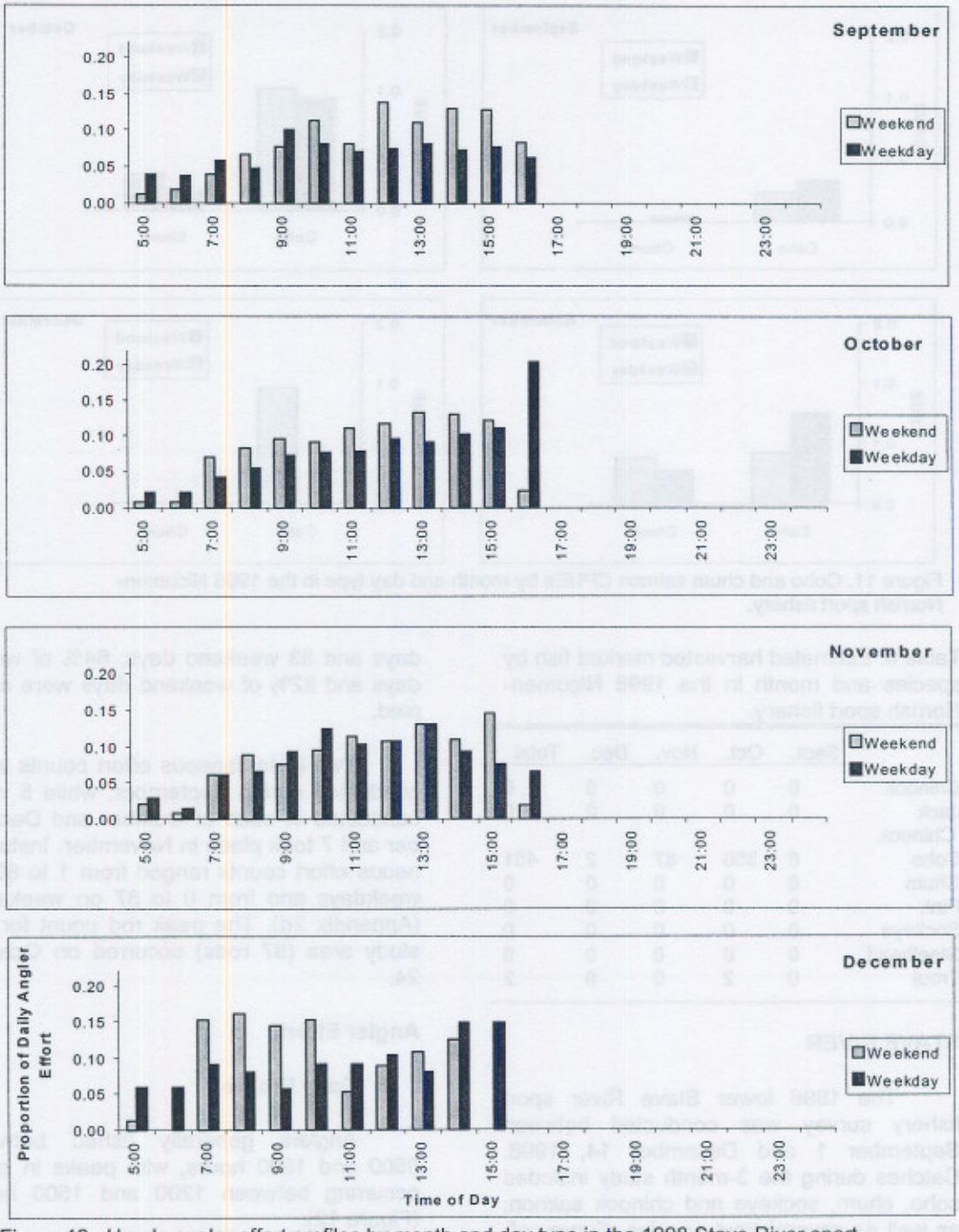

Figure 12. Hourly angler effort profiles by month and day type in the 1998 Stave River sport fishery.

December (964 hours). Sixty percent of the angling effort took place on weekdays. Angler effort totals by month are presented in Appendix 4d.

Catch per Unit Effort

CPUEs for coho and chum salmon are presented in Figure 13 and, along with HPUEs and RPUEs, in Appendix 5d. Peak and average CPUEs are described below by

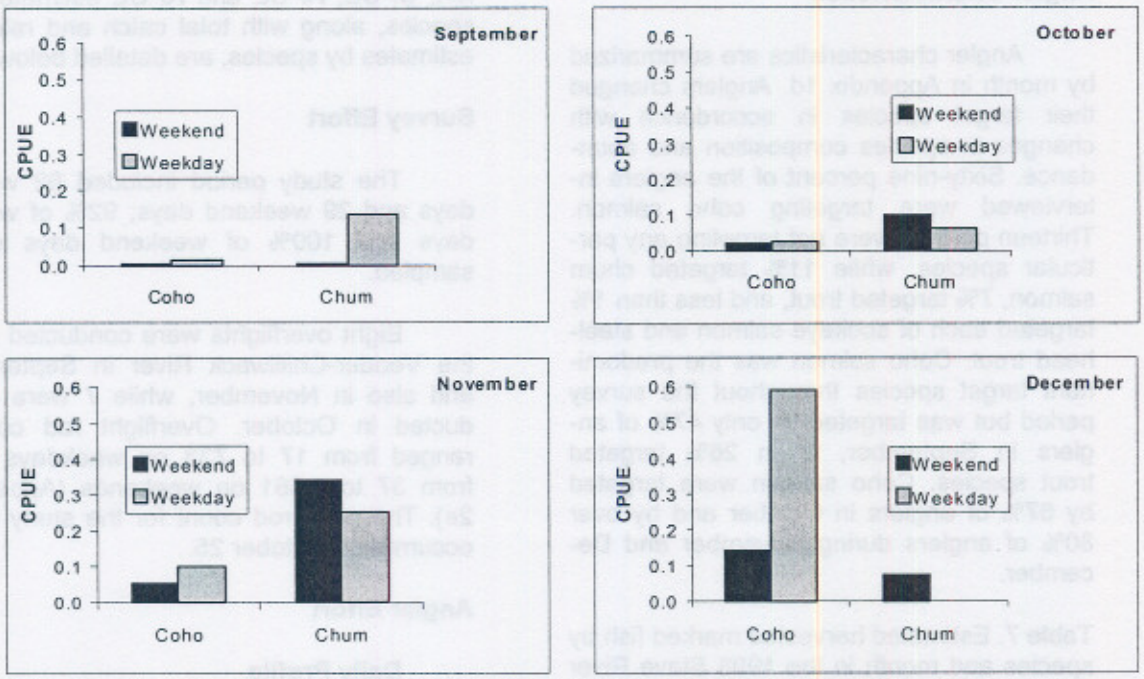

Figure 13. Coho and chum salmon CPUEs by month and day type in the 1998 Stave River sport fishery.

month and day type. The proportion of harvested fish to total catch is also described.

CPUEs, HPUEs and RPUEs for all other species caught in the study area during the survey are detailed in Appendix 5d. Following coho and chum salmon, trout was the main target and had average weekend and weekday CPUEs from September through November of 0.0203 and 0.0246.

Average weekend and weekday CPUEs for coho salmon were 0.0563 and 0.1826. Weekend and weekday HPUEs averaged 0.0090 and 0.0454. The peak weekend and weekday CPUEs both occurred in December (0.1449 and 0.5914).

Average weekend and weekday CPUEs for chum salmon were 0.1309 and 0.1123. Weekend and weekday HPUEs averaged 0.0194 and 0.0237. The peak weekend and weekday CPUEs both occurred in November (0.3441 and 0.2528).

Total Catch

Catches of 1,169 coho, 3,797 chum, 64 sockeye and 17 chinook salmon, representing 91% of the total sport catch, were estimated for the Stave River study area for September 1 through December 14. Monthly harvest and release totals for all species are detailed in Appendix 4d.

Coho and chum salmon were caught throughout the study period. Catches of both species peaked during November, when 42% of the coho and 52% of the chum salmon were caught. In total, 27% percent of coho and 26% of chum salmon caught were harvested. Sockeye salmon were caught only during October and made up only 1% of the season's sport catch. Chinook salmon were caught only during September and made up less than 1% of the season's sport catch.

Marked Catch

Forty-five percent of the coho salmon harvested during the study were recorded as marked. Marked harvest estimates are presented by species and month in Table 7. Interview staff did not record mark data for released fish, as angler mark recognition was not considered reliable.

Angler Characteristics

Angler characteristics are summarized by month in Appendix 1d. Anglers changed their target species in accordance with changes in species composition and abundance. Sixty-nine percent of the anglers interviewed were targeting coho salmon. Thirteen percent were not targeting any particular species, while 11% targeted chum salmon, 7% targeted trout, and less than 1% targeted each of sockeye salmon and steelhead trout. Coho salmon was the predominant target species throughout the survey period but was targeted by only 47% of anglers in September, when 26% targeted trout species. Coho salmon were targeted by 67% of anglers in October and by over 80% of anglers during November and December.

Table 7. Estimated harvested marked fish by species and month in the 1998 Stave River sport fishery.

	Sept.	Oct.	Nov.	Dec.	Total
Chinook	0	0	0	0	0
Jack Chinook	0	0	0	0	0
Coho	0	87	48	9	144
Chum	0	2	2	0	4
Pink	0	0	0	0	0
Sockeye	0	0	0	0	0
Steelhead	0	0	0	0	0
Trout	0	0	0	0	0

Sixty-two percent of anglers interviewed used lures as their gear type, with the remainder using bait (19%), flies (15%), or bait and lure combinations (4%). Mean angler trip length over the study period was 3.1 hours. Average angler trip length was shortest in September (2.6 hours) and longest in October (3.4 hours).

VEDDER-CHILLIWACK RIVER

The 1998 Vedder-Chilliwack River sport fishery survey was conducted between September 1 and November 30, 1998. Catches during the 3-month study included coho, chum, sockeye, chinook and pink salmon, as well as sturgeon and several trout species. Survey effort, total angler effort, CPUE, HPUE and RPUE estimates by species, along with total catch and release estimates by species, are detailed below.

Survey Effort

The study period included 62 weekdays and 29 weekend days; 92% of weekdays and 100% of weekend days were sampled.

Eight overflights were conducted over the Vedder-Chilliwack River in September and also in November, while 7 were conducted in October. Overflight rod counts ranged from 17 to 733 on weekdays and from 37 to 1,361 on weekends (Appendix 2e). The peak rod count for the study area occurred on October 25.

Angler Effort

Daily Profile

Anglers generally fished between 0500 and 1700 hours, with peaks in effort occurring between 0700 and 1200 hours (Figure 14).

Total Angler Effort

Total estimated angler effort for September through November was 291,027 hours or 51,303 angler days. Angling effort increased from September (23,626 hours) to October (207,962 hours) and then decreased again in November (59,439 hours). Sixty-one percent of the angling effort took place on weekdays. Angler effort totals by month are presented in Appendix 4e.

Catch per Unit Effort

CPUEs for coho, chum, sockeye and chinook salmon are presented in Figure 15 and, along with HPUEs and RPUEs, in Appendix 5e. Peak and average CPUEs are described below by month and day type. The proportion of harvested fish to total catch is also described.

CPUEs, HPUEs and RPUEs for all other species caught in the study area during the survey are detailed in Appendix 5e.

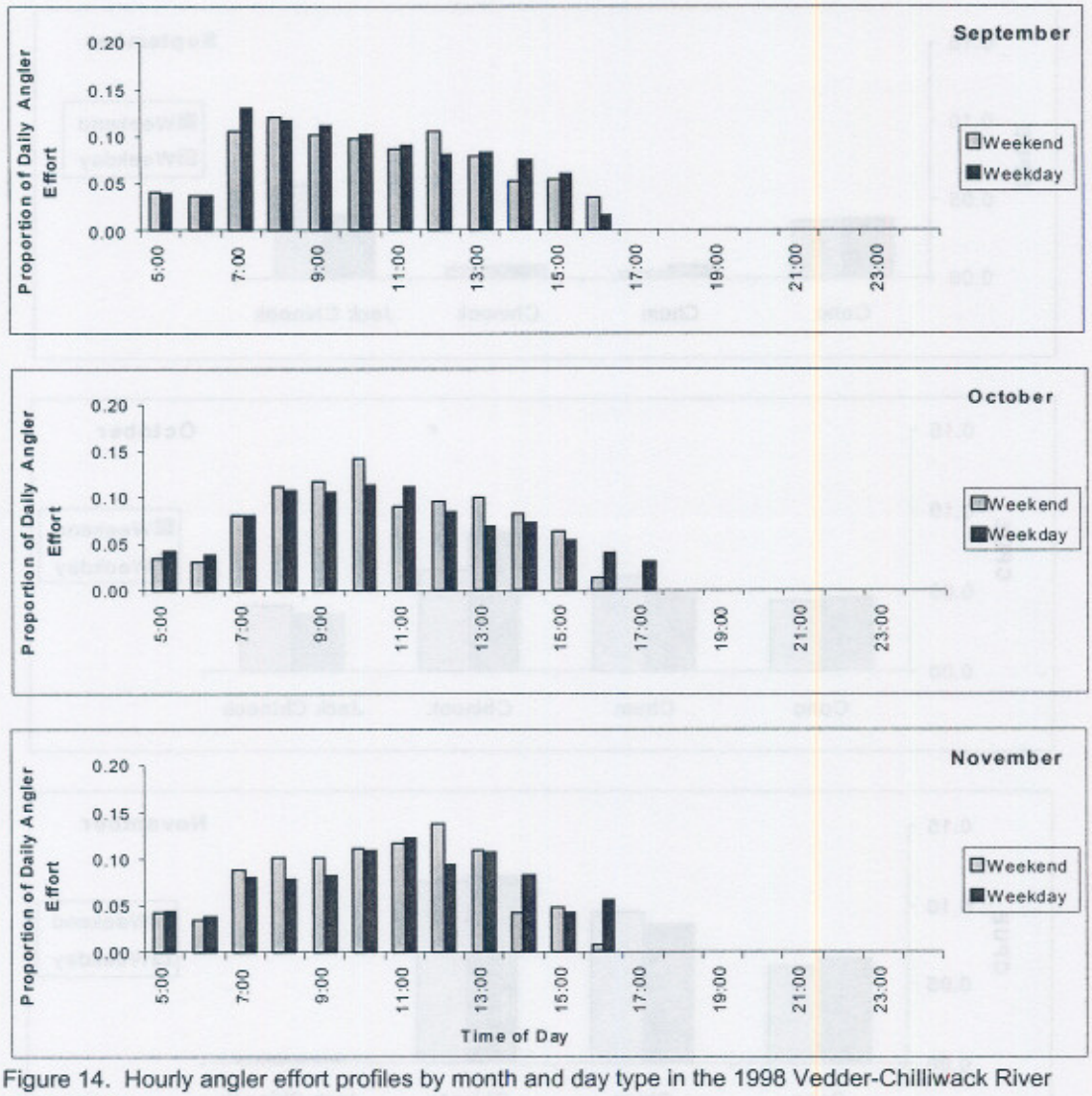

Figure 14. Hourly angler effort profiles by month and day type in the 1998 Vedder-Chilliwack River sport fishery.

Average weekend and weekday CPUEs for coho salmon were 0.0497 and 0.0466. Less than one half of the catch was harvested; weekend and weekday HPUEs averaged 0.0190 and 0.0193. The peak weekend and weekday CPUEs both occurred in November (0.0657 and 0.0604).

Average weekend and weekday CPUEs for chum salmon were 0.0478 and 0.0527. Approximately one quarter of the catch was harvested; weekend and weekday HPUEs averaged 0.0125 and 0.0110. The peak weekend and weekday CPUEs both occurred in November (0.0874 and 0.0952).

Average weekend and weekday CPUEs for adult chinook salmon were 0.0710 and 0.0614. Approximately one third of the catch was harvested; weekend and weekday HPUEs averaged 0.0213 and 0.0196. The peak weekend and weekday CPUEs both occurred in November (0.1173 and 0.1143).

Average weekend and weekday CPUEs for jack chinook salmon were 0.0266 and 0.0341. Approximately one half of the catch was harvested; weekend and weekday HPUEs averaged 0.0135 and 0.0138. The peak weekend and weekday CPUEs both occurred in September (0.0405 and 0.0583).

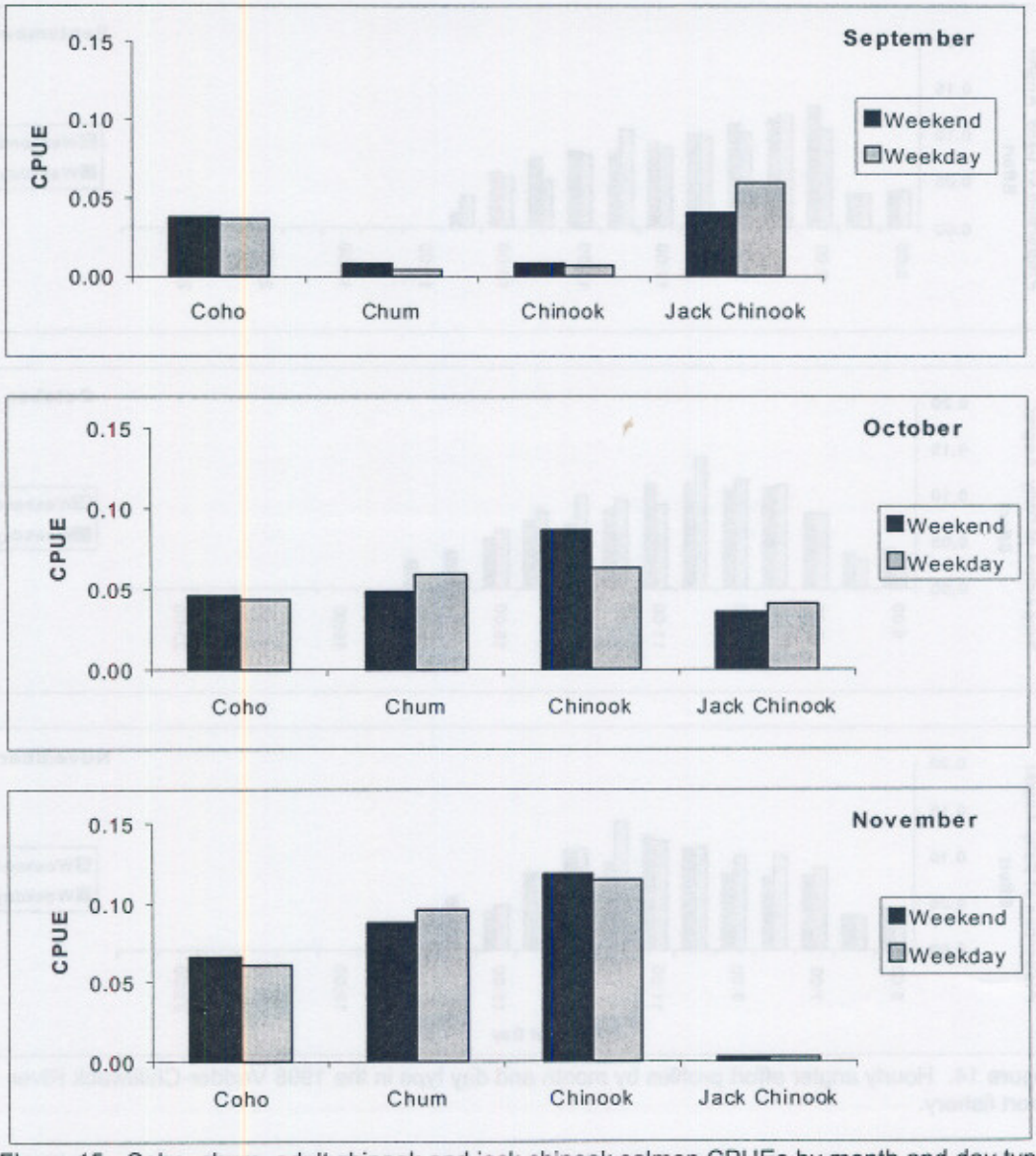

Figure 15. Coho, chum, adult chinook and jack chinook salmon CPUEs by month and day type in the 1998 Vedder-Chilliwack River sport fishery.

Total Catch

Catches of 13,962 coho, 17,171 chum, 183 sockeye, 21,936 adult chinook, 9,558 jack chinook salmon, representing 99% of the total sport catch, were estimated for the Vedder-Chilliwack River study area for September through November. Monthly harvest and release totals for all species are detailed in Appendix 4e.

Coho, chum, sockeye and adult and jack chinook salmon were caught throughout the study period. Catches of all these species peaked in October, when 67% of coho, 68% of chum, 75% of sockeye, 68% of adult chinook and 86% of jack chinook salmon catches occurred. In total, 44% of coho, 25% of chum, 37% of adult chinook and 47% of jack chinook salmon caught were harvested. No sockeye were harvested.

Marked Catch

Ninety-seven percent of the coho salmon harvested during the study were recorded as marked. Marked harvest estimates are presented by species and month in Table 8. Interview staff did not record mark data for released fish, as angler mark recognition was not considered reliable.

Table 8. Estimated harvested marked fish by species and month in the 1998 Vedder-Chilliwack River sport fishery.

	Sept.	Oct.	Nov.	Total
Chinook	7	2,234	634	2,875
Jack Chinook	0	86	0	86
Coho	267	4,425	1,300	5,992
Chum	0	28	18	46
Pink	0	0	0	0
Sockeye	0	0	0	0
Steelhead	0	0	3	3
Trout	14	0	0	14

Angler Characteristics

Angler characteristics are summarized by month in Appendix 1e. On average, anglers were quite evenly distributed throughout the Vedder-Chilliwack study area. Over the entire course of the survey, 29% of anglers counted during overflights were in Section 1, with 36% in Section 2 and 35% in Section 3. The distribution of anglers among the three sections did, however, vary between months; Section 2 had the highest overflight rod counts in September and October, but the lowest in November (Figure 16).

Anglers changed their target species in accordance with changes in species composition and abundance. Eighty-eight percent of the anglers interviewed were targeting coho salmon. Seven percent targeted 'other' species, which probably included dolly varden and kokanee and 4% were not targeting any particular species. Less than 1% targeted each of chinook, chum and sockeye salmon, trout and sturgeon. Coho salmon were targeted by over 86% of anglers in each of the three months surveyed.

Fifty-two percent of anglers interviewed used lures as their gear type, with the remainder using bait and lure combinations (39%), bait (8%), or flies (1%). Mean angler trip length over the study period was 5.7 hours. Average angler trip length was shortest in September (4.3 hours) and longest in October (6.0 hours).

DISCUSSION

HARRISON RIVER

The combined access point and overflight survey design used in this study incorporated the main advantages of both access point surveys (i.e., high proportion of complete trip interviews) and overflight surveys (i.e., able to effectively survey a large area). It avoided the problems of biased catch rate estimates that are sometimes associated with roving surveys (Robson and Jones, 1989).

A major assumption underlying the access point and overflight survey methodology is that either the interview sites are representative of the entire study area, or the proportion of effort occurring at the interview sites is sufficient to make CPUE estimates insensitive to effort occurring at non-survey sites. This assumption is not believed to have been violated in the Harrison River study because a large proportion of anglers enter and exit the river at the two survey sites.

CHEHALIS RIVER

A few anglers accessed the Chehalis River by the Canfor logging road and the Elbow Lake Prison Road. These anglers were not interviewed, but their contribution to the total effort on the system is believed to be negligible.

STAVE RIVER

To make the most efficient use of limited survey funds, the Nicomen-Norrish and Stave River study areas were initially grouped into a single study area; sampling schedules were determined for the area as a whole. After the survey was completed, it was decided that the data from the two areas should be analyzed separately. As a

result of the survey shift scheduling method, however, only one September weekend instantaneous effort count was conducted on the Stave River. Unfortunately, no anglers were visible during the single count, which resulted in the September weekend effort being calculated as zero. Because 142 angler interviews were conducted during September weekend shifts, we knew this wasn't a true estimation of the effort, but was rather the result of the single effort count being unrepresentative. The problem was solved by replacing the 1998 value with the average angler count from instantaneous effort counts conducted during 1999 September weekend shifts. Stave River angler effort profiles were similar in 1998 and 1999, so it is reasonable to substitute the 1999 value which, because it is derived from several counts, is more representative of the actual effort on the system.

As mentioned in the study area description, over 95% of anglers fished from shore in the 1 km stretch of river immediately downstream of the dam, but a very small number of anglers fished from boats near the mouth of the river. It should be noted that these boat anglers were not interviewed, as they did not access the river from the area where the interviewer was stationed, but they were included in instantaneous effort counts. Their contribution to the overall effort was believed to be negligible.

VEDDER-CHILLIWACK RIVER

The Vedder-Chilliwack River fishery was the most popular of those assessed, receiving more than double the angling effort of the other three fisheries combined. Angling effort on the Vedder-Chilliwack had also increased substantially from previous years when the fishery was assessed. Although previous surveys of the Vedder-Chilliwack included August or December, discussion will include September - November only, to allow comparison with 1998 estimates.

Angling effort on the Vedder-Chilliwack River increased dramatically between 1985 (58,728 hours) and 1986 (115,131 hours) in response to a tripling in coho salmon abundance resulting from increased hatchery production (Whyte and Schubert, 1990). Angler effort changed little between 1986 and 1988 (107,492 hours), because hatchery production and, therefore, coho salmon abundance had stabilized. The 1998 total angler effort estimate of 291,027 hours represents a 170% increase in effort from 1988. The increase in effort can be attributed in part to the closure of fisheries in Georgia Strait and on the Fraser River mainstem, which resulted in decreased fishing opportunities in both of these areas. Georgia Strait fisheries were closed because of coho salmon conservation concerns. There were several closures of chinook and sockeye salmon fisheries on the Fraser River mainstem between August and November, and coho salmon retention was banned on the mainstem Fraser for the entire season. In addition, angling on the Vedder-Chilliwack River does not require a boat and so may be easier and less expensive, compared with mainstem Fraser and ocean angling. It is also reasonable to assume that the Lower Mainland's population growth has contributed to increased angler pressure on the system.

Total catch estimates from previous years cannot be compared directly to the 1998 estimates, because the previous studies estimated total harvest and release for the study area upstream of the Highway 1 bridge only (Hickey et al., 1987; Whyte et al., 1987; Whyte and Schubert, 1990), while 1998 estimates are for the entire study area. CPUE estimates, however, can be used for interannual fishery comparisons.

Coho salmon CPUE estimates for 1998 were down from 1988. In 1988, weekend and weekday CPUEs averaged 0.1871 and 0.2225; in 1998 they were estimated at 0.0497 and 0.0466. The proportion of the coho salmon catch that was harvested also decreased dramatically from 1988 to 1998 as a result of increasingly stringent harvest regulations. In 1988 weekend and weekday HPUEs were estimated at 0.1391 and 0.1582; in 1998, they were 0.0190 and 0.0193. Coho salmon harvests were limited to 4 fish per day during both the 1988 and 1998 seasons, but in 1998 it was illegal to harvest wild fish; only marked hatchery coho salmon could be kept.

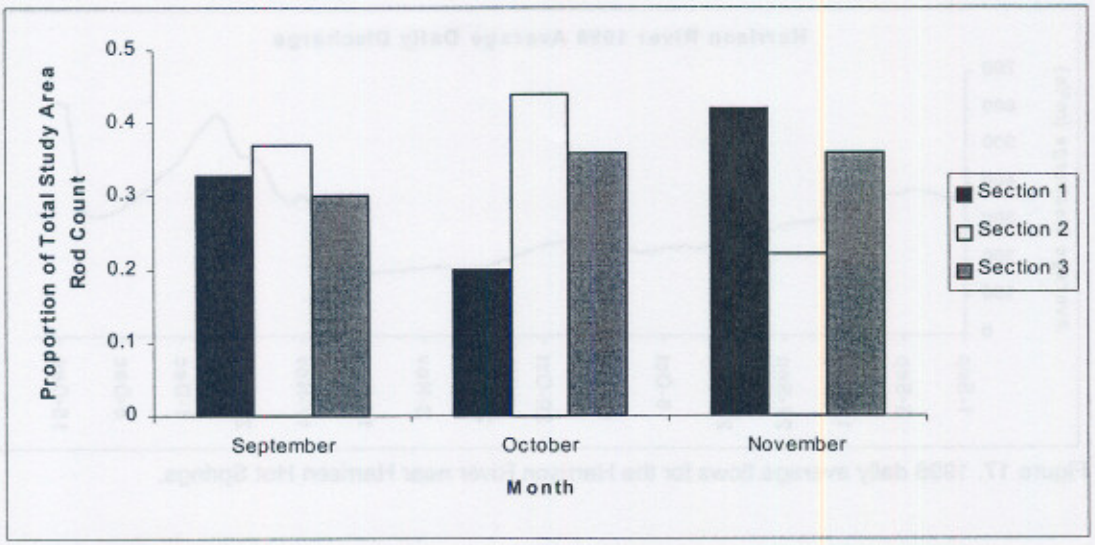

Figure 16. Monthly proportion of anglers observed in each survey section in the 1998 Vedder-Chilliwack River sport fishery.

Chum salmon CPUEs decreased from 1988 (0.0828 weekends, 0.1335 weekdays) to 1998 (0.0478 weekends, 0.0527 weekdays). There was, however, an increase in the proportion of the chum salmon catch that was harvested, probably because fewer coho salmon were being retained. In 1988 weekend and weekday chum salmon HPUEs were 0 and 0.0002; in 1998 the HPUEs increased to 0.0125 and 0.0110.

Chinook salmon CPUEs and HPUEs increased dramatically from 1988 to 1998. In 1988, weekend and weekday chinook salmon CPUEs averaged 0.0073 and 0.0119; in 1998 they were estimated at 0.0976 and 0.0955. In 1988 weekend and weekday HPUEs were estimated at 0.0025 and 0.0061; in 1998, they were 0.0348 and 0.0334. The increase in catch rate can be attributed to chinook salmon returning to the river in greater numbers, as stricter regulations and increased enhancement efforts are allowing the stock to recover.

Angler distribution among the three survey sections varied between months and reflected the distribution of fish in the river (Figure 16). During September and October, Section 2 had the highest proportion of anglers, according to overflight rod counts; Section 1 hosted the most anglers during November. Sections 2 and 3 might have been expected to receive an increasing proportion of the effort as the season progressed, but there were some late coho salmon runs entering the river during November and a dry autumn had resulted in many fish pooling in the lower reaches of the river, awaiting higher water levels.

ENVIRONMENTAL CONDITIONS

Interannual variation in environmental conditions can influence the timing and effectiveness of a fishery. Schubert and Whyte (1992) have shown that river level can affect both angler effort and success. High river levels may flood fishing sites, making them inaccessible to anglers. Also, the proportion of a run that is vulnerable to a fishery is affected by river discharge, since river discharge affects migration timing.

For this report we will not attempt to draw conclusions about the effects of environmental conditions on the fisheries investigated, but flow rates for Norrish Creek and the Harrison, Chehalis, upper Stave, Chilliwack and Fraser rivers are presented in Figures 17 - 22, to allow for comparison with future studies. Flow data are not available for the lower Stave River. 1998 Chilliwack River and Chehalis River flow data are not available because the flow stations were vandalized in-season, so Figures 18 and 21 present the average of daily flow rates from 1990 to 1996.

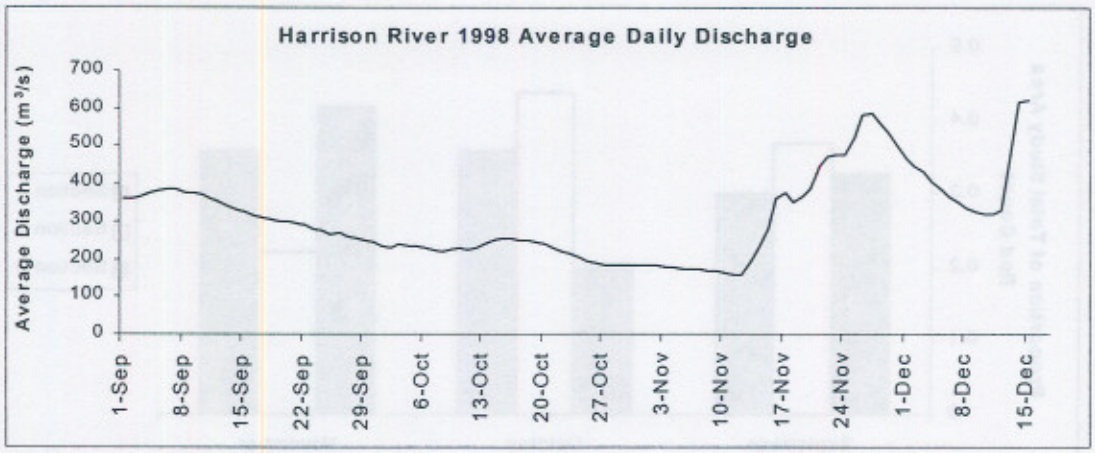

Figure 17. 1998 daily average flows for the Harrison River near Harrison Hot Springs.

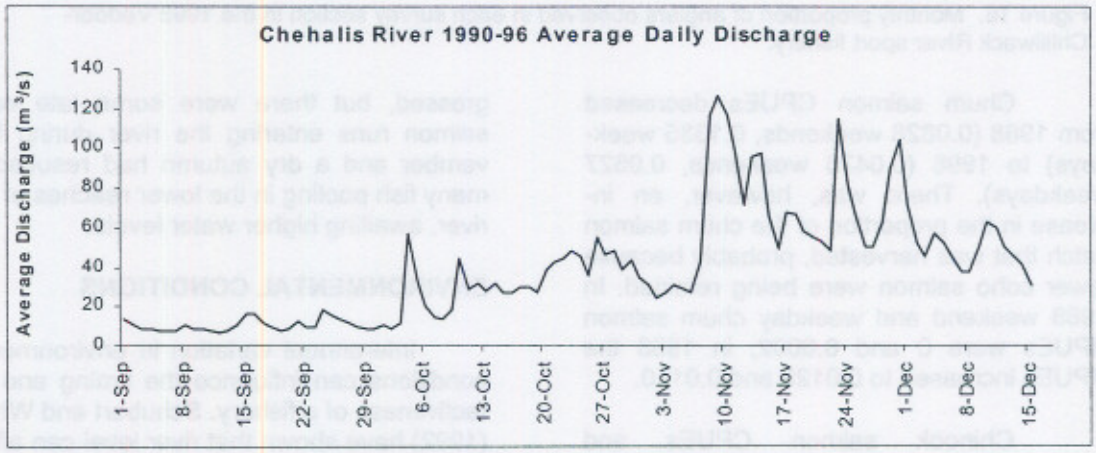

Figure 18. 1990-96 daily average flows for the Chehalis River near Harrison Mills.

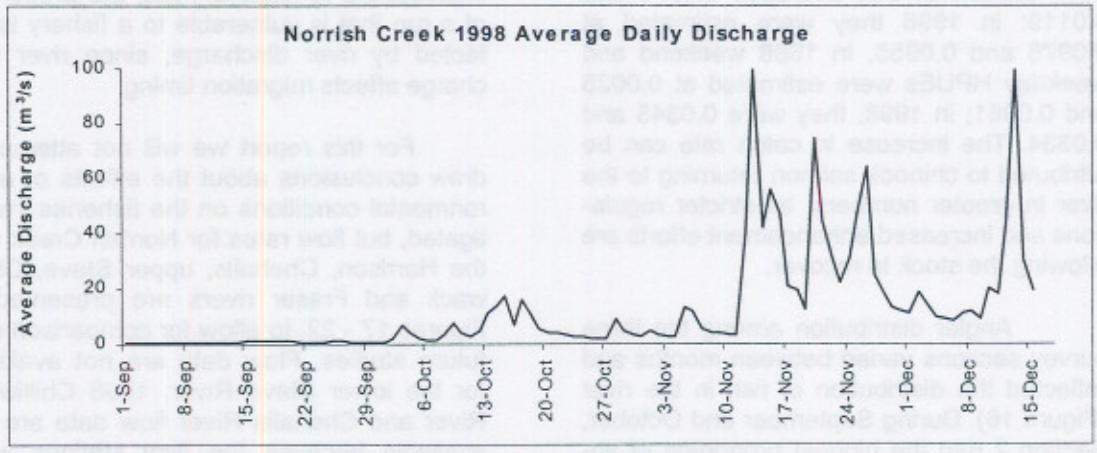

Figure 19. 1998 daily average flows for Norrish Creek near Dewdney.

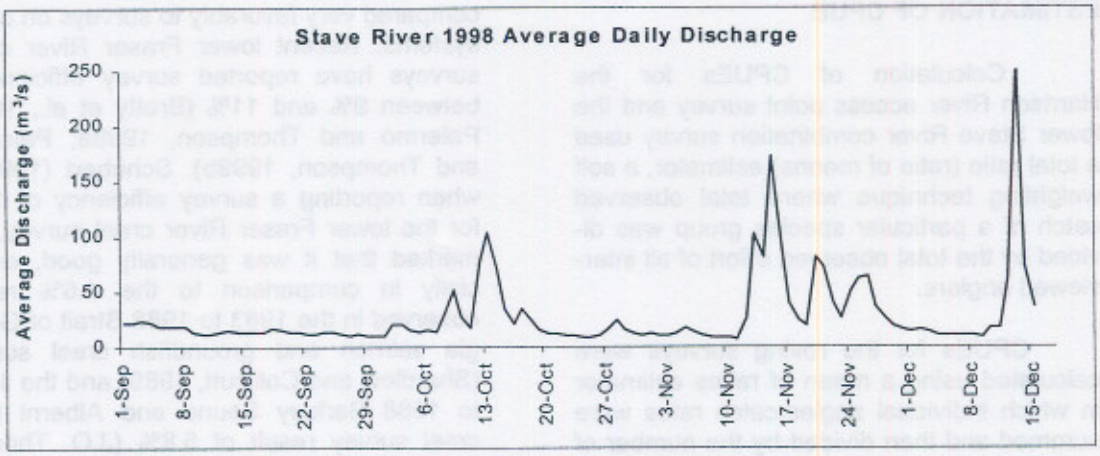

Figure 20. 1998 daily average flows for the Stave River above Stave Lake.

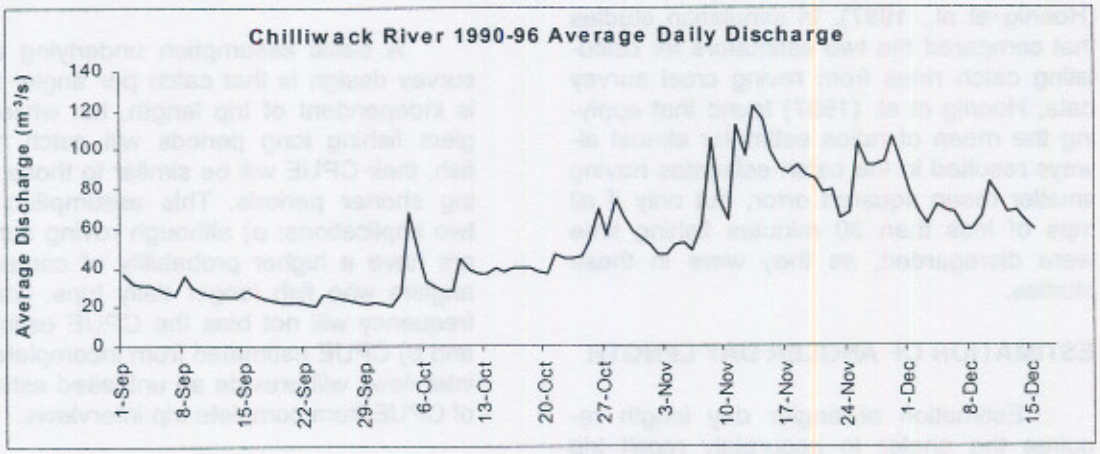

Figure 21. 1990-96 daily average flows for the Chilliwack River at Vedder Crossing.

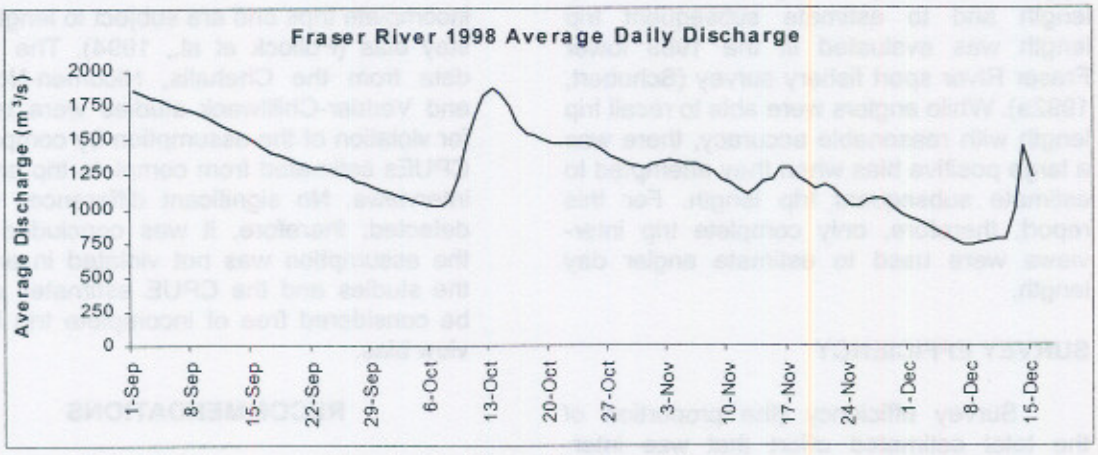

Figure 22. 1998 daily average flows for the Fraser River near Hope.

ESTIMATION OF CPUE

Calculation of CPUEs for the Harrison River access point survey and the lower Stave River combination survey used a total ratio (ratio of means) estimator, a self weighting technique where total observed catch of a particular species group was divided by the total observed effort of all interviewed anglers.

CPUEs for the roving surveys were calculated using a mean of ratios estimator in which individual angler catch rates were summed and then divided by the number of anglers interviewed. There has been much debate about which of the two estimators is best suited to analyzing roving creel data (Hoenig et al., 1997). In simulation studies that compared the two estimators for calculating catch rates from roving creel survey data, Hoenig et al. (1997) found that applying the mean of ratios estimator almost always resulted in the catch estimates having smaller mean squared error, but only if all trips of less than 30 minutes fishing time were disregarded, as they were in these studies.

ESTIMATION OF ANGLER DAY LENGTH

Estimation of angler day length requires the angler to accurately recall trip length to the time of the interview and, if still fishing, to accurately predict subsequent trip length. The ability of anglers to recall trip length and to estimate subsequent trip length was evaluated in the 1989 lower Fraser River sport fishery survey (Schubert, 1992a). While anglers were able to recall trip length with reasonable accuracy, there was a large positive bias when they attempted to estimate subsequent trip length. For this report, therefore, only complete trip interviews were used to estimate angler day length.

SURVEY EFFICIENCY

Survey efficiency (the proportion of the total estimated effort that was interviewed) averaged 26% for the Harrison River, 31% for the Chehalis River, 42% for the Nicomen-Norrish, 20% for the Stave River and 10% for the Vedder-Chilliwack River survey. These survey efficiencies compared very favorably to surveys on other systems. Recent lower Fraser River creel surveys have reported survey efficiencies between 9% and 11% (Bratty et al., 1998; Palermo and Thompson, 1999a; Palermo and Thompson, 1999b). Schubert (1992b), when reporting a survey efficiency of 11% for the lower Fraser River creel survey, remarked that it was generally good, especially in comparison to the 4.6% result observed in the 1983 to 1988 Strait of Georgia salmon and groundfish creel survey (Shardlow and Collicutt, 1989) and the 1984 to 1988 Barkley Sound and Alberni Inlet creel survey result of 5.8% (J.O. Thomas and Associates, MS 1988).

INCOMPLETE TRIP INTERVIEW BIAS

A basic assumption underlying creel survey design is that catch per angler hour is independent of trip length, i.e. while anglers fishing long periods will catch more fish, their CPUE will be similar to those fishing shorter periods. This assumption has two implications: a) although roving surveyors have a higher probability of contacting anglers who fish longer daily trips, contact frequency will not bias the CPUE estimate; and b) CPUE estimated from incomplete trip interviews will provide an unbiased estimate of CPUE from complete trip interviews.

This assumption is an important one in any study that has a roving survey component because most interviews are from incomplete trips and are subject to length-of-stay bias (Pollock et al., 1994). The 1998 data from the Chehalis, Nicomen-Norrish and Vedder-Chilliwack studies were tested for violation of the assumption by comparing CPUEs estimated from complete trip and all interviews. No significant differences were detected; therefore, it was concluded that the assumption was not violated in any of the studies and the CPUE estimates could be considered free of incomplete trip interview bias.

RECOMMENDATIONS

It is commonly believed that recreational fishing has substantially increased on the lower Fraser River and its tributaries, due in part to increased population levels in the Lower Mainland. This belief appears to

be supported by the large increase in angling effort on the Vedder-Chilliwack River over the last decade. The Vedder-Chilliwack River has become the most important sport fishery in the Lower Mainland now receives greater recreational angling effort than the lower Fraser River sport fishery. We recommend that the survey of lower Fraser River tributaries be broadened to provide more thorough and extended coverage. Specifically:

1. Extend coverage on the Vedder-Chilliwack to include July through mid-December in order to estimate sport catch of chinook and coho.

2. Provide additional staff to allow for better coverage of the Nicomen-Norrish and lower Stave River study areas.

Further recommendations regarding the general evaluation of recreational fisheries are discussed by Schubert (1995).

SUMMARY

1. Assessments of the autumn sport fisheries on the Harrison, Chehalis, lower Stave and Vedder-Chilliwack rivers, along with Nicomen Slough and Norrish Creek were conducted between September 1 and December 15, 1998. The fisheries were managed by daily and annual catch limits, fish size restrictions, and fishing time and location restrictions.

2. The Harrison River fishery was assessed by a combined access point and overflight survey, while the lower Stave River survey combined access point and roving interviews and instantaneous effort counts. The Chehalis River and the Nicomen Slough - Norrish Creek study area were assessed using roving and instantaneous effort count methods. The Vedder-Chilliwack River fishery was assessed by a combined roving and overflight survey.

3. During the study period, each fishery was assessed by one to three surveyors, depending on the size of the study area, expected angler effort and available resources. The surveyors recorded the following information during 19,808 angler interviews: trip length, preferred species, number and species of fish harvested and released, identifying marks on harvested fish and gear type.

4. Total angler effort in the four fisheries was estimated at 423,369 hours or 84,462 angler days. Angler fished for 44,288 hours (9,544 angler days) on the Harrison River, 41,430 hours (9,961 days) on the Chehalis River, 14,748 hours (3,208 days) in the Nicomen-Norrish study area, 31,876 hours (10,446 days) on the lower Stave River and 291,027 hours (51,303 days) on the Vedder-Chilliwack River. Coho salmon was targeted more than any other species, although anglers did vary their target species in accordance with changes in species composition and abundance.

5. Total harvests of coho and chum salmon were estimated at 11,075 and 6,329, while harvests of sockeye and chinook salmon were estimated at 1,733 and 12,852.

6. Total releases of coho and chum salmon were estimated at 13,992 and 37,796, while releases of sockeye and chinook salmon were estimated at 2,559 and 19,703.

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APPENDICES

Appendix 1a. Month-specific interview responses in the 1998 Harrison River sport fishery survey.

		September	October	November	Total
Number of Interviews		623	903	511	2,037
Mean Angler Day Length		3.4	6.2	5.9	4.6
Target Species (%)	None	3.7	4.5	0.2	3.2
	Chinook	3.4	0.1	0.0	1.1
	Jack Chinook	0.0	0.0	0.0	0.0
	Coho	5.3	63.6	71.8	47.8
	Chum	0.2	3.8	1.8	2.2
	Pink	0.0	0.0	0.0	0.0
	Sockeye	68.5	8.5	0.6	24.9
	Steelhead	0.5	1.6	1.2	1.1
	Trout	11.4	5.6	10.4	8.6
	Sturgeon	5.3	12.1	14.1	10.5
	Other	1.8	0.2	0.0	0.6
Gear (%)	Bait	13.2	12.8	19.2	14.5
	Lure	61.3	55.1	48.9	55.5
	Bait and Lure	10.6	9.4	6.1	8.9
	Fly	14.9	22.6	25.8	21.1

Appendix 1b. Month-specific interview responses in the 1998 Chehalis River sport fishery survey.

		September	October	November	December	Total
Number of Interviews		175	1,815	1,224	462	3,676
Mean Angler Day Length		2.4	4.6	4.0	3.9	4.2
Target Species (%)	None	20.6	3.7	1.0	0.4	3.2
	Chinook	0.0	0.1	0.0	0.0	0.0
	Jack Chinook	0.0	0.0	0.0	0.0	0.0
	Coho	56.6	93.9	99.0	97.2	94.2
	Chum	0.0	1.2	0.0	0.0	0.6
	Pink	0.0	0.0	0.0	0.0	0.0
	Sockeye	2.3	0.0	0.0	0.0	0.1
	Steelhead	8.0	0.7	0.0	1.9	1.0
	Trout	12.6	0.5	0.0	0.4	0.9
	Sturgeon	0.0	0.0	0.0	0.0	0.0
	Other	0.0	0.1	0.0	0.0	0.0
Gear (%)	Bait	11.4	27.6	11.4	0.7	18.1
	Lure	57.1	54.8	86.1	97.1	70.6
	Bait and Lure	14.9	13.4	1.7	0.0	7.9
	Fly	16.6	4.2	0.7	2.2	3.4

Appendix 1c. Month-specific interview responses in the 1998 Nicomen-Norrish sport fishery survey.

		September	October	November	December	Total
Number of Interviews		84	1,065	919	37	2,105
Mean Angler Day Length		3.6	4.1	6.9	2.3	4.6
Target Species (%)	None	11.9	3.0	0.1	0.0	2.0
	Chinook	0.0	0.0	0.0	0.0	0.0
	Jack Chinook	0.0	0.0	0.0	0.0	0.0
	Coho	70.2	94.5	97.9	100.0	95.1
	Chum	0.0	0.1	0.0	0.0	0.0
	Pink	0.0	0.0	0.0	0.0	0.0
	Sockeye	0.0	0.0	0.0	0.0	0.0
	Steelhead	0.0	0.0	0.0	0.0	0.0
	Trout	7.1	1.5	1.1	0.0	1.5
	Sturgeon	10.7	0.9	0.9	0.0	1.3
	Other	0.0	0.0	0.0	0.0	0.0
Gear (%)	Bait	40.5	35.0	25.6	13.5	30.7
	Lure	53.6	60.3	67.8	37.8	62.9
	Bait and Lure	4.8	2.0	5.3	16.2	3.8
	Fly	1.2	2.7	1.3	32.4	2.6

Appendix 1d. Month-specific interview responses in the 1998 Stave River sport fishery survey.

		September	October	November	December	Total
Number of Interviews		440	1,762	844	85	3,131
Mean Angler Day Length		2.6	3.4	2.7	3.1	3.1
Target Species (%)	None	24.8	15.0	4.3	0.0	13.1
	Chinook	0.2	0.0	0.0	0.0	0.0
	Jack Chinook	0.0	0.0	0.0	0.0	0.0
	Coho	46.8	66.9	81.5	89.4	68.6
	Chum	1.4	15.4	8.4	0.0	11.1
	Pink	0.0	0.0	0.0	0.0	0.0
	Sockeye	0.2	0.2	0.0	0.0	0.1
	Steelhead	0.5	0.1	0.0	0.0	0.1
	Trout	26.1	2.6	5.8	10.6	7.0
	Sturgeon	0.0	0.0	0.0	0.0	0.0
	Other	0.0	0.0	0.0	0.0	0.0
Gear (%)	Bait	36.6	18.8	9.2	27.1	18.9
	Lure	39.8	63.1	72.3	34.1	61.5
	Bait and Lure	8.2	4.5	2.5	1.2	4.4
	Fly	15.5	13.6	16.0	37.6	15.2

Appendix 1e. Month-specific interview responses in the 1998 Vedder-Chilliwack River sport fishery survey.

		September	October	November	Total
Number of Interviews		1,547	4,672	2,640	8,859
Mean Angler Day Length		4.3	6.0	5.3	5.7
Target Species (%)	None	6.4	3.1	3.1	3.7
	Chinook	1.0	0.4	1.4	0.8
	Jack Chinook	0.1	0.0	0.0	0.0
	Coho	88.1	86.6	89.9	87.9
	Chum	0.0	0.1	0.3	0.1
	Pink	0.0	0.0	0.0	0.0
	Sockeye	0.6	0.0	0.0	0.1
	Steelhead	0.0	0.0	0.0	0.0
	Trout	2.7	0.0	0.0	0.5
	Sturgeon	0.4	0.0	0.0	0.1
	Other	0.8	9.7	5.2	6.8
Gear (%)	Bait	18.4	7.0	3.7	8.0
	Lure	40.4	48.0	65.9	52.0
	Bait and Lure	38.8	44.5	29.8	39.1
	Fly	2.5	0.5	0.5	0.9

Appendix 2a. Overflight angler counts in the 1998 Harrison River sport fishery survey.

Month	Day	Day of Week	Count
September	3	Thursday	32
	8	Tuesday	43
	10	Thursday	21
	12	Saturday	50
	20	Sunday	77
	22	Tuesday	18
	26	Saturday	162
	29	Tuesday	65
		Mean	58.5
October	3	Saturday	59
	6	Tuesday	39
	10	Saturday	121
	15	Thursday	32
	23	Friday	84
	25	Sunday	110
	28	Wednesday	26
		Mean	67.3
November	1	Sunday	84
	5	Thursday	19
	8	Wednesday	66
	14	Saturday	2
	19	Thursday	14
	22	Sunday	2
	26	Thursday	0
	29	Sunday	26
		Mean	26.6

Appendix 2b. Instantaneous effort counts in the 1998 Chehalis River sport fishery survey.

Month	Day	Day of Week	Count
September	19	Saturday	2
	24	Thursday	5
	27	Sunday	0
	30	Wednesday	2
		Mean	2.3
October	1	Thursday	57
	4	Sunday	24
	9	Friday	44
	11	Sunday	36
	16	Friday	47
	18	Sunday	38
	23	Friday	52
	31	Saturday	67
		Mean	45.6
November	5	Thursday	52
	9	Monday	33
	14	Saturday	37
	18	Wednesday	81
	20	Friday	12
	22	Sunday	38
	25	Wednesday	16
	28	Saturday	50
		Mean	39.9
December	2	Wednesday	23
	5	Saturday	51
	9	Wednesday	32
		Mean	35.3

Appendix 2c. Instantaneous effort counts in the 1998 Nicomen-Norrish sport fishery survey.

Month	Day	Day of Week	Count
September	22	Tuesday	0
	26	Saturday	5
	30	Wednesday	6
		Mean	3.7
October	3	Saturday	6
	7	Wednesday	14
	15	Thursday	27
	20	Tuesday	36
	24	Saturday	36
	28	Wednesday	39
		Mean	26.3
November	1	Sunday	55
	12	Thursday	10
	14	Saturday	32
	28	Saturday	29
		Mean	31.5
December	3	Thursday	0
	4	Friday	3
	6	Sunday	4
	11	Friday	0
	14	Monday	7
		Mean	2.8

Appendix 2d. Instantaneous effort counts in the 1998 Stave River sport fishery survey.

Month	Day	Day of Week	Count
September	22	Tuesday	11
	26	Saturday	0
		Mean	5.5
October	3	Saturday	38
	7	Wednesday	33
	23	Friday	80
	24	Saturday	87
	28	Wednesday	25
		Mean	52.6
November	1	Sunday	73
	4	Wednesday	14
	8	Sunday	64
	14	Saturday	23
	20	Friday	14
	24	Tuesday	15
	28	Saturday	22
		Mean	32.1
December	5	Saturday	9
	6	Sunday	21
	7	Monday	1
	10	Thursday	1
	12	Saturday	5
		Mean	7.4

Appendix 2e. Overflight angler counts in the 1998 Vedder-Chilliwack River sport fishery survey.

Month	Day	Day of Week	Section 1	Section 2	Section 3	Daily Total
September	5	Saturday	15	21	1	37
	10	Thursday	1	6	20	27
	12	Saturday	27	14	5	46
	16	Wednesday	5	2	10	17
	20	Sunday	52	59	53	164
	22	Tuesday	21	7	37	65
	26	Saturday	80	72	61	213
	29	Tuesday	28	79	25	132
		Total	229	260	212	701
		Mean	28.6	32.5	26.5	87.6
October	3	Saturday	99	47	135	281
	6	Tuesday	27	32	50	109
	10	Saturday	135	383	127	645
	15	Thursday	139	304	95	538
	23	Friday	175	227	331	733
	25	Sunday	73	707	581	1361
	28	Wednesday	165	81	134	380
		Total	813	1,781	1,453	4,047
		Mean	116.1	254.4	207.6	578.1
November	1	Sunday	413	176	380	969
	5	Thursday	98	39	114	251
	8	Sunday	305	221	296	822
	14	Saturday	74	42	47	163
	19	Thursday	56	26	16	98
	22	Sunday	56	36	17	109
	26	Thursday	20	4	7	31
	29	Sunday	30	10	22	62
		Total	1,052	554	899	2,505
		Mean	131.5	69.3	112.4	313.1

Appendix 3a. Mean hourly proportion of angler effort by month and day type in the 1998 Harrison River sport fishery.

	September		October		November	
Hour	Weekend	Weekday	Weekend	Weekday	Weekend	Weekday
5:00	0.06146	0.06297	0.02832	0.03761	0.03810	0.08363
6:00	0.05371	0.05542	0.02649	0.03398	0.03869	0.07740
7:00	0.00000	0.00000	0.15336	0.00000	0.00000	0.00000
8:00	0.08445	0.00000	0.18124	0.00000	0.00000	0.00000
9:00	0.09500	0.09592	0.11153	0.00000	0.00000	0.00000
10:00	0.09500	0.10278	0.09759	0.00000	0.00000	0.00000
11:00	0.09500	0.09592	0.09294	0.10979	0.13267	0.00000
12:00	0.10134	0.07194	0.08365	0.27447	0.00000	0.77795
13:00	0.10134	0.06852	0.06971	0.32936	0.13267	0.05557
14:00	0.08709	0.10278	0.03253	0.00000	0.13267	0.02778
15:00	0.11084	0.09592	0.00000	0.10979	0.53068	0.00000
16:00	0.06334	0.09592	0.00000	0.00000	0.00000	0.00000
17:00	0.06334	0.16444	0.00000	0.10979	0.00000	0.00000
18:00	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
19:00	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
20:00	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
21:00	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
22:00	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
23:00	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
24:00	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000

Appendix 3b. Mean hourly proportion of angler effort by month and day type in the 1998 Chehalis River sport fishery.

	September		October		November		December	
Hour	Weekend	Weekday	Weekend	Weekday	Weekend	Weekday	Weekend	Weekday
5:00	0.05357	0.09607	0.08602	0.08469	0.11323	0.12328	0.16602	0.16372
6:00	0.07143	0.08297	0.06759	0.07854	0.08367	0.08345	0.10547	0.11062
7:00	0.09460	0.06836	0.09225	0.09419	0.07091	0.05211	0.06238	0.02020
8:00	0.07391	0.07324	0.10582	0.09384	0.07901	0.07906	0.07929	0.05767
9:00	0.09855	0.05290	0.10362	0.07689	0.07812	0.08338	0.09315	0.07872
10:00	0.10347	0.05697	0.10013	0.07094	0.08656	0.09080	0.08538	0.09266
11:00	0.10347	0.06409	0.08656	0.06439	0.08296	0.09237	0.08095	0.08882
12:00	0.11333	0.09460	0.07574	0.05681	0.07506	0.07979	0.07374	0.09328
13:00	0.06504	0.09417	0.07189	0.05128	0.07632	0.07307	0.07263	0.09927
14:00	0.08869	0.08138	0.06822	0.04330	0.07758	0.06532	0.07263	0.08491
15:00	0.08869	0.06103	0.09573	0.05844	0.08808	0.06111	0.07319	0.06817
16:00	0.00000	0.06103	0.00000	0.04460	0.07596	0.05935	0.07818	0.05573
17:00	0.00000	0.08545	0.00000	0.02933	0.00000	0.04378	0.00000	0.03483
18:00	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
19:00	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
20:00	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
21:00	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
22:00	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
23:00	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
24:00	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000

Appendix 3c. Mean hourly proportion of angler effort by month and day type in the 1998 Nicomen-Norrish sport fishery.

	September		October		November		December	
Hour	Weekend	Weekday	Weekend	Weekday	Weekend	Weekday	Weekend	Weekday
5:00	0.04846	0.01869	0.01010	0.01915	0.00746	0.02092	0.08824	0.00000
6:00	0.03965	0.02804	0.00808	0.01545	0.00419	0.01220	0.02941	0.00000
7:00	0.11704	0.04215	0.10262	0.09522	0.16955	0.05934	0.13194	0.00000
8:00	0.05852	0.10537	0.12453	0.10571	0.10760	0.05835	0.09071	0.18750
9:00	0.09753	0.13698	0.12689	0.11145	0.10597	0.10472	0.08659	0.18750
10:00	0.06827	0.12644	0.11770	0.12333	0.12472	0.11938	0.09071	0.00000
11:00	0.08046	0.13698	0.09992	0.10281	0.10271	0.12881	0.09896	0.25000
12:00	0.09363	0.11239	0.09808	0.11234	0.07418	0.14033	0.10720	0.37500
13:00	0.08778	0.11239	0.10345	0.08781	0.10271	0.12671	0.14844	0.00000
14:00	0.08778	0.05620	0.08689	0.06972	0.07499	0.11729	0.09071	0.00000
15:00	0.16580	0.12644	0.06965	0.07410	0.08912	0.08509	0.04948	0.00000
16:00	0.05852	0.00000	0.05241	0.01147	0.03695	0.02793	0.00000	0.00000
17:00	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
18:00	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
19:00	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
20:00	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
21:00	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
22:00	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
23:00	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
24:00	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000

Appendix 3d. Mean hourly proportion of angler effort by month and day type in the 1998 Stave River sport fishery.

	September		October		November		December	
Hour	Weekend	Weekday	Weekend	Weekday	Weekend	Weekday	Weekend	Weekday
5:00	0.01148	0.03962	0.00727	0.01992	0.02115	0.02901	0.01250	0.05882
6:00	0.01786	0.03803	0.00824	0.02123	0.00890	0.01541	0.00000	0.05882
7:00	0.03902	0.05746	0.07049	0.04312	0.06175	0.06156	0.15264	0.09177
8:00	0.06748	0.04769	0.08398	0.05565	0.08887	0.06493	0.16162	0.08030
9:00	0.07712	0.10117	0.09688	0.07166	0.07580	0.09234	0.14366	0.05735
10:00	0.11293	0.08119	0.09201	0.07748	0.09566	0.12337	0.15264	0.09177
11:00	0.08125	0.07182	0.11222	0.07902	0.11448	0.10389	0.05387	0.09177
12:00	0.13771	0.07405	0.11806	0.09676	0.10769	0.10788	0.08979	0.10324
13:00	0.11155	0.08167	0.13388	0.09141	0.12964	0.13130	0.10774	0.08030
14:00	0.13083	0.07286	0.12950	0.10372	0.10873	0.09307	0.12570	0.14912
15:00	0.12739	0.07772	0.12296	0.11058	0.14585	0.07668	0.00000	0.14912
16:00	0.08263	0.06245	0.02239	0.20406	0.01882	0.06493	0.00000	0.00000
17:00	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
18:00	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
19:00	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
20:00	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
21:00	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
22:00	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
23:00	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
24:00	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000

Appendix 3e. Mean hourly proportion of angler effort by month and day type in the 1998 Vedder-Chilliwack River sport fishery.

	September		October		November	
Hour	Weekend	Weekday	Weekend	Weekday	Weekend	Weekday
5:00	0.04087	0.03904	0.03521	0.04226	0.04297	0.04435
6:00	0.03594	0.03639	0.03015	0.03782	0.03571	0.03815
7:00	0.10581	0.12962	0.08168	0.08038	0.08866	0.08062
8:00	0.12088	0.11591	0.11239	0.10865	0.10084	0.07931
9:00	0.10258	0.11165	0.11805	0.10656	0.10058	0.08353
10:00	0.09752	0.10136	0.14168	0.11439	0.11187	0.10864
11:00	0.08722	0.09023	0.09072	0.11254	0.11709	0.12287
12:00	0.10581	0.08142	0.09598	0.08527	0.13730	0.09390
13:00	0.07822	0.08311	0.09967	0.06956	0.11014	0.10766
14:00	0.05290	0.07509	0.08329	0.07275	0.04205	0.08227
15:00	0.05461	0.05917	0.06301	0.05280	0.04779	0.04279
16:00	0.03413	0.01614	0.01400	0.03960	0.00765	0.05649
17:00	0.00000	0.00000	0.00000	0.03111	0.00000	0.00000
18:00	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
19:00	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
20:00	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
21:00	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
22:00	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
23:00	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
24:00	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000

Appendix 4a. Estimated angler effort, harvest and release by month and species in the 1998 Harrison River sport fishery.

	September	October	November	Total
# of interviews	623	903	511	2,037
# of overflights	8	7	8	23
ANGLER EFFORT				
Estimated effort (hours)	17,743	15,574	10,971	44,288
Estimated effort (days)	5,186	2,513	1,845	9,544
Average angler day (hours)	3.4	6.2	5.9	4.6
ESTIMATED HARVEST				
Chinook	8	28	0	36
Jack Chinook	0	0	0	0
Coho	6	266	292	564
Chum	104	301	80	485
Pink	0	4	0	4
Sockeye	1,410	300	1	1,711
Steelhead	0	0	0	0
Trout	31	50	23	104
Sturgeon	0	0	0	0
Other	32	7	0	39
ESTIMATED RELEASE				
Chinook	62	278	188	528
Jack Chinook	8	105	4	117
Coho	96	766	683	1,545
Chum	318	1,769	700	2,787
Pink	0	0	1	1
Sockeye	1,722	612	0	2,334
Steelhead	0	16	1	17
Trout	308	399	94	801
Sturgeon	198	585	447	1,230
Other	293	160	16	469
TOTAL CATCH				
Chinook	70	306	188	564
Jack Chinook	8	105	4	117
Coho	102	1,032	975	2,109
Chum	422	2,070	780	3,272
Pink	0	4	1	5
Sockeye	3,132	912	1	4,045
Steelhead	0	16	1	17
Trout	339	449	117	905
Sturgeon	198	585	447	1,230
Other	325	167	16	508

Appendix 4b. Estimated angler effort, harvest and release by month and species in the 1998 Chehalis River sport fishery.

	September	October	November	December	Total
# of interviews	175	1,815	1,224	462	3,676
# of instant. effort counts	4	8	8	3	23
ANGLER EFFORT					
Estimated effort (hours)	1,700	21,191	13,230	5,309	41,430
Estimated effort (days)	696	4,607	3,305	1,353	9,961
Average angler day (hours)	2.4	4.6	4.0	3.9	4.2
ESTIMATED HARVEST					
Chinook	0	0	0	0	0
Jack Chinook	0	81	0	0	81
Coho	0	1,705	1,041	353	3,099
Chum	0	141	392	0	533
Pink	0	0	0	0	0
Sockeye	0	0	0	0	0
Steelhead	0	152	0	0	152
Trout	3	8	7	17	35
Sturgeon	0	0	0	0	0
Other	0	0	0	0	0
ESTIMATED RELEASE					
Chinook	17	127	31	0	175
Jack Chinook	0	72	7	0	79
Coho	0	1,960	1,584	0	3,544
Chum	10	7,204	11,760	0	18,974
Pink	0	0	24	0	24
Sockeye	0	0	0	0	0
Steelhead	3	86	35	0	124
Trout	98	70	48	0	216
Sturgeon	0	0	0	0	0
Other	0	75	15	0	90
TOTAL CATCH					
Chinook	17	127	31	0	175
Jack Chinook	0	153	7	0	160
Coho	0	3,665	2,625	353	6,643
Chum	10	7,345	12,152	0	19,507
Pink	0	0	24	0	24
Sockeye	0	0	0	0	0
Steelhead	3	238	35	0	276
Trout	101	78	55	17	251
Sturgeon	0	0	0	0	0
Other	0	75	15	0	90

Appendix 4c. Estimated angler effort, harvest and release by month and species in the 1998 Nicomen-Norrish sport fishery.

	September	October	November	December	Total
# of interviews	84	1,065	919	37	2,105
# of instant. effort counts	3	6	4	5	18
ANGLER EFFORT					
Estimated effort (hours)	1,380	8,097	5,019	252	14,748
Estimated effort (days)	380	1,994	723	111	3,208
Average angler day (hours)	3.6	4.1	6.9	2.3	4.6
ESTIMATED HARVEST					
Chinook	0	4	1	0	5
Jack Chinook	0	4	0	0	4
Coho	11	692	232	6	941
Chum	0	6	8	0	14
Pink	0	0	0	0	0
Sockeye	0	0	0	0	0
Steelhead	0	0	0	0	0
Trout	0	3	0	0	3
Sturgeon	0	0	0	0	0
Other	0	4	0	0	4
ESTIMATED RELEASE					
Chinook	0	1	2	0	3
Jack Chinook	0	14	2	0	16
Coho	26	120	95	2	243
Chum	2	213	149	0	364
Pink	0	0	0	0	0
Sockeye	0	0	0	0	0
Steelhead	0	0	0	0	0
Trout	70	37	7	0	114
Sturgeon	47	30	15	0	92
Other	0	1	2	0	3
TOTAL CATCH					
Chinook	0	5	3	0	8
Jack Chinook	0	18	2	0	20
Coho	37	812	327	8	1,184
Chum	2	219	157	0	378
Pink	0	0	0	0	0
Sockeye	0	0	0	0	0
Steelhead	0	0	0	0	0
Trout	70	40	7	0	117
Sturgeon	47	30	15	0	92
Other	0	5	2	0	7

Appendix 4d. Estimated angler effort, harvest and release by month and species in the 1998 Stave River sport fishery.

	September	October	November	December	Total
# of interviews	440	1,762	844	85	3,131
# of instant. effort counts	2	5	7	5	19
ANGLER EFFORT					
Estimated effort (hours)	6,619	17,819	6,474	964	31,876
Estimated effort (days)	2,546	5,219	2,369	312	10,446
Average angler day (hours)	2.6	3.4	2.7	3.1	3.1
ESTIMATED HARVEST					
Chinook	0	0	0	0	0
Jack Chinook	5	0	0	0	5
Coho	20	178	91	31	320
Chum	15	649	302	4	970
Pink	0	0	0	0	0
Sockeye	0	22	0	0	22
Steelhead	0	0	0	0	0
Trout	16	8	2	10	36
Sturgeon	0	0	0	0	0
Other	0	0	0	0	0
ESTIMATED RELEASE					
Chinook	7	0	0	0	7
Jack Chinook	5	0	0	0	5
Coho	27	267	402	153	849
Chum	446	657	1,661	63	2,827
Pink	0	0	0	0	0
Sockeye	0	42	0	0	42
Steelhead	0	0	0	0	0
Trout	323	68	14	9	414
Sturgeon	0	0	0	0	0
Other	23	3	0	0	26
TOTAL CATCH					
Chinook	7	0	0	0	7
Jack Chinook	10	0	0	0	10
Coho	47	445	493	184	1,169
Chum	461	1,306	1,963	67	3,797
Pink	0	0	0	0	0
Sockeye	0	64	0	0	64
Steelhead	0	0	0	0	0
Trout	339	76	16	19	450
Sturgeon	0	0	0	0	0
Other	23	3	0	0	26

Appendix 4e. Estimated angler effort, harvest and release by month and species in the 1998 Vedder-Chilliwack River sport fishery.

	September	October	November	Total
# of interviews	1,547	4,672	2,640	8,859
# of overflights	8	7	8	23
ANGLER EFFORT				
Estimated effort (hours)	23,626	207,962	59,439	291,027
Estimated effort (days)	5,434	34,621	11,248	51,303
Average angler day (hours)	4.3	6.0	5.3	5.7
ESTIMATED HARVEST				
Chinook	92	6,489	1,615	8,196
Jack Chinook	484	3,911	130	4,525
Coho	292	4,514	1,345	6,151
Chum	15	3,124	1,188	4,327
Pink	0	0	0	0
Sockeye	0	0	0	0
Steelhead	0	0	3	3
Trout	24	0	0	24
Sturgeon	0	0	0	0
Other	0	0	0	0
ESTIMATED RELEASE				
Chinook	75	8,382	5,283	13,740
Jack Chinook	705	4,277	51	5,033
Coho	560	4,820	2,431	7,811
Chum	105	8,541	4,198	12,844
Pink	3	0	0	3
Sockeye	37	137	9	183
Steelhead	35	20	14	69
Trout	221	86	10	317
Sturgeon	52	56	0	108
Other	87	180	8	275
TOTAL CATCH				
Chinook	167	14,871	6,898	21,936
Jack Chinook	1,189	8,188	181	9,558
Coho	852	9,334	3,776	13,962
Chum	120	11,665	5,386	17,171
Pink	3	0	0	3
Sockeye	37	137	9	183
Steelhead	35	20	17	72
Trout	245	86	10	341
Sturgeon	52	56	0	108
Other	87	180	8	275

Appendix 5a. Mean monthly HPUE, RPUE and CPUE by day type and species in the 1998 Harrison River sport fishery.

Weekend	Month	Chinook	Jack Chinook	Coho	Chum	Pink	Sockeye	Steelhead	Trout	Sturgeon	Other
HPUE	September	0.0008	0	0	0.0067	0	0.0896	0	0.0005	0	0
	October	0.0021	0	0.0155	0.0202	0.0003	0.0202	0	0.0039	0	0.0006
	November	0	0	0.0172	0.0093	0	0.0005	0	0.0020	0	0
RPUE	September	0.0066	0.0009	0.0037	0.0178	0	0.1012	0	0.0101	0.0128	0.0120
	October	0.0204	0.0078	0.0444	0.1174	0	0.0369	0.0009	0.0273	0.0363	0.0107
	November	0.0122	0.0015	0.0458	0.1090	0.0005	0.0000	0.0005	0.0081	0.0734	0.0020
Total (CPUE)	September	0.0074	0.0009	0.0037	0.0245	0	0.1908	0	0.0105	0.0128	0.0120
	October	0.0224	0.0078	0.0599	0.1376	0.0003	0.0571	0.0009	0.0312	0.0363	0.0113
	November	0.0122	0.0015	0.0630	0.1183	0.0005	0.0005	0.0005	0.0101	0.0734	0.0020
Weekday	Month	Chinook	Jack Chinook	Coho	Chum	Pink	Sockeye	Steelhead	Trout	Sturgeon	Other
HPUE	September	0	0	0.0007	0.0049	0	0.0679	0	0.0032	0	0.0039
	October	0.0006	0	0.0235	0.0159	0	0.0155	0	0.0006	0	0
	November	0	0	0.0293	0.0067	0	0	0	0.0022	0	0
RPUE	September	0	0	0.0073	0.0181	0	0.0923	0	0.0257	0.0093	0.0216
	October	0.0077	0.0025	0.0684	0.0984	0	0.0489	0.0014	0.0190	0.0426	0.0087
	November	0.0186	0	0.0670	0.0509	0	0	0	0.0087	0.0314	0.0012
Total (CPUE)	September	0	0	0.0080	0.0230	0	0.1602	0	0.0289	0.0093	0.0255
	October	0.0083	0.0025	0.0918	0.1143	0	0.0644	0.0014	0.0196	0.0426	0.0087
	November	0.0186	0	0.0963	0.0576	0	0	0	0.0108	0.0314	0.0012

Appendix 5b. Mean monthly HPUE, RPUE and CPUE by day type and species in the 1998 Chehalis River sport fishery.

Weekend	Month	Chinook	Jack Chinook	Coho	Chum	Pink	Sockeye	Steelhead	Trout	Sturgeon	Other
HPUE	September	0	0	0	0	0	0	0	0.0063	0	0
	October	0	0.0006	0.0691	0.0168	0	0	0.0310	0.0019	0	0
	November	0	0	0.0515	0.0130	0	0	0	0.0016	0	0
	December	0	0	0.1123	0	0	0	0	0	0	0
RPUE	September	0.0127	0	0	0	0	0	0.0051	0.0283	0	0
	October	0.0051	0.0025	0.0616	0.2133	0	0	0.0060	0	0	0.0114
	November	0.0017	0.0016	0.0806	0.9087	0	0	0.0013	0	0	0.0033
	December	0	0	0.1258	0	0	0	0	0.0227	0	0
Total (CPUE)	September	0.0127	0	0	0	0	0	0.0051	0.0346	0	0
	October	0.0051	0.0032	0.1307	0.2301	0	0	0.0370	0.0019	0	0.0114
	November	0.0017	0.0016	0.1321	0.9217	0	0	0.0013	0.0016	0	0.0033
	December	0	0	0.2381	0.0000	0	0	0	0.0227	0	0
Weekday	Month	Chinook	Jack Chinook	Coho	Chum	Pink	Sockeye	Steelhead	Trout	Sturgeon	Other
HPUE	September	0	0	0	0	0	0	0	0	0	0
	October	0	0.0046	0.0833	0.0041	0	0	0.0011	0	0	0
	November	0	0	0.0928	0.0383	0	0	0	0	0	0
	December	0	0	0.0250	0.0000	0	0	0	0.0061	0	0
RPUE	September	0.0089	0	0	0.0089	0	0	0	0.0714	0	0
	October	0.0063	0.0036	0.1003	0.3722	0	0	0.0036	0.0042	0	0.0015
	November	0.0028	0	0.1401	0.8786	0.0028	0	0.0033	0.0055	0	0
	December	0	0	0.2694	0.1056	0	0	0	0	0	0
Total (CPUE)	September	0.0089	0	0	0.0089	0	0	0.0000	0.0714	0	0
	October	0.0063	0.0082	0.1836	0.3762	0	0	0.0046	0.0042	0	0.0015
	November	0.0028	0	0.2328	0.9168	0.0028	0	0.0033	0.0055	0	0
	December	0	0	0.2944	0.1056	0	0	0	0.0061	0	0

Appendix 5c. Mean monthly HPUE, RPUE and CPUE by day type and species in the 1998 Nicomen-Norrish sport fishery.

Weekend	Month	Chinook	Jack Chinook	Coho	Chum	Pink	Sockeye	Steelhead	Trout	Sturgeon	Other
HPUE	September	0	0	0.0225	0	0	0	0	0	0	0
	October	0	0	0.0778	0	0	0	0	0.0006	0	0
	November	0	0	0.0548	0	0	0	0	0	0	0
	December	0	0	0	0	0	0	0	0	0	0
RPUE	September	0	0	0.0106	0.0033	0	0	0	0	0.0661	0
	October	0.0006	0.0006	0.0158	0.0155	0	0	0	0.0050	0.0055	0.0006
	November	0.0005	0.0005	0.0213	0.0278	0	0	0	0.0011	0.0010	0.0005
	December	0	0	0	0	0	0	0	0	0	0
Total (CPUE)	September	0	0	0.0331	0.0033	0	0	0	0	0.0661	0
	October	0.0006	0.0006	0.0936	0.0155	0	0	0	0.0055	0.0055	0.0006
	November	0.0005	0.0005	0.0762	0.0278	0	0	0	0.0011	0.0010	0.0005
	December	0	0	0	0	0	0	0	0	0	0

Weekday	Month	Chinook	Jack Chinook	Coho	Chum	Pink	Sockeye	Steelhead	Trout	Sturgeon	Other
HPUE	September	0	0	0	0	0	0	0	0	0	0
	October	0.0007	0.0007	0.0877	0.0010	0	0	0	0.0004	0	0.0007
	November	0.0006	0	0.0285	0.0048	0	0	0	0	0	0
	December	0	0	0.0700	0	0	0	0	0	0	0
RPUE	September	0	0	0.0238	0	0	0	0	0.0794	0.0159	0
	October	0	0.0021	0.0145	0.0296	0	0	0	0.0044	0.0031	0
	November	0	0	0.0139	0.0335	0	0	0	0.0019	0.0070	0
	December	0	0	0.0263	0	0	0	0	0	0	0
Total (CPUE)	September	0	0	0.0238	0	0	0	0	0.0794	0.0159	0
	October	0.0007	0.0028	0.1022	0.0306	0	0	0	0.0047	0.0031	0.0007
	November	0.0006	0	0.0423	0.0383	0	0	0	0.0019	0.0070	0
	December	0	0	0.0963	0	0	0	0	0	0	0

Appendix 5d. Mean monthly HPUE, RPUE and CPUE by day type and species in the 1998 Stave River sport fishery.

Weekend	Month	Chinook	Jack Chinook	Coho	Chum	Pink	Sockeye	Steelhead	Trout	Sturgeon	Other
HPUE	September	0	0.0016	0.0016	0	0	0	0	0.0031	0	0
	October	0	0	0.0091	0.0309	0	0	0	0.0003	0	0
	November	0	0	0.0060	0.0424	0	0	0	0.0007	0	0
	December	0	0	0.0195	0.0042	0	0	0	0.0111	0	0
RPUE	September	0	0.0016	0	0.0031	0	0	0	0.0561	0	0.0016
	October	0	0	0.0132	0.0691	0	0	0	0.0017	0	0.0006
	November	0	0	0.0504	0.3016	0	0	0	0.0040	0	0
	December	0	0	0.1254	0.0724	0	0	0	0.0042	0	0
Total (CPUE)	September	0	0.0031	0.0016	0.0031	0	0	0	0.0592	0	0.0016
	October	0	0	0.0223	0.1000	0	0	0	0.0020	0	0.0006
	November	0	0	0.0564	0.3441	0	0	0	0.0046	0	0
	December	0	0	0.1449	0.0766	0	0	0	0.0153	0	0
Weekday	Month	Chinook	Jack Chinook	Coho	Chum	Pink	Sockeye	Steelhead	Trout	Sturgeon	Other
HPUE	September	0	0	0.0044	0.0044	0	0	0	0.0018	0	0
	October	0	0	0.0104	0.0386	0	0.0017	0	0.0005	0	0
	November	0	0	0.0239	0.0517	0	0	0	0	0	0
	December	0	0	0.1429	0	0	0	0	0	0	0
RPUE	September	0.0022	0	0.0079	0.1293	0	0	0	0.0416	0	0.0053
	October	0	0	0.0157	0.0243	0	0.0029	0	0.0046	0	0
	November	0	0	0.0766	0.2011	0	0	0	0	0	0
	December	0	0	0.4485	0	0	0	0	0.0498	0	0
Total (CPUE)	September	0.0022	0	0.0123	0.1337	0	0	0	0.0434	0	0.0053
	October	0	0	0.0261	0.0629	0	0.0046	0	0.0052	0	0
	November	0	0	0.1005	0.2528	0	0	0	0	0	0
	December	0	0	0.5914	0	0	0	0	0.0498	0	0

Appendix 5e. Mean monthly HPUE, RPUE and CPUE by day type and species in the 1998 Vedder-Chilliwack River sport fishery.

Weekend	Month	Chinook	Jack Chinook	Coho	Chum	Pink	Sockeye	Steelhead	Trout	Sturgeon	Other
HPUE	September	0.0026	0.0210	0.0128	0.0010	0	0	0	0.0016	0	0
	October	0.0307	0.0169	0.0233	0.0150	0	0	0	0	0	0
	November	0.0306	0.0027	0.0211	0.0216	0	0	0	0	0	0
RPUE	September	0.0054	0.0195	0.0240	0.0061	0.0003	0.0016	0.0023	0.0106	0	0.0029
	October	0.0570	0.0191	0.0234	0.0341	0	0.0005	0.0001	0.0005	0.0008	0.0007
	November	0.0867	0.0005	0.0447	0.0657	0	0.0002	0.0004	0.0002	0	0
Total (CPUE)	September	0.0080	0.0405	0.0368	0.0070	0.0003	0.0016	0.0023	0.0122	0	0.0029
	October	0.0877	0.0360	0.0466	0.0491	0	0.0005	0.0001	0.0005	0.0008	0.0007
	November	0.1173	0.0032	0.0657	0.0874	0	0.0002	0.0004	0.0002	0	0
Weekday	Month	Chinook	Jack Chinook	Coho	Chum	Pink	Sockeye	Steelhead	Trout	Sturgeon	Other
HPUE	September	0.0050	0.0201	0.0120	0.0004	0	0	0	0.0005	0	0
	October	0.0314	0.0198	0.0209	0.0150	0	0	0	0	0	0
	November	0.0224	0.0014	0.0248	0.0177	0	0	0.0001	0	0	0
RPUE	September	0.0014	0.0382	0.0235	0.0031	0	0.0016	0.0008	0.0084	0.0039	0.0043
	October	0.0321	0.0213	0.0231	0.0445	0	0.0007	0.0001	0.0004	0	0.0010
	November	0.0919	0.0014	0.0356	0.0775	0	0.0001	0	0.0002	0	0.0003
Total (CPUE)	September	0.0063	0.0583	0.0355	0.0035	0	0.0016	0.0008	0.0089	0.0039	0.0043
	October	0.0635	0.0410	0.0440	0.0596	0	0.0007	0.0001	0.0004	0	0.0010
	November	0.1143	0.0029	0.0604	0.0952	0	0.0001	0.0001	0.0002	0	0.0003