# Angler Effort and Catch in the 1997 Lower Fraser River Sport Fishery

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## ABSTRACT

Palermo, V. and A.S. Thompson. 1999. Angler effort and catch in the 1997 lower Fraser River sport fishery. Can. Manuscr. Fish. Aquat. Sci. 2488: 24 p.

The lower Fraser River mainstem recreational fishery was assessed from 1985 to 1988 and again in 1995 and 1996, using a combined access point/overflight survey design. From July 1 to August 31, 1997, another recreational fishery survey was conducted on the lower Fraser River using the same study design and the data entry and analysis program that was implemented during the 1996 survey. The 1997 survey focused on angler effort and the harvest and release of chinook (*Oncorhynchus tshawytscha*), sockeye (*O. nerka*) and pink (*O. gorbuscha*) salmon.

Over the course of the survey, 17 overflights and 5,275 angler interviews were conducted. Angler effort was estimated at 260,874 hours. Total harvests of chinook (adults and jacks combined) and sockeye were estimated at 1,687 and 30,458, respectively. Chinook and sockeye released were estimated at 184 and 20,764, respectively. Pink salmon constituted less than 1% of the total season sport catch.

The 1997 July chinook catch was significantly less than the 1996 catch, due to a decreased proportion of effort directed at chinook and low abundance of chinook in the river. Chinook abundance increased substantially during August, but they were not targeted and catch rates remained low. Catch rates for sockeye increased dramatically from 1996 to 1997, particularly during July, due to an increased proportion of angler effort directed at sockeye and high sockeye abundance. August angler effort was moderately higher than in 1996.

**Key Words**: lower Fraser River, sport fishery, chinook salmon, sockeye salmon, angler effort, catch, harvest, release.

## RÉSUMÉ

Palermo, V. and A.S. Thompson. 1999. Angler effort and catch in the 1997 lower Fraser River sport fishery. Can. Manuscr. Fish. Aquat. Sci. 2488: 24 p.

La pêche sportive dans le bras principal du cours inférieur du Fraser a fait l'objet d'une évaluation de 1985 à 1988, puis de nouveau en 1995 et en 1996, par une méthode combinant les points d'accès et le survol aérien. Du 1er juillet au 31 août 1997, un autre relevé de la pêche sportive a été effectué sur le cours inférieur du Fraser par la même méthode et avec le même système d'entrée et d'analyse des données qu'en 1996. L'accent du relevé de 1997 était mis sur l'effort de pêche à la ligne et sur la capture avec graciation du quinnat (*Oncorhynchus tshawytscha*), du saumon rouge (*O. nerka*) et du saumon rose (*O. gorbuscha*).

Dans le cours du relevé, 17 survols ont été effectués, et 5 275 entrevues avec des pêcheurs ont été réalisées. L'effort de pêche a été estimé à 260 874 heures. Les captures totales de quinnats (adultes et jacks combinés) et de saumons rouges ont été estimées respectivement à 1 687 et 30 458. On estime à 184 et 20 764 respectivement le nombre de quinnats et de saumons rouges graciés. Le saumon rose représentait moins de 1 % du total des prises sportives de la saison.

Le nombre de captures de quinnat en juillet 1997 était nettement inférieur à celui de 1996, ce qui est dû à une baisse de l'effort de pêche dirigé vers ce poisson et à sa faible abondance dans le Fraser. L'abondance a sensiblement augmenté en août, mais le quinnat n'étant pas ciblé, les taux de capture sont restés bas. Les taux de capture du saumon rouge ont grimpé de façon spectaculaire entre 1996 et 1997, particulièrement en juillet, à cause de l'augmentation de l'effort de pêche dirigé vers le saumon rouge et de sa grande abondance. En août, l'effort de pêche était un peu plus élevé qu'en 1996.

**Mots clés** : cours inférieur du Fraser, pêche sportive, quinnat, saumon rouge, effort de pêche sportive, captures, prélèvements, graciation.

## INTRODUCTION

The Fraser River downstream of Hope, British Columbia supports a year round sport fishery that targets all five salmon species (*Oncorhynchus* spp.), and sturgeon (*Acipenser* spp.), as well as steelhead (*O. mykiss*), rainbow (*O. mykiss*) and cutthroat (*O. clarki*) trout. Previous studies describe the lower Fraser River sport fishery as one of the largest in British Columbia (Mosley MS, 1983; DPA Group MS, 1985; Schubert, 1992b).

The lower Fraser River recreational fishery was studied by creel survey from 1985 to 1988. These studies focused on angler effort and catch of salmon and trout in the lower 150 km of the Fraser River, below Hope. In 1995, the lower Fraser River recreational fishery was again studied by creel survey. The focus of the 1995 study was expanded to include angler effort and catch of sockeye (*O. nerka*) and pink (*O. gorbuscha*) salmon, which could not be legally harvested during the 1985 to 1988 creel surveys (Bratty et al., 1998). Assessment of the lower Fraser River recreational fishery continued in 1996, with a creel survey focusing on angler effort and catch of chinook (*O. tshawytscha*) and sockeye salmon. Pink salmon were not assessed in 1996 because upstream spawning migration of pinks does not occur in the Fraser River in even-numbered years (Anon., 1995). The 1997 creel survey focused on the angler effort and catch of chinook, sockeye and pink salmon.

This report describes the methods and procedures of the 1997 survey and 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 lower Fraser River between the Sumas River and Hope, from July 1 to August 31, 1997. The results are compared with previous lower Fraser River recreational fishery surveys. Finally, recommendations are made for future surveys and management of the recreational fishery on the lower Fraser River.

## 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 (Figure 1). The mean daily discharge for the Fraser River in the Hope area is 3,680 $m^3/s$ (Water Survey of Canada, pers. comm.). The average width of this section is 600 meters. Maximum freshet width is 5 km in some areas. The Fraser River is tidal as far upstream as the City of Chilliwack, approximately 90 km from the river's outlet.

Schubert (1992b) separated the lower Fraser River into four study regions (Figure 1). The 1997 study focused on the last two regions (Regions 3 and 4) from the outlet of the Sumas River to Hope. This section of the Fraser was chosen as the study area for the 1995 and 1996 Fraser River sport fishery surveys and has historically accounted for the highest harvest of chinook salmon in the lower Fraser River (Schubert, 1992b). In 1996 the area between the Agassiz-Rosedale powerline and Hope was not surveyed, due to budget constraints, and was designated as Region 5. The boundaries of Regions 3 and 4 used in the 1997 study were the same as those used in the 1985-1988 and 1995 surveys.

Region 3 extended from the outlet of the Sumas River to the outlet of the Harrison River (Figure 1). The region is characterized by many treed islands and mid-channel bars that become exposed as the water level of the Fraser River drops. Angler effort was concentrated at Englebrich bar (locally known as Island 22) and Wellington bar. Interviews in Region 3 were conducted at Englebrich bar, which was the main boat launch site for the area; by interviewing at this site surveyors were able to get complete

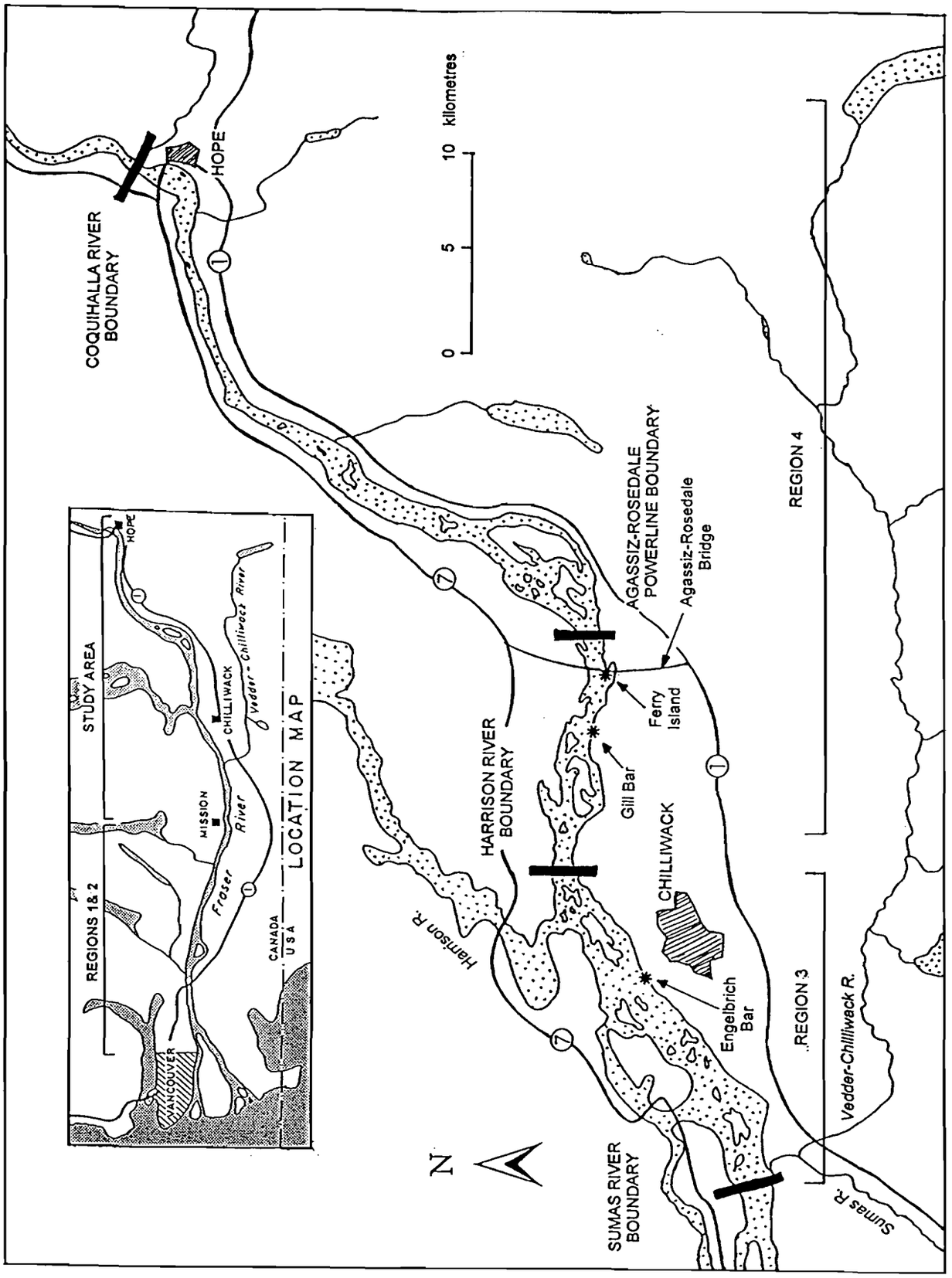


Figure 1. Lower Fraser River sport fishery survey study area.

trip interviews from a large proportion of anglers fishing in the surrounding area.

Region 4 extended from the outlet of the Harrison River to Hope (Figure 1). This region is similar to Region 3, containing many bars and treed islands. Anglers were concentrated at Landstrom bar, Gill bar, Herrling Island and the exposed bars offshore from Ferry Island (Figure 1). Interviews in Region 4 were conducted at Gill bar and Ferry Island Provincial Park. As in Region 3, these bars were primary boat launch sites and allowed interviewers to get complete trip interviews from a large proportion of anglers fishing in the surrounding area. No interviews were conducted between the Agassiz-Rosedale powerline and Hope.

## FISHERY REGULATIONS

The 1997 lower Fraser River sport fishery was managed by daily and annual catch limits, fish size restrictions, and fishing time restrictions (Table 1). During the survey, the daily catch limit for chinook was 4 per day, 1 of which could be over 50 cm. The annual catch limit for chinook adults over 50 cm was 10. The sockeye fishery opened on July 12, closed on July 18, opened again on July 25, and then remained open for the duration of the survey. The limit for sockeye was 2 per day, 30 cm or over. The pink salmon fishery opened on July 19 and remained open for the duration of the survey, with a limit of 4 per day, 30 cm or over. There was no annual catch limit for sockeye or pink salmon. The aggregate limit for all salmon species was 4 per day.

## METHODS

### STUDY DESIGN

The lower Fraser River sport fishery was assessed from July 1 to August 31, 1997. The study design, which was similar to that of the 1995 and 1996 lower Fraser River sport fishery surveys, used a combined access point and overflight survey (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.

The access point/overflight survey design was based on the assumption that either interview sites were representative of the entire study area, or the proportion of angler effort at the interview sites was large enough to make HPUE estimates insensitive to effort occurring at non-interview sites. These assumptions were not believed to have been violated in the 1995 and 1996 surveys because of the high concentration of angler effort at the interview sites in proportion to the rest of the survey area (Bratty et al., 1998; Walter et al., 1998). Similarly, in 1997 these assumptions were not believed to have been violated because, despite high overflight rod counts at non-survey sites, a high proportion of the anglers exited the river at the access point survey sites; therefore a reasonably high proportion of the total effort was surveyed.

A total of 5,275 angler interviews and 17 overflights were conducted between July 1 and August 31 in the 1997 lower Fraser River sport fishery survey (Table 2).

### Access Point Methods

One interviewer was stationed in each region, at a site chosen for maximum expected angling effort. Interviews were conducted from July 1 to August 31, 1997 and were stratified by month into weekday and weekend (including holiday) day types. Interviews took place on all weekend days and holidays and on an average of two weekdays per week in each region. Interview days were divided into morning and afternoon shifts lasting from 7:00 to 15:00 and from 14:00 to 22:00, respectively. Shifts were scheduled to allow at least two morning shifts and two afternoon shifts per month on both weekends and weekdays, in each region. This fulfilled the minimum monthly effort requirement (Bratty et al., 1998).

Each shift started with interviewers asking anglers to take part in the survey at the end of their fishing trip. Hourly rod counts were then conducted to build effort

Table 1. Fraser River (Mission to Hope) non-tidal fishery regulations for chinook, sockeye and pink salmon during the 1997 lower Fraser River sport fishery survey.

| Location | Species | Openings | Daily Catch Limits | Annual Catch Limits |
|---|---|---|---|---|
| Mission Bridge to Powerline above Agassiz/Rosedale Br. | Chinook | June 1 - Sept 1 | 4 ≥ 30 cm incl. 1 > 50 cm | 10 adults > 50 cm |
| | Sockeye | July 12 - July 18; July 25 - Mar 31 | 2 ≥ 30 cm | - |
| | Pink | July 19 - Mar 31 | 4 ≥ 30 cm | - |
| Powerline to Alexandra Bridge | Chinook | June 1 - Dec 31 | 4 ≥ 30 cm incl. 1 > 50 cm | 10 adults > 50 cm |
| | Sockeye | July 12 - July 18; July 25 - Mar 31 | 2 ≥ 30 cm | - |
| | Pink | July 19 - Mar 31 | 4 ≥ 30 cm | - |

- No annual catch limit was set for this species

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 kept 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.

**Overflight Methods**

An average of two overflights per week (one on weekends and one on weekdays) was scheduled for the duration of the survey. All overflights covered Regions 3 and 4. Twice a month Region 2 was also included to observe distribution of effort outside the study area.

Overflights were conducted primarily with a Cessna 182 traveling 30 m above the water, at an average speed of 130 kph. All surveys began at 11:30 a.m. and lasted between 1 and 2 hours, depending on the number of regions flown and the amount of angler effort observed.

When conducting overflights, two observers were seated on the same side of the plane. Rod counts and flight times over high effort bars were recorded on a study area map of the lower Fraser River. These maps were then compiled to provide mean daily rod counts for the study area, as well as for specific bars and regions.

**DATA MANAGEMENT**

Historical data management and analytic procedures are thoroughly outlined in Schubert (1992a, 1992b) and Schubert and Whyte (1992). The methodology is reprinted below with relevant modifications.

The use of historical data management programs became increasingly problematic during the 1995 creel survey program, resulting in high rates of input errors and frustration for the data entry staff (R. Diewert, pers. comm.). A review of these programs in 1996 found that the data management and analysis functions were performed by a collection of DOS executable files, with little or no accompanying documentation. In some cases it was impossible to discern what language was used to write the programs, and because the source code was non-

existent, it was impossible to perform improvement modifications. For these reasons, we decided that the entire data management and analysis functions would be re-written for the 1996 creel program. This was undertaken with the following specific objectives in mind: 1) the programs would be fully documented with annotated source code and documentation to ease subsequent modification and development; 2) the source language would be a modern generation language, capable of relational database support and running in a Microsoft Windows environment both in 16 and 32 bit versions, taking full advantage of the modern graphical interface design; 3) there would be support for upgrading the database structures to Access and/or Oracle tables when and if necessary, and 4) the system would be modular, allowing greater flexibility for modifications.

The Delphi development system by Borland met all these criteria and was therefore used to develop the database management system for the 1996 creel program. The Delphi language is based on PASCAL rather than C, offering greatly improved annotated code and reduced cryptic language structures. Three other major features of this system made it very attractive for this project: 1) the Delphi system enables rapid development by tightly integrating the design process with the use of intelligent components, in fact, the entire data entry section was completed and debugged to beta stage within two months; 2) the system produces a native code compiled executable that runs much faster than an interpretative system such as Microsoft's Visual Basic, and 3) Delphi can also compile .OBJ files for integration with C++ and other development systems and exists in two flavours. Delphi 1.0 will compile a 16-bit executable for use on older computers running Windows version 3.x. The 16-bit executable will also run on modern computers with the Windows 95 operating system. Delphi 2.0 produces 32-bit executables which will run on Windows 95 and Windows NT operating systems, virtually without changes in source code. We have produced both 16 and 32 bit versions of the program, with the more extensive analysis components in the 32 bit version, to take advantage of the execution speed increase and memory space increase afforded under the 32 bit version. The 16-bit version is primarily used as a vehicle for data entry and editing functions on machines running Windows versions 3.x. Currently, the program consists of approximately 4200 lines of code and compiles into an executable file of .6 MB in size.

Delphi also supports modern relational database design, using the Borland Database Engine. Although we originally designed the database using Microsoft Access tables interfaced through an ODBC connection with Delphi, we discovered that using Paradox table formats directly through the BDE proved to be much faster, more efficient, and less prone to error. We were also able to copy the data tables to ASCII, Oracle, and Access formats without difficulty, demonstrating the flexibility of the Delphi/Paradox/BDE combination.

The program is modular in design and presents the user with selection choices for the category of data to input, edit, or analyse. For each main data category, (interview data, overflight data, effort verification) the program displays visually clear and intelligent forms to aid the entry of the data. Specific mandatory fields are checked for completeness and the entered data is verified for allowable ranges. These design criteria and procedures were proven to be effective in a post-season review of all the data, which indicated data entry error rates of less than 0.5%.

The creel database has a modern relational design consisting of related data tables that can be grouped by two main functions: support tables and data tables. Support tables include: 1) the Bar Table consists of uniquely identified river bars and their location by regional association, and is used extensively to identify sampling locations and locations of overflight observations; 2) the Species Table uniquely identifies the species of fish likely to be observed in the survey, and is extensively used to organise information on the basis of unique species groupings; 3) the Periods Table is used to track stint information later used in analysis, and 4) the Region Table lists the unique regions and their identifiers.

Data tables include: 1) the Angler Interview Table set, a group of tables linked together by a unique interview number, which is also linked to an interview sheet for subsequent editing and data verification. The tables in this set are a) the Angler Interview data table, b) the Catch/Release data table, c) the Gear Used table, and d) the Hours Fished by the Angler table. The other data tables are: 2) the Overflight Table, where the information from the unique overflights is recorded, and 3) the Rod count table, where the observed rod counts, later used for effort verification, are recorded by hour. A complete description of these tables, their relationships and the computer programs are documented in Palermo (in prep.).

In 1997, improvements to the program included the division of its input and analysis portions into 2 separate programs. We also made improvements to the data entry portion of the program, based on feedback received in 1996, and the analysis portion was re-written to allow greater analytical flexibility.

## DATA ANALYSIS

Before the analysis algorithms were performed, data were stratified according to region, 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 overflight 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 07:00 and after 22:00) 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 (region, month and day type) was the ratio of the mean overflight rod count to the proportion of daily effort occurring during the overflight rod 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 rod count time block, by day type:

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

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

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

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

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

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 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 region and day type for each species and mark group, using a total ratio estimator (Von Geldern, Jr. and Thomlinson, 1973; Malvestuto, 1983; Hoenig et al., 1997), 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 region and 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 region and 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 region and 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 $h$.

However, before calculating CPUE, the raw interview data were tested for significant differences in CPUE between all interviews and complete trip interviews. 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 1997 survey, approximately 7% of all interviews were in-

complete; all of these were excluded from analysis.

**Harvest and Release**

Monthly regional harvest and release, estimated by species and mark group, was the sum of the weekday and weekend/holiday 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 were also summarized by site and month (Appendix 1). These were: mean angler day length, preferred species, and gear type. Study period mean angler day length was calculated from site-specific data from complete trip interviews only.

## RESULTS

The 1997 lower Fraser River sport fishery survey was conducted between July 1 and August 31, 1997. Catches during the two-month study included chinook, sockeye, pink and coho salmon, as well as sturgeon and several trout species. Survey effort, total angler effort, CPUE, HPUE and RPUE estimates by species, and total catch and release by species are detailed below.

**SURVEY EFFORT**

The study period included 42 weekdays and 20 weekend/holiday days, of which 50% and 100% were sampled, respectively. More interviews were conducted in August (3,335) than in July (1,940). Fifty-four percent of the interviews were conducted at Englebrich bar in Region 3, with the remaining 46% divided evenly between Gill bar (23%) and Ferry Island (23%) in Region 4.

Eight overflights were conducted over Regions 3 and 4 in July and 9 were conducted in August. Mean daily regional rod counts ranged from 68 (Region 4, July) to 185 (Region 4, August) on weekdays and from 77 (Region 4, July) to 237 (Region 4, August) on weekends and holidays (Appendix 2). The peak rod count for the entire study area (697) occurred on August 31. On average, 53% of the anglers in the study area were observed in Region 4, with the remaining 47% observed in Region 3.

**ANGLER EFFORT**

**Daily Profile**

The majority of anglers fished during the daylight hours, with peaks in effort generally occurring between 7:00 and 11:00 and also between 17:00 and 19:00 (Figures 2a and 2b, Appendix 3). Angler effort during evening hours (between 20:00 and midnight) dropped by 17% from July to August.

**Total Angler Effort**

Total estimated angler effort from July 1 through August 31 was 260,874 hours or 53,905 angler days. Angling effort was greater in Region 4 (57.5% of total effort) than in Region 3 and monthly angling effort was much greater in August (175,238 hours) than in July (85,636 hours). Angler effort totals by month and region are presented in Table 2 and Appendix 4.

**CATCH PER UNIT EFFORT**

CPUEs for adult and jack chinook, sockeye and pink salmon are presented in Figure 3 and in Appendix 5, along with HPUEs and RPUEs. Peak and average CPUEs are described below by month, region and day type. The proportion of harvested fish to total catch is also described.

CPUEs, HPUEs and RPUEs of all other species caught in the study area during the survey are detailed in Appendix 5. Following chinook and sockeye, sturgeon and trout species were the most targeted species and had average weekday CPUEs from July 1 to August 31 of 0.0028 and

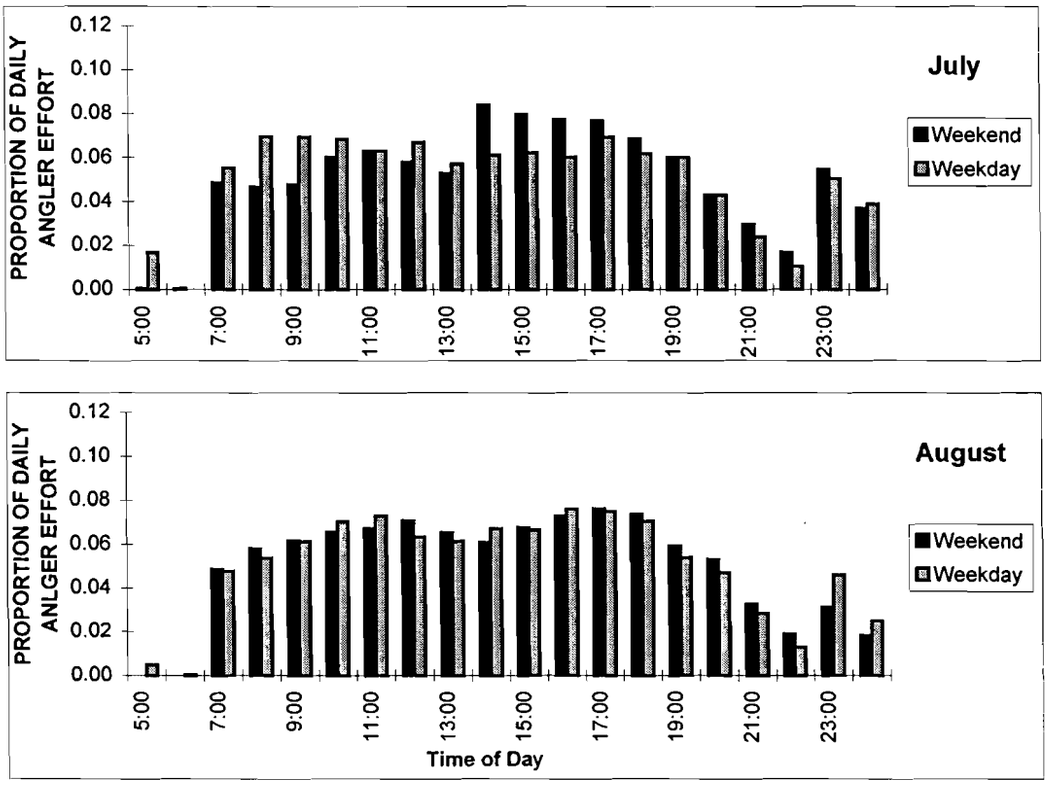


Figure 2a. Hourly effort profiles by month and day type in the 1997 lower Fraser River sport fishery, Region 3.

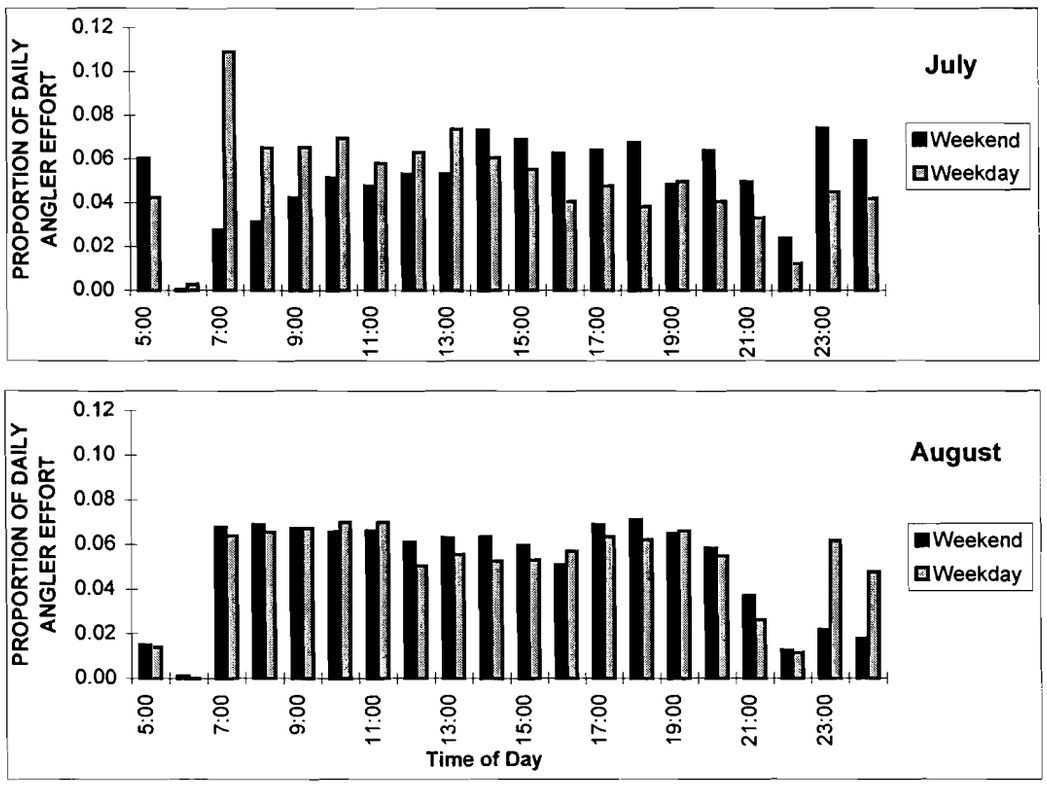


Figure 2b. Hourly effort profiles by month and day type in the 1997 lower Fraser River sport fishery, Region 4.

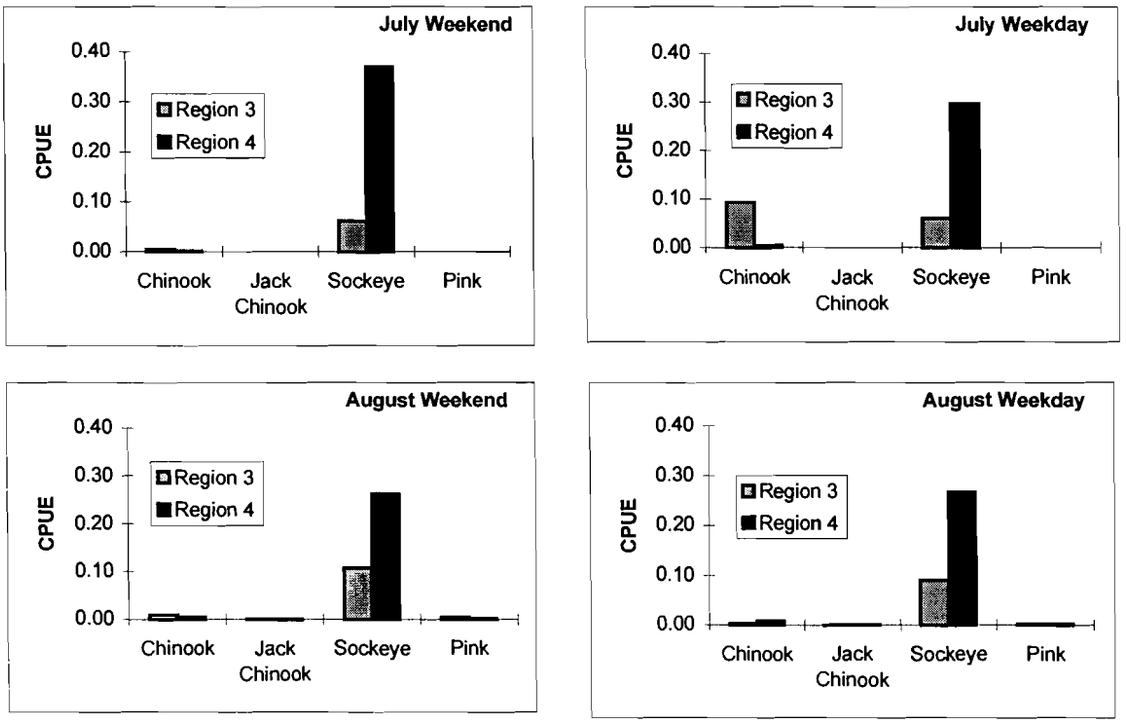


Figure 3. CPUE by species, month, day type and region in the 1997 lower Fraser River sport fishery.

0.0013, respectively.

Average weekend and weekday CPUEs for adult chinook for the study period were 0.0052 and 0.0065, respectively. Most of the adult chinook catch was harvested, with weekend and weekday HPUEs averaging 0.0052 and 0.0059, respectively. The peak weekend and weekday CPUEs for adult chinooks occurred in Region 3 during August (0.0092) and July (0.0100), respectively.

Average weekend and weekday CPUE for jack chinook were both 0.0005. Most of the jack chinook catch was harvested, with weekend and weekday HPUEs averaging 0.0005 and 0.0004, respectively. The peak weekend CPUE for chinook jacks occurred in Region 3 during August (0.0014) and the peak weekday CPUE also occurred during August, but in Region 4 (0.0012).

Sockeye CPUE averaged 0.1896 for the study period. On average, more than half of the sockeye caught were harvested (average HPUE was 0.1005). The peak weekend and weekday CPUEs for sockeye both occurred in Region 4 during July (0.3702 and 0.2977, respectively).

Pink CPUE averaged 0.0031 during August; no pinks were caught during July. There was no significant difference between pink CPUEs in Region 3 and Region 4.

## TOTAL CATCH

A total catch of 1,693 adult chinook, 178 chinook jacks, 51,222 sockeye and 547 pink salmon, representing 98% of the total sport catch, was estimated for the study area from July through August. Monthly harvest and release totals for all species are detailed in Table 2. Harvest and release totals by month and region are detailed in Appendix 4.

Chinook were caught throughout the study period, with both the adult and the jack catch peaking in Region 4 during August (46% and 60% of the total survey chinook

Table 2. Harvest, release and angler effort by species and month in the 1997 lower Fraser River sport fishery, Regions 3 and 4.

| | July | August | Total |
|---|---|---|---|
| # of interviews | 1,940 | 3,335 | 5,275 |
| # of overflights | 8 | 9 | 17 |
| ANGLER EFFORT | | | |
| Estimated effort (hrs) | 85,636 | 175,238 | 260,874 |
| Estimated effort (days) | 17,391 | 40,469 | 57,860 |
| Average angler day (hrs) | 4.9 | 4.3 | 4.8 |
| ESTIMATED HARVEST | | | |
| Chinook | 510 | 1,028 | 1,538 |
| Jack Chinook | 0 | 149 | 149 |
| Sockeye | 6,749 | 23,709 | 30,458 |
| Pink | 0 | 484 | 484 |
| Coho | 0 | 0 | 0 |
| Chum | 0 | 0 | 0 |
| Steelhead | 0 | 0 | 0 |
| Trout | 0 | 9 | 9 |
| Sturgeon | 0 | 0 | 0 |
| Other | 10 | 41 | 51 |
| ESTIMATED RELEASE | | | |
| Chinook | 18 | 137 | 154 |
| Jack Chinook | 0 | 29 | 29 |
| Sockeye | 8,254 | 12,510 | 20,764 |
| Pink | 0 | 63 | 63 |
| Coho | 0 | 5 | 5 |
| Chum | 0 | 0 | 0 |
| Steelhead | 16 | 9 | 26 |
| Trout | 0 | 145 | 145 |
| Sturgeon | 242 | 329 | 571 |
| Other | 71 | 30 | 100 |

catch, respectively). On average, 54% of adult chinook and 60% of jacks were caught in Region 4 . A total of 90% of the combined chinook catch was harvested.

Eighty-two percent of the sockeye caught were in Region 4, 24.5% during July and 58.5% during August. Seventy percent of all sockeye caught in the study area were caught during August. A total of 59% of the sockeye catch was harvested.

One hundred percent of the pink catch occurred during August, 36% in Region 3 and the other 64% in Region 4. A total of 88% of the pink catch was harvested.

**MARKED CATCH**

Of the 1,835 fish examined during the study, only 1 (0.05%) was marked with an adipose fin clip or any other mark. Marked fish estimates are presented in Table 3. Interview staff did not record mark data for released fish, as angler mark recognition was not considered reliable.

Table 3. Estimated marks by species and month in the 1997 lower Fraser River sport fishery, Regions 3 and 4.

| | July | August | Total |
|---|---|---|---|
| Chinook | 7 | 0 | 7 |
| Jack Chinook | 0 | 0 | 0 |
| Sockeye | 0 | 0 | 0 |
| Pink | 0 | 0 | 0 |
| Coho | 0 | 0 | 0 |
| Steelhead | 0 | 0 | 0 |
| Trout | 0 | 0 | 0 |
| Sturgeon | 0 | 0 | 0 |
| Other | 0 | 0 | 0 |

## ANGLER CHARACTERISTICS

Weekly and site-specific angler characteristics are detailed in Appendix 1. Anglers changed their fishing location, as well as target species, in accordance with changes in river conditions, species composition, species abundance and fishery openings.

The majority of anglers in the 1997 lower Fraser River sport fishery fished from shore, or from mid-channel gravel bars, as they became exposed. Many anglers launched boats at the access points and traveled to other bars, where they fished from shore. Some fished directly from their boats, particularly during July when the water was high.

Ninety-nine percent of the anglers interviewed were targeting either adult chinook or sockeye salmon. During July, 35% of the anglers targeted adult chinook, with 64% targeting sockeye. In August, the proportion of anglers targeting adult chinook dropped to 4% and 95% of the anglers targeted sockeye.

Ninety-nine percent of the anglers interviewed (1,205) used lures as their gear type, with the other 1% using either bait (3), bait and lure combinations (5) or flies (4). Mean angler trip length over the study period was 4.8 hours. On average, trips were longer in July (5.2 hours) than in August (4.7 hours).

## DISCUSSION

As previously explained, Region 4 boundaries were reduced during the 1996 lower Fraser River sport fishery survey. As a result, any comparisons between the 1996 and 1997 fisheries will focus on Region 3 only, unless specifically stated otherwise.

## MIGRATION TIMING AND ABUNDANCE

In the 1997 lower Fraser River sport fishery survey, monthly and regional catch patterns, along with effort, were associated with salmon migration timing and abundance.

The 1997 test fishery index indicated that there were low numbers of chinook in the lower Fraser River during July; the run hit one peak in late June and a much larger one in mid-August (Figure 4). This bimodal distribution was probably the result of the summer rainfall patterns, and a long dry spell in July. The low numbers of chinook in the river during July, along with a decreased proportion of anglers targeting chinook resulted in a low catch of adult chinook in July 1997 (395), as compared to 1995 and 1996 (2,479 and 1,163, respectively). The August chinook catch was also relatively low (451) compared to 1996 (1027), despite August 1997 average test fishery index values approximately 8.5 times higher than the 1996 values. Therefore, we concluded that the low August catch resulted from the low proportion of anglers targeting chinook (8% in 1997, compared to 44% in 1996).

Sockeye dominated the catch throughout the 1997 survey, as 1997 was a peak year in the Fraser River sockeye cycle. Sockeye catch peaked in August, accounting for 94% of the total sport catch for that month. The July sockeye catch (2,965) was up dramatically from both 1995 and 1996 (which had catches of 37 and 51, respectively), largely due to anglers beginning to target sockeye during July (50% in 1997 as compared with 0% in both 1995 and 1996). The catch results also reflect the larger numbers of sockeye in the river throughout the season.

Pink salmon represented only 1% of the total season sport catch; all of this catch took place after August 10, when pinks began to migrate through lower Fraser River. There didn't appear to be a significant change in pink CPUE from 1995 to 1997, but this conclusion is based on comparing data from one month and one region only, and so may not be accurate.

Changes in species abundance also affected angling effort distribution on the lower Fraser River. In July, approximately 57% of the effort within the study area occurred in Region 3, which contained prime chinook angling sites (i.e., Wellington bar). In late July and August, as the number of sockeye in the lower Fraser River increased and the sockeye fishery opened, effort began to shift to Region 4 (approximately 65% of the total effort for August) and sites known to produce high numbers of sockeye salmon, such as Gill bar and Ferry Island. As mentioned previously, the proportion of anglers targeting adult chinook dropped from 35% in July to 4% in August; conversely, the proportion of anglers targeting sockeye rose from 64% to 95%.

## ENVIRONMENTAL CONDITIONS

Interannual variation in environmental conditions can also impact the effectiveness of a fishery. Schubert and Whyte (1992) have shown that river level can affect both angler effort and success. High river levels flood the most effective 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. Although the chinook fishery was already open at the start of the survey on July 1, water levels were still high (Figure 4), flooding many of the traditional fishing bars (i.e., Wellington and Bowmans).

The river level was higher in July 1997 than in 1996, particularly during the latter half of the month (Figure 4). The high water levels may have deterred anglers and resulted in the decrease in angling effort from 50,308 hours in July 1996 to 48,839 hours in July 1997. Angling effort during July was significantly down in both 1996 and 1997, from 81,570 hours in 1995, when the water level was much lower (Figure 4).

As mentioned previously, the bimodal distribution of the chinook index, which indicated low numbers of chinook in the lower river during July, was related to the summer rainfall patterns and a long dry stretch in July. The catch rates for anglers targeting chinook were likely higher during June, when the fishery was open but not surveyed.

In addition to the low numbers of chinook in the river during July, high water may also have made the chinook less vulnerable to anglers. Walter et al. (1998) found that chinook HPUEs for June and July were significantly lower in 1996 than in 1995, and attributed this to the high water levels in 1996. Similarly, chinook weekend and weekday HPUEs for July 1997 (0.0050 and 0.0094, respectively) were significantly lower than in 1996 (0.0199 and 0.0223).

In contrast, August water levels were low enough to expose prime fishing bars during peak sockeye migration. These conditions resulted in a highly effective sockeye fishery, with weekday HPUEs for Region 3 and Region 4 of 0.0732 and 0.1812, respectively. Despite high water levels, the sockeye fishery was also very effective in July, as mentioned previously, with weekday HPUEs for Region 3 and Region 4 of 0.0378 and 0.1779, respectively. While July effort was down somewhat from 1996, August effort increased by at least 13% (from 53,926 hours in 1996 to 61,938 hours in 1997), perhaps as a result of the high success rates anglers were experiencing in the sockeye fishery.

## FISHERY REGULATIONS

Angling effort was also affected by openings and closures in the fishery. For example, overflight rod counts increased substantially when the sockeye fishery opened (182 rods counted on Sunday, July 6, before the sockeye fishery, compared to 353 rods on Saturday, July 12, during the sockeye fishery). Schubert (1992a) noted 89% of anglers were targeting chinook, with

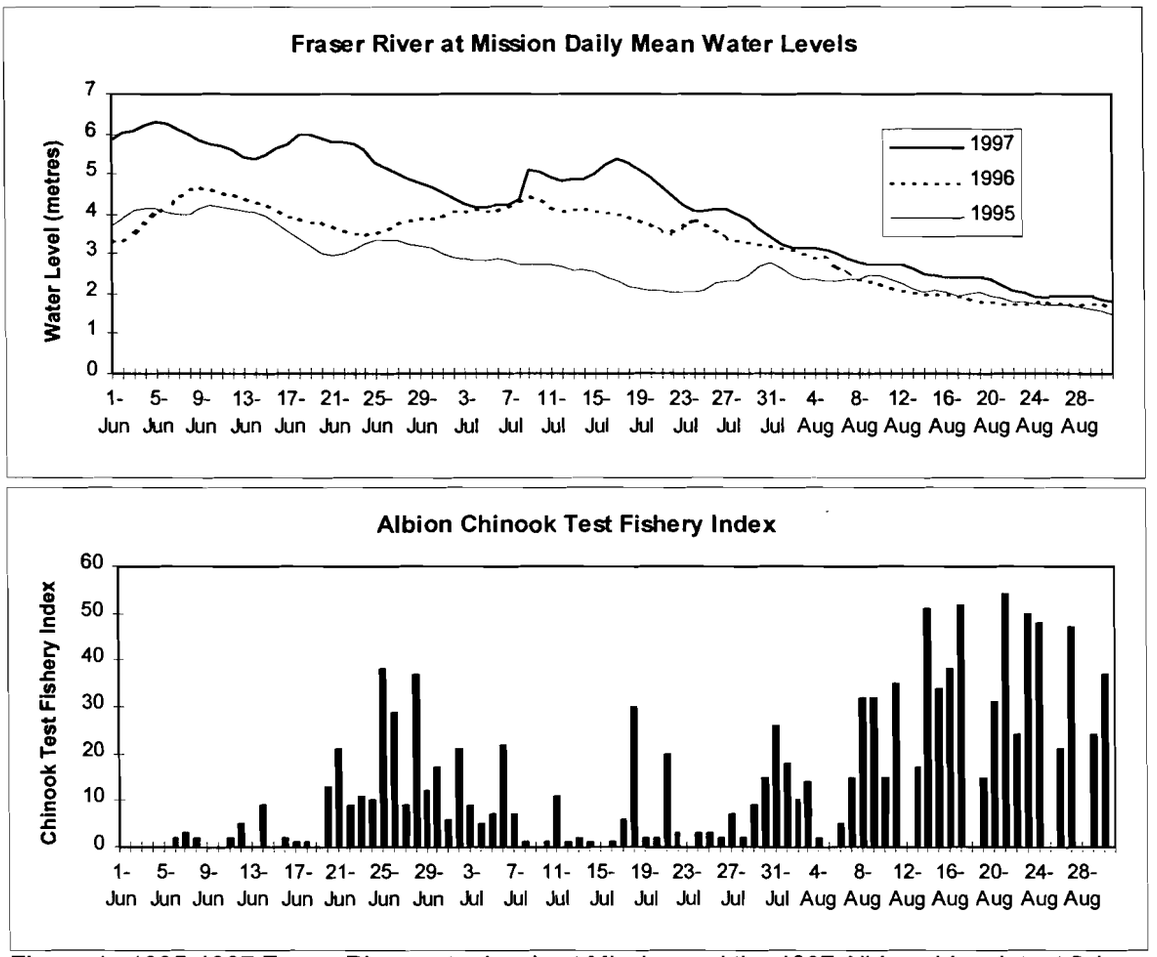


Figure 4. 1995-1997 Fraser River water levels at Mission and the 1997 Albion chinook test fishery index.

increased angler effort at the initiation of special fisheries as well.

The opening of the sockeye fishery in July prompted the majority of anglers to change their target species from chinook to sockeye. Prior to July 12, approximately 10% of anglers were targeting sockeye; after July 12, 91% targeted sockeye. Despite a sockeye retention ban between July 19 and July 24, 67% of anglers still targeted sockeye, probably because sockeye were so abundant and chinook relatively few in the river.

Few sockeye were harvested during the non-retention periods of July 1 to 11 and July 19-24; 98% of the total sockeye catch was released during each of these periods.

The opening of the pink salmon fishery on July 19 did not appear to affect angler effort; none of the anglers interviewed during the survey listed pink salmon as their target species.

## PROPORTION OF ANGLERS AT SURVEY SITES AND SURVEY EFFICIENCY

In previous lower Fraser River sport fishery surveys, the proportion of anglers at survey sites was assessed to determine whether the assumption that either the interview sites were representative of the entire study area, or the proportion of angler effort

occurring at the interview sites was sufficient to make HPUE estimates insensitive to effort occurring at non-interview sites was satisfied (Schubert 1992a, 1995). It has been sug-

gested that if the interview sites account for a large proportion (>50%) of the total angler effort, the difference between survey sites and the remainder of the fishery would have to be large to appreciably affect effort estimates (Schubert, 1995). Bratty et al. (1998) found that effort at survey sites during the 1995 survey was high in June and July (68% and 56%, respectively) and somewhat lower during August (42%) and concluded that there may have been more error associated with the August estimate than with the June and July estimates. Walter et al. (1998) chose not to evaluate effort distribution for the 1996 survey, since the study design and methodology were consistent with those of the 1995 survey.

For the 1997 survey, no attempt will be made to quantify the proportion of effort occurring at non-survey sites. Using overflight rod counts to determine effort distribution is misleading and underestimates the proportion of effort essentially occurring at survey sites, since many anglers use boats to access and fish at other bars, but enter and exit the river via the access point survey areas. This was particularly common in Region 3, and the assumptions associated with the study design were not believed to have been violated in this region. In Region 4, however, an unexpectedly high proportion of effort took place at Landstrom bar; this site was directly accessed and not surveyed. More error may therefore be associated with the Region 4 estimates, particularly during August, when Region 4 received a greater proportion of the total study area effort.

Survey efficiency (the proportion of the total estimated effort that was interviewed) has averaged between 9% and 11% in previous lower Fraser River sport fishery surveys, comparing favourably to surveys in other systems (Bratty et al., 1998). In 1997, survey efficiency averaged 9.8%.

## EFFORT DISTRIBUTION

Examining effort distribution was not a primary objective of the 1997 survey. Nonetheless, angler distribution was monitored from overflights conducted one weekday and one weekend day a month. Due to budget constraints, overflights outside the study area were limited to Region 2 (Port Mann Bridge to Sumas River). It was found that effort was consistently greater inside the study area than outside. For example, for the two July overflights that extended into Region 2, the total rod count for Regions 3 and 4 was 182, whereas Region 2 had a total count of 55.

Due to changes in region boundaries and in overflight patterns, effort distribution was not compared extensively to previous fisheries. In general, however, Bratty et al. (1998) also found the majority of effort taking place within, rather than outside, the study area (Regions 3 and 4).

## RECOMMENDATIONS

Due to increased population levels in the Lower Mainland, there is a common belief that sport fishing has substantially increased in the lower Fraser River area. Therefore, we recommend that the survey be extended to cover areas and species currently not covered. Specifically:

1. Extend the survey coverage to include the area below the confluence of the Sumas River to the mouth of the Fraser River.

2. Extend the survey coverage to include the months June through November in order to estimate sport catch of chinook, coho, sockeye, pink salmon and steelhead.

3. Extend the survey coverage to the lower Fraser River tributary fisheries, such as the Chilliwack/Vedder sport fishery, that target coho salmon.

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

## SUMMARY

1. The 1997 July chinook catch was down considerably from 1996, due to a decreased proportion of effort directed at chinook and low chinook abundance in the river. In July 1997, a total of 395 chinook were caught in

Region 3, compared with 1,184 chinook caught in the same month and region in 1996. In August, chinook abundance in the river increased substantially, but they were not targeted and catch rates remained low; 451 chinook were caught in Region 3 during August 1997, compared with 1,027 chinook caught in the same month and region in 1996.

2. Catch rates for sockeye increased dramatically from 1996 to 1997, due to their increased abundance in the river and an increased proportion of angler effort directed at the species. The Region 3 sockeye catch for July and August 1997 was 9,108, compared with 5,287 sockeye caught in the same months and region in 1996.

3. Overall, angler effort was up from 1996, although the increase is difficult to quantify due to changes in region boundaries. Angler effort in Region 3 increased from 104,234 hours in July and August 1996 to 110,777 hours in 1997. The proportion of angler effort directed at chinook decreased from 1996 to 1997. In 1997, 35% and 4% of anglers targeted chinook in July and August, respectively, compared with 99.7% and 28% targeting chinook in the same months of 1996.

## ACKNOWLEDGMENTS

Over the course of the study period, interviews were conducted by the field staff of Scott Resource Services Inc. Thank you T. Gjernes and B. Otway for reviewing the manuscript. Special thanks to all the anglers who willingly provided both time and information to the 1997 lower Fraser River sport fishery survey, and also to the staff at Air Southwest for their continued high standards for overflights.

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# APPENDICES

Appendix 1. Month-specific interview responses in the 1997 lower Fraser River sport fishery survey.

| | | Englebrich Bar | | | Gill Bar | | | Ferry Island |
|---|---|---|---|---|---|---|---|---|
| | | July | August | Total | July | August | Total | August/Total |
| **Number of Interviews** | | 1227 | 1621 | 2848 | 713 | 497 | 1210 | 1217 |
| **Mean Angler Day Length** | | | | | | | | |
| - All Anglers | Hours | 5.2 | 5.1 | 5.2 | 4.6 | 3.9 | 4.3 | 4.0 |
| - Complete Trip Interviews | Number | 1213 | 1595 | 2808 | 558 | 446 | 1004 | 1117 |
| | Hours | 5.2 | 5.1 | 5.2 | 4.1 | 3.7 | 4.0 | 3.9 |
| - Incomplete Trip Interviews | Number | 14 | 26 | 40 | 155 | 51 | 206 | 100 |
| | Hours | 5.0 | 7.4 | 6.6 | 6.4 | 5.4 | 6.2 | 5.5 |
| **Target Species** | None | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Chinook | 590 | 128 | 718 | 86 | 5 | 91 | 5 |
| | Coho | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Chum | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Pink | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Sockeye | 611 | 1475 | 2086 | 625 | 492 | 1117 | 1205 |
| | Steelhead | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Trout | 8 | 5 | 13 | 0 | 0 | 0 | 0 |
| | Sturgeon | 18 | 13 | 31 | 0 | 0 | 0 | 7 |
| | Jack Chinook | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Other | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **Gear** | Bait | 24 | 16 | 40 | 0 | 0 | 0 | 3 |
| | Lure | 1199 | 1604 | 2803 | 705 | 496 | 1201 | 1205 |
| | Bait and Lure | 1 | 0 | 1 | 4 | 1 | 5 | 5 |
| | Fly | 3 | 1 | 4 | 4 | 0 | 4 | 4 |
| **Inspection of Catch** | Number | 209 | 839 | 1048 | 200 | 112 | 312 | 475 |
| | Number Correct | 209 | 836 | 1045 | 200 | 112 | 312 | 475 |

Appendix 2. Daily angler counts (from overflights) in the 1997 lower Fraser sport fishery survey.

| Month | Date | Day of Week | Region 2 | Region 3 | Region 4 | Regions 3 & 4 Total |
|---|---|---|---|---|---|---|
| **July** | 7/1/97 | Tues | - | 115 | 44 | 159 |
| | 7/6/97 | Sun | - | 122 | 60 | 182 |
| | 7/9/97 | Wed | - | 46 | 21 | 67 |
| | 7/12/97 | Sun | - | 212 | 141 | 353 |
| | 7/16/97 | Wed | - | 131 | 135 | 265 |
| | 7/19/97 | Sat | 25 | 67 | 66 | 132 |
| | 7/21/97 | Mon | 30 | 24 | 25 | 48 |
| | 7/28/97 | Mon | - | 116 | 92 | 208 |
| | weekday | mean | N/A | 79 | 68 | 147 |
| | | % | N/A | 38% | 47% | 42% |
| | weekend | mean | N/A | 129 | 77 | 206 |
| | | % | N/A | 62% | 53% | 58% |

| Month | Date | Day of Week | Region 2 | Region 3 | Region 4 | Regions 3 & 4 Total |
|---|---|---|---|---|---|---|
| **August** | 8/1/97 | Fri | - | 168 | 114 | 282 |
| | 8/3/97 | Sun | - | 237 | 183 | 420 |
| | 8/9/97 | Sat | 49 | 103 | 137 | 240 |
| | 8/12/97 | Tues | - | 106 | 113 | 219 |
| | 8/16/97 | Sat | - | 167 | 209 | 376 |
| | 8/19/97 | Tues | 58 | 56 | 201 | 257 |
| | 8/23/97 | Sat | - | 201 | 366 | 567 |
| | 8/27/97 | Wed | - | 103 | 240 | 343 |
| | 8/31/97 | Sun | - | 281 | 416 | 697 |
| | weekday | mean | N/A | 88 | 185 | 273 |
| | | % | N/A | 31% | 44% | 39% |
| | weekend | mean | N/A | 193 | 237 | 430 |
| | | % | N/A | 69% | 56% | 61% |

- No count was done in this region

Appendix 3. Mean hourly proportion of angler effort in the 1997 lower Fraser River sport fishery survey by region, month and day type.

| Region 3 | July | | August | |
|---|---|---|---|---|
| Hour | Weekend | Weekday | Weekend | Weekday |
| 5:00 | 0.00057 | 0.01688 | 0.00000 | 0.00479 |
| 6:00 | 0.00057 | 0.00000 | 0.00000 | 0.00048 |
| 7:00 | 0.04868 | 0.05546 | 0.04861 | 0.04775 |
| 8:00 | 0.04656 | 0.06979 | 0.05815 | 0.05389 |
| 9:00 | 0.04762 | 0.06933 | 0.06178 | 0.06140 |
| 10:00 | 0.06031 | 0.06840 | 0.06541 | 0.07026 |
| 11:00 | 0.06349 | 0.06332 | 0.06723 | 0.07299 |
| 12:00 | 0.05820 | 0.06702 | 0.07087 | 0.06344 |
| 13:00 | 0.05291 | 0.05731 | 0.06541 | 0.06140 |
| 14:00 | 0.08412 | 0.06124 | 0.06078 | 0.06698 |
| 15:00 | 0.07976 | 0.06240 | 0.06760 | 0.06667 |
| 16:00 | 0.07746 | 0.06008 | 0.07291 | 0.07618 |
| 17:00 | 0.07682 | 0.06933 | 0.07632 | 0.07504 |
| 18:00 | 0.06857 | 0.06193 | 0.07359 | 0.07049 |
| 19:00 | 0.06031 | 0.06055 | 0.05928 | 0.05401 |
| 20:00 | 0.04317 | 0.04298 | 0.05315 | 0.04718 |
| 21:00 | 0.02984 | 0.02403 | 0.03271 | 0.02842 |
| 22:00 | 0.01714 | 0.01063 | 0.01908 | 0.01308 |
| 23:00 | 0.05479 | 0.05065 | 0.03127 | 0.04602 |
| 24:00 | 0.03701 | 0.03888 | 0.01818 | 0.02493 |

| Region 4 | July | | August | |
|---|---|---|---|---|
| Hour | Weekend | Weekday | Weekend | Weekday |
| 5:00 | 0.06027 | 0.04236 | 0.01501 | 0.01397 |
| 6:00 | 0.00059 | 0.00279 | 0.00123 | 0.00030 |
| 7:00 | 0.02763 | 0.10898 | 0.06766 | 0.06387 |
| 8:00 | 0.03131 | 0.06539 | 0.06893 | 0.06559 |
| 9:00 | 0.04237 | 0.06539 | 0.06724 | 0.06732 |
| 10:00 | 0.05158 | 0.06954 | 0.06575 | 0.06991 |
| 11:00 | 0.04789 | 0.05812 | 0.06618 | 0.06991 |
| 12:00 | 0.05342 | 0.06331 | 0.06109 | 0.05049 |
| 13:00 | 0.05342 | 0.07369 | 0.06321 | 0.05567 |
| 14:00 | 0.07322 | 0.06072 | 0.06345 | 0.05243 |
| 15:00 | 0.06907 | 0.05553 | 0.05939 | 0.05299 |
| 16:00 | 0.06300 | 0.04048 | 0.05090 | 0.05696 |
| 17:00 | 0.06410 | 0.04774 | 0.06893 | 0.06344 |
| 18:00 | 0.06742 | 0.03840 | 0.07105 | 0.06214 |
| 19:00 | 0.04863 | 0.04982 | 0.06469 | 0.06603 |
| 20:00 | 0.06410 | 0.04048 | 0.05833 | 0.05502 |
| 21:00 | 0.04973 | 0.03321 | 0.03712 | 0.02632 |
| 22:00 | 0.02395 | 0.01245 | 0.01273 | 0.01165 |
| 23:00 | 0.07431 | 0.04516 | 0.02201 | 0.06181 |
| 24:00 | 0.06846 | 0.04190 | 0.01810 | 0.04785 |

Appendix 4. Estimated angler effort, harvest and release by month and region in the 1997 lower Fraser River sport fishery.

| | July | | | August | | |
|---|---|---|---|---|---|---|
| | Region 3 | Region 4 | Total | Region 3 | Region 4 | Total |
| # of interviews | 1,227 | 713 | 1,940 | 1,621 | 1,714 | 3,335 |
| # of overflights | 8 | 8 | 8 | 9 | 9 | 9 |
| ANGLER EFFORT | | | | | | |
| Estimated effort (hours) | 48,839 | 36,797 | 85,636 | 61,938 | 113,300 | 175,238 |
| Estimated effort (days) | 9392 | 7,999 | 17,391 | 12,144 | 28,325 | 40,469 |
| Average angler day (hours) | 5.2 | 4.6 | 4.9 | 5.1 | 4.0 | 4.3 |
| ESTIMATED HARVEST | | | | | | |
| Chinook | 377 | 133 | 510 | 359 | 668 | 1,028 |
| Jack Chinook | 0 | 0 | 0 | 72 | 77 | 149 |
| Sockeye | 1,798 | 4,951 | 6,749 | 4,754 | 18,955 | 23,709 |
| Pink | 0 | 0 | 0 | 197 | 287 | 484 |
| Coho | 0 | 0 | 0 | 0 | 0 | 0 |
| Chum | 0 | 0 | 0 | 0 | 0 | 0 |
| Steelhead | 0 | 0 | 0 | 0 | 0 | 0 |
| Trout | 0 | 0 | 0 | 9 | 0 | 9 |
| Sturgeon | 0 | 0 | 0 | 0 | 0 | 0 |
| Other | 0 | 10 | 10 | 41 | 0 | 41 |
| ESTIMATED RELEASE | | | | | | |
| Chinook | 18 | 0 | 18 | 20 | 117 | 137 |
| Jack Chinook | 0 | 0 | 0 | 0 | 29 | 29 |
| Sockeye | 1,167 | 7,087 | 8,254 | 1,389 | 11,121 | 12,510 |
| Pink | 0 | 0 | 0 | 0 | 63 | 63 |
| Coho | 0 | 0 | 0 | 0 | 5 | 5 |
| Chum | 0 | 0 | 0 | 0 | 0 | 0 |
| Steelhead | 0 | 016 | 016 | 9 | 0 | 9 |
| Trout | 0 | 0 | 0 | 145 | 0 | 145 |
| Sturgeon | 232 | 10 | 242 | 271 | 58 | 329 |
| Other | 43 | 28 | 71 | 15 | 15 | 30 |

Appendix 5. Mean monthly HPUE, RPUE and CPUE by region, month, day type and species in the 1997 lower Fraser River sport fishery survey.

**Region 3**

**Weekend**

| | Month | Chinook | Jack chinook | Coho | Chum | Pink | Sockeye | Steelhead | Trout | Sturgeon | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|
| HPUE | July | 0.00504 | 0 | 0 | 0 | 0 | 0.03516 | 0 | 0.00000 | 0 | 0 |
| | August | 0.00891 | 0.00138 | 0 | 0 | 0.00406 | 0.07999 | 0 | 0.00013 | 0 | 0 |
| RPUE | July | 0 | 0 | 0 | 0 | 0 | 0.02636 | 0 | 0 | 0.00887 | 0.00073 |
| | August | 0.00031 | 0 | 0 | 0 | 0 | 0.02733 | 0.00013 | 0 | 0.00125 | 0 |
| Total | July | 0.00504 | 0 | 0 | 0 | 0 | 0.06152 | 0 | 0 | 0.00887 | 0.00073 |
| (CPUE) | August | 0.00922 | 0.00138 | 0 | 0 | 0.00406 | 0.10732 | 0.00013 | 0.00013 | 0.00125 | 0 |

**Weekday**

| | Month | Chinook | Jack chinook | Coho | Chum | Pink | Sockeye | Steelhead | Trout | Sturgeon | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|
| HPUE | July | 0.00941 | 0 | 0 | 0 | 0 | 0.03784 | 0 | 0 | 0 | 0 |
| | August | 0.00241 | 0.00093 | 0 | 0 | 0.00220 | 0.07321 | 0 | 0.00018 | 0 | 0.00140 |
| RPUE | July | 0.00059 | 0 | 0 | 0 | 0 | 0.02235 | 0 | 0 | 0.00216 | 0.00098 |
| | August | 0.00033 | 0 | 0 | 0 | 0 | 0.01706 | 0.00018 | 0.00490 | 0.00778 | 0.00051 |
| Total | July | 0.01000 | 0 | 0 | 0 | 0 | 0.06019 | 0 | 0 | 0.00216 | 0.00098 |
| (CPUE) | August | 0.00274 | 0.00093 | 0 | 0 | 0.00220 | 0.09027 | 0.00018 | 0.00508 | 0.00778 | 0.00191 |

**Region 4**

**Weekend**

| | Month | Chinook | Jack chinook | Coho | Chum | Pink | Sockeye | Steelhead | Trout | Sturgeon | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|
| HPUE | July | 0.00165 | 0 | 0 | 0 | 0 | 0.07115 | 0 | 0 | 0 | 0 |
| | August | 0.00481 | 0.00065 | 0 | 0 | 0.00200 | 0.14787 | 0 | 0 | 0 | 0 |
| RPUE | July | 0 | 0 | 0 | 0 | 0 | 0.29907 | 0 | 0 | 0 | 0.00186 |
| | August | 0 | 0 | 0.00011 | 0 | 0.00011 | 0.11425 | 0 | 0 | 0 | 0 |
| Total | July | 0.00165 | 0 | 0 | 0 | 0 | 0.37022 | 0 | 0 | 0 | 0.00186 |
| (CPUE) | August | 0.00481 | 0.00065 | 0.00011 | 0 | 0.00211 | 0.26212 | 0 | 0 | 0 | 0 |

**Weekday**

| | Month | Chinook | Jack chinook | Coho | Chum | Pink | Sockeye | Steelhead | Trout | Sturgeon | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|
| HPUE | July | 0.00497 | 0 | 0 | 0 | 0 | 0.17790 | 0 | 0 | 0 | 0.00045 |
| | August | 0.00667 | 0.00071 | 0 | 0 | 0.00292 | 0.18118 | 0 | 0 | 0 | 0 |
| RPUE | July | 0 | 0 | 0 | 0 | 0 | 0.11981 | 0.00075 | 0 | 0.00045 | 0 |
| | August | 0.00177 | 0.00044 | 0 | 0 | 0.00088 | 0.08666 | 0 | 0 | 0.00088 | 0.00022 |
| Total | July | 0.00497 | 0 | 0 | 0 | 0 | 0.29771 | 0.00075 | 0 | 0.00045 | 0.00045 |
| (CPUE) | August | 0.00844 | 0.00115 | 0 | 0 | 0.00380 | 0.26784 | 0 | 0 | 0.00088 | 0.00022 |