

Lower Skeena River Angling Creel Survey 2012

FINAL REPORT



Prepared for:

Pacific Salmon Commission
Vancouver, BC

Fisheries and Oceans Canada
Prince Rupert, BC

Kitsumkalum First Nation
Terrace, BC

Prepared by:

Dave Robichaud, Anita C. Blakley, and Karl K. English

LGL Limited
environmental research associates
9768 Second Street
Sidney, BC, V8L 3Y8



environmental research associates

EXECUTIVE SUMMARY

Catches of Chinook salmon by the Lower Skeena River sport fishery can be substantial. Chinook salmon catch was estimated to have exceeded 6,700 fish in 2003, but appeared to have dropped to less than 3,000 fish in 2010-2011. Fishing effort in 2010 and 2011 was estimated to be half of that reported in 2003. This report documents the results from survey efforts conducted from June to September, 2012. The three objectives for this study were: 1) to provide monthly catch estimates (June to September) for all salmon species caught in the sport fishery on the waters of the Skeena River downstream of Terrace; 2) to inspect as many Chinook salmon as possible and record the incidence of adipose fin clips; and 3) to collect length and age data of Chinook salmon. The design for the 2012 lower Skeena creel survey was similar to that in 2010 and 2011, and was based on similar recreational fishery surveys conducted on the Skeena, Nass and Peace rivers.

The 2012 creel survey produced catch estimates with relatively large standard errors resulting from small catches and high variability in catch rates. Sockeye salmon was the most abundantly caught fish (5,079 fish caught, SE = 804), the most retained species (4,235 fish harvested, SE = 688) and the most likely species to be retained (83% of the total Sockeye salmon catch was retained). Steelhead was the second most commonly caught species (3,446, SE = 421), and was the least frequently harvested species, with only 17 fish harvested (0.5% of total Steelhead catch was retained). The harvested Steelhead estimate was based on 3 interviews during which 12 anglers reported a total of 3 retained Steelhead, likely because they were unaware of the regulations or could not distinguish between Steelhead and other species. Pink and Coho salmon were the next most frequently caught species (Pink: 1,848, SE = 902; Coho: 1,825, SE = 308). Pink salmon were harvested 12% of the time, and Coho salmon 68%. Overall Chinook salmon catches were 571 adults (SE = 108) and 387 jacks (SE = 58), with 74% and 66% harvest rates. Consistent with the fishing regulations, no Chinook salmon were harvested in Stratum One (Ferry Island to Lakelse) on or after 7 August. Angling effort and catch differed significantly among months.

Average Chinook salmon CPE was similar in 2003, 2010, 2011 and 2012. However, total angler effort estimates for the June-August period in 2010 to 2012 were $\leq 42\%$ of the comparable effort estimate for 2003. As a result, thus total catches from 2010 to 2012 were considerably reduced in comparison to that reported for 2003. In contrast, catches and catch rates of Coho salmon, Sockeye salmon and Steelhead CPE estimates have increased in each year of study. Compared to estimates from 2003, CPE estimates from 2012 had increased by 710%, 749%, and 478% for Coho salmon, Sockeye salmon and Steelhead, respectively.

Despite the general success of the survey implementation, the deficiencies with Chinook salmon biosampling that were observed in 2011 were not corrected in 2012. The importance of biosampling must be emphasized to crews prior to the next creel survey period and these data must be submitted to the field crew supervisor on a weekly basis along with the other survey data forms.

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INTRODUCTION

Catches of Chinook salmon by the Lower Skeena River sport fishery can be substantial when conditions are favorable for anglers. Estimates of the catch of Chinook salmon by the sport fishery in the Skeena were sporadic prior to 2010. Creel surveys were conducted over most of the Chinook salmon fishing season in 1995, 2001, and 2003. The catch of Chinook salmon in the Lower Skeena sport fishery was estimated to have exceeded 6,700 fish in 2003 (Tallman 2004). In 2010, the Pacific Salmon Commission (PSC) Northern Endowment Fund supported the development and implementation of a new series of creel surveys and angling effort counts to provide reliable estimates of angler catches of salmon and Steelhead between early June and late September each year, with emphasis on the Chinook salmon catch. Surveys conducted in 2010-2011 documented a substantial reduction in fishing effort (103,806 and 97,544 angler-hours in 2010 and 2011, respectively) from that estimated for 2003 (203,587 angler-hours), which may have been the result of poorer fishing conditions and a lower abundance of Chinook salmon. The resulting Chinook salmon catch estimates for 2010 and 2011 were 2,720 (Robichaud and English 2011) and 2,540 (Robichaud and English 2012), respectively.

In 2012, a third year of creel assessments was conducted. The 2012 survey was based on the 2011 study design. In all three years of study, we used the same spatial strata as the 2003 creel survey program conducted by J.O. Thomas in order to facilitate comparisons between the current and results and those from or before 2003.

This report documents the results from survey efforts conducted from early June to late September 2012. The report describes the methods used to derive estimates of angler activity pattern, catch and fishing effort.

SCOPE

The geographic scope of the lower Skeena creel survey study in 2012 was the same as in the previous two years, i.e., from Ferry Island near Terrace BC to the Kwinitsa boat launch near the mouth of the Skeena River, a distance of 150 km (Figure 1).

For the purposes of data collection and analysis, the study area was divided into three geographic strata (called “river zones”), selected to align with previous surveys. These strata were:

- 1) Terrace to the Lakelse Confluence;
- 2) the Lakelse Confluence to the Exstew Confluence; and
- 3) the Exstew Confluence to the Kwinitsa boat launch.

The temporal scope of the full study was from June through September 2012. Survey schedules were designed to provide sufficient data to derive catch and efforts estimates for each month and for each river zone.

The study included creel analysis of all major local sport fish species, including all five salmon species and Steelhead.

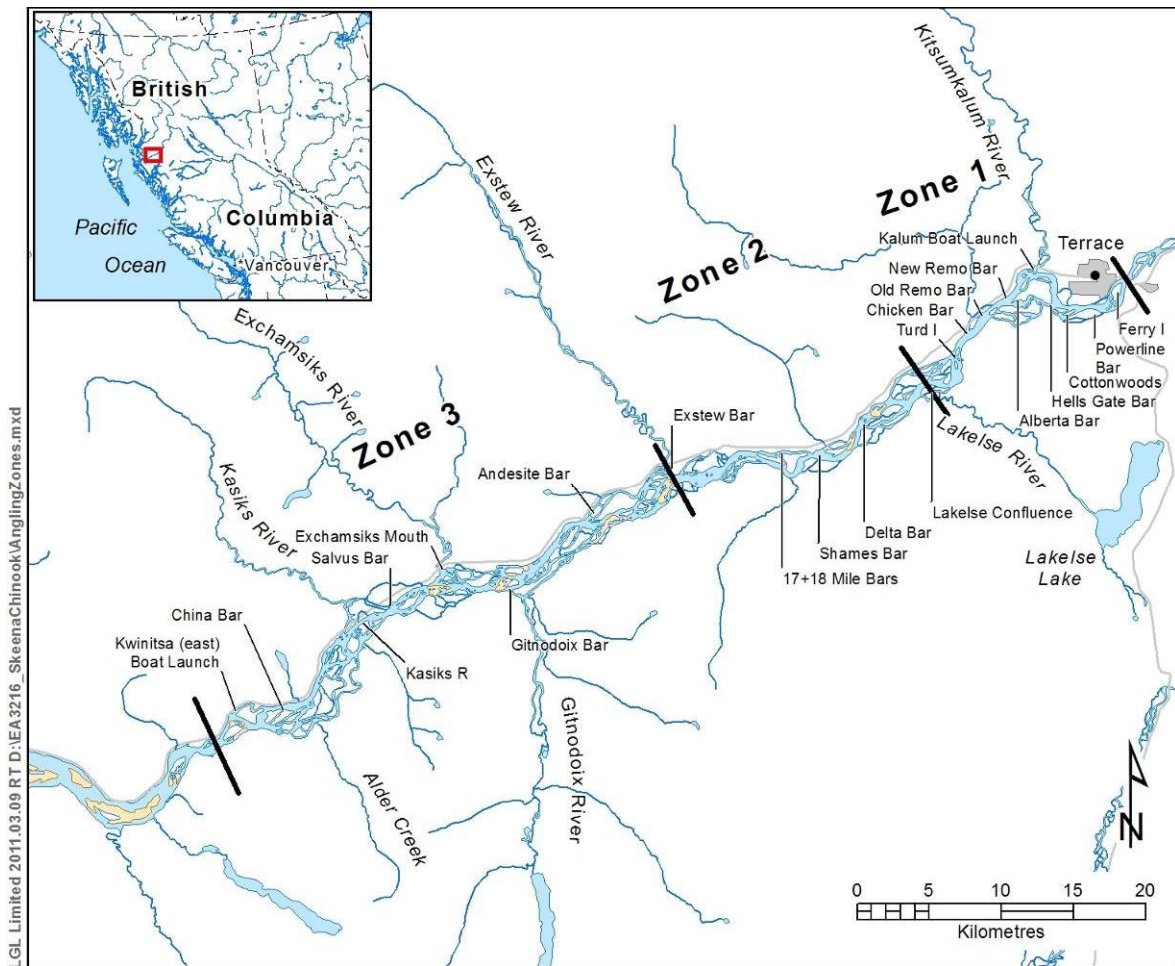


Figure 1. Map of the lower Skeena River showing the major fishing sites and boundaries for the three river zones (strata) used for the 2012 creel survey design.

OBJECTIVES

The three objectives for this study were:

- 1) to provide monthly catch estimates for all salmon species caught in the sport fishery on the waters of the Skeena River downstream of Terrace;
- 2) to inspect as many Chinook salmon as possible and record the incidence of adipose fin clips such that awareness factors for the expansion of voluntary CWT head submissions may be developed; and
- 3) to collect length and age data from Chinook salmon.

These objectives were addressed by conducting effort counts and angler interviews throughout the lower Skeena recreational fishery from June through September 2012. The precision goal for the study was to estimate total Chinook salmon catch within 25% of the true value 19 times out of 20. Creel survey strata included temporal separation by month, including week and weekend days. Spatial stratification was similar to past surveys,

including three zones (described above). All local fishing areas accessed by bank and boat sport fishers along the Skeena River in these zones were included in our survey design.

The incidence of adipose fin clips for Chinook and Coho salmon were obtained by examining fish during angler interviews. Scale samples were collected from Chinook salmon, stored in scale books and used for age analysis.

METHODS

The study area spans a very large geographic area, making it unreasonable to obtain a complete and direct (interview-based) census of the entire catch. Therefore, our approach relied on statistical methods to estimate catch by the multiplication of angler effort estimates by catch per effort estimates, for each river stratum, month, day type (weekday vs. weekend), and species.

For each river stratum during each month, fishing effort was estimated by counting anglers during boat-based river-surveys; and catch per effort was estimated from interviews (see data forms in Appendix 1). Interviews were conducted at known access points, and also from a boat (after conducting the effort surveys). During interviews, anglers were asked about their catch, effort, and fishing locations. They were also asked about their hourly fishing activity patterns on the current and previous day, and whether or not they were finished their fishing activity for the day.

Data collected during interviews included:

- Angler effort – number of anglers, total fishing effort (in angler-hours), fishing location, access location, target species, and gear/bait used;
- Angler activity – the hours during which angling activity was conducted on the day of the interview if the fishing trip was complete and on the previous day, if fishing occurred;
- Fish kept – number of fish caught and kept, by river stratum and by species for the five main salmonids types: Chinook (with jacks tallied separately) salmon (*Oncorhynchus tshawytscha*), Coho salmon (*Oncorhynchus kisutch*), Sockeye salmon (*Oncorhynchus nerka*), Pink salmon (*Oncorhynchus gorbuscha*), and Steelhead (*Oncorhynchus mykiss*);
- Fish released – number of fish caught and intentionally released, by species and by river stratum;
- Whether or not the catch was verified and counted;
- Whether or not the trip was guided by a professional;
- Angler demographics – region or community of origin;
- Angler access methods (shore vs. boat); and
- Timestamp, including date, month, ‘day type’ (i.e., weekday vs. weekend/holiday) and time of day.

The methods used were identical to the previous two years of this study (Robichaud and English 2011, 2012), originally adapted from those developed and documented for the

Georgia Strait Creel Survey (English et al. 2002). The methods used to estimate the statistical precision associated with creel survey catch and effort estimates are based on those documented in English et al. (2002) and Blakley et al. (2003).

This procedure provides a statistically unbiased estimate of catch per effort, provided the anglers interviewed are representative of the entire fishery. To ensure this, the interview schedule was designed to capture data from representative fishermen in each river stratum, on both day types, and over all time periods of the day.

Shore-based interviewing locations are listed in Table 1. The locations surveyed were selected from all available access points, based on their geographical distribution and the amount of fishing activity that was assumed to be conducted from that site. Within each geographic region, the busiest (i.e., most accessible) access points were selected preferentially in order to obtain the maximum number of interviews. This approach was based on two important observations: 1) the variability in CPE (catch-per-effort) among fishing parties landing at a single access point tends to be as great as the variability in CPE among different access points within a geographic area; and 2) CPE and effort can vary substantially both within and between days at a single site (English et al. 2002). Under these conditions it is better to obtain a large number of interviews covering all temporal strata for a small number of sites than to sample a larger number of sites and obtain fewer interviews and less complete temporal coverage for any specific site. Nevertheless, these access-point interviews were supplemented with boat-based interviews collected opportunistically following the boat-based effort estimation surveys.

Sampling schedules were designed to ensure adequate coverage in all river strata, on both day types (Table 2). Detailed monthly survey schedules are provided in Appendix 2. Complete counts of anglers were conducted during peak fishing periods on most weekend days and usually on three of the five available weekdays each week. Angler interviews were to be conducted for a random sample of the anglers encountered during the roving effort surveys and additional survey effort was scheduled for each of the major angler access points. The roving surveys provided complete coverage of the fishing area, but the data collected was usually for incomplete fishing trips. Surveys at major access points provided more opportunities to interview anglers at the end of their daily fishing trips, especially if surveyors work PM shifts. In order to remove the known fishing effort biases associated with incomplete fishing trips, we used information of fishing activity for the previous day (yesterday line times) to derive fishing activity patterns and estimates of the average number of hours fished each day. Shore interviewing sessions were to be separated into AM and PM shifts, with AM shifts occurring between 6:00 and 14:00 and PM shifts from 14:00 to 22:00. The majority of the roving boat surveys were conducted in the afternoon from 13:00 to 21:00. The exact timing of work shifts changed over the study period in concert with the shortening daylight hours. Surveyors were allocated 30 minutes at each end of the shift to access the local survey sites and one hour to access the more remote sites. In total, 158 shifts were scheduled (Table 2), including 79 roving boat surveys and 79 access point surveys.

Table 1. Locations where anglers were counted and interviews conducted in 2012.

Stratum #	Stratum Name	Site #	Site Name	Shore Survey
1	Ferry Island to Lakelse Confluence	1	Upper Ferry Is.	X
		2	Lower Ferry Is.	X
		3	Power Line Bar	X
		4	Cottonwoods	
		5	Hells Gate Bar	
		6	Kalum Boat Launch	X
		7	Alberta Bar	X
		8	Chicken Bar	X
		9	New Remo Bar	X
		10	Kraut Bar	X
		11	Old Remo Bar	X
		12	Turd Island	X
		13	Lakelse Confluence	
2	Lakelse Confluence to Exstew Confluence	14	Delta Bar	X
		15	17 Mile Bar (Shames R. top)	X
		16	18 Mile Bar (Shames R. bottom)	X
		17	Esker Bar	X
		18	Shames Bar (Konaham)	X
		19	Exstew Bar	
3	Exstew Confluence to Kwinita	20	Andesite Bar (river right)	X
		21	28 Mile Bar (bottom of Andesite)	
		22	Gitnadoix Bar	X
		23	Exchamsiks Mouth (river left)	X
		24	Salvus Bar (river right)	X
		25	Kasiks River (Snowbound)	X
		26	China Bar	X
		27	Kwinita	X

Table 2. Summary of scheduled sampling effort (number of interviewer shifts by shore-based survey site and for boat surveys) by month for AM and PM strata and weekend/holiday (WE) and weekday (WD) strata.

Month	Daytype	Boat Survey					Shore Survey					Grand Total *
		Kwinista		Kalum		Total	Terrace		China Bar		Total	
		AM	PM	AM	PM		AM	PM	AM	PM		
June	WD	0	6	0	6	12	4	4	4	0	12	24
	WE	0	4	0	4	8	3	3	2	0	8	16
July	WD	0	5	0	6	11	4	4	4	0	12	23
	WE	0	6	0	5	11	4	4	2	0	10	21
August	WD	1	6	0	6	13	5	6	2	0	13	26
	WE	0	5	0	4	9	4	3	2	0	9	18
September	WD	0	3	0	4	7	3	3	1	0	7	14
	WE	0	4	0	4	8	3	3	2	0	8	16
		1	39	0	39	79	30	30	19	0	79	158

* Six Food, Social, and Ceremonial (FSC) days are also included in the total survey days. The survey teams also conducted creel data in addition to FSC data on those days.

August Creel Data

Starting on 7 August, no fishing for Chinook salmon was permitted from Lakelse River mouth upstream to the Skeena River Overpass at Ferry Island. Because of this fishing regulation change, it made sense to treat the first week of August as ‘part of July’ for the purposes of analysis. In this report, estimates for catch and effort in ‘August’ will be based on the period August 7-31.

Angler Activity Patterns

Two weighting factors were used together with the interview-derived angling activity data to estimate the daily fishing activity pattern (English et al. 2002).

The first weighting factor, $W1$, expanded the numbers of days spent interviewing in each river stratum, to account for the total number of days available for sampling. That is, it was assumed that the daily activity pattern recorded during the interview shifts in river stratum s , were consistent for river stratum s , even during the days when no interviews occurred. A specific $W1$ was calculated for each river stratum during each month and day type:

$$W1_{m ds} = \frac{N_{md}}{K_{m ds}} \quad (\text{Eqn. 1})$$

where N_{md} was the total number of type d days in month m ; and $K_{m ds}$ was the number of days during which interviews occurred in river stratum s , on type d days during month m .

The second weighting factor, $W2$, expanded the numbers of interviews conducted, to account for the anglers that were *not* interviewed. That is, it was assumed that the activity pattern recorded during the interview shifts also held for those anglers that were not interviewed. A

specific $W2$ was calculated for each surveyor (u) operating on each surveying date (k) in each river stratum during each month and day type:

$$W2_{m\text{d}sk\text{u}} = \frac{L_{m\text{d}sk\text{u}}}{A_{m\text{d}sk\text{u}}}, \quad (\text{Eqn. 2})$$

where $L_{m\text{d}sk\text{u}}$ was the number of anglers observed and $A_{m\text{d}sk\text{u}}$ was the number of anglers interviewed by surveyor u , during surveying date k , in river stratum s , during day type d , and month m .

We used the term $A_{m\text{d}sfk\text{u}q\text{t}}$ to denote the number of anglers reporting activity during time-block t , that were part of the fishing party (q) that was interviewed by surveyor u on survey date k , in river stratum s , with access method f , during month m , and on day type d ($n_{m\text{d}sfk\text{q}}$ was used to denote the total number of anglers that were part of that fishing party). The two correction factors were applied, and the data were summed over surveyors, survey dates and fishing parties (within month, day type, stratum, access method and time-block):

$$A'_{m\text{d}sf\text{t}} = W1_{m\text{d}s} \cdot \sum_k \sum_u \sum_q (W2_{m\text{d}sk\text{u}} \cdot A_{m\text{d}sfk\text{u}q\text{t}}). \quad (\text{Eqn. 3})$$

Summing the adjusted number of anglers over the 16 time-blocks gave:

$$T'_{m\text{d}sf} = \sum_t A'_{m\text{d}sf\text{t}}. \quad (\text{Eqn. 4})$$

The proportion of anglers ($P_{m\text{d}sf\text{t}}$) that were active during in each of 16 hourly time-blocks (t) was calculated for each month, day type, river stratum and access method:

$$P_{m\text{d}sf\text{t}} = \frac{A'_{m\text{d}sf\text{t}}}{\left(W1_{m\text{d}s} \cdot \sum_k \sum_q (W2_{m\text{d}sk} \cdot n_{m\text{d}sfk\text{q}}) \right)}. \quad (\text{Eqn. 5})$$

For this calculation, ‘current day’ activity was included only if the anglers said their trip was finished for the day. Regardless, ‘prior day’ activity was included in the analyses, being careful to assign the data to the correct temporal categories. For example, if an interview was conducted on a Monday, the ‘prior day’ activity data would be counted under day type = ‘weekend’. It should be noted that the ratio of interviewed-to-not-interviewed anglers was not known for the day prior to the interview, thus $W2$ weights were assigned a value of 1 when processing ‘prior day’ activity data.

Using this method, 48 unique angler activity patterns were to be estimated (i.e., 4 months \times 2 day types \times 3 river strata \times 2 access methods, see Figure 2, Figure 3 and Figure 4). To reliably describe angler activity, a relatively large number of anglers (~ 60) needed to be interviewed in each of the 48 blocks. In the end, some blocks contained too few interviews (Table 3), so it was decided to pool activity data over month (poor data reliability in June) and access method (too little boat angler data in River Stratum Two and Three). The equation for angler activity was thus

$$P_{dst} = \frac{\sum_m \sum_f A'_{m\text{d}sf\text{t}}}{\sum_m \sum_f \left(W1_{m\text{d}s} \cdot \sum_k \sum_q (W2_{m\text{d}sk} \cdot n_{m\text{d}sfk\text{q}}) \right)}, \quad (\text{Eqn. 6})$$

with its associated variance:

$$S_{P_{dst}}^2 = \frac{(P_{dst})(1 - P_{dst})}{\sum_m \sum_f \left(W1_{mfs} \cdot \sum_k \sum_q (W2_{mfskq} \cdot n_{mfskq}) \right)} \tag{Eqn. 7}$$

The average number of hours fished per angler (G_{ds}) was calculated for each day type / river stratum combination using weighted observations:

$$G_{ds} = \frac{\sum_m \sum_f (T'_{mfs})}{\sum_m \sum_f \left(W1_{mfs} \cdot \sum_k \sum_q (W2_{mfskq} \cdot n_{mfskq}) \right)} \tag{Eqn. 8}$$

but the variance was calculated from the raw interview data (rather than from the weighted values) using the standard formula.

Table 3. The amount of data (number of anglers) available to estimate angler activity patterns, for all levels of each factor (data from 3 June to 27 September 2012).

Month	Day Type	Access Method	River Stratum		
			One	Two	Three
June	Weekday	Boat	0	0	0
		Shore	0	0	0
	Weekend	Boat	3	0	0
		Shore	1	0	0
July	Weekday	Boat	176	0	0
		Shore	240	8	25
	Weekend	Boat	222	2	5
		Shore	224	20	28
August	Weekday	Boat	228	0	0
		Shore	475	32	123
	Weekend	Boat	272	0	2
		Shore	272	29	104
September	Weekday	Boat	6	0	0
		Shore	109	0	16
	Weekend	Boat	23	0	2
		Shore	125	8	92

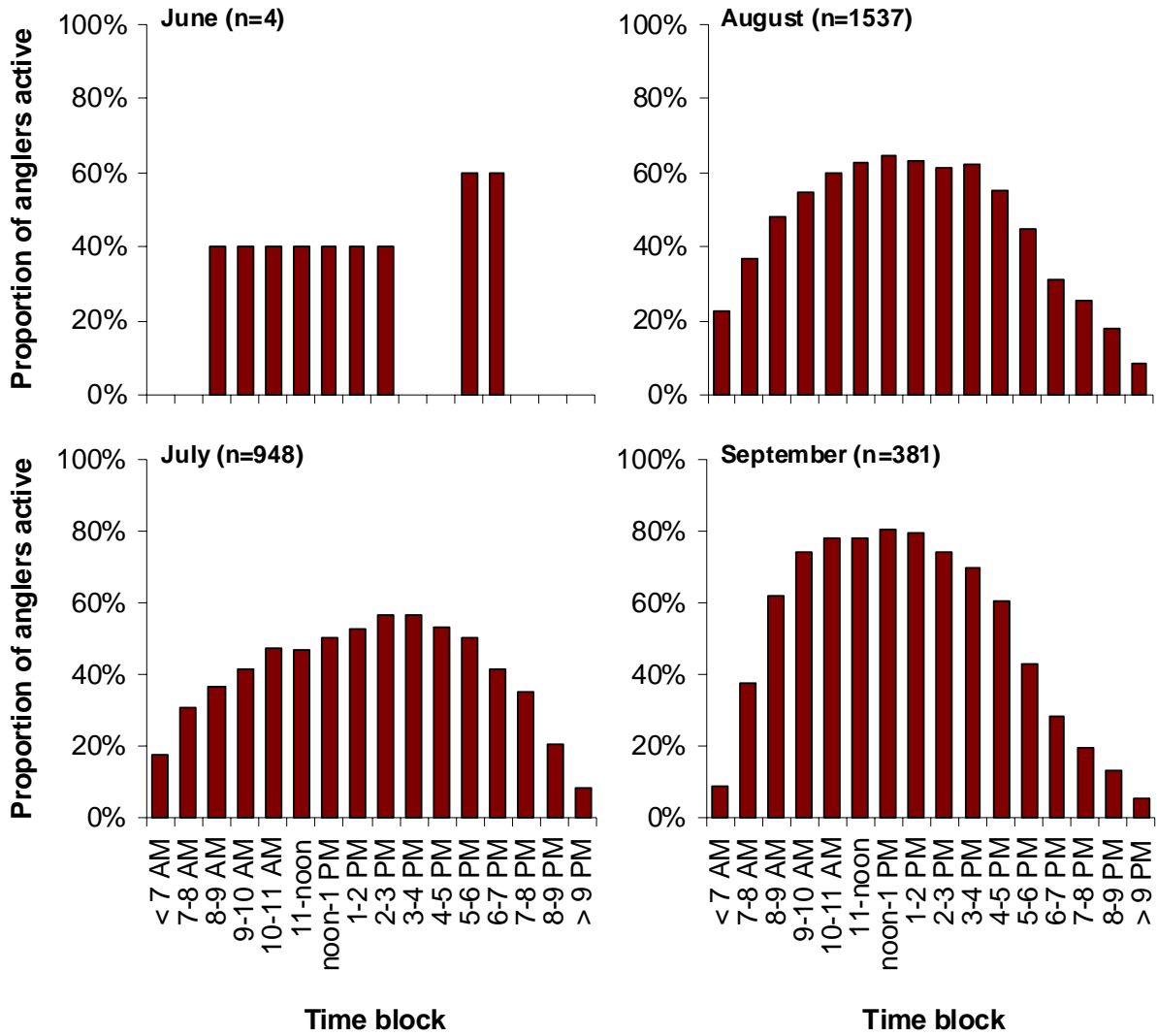


Figure 2. Angler activity patterns, by month, from interview data collected from 3 June to 27 September 2012.

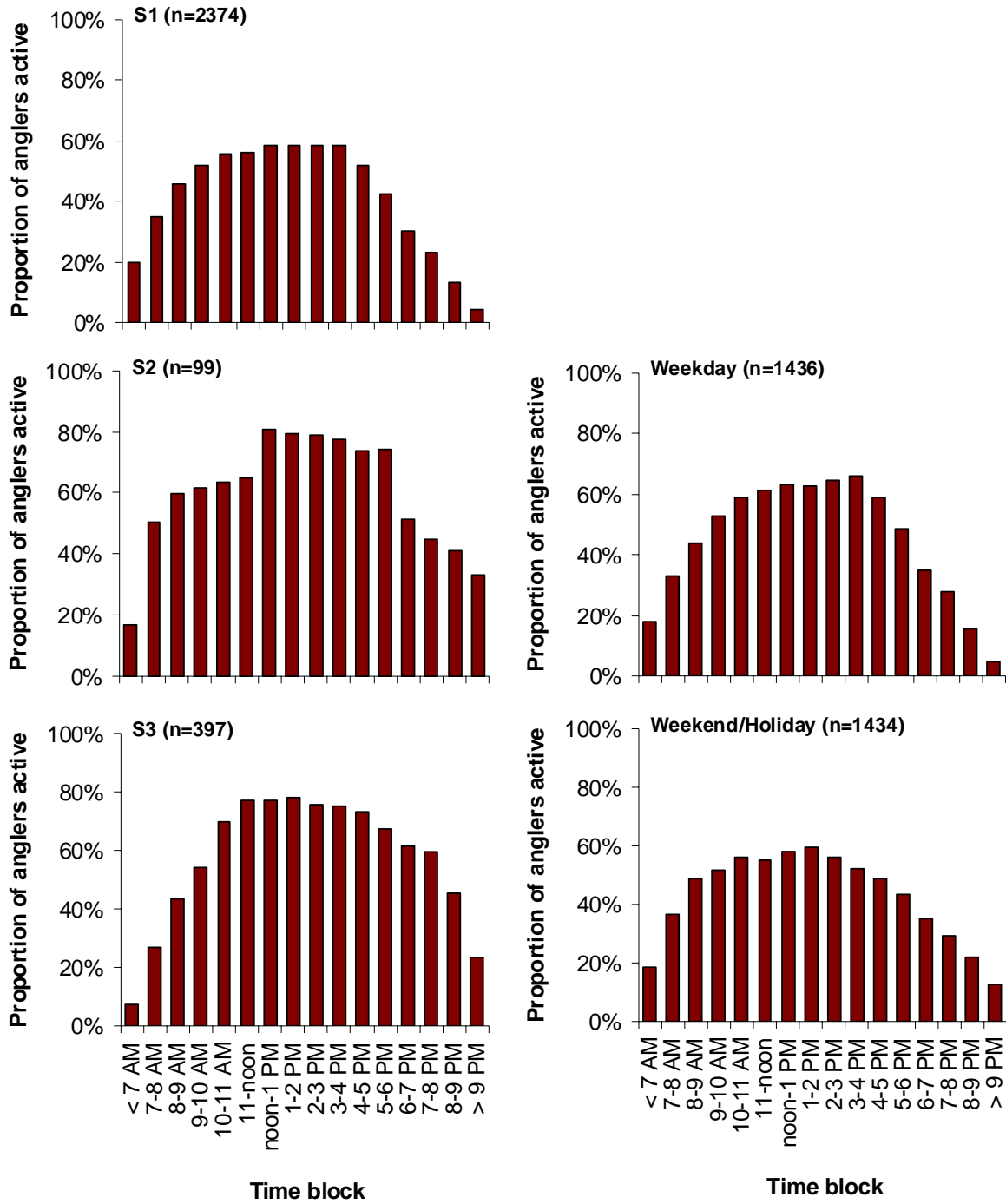


Figure 3. Angler activity patterns, by river stratum (left column) and day type (right column) from interview data collected from 3 June to 27 September 2012.

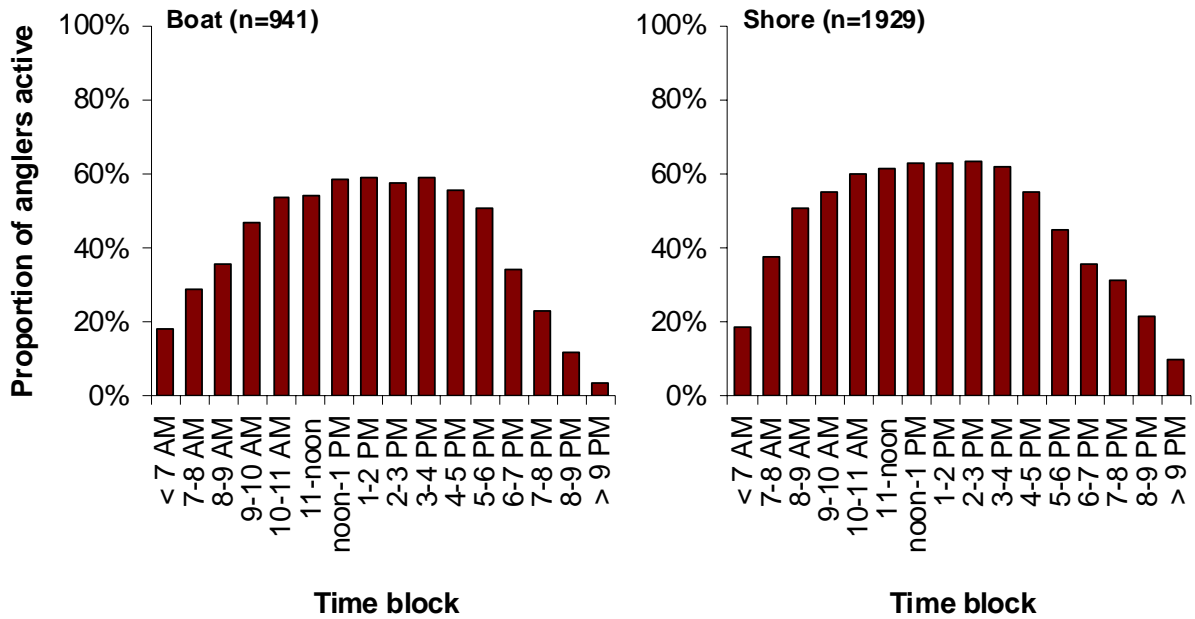


Figure 4. Angler activity patterns, by access method, from interview data collected from 3 June to 27 September 2012.

Catch Per Effort Estimation

Catch per effort (and, similarly, harvest per effort) was estimated for each species of fish from interviews of anglers. For each interview (*i*), the month (*m*), day type (*d*) and access method (*f*) was recorded, along with the catch (*C*) of each species (*r*), the number of anglers (*A*), and the number of hours spent fishing (*H*) in each river stratum (*s*). Using these data, catch per effort was calculated as:

$$CPE_{msfri} = \frac{C_{msfri}}{A_{msfri} \cdot H_{msfri}} \tag{Eqn. 9}$$

Ideally, mean *CPE* would have been calculated for each month, river stratum, day type, access method and species. However, too few interviews were obtained to provide adequate sample size (*n* ~3) to reliably estimate *CPE* and its variance for each of the 48 blocks (Table 4). As *CPE* was expected to change with month, river stratum and access method, it was decided to pool interview data by day type.

In most cases, mean *CPE* was calculated by summing the catch for all *n_{msdf}* interviews, pooling over day type, and dividing by the total number of angler-hours of fishing effort recorded for these interviews:

$$\hat{CPE}_{msfr} = \frac{\sum_d \sum_{i=1}^{n_{msdf}} C_{msfri}}{\sum_d \sum_{i=1}^{n_{msdf}} (A_{msfri} \cdot H_{msfri})} \tag{Eqn. 10}$$

The variance for the estimate of mean catch per effort was calculated as:

$$S_{C\hat{P}E_{msfr}}^2 = \frac{\sum_{i=1}^{n_{msdf}} (C\hat{P}E_{msfri}^2) - \frac{\sum_{i=1}^{n_{msdf}} (C\hat{P}E_{msfri})^2}{n_{msdf}}}{(n_{msdf} - 1)} \quad (\text{Eqn. 11})$$

In several instances, the month/access method/river stratum-specific sample size was too low, even after the data were pooled over day type (Table 4). Three modifications were made. First, sample sizes precluded reliable estimation of CPE for any stratum within the month of June, thus data were pooled over river-strata and access method. Second, CPE data were pooled over access method in late August and September due to low interview counts obtained from boats after 6 Aug. Lastly, CPE for boat-based angler fishing in River Stratum Three in July was based on July boat angler data from River Stratum Two and Three combined.

The CPE of fish that were harvested was calculated by repeating the creel analyses with released fish excluded from the interview database.

Table 4. The sample size of angler CPE data (i.e., the number of interviewed parties reporting catch and effort) for each river stratum, and for each month, day type, and access method (data from 3 June to 27 September 2012).

Month	Day Type	Access	River Stratum		
			1	2	3
June	Weekday	Boat	0	0	0
		Shore	0	0	0
	Weekend	Boat	1	0	0
		Shore	2	0	0
1 July - 6 Aug	Weekday	Boat	38	3	0
		Shore	135	5	8
	Weekend	Boat	47	8	2
		Shore	112	8	13
7-31 Aug	Weekday	Boat	63	8	3
		Shore	236	23	78
	Weekend	Boat	65	5	1
		Shore	152	21	76
September	Weekday	Boat	2	0	1
		Shore	49	1	22
	Weekend	Boat	8	1	2
		Shore	59	7	81

Angler Effort Estimation

To obtain statistically valid estimates of angler effort, anglers were counted during surveys conducted from a boat traveling through the study area. The study area was split into two subsections, the first comprising River Strata One and Two, and the second being equivalent to River Stratum Three. On any given survey day, anglers were enumerated in one of the two study area subsections. Table 2 shows the number of boat surveys scheduled for each month and day type. Each survey was supposed to cover the entire subarea with the start and end times for angler counts recorded for each of the River Strata surveyed (Appendix 1). The initial schedule included surveys on every weekend day and usually three of the five weekdays each week.

During survey o (conducted during month m and on day type d), observers tallied the total number of anglers (boating and shore-based counted separately, f) that were actively fishing at time t in sub-stratum u (within river stratum s), $V_{mdsfout}$. These tallies were pooled by sub-stratum. Since angling occurs over the course of the entire day, the number of anglers that were observed at the moment of the survey was divided by the proportion of average daily number of shore and boat-based anglers active (P_{sft}) during the time block when the observations were recorded, and multiplied by the average number of hours fished per angler (G_{sf}). These adjusted tallies were summed over the duration of the survey, to calculate the total number of angler-hours of fishing on the day of the survey, by river stratum and access method, B_{mdsfo} :

$$B_{mdsfo} = \sum_t \left(\frac{\sum_u V_{mdsfout}}{P_{sft}} \cdot G_{sf} \right) . \quad (\text{Eqn. 12})$$

These estimates were then averaged over the number of surveys conducted, n_{mds} , as:

$$\hat{B}_{mdsf} = \frac{\sum_{o=1}^{n_{mds}} B_{mdsfo}}{n_{mds}} . \quad (\text{Eqn. 13})$$

Total monthly fishing effort, was calculated for each day type, river stratum and access method by multiplying the average daily effort by the number days of day type d that occurred in month m :

$$E_{mdsf} = \hat{B}_{mdsf} \cdot N_{md} . \quad (\text{Eqn. 14})$$

The variance of B_{mdsfo} was calculated using the standard formulas for combining the variance of products and quotients of two independent random variables (Goodman 1960):

$$\begin{aligned} \text{if } z = x / y, \text{ } Var(z) &= (y^{-2})Var(x) + (x^2 y^{-4})Var(y) \\ \text{if } z = xy, \text{ } Var(z) &= (y^2)Var(x) + (x^2)Var(y) \end{aligned} . \quad (\text{Eqn. 15})$$

Thus,

$$\begin{aligned} S_{V/P}^2 &= (P_{sft}^{-2})S_V^2 + (V^2 P_{sft}^{-4})S_{P_{sft}}^2 \text{ and} \\ S_B^2 &= (G_{sf}^2)S_{V/P}^2 + \left(\frac{V}{P_{sft}} \right)^2 S_{G_{sf}}^2 , \end{aligned} \quad (\text{Eqn. 16})$$

where the variance of the observed angler counts S^2_V was calculated from the raw data as:

$$S^2_{V_{mdsf}} = \frac{\sum_{o=1}^{n_{mds}} V^2_{mdsfo} - \left(\frac{\sum_{o=1}^{n_{mds}} (V_{mdsfo})^2}{n_{mds}} \right)}{n_{mds} - 1} \cdot \left[\frac{N_{md} - n_{mds}}{N_{md} - 1} \right]. \quad (\text{Eqn. 17})$$

The variance of the estimate of the total monthly fishing effort was:

$$S^2_{E_{mdsf}} = S^2_{\hat{B}_{mdsf}} \cdot N^2_{md} \quad (\text{Eqn. 18})$$

The standard error of the estimate of the total monthly fishing effort, after pooling over day types, was:

$$S_{E_{msf}} = \sqrt{\sum_d \frac{S^2_{E_{mdsf}}}{n_{mds}}} \quad (\text{Eqn. 19})$$

Catch Estimation

Total catch was calculated for each month, river stratum and species by multiplying total angling effort by catch per effort, and then summing over day type and access method:

$$C_{msr} = \sum_f \sum_d (E_{mdsf} \cdot \hat{CPE}_{msfr}). \quad (\text{Eqn. 20})$$

The standard errors for these catch estimates were derived using the Goodman (1960) equation:

$$S_{C_{msr}} = \sqrt{\sum_f \sum_d \left(E^2_{mdsf} \frac{S^2_{CPE_{msfr}}}{n_{msf}} + CPE^2_{msfr} \frac{S^2_{E_{mdsf}}}{n_{mdsf}} + \frac{S^2_{CPE_{msfr}}}{n_{msf}} \frac{S^2_{E_{mdsf}}}{n_{mdsf}} \right)}. \quad (\text{Eqn. 21})$$

Because the Chinook salmon fishery was closed on 7 August, it made the most sense to include the first week of August in with July, and to treat the last three weeks of August separately. As a result, it was necessary that comparisons of catch among months, river strata and access method be made using ‘catch per day’ in lieu of ‘catch per month’. Catch per day was calculated by dividing the ‘monthly’ catch estimates by the number of days included in each period (30, 37, 25, and 30 days for the four ‘months’, respectively).

To estimate the monthly number of fish that were harvested, the creel analyses were repeated with released fish excluded from the interview database.

RESULTS

Angler Interviews

Over the four month study period, 3,176 anglers were questioned during 1,339 interviews. Of the 3,716 anglers interviewed, 1,177 (31.7%) reported on completed fishing trips, and 1,695 (45.6%) reported their previous-day's fishing activity. Interviews were conducted during 163 survey shifts (Table 5, Appendix 2). Completed survey shifts represented 103% of the scheduled survey effort (106% of the shore-based effort, and 100% of the boat-based effort). The difference between the scheduled and actual survey effort can be attributed to the budget, which allowed for five additional survey days in September (two boat and three shore surveys).

Table 5. Summary of observed sampling effort (number of interviewer shifts by shore-based survey site and for boat surveys) by month for AM and PM strata and weekend/holiday (WE) and weekday (WD) strata.

Month	Daytype	Boat Survey					Shore Survey					Grand Total ^{1,2}		
		Kwinista		Kalum		Total	Terrace		China Bar		Total			
		AM	PM	AM	PM			AM	PM	AM		PM		
June	WD	0	3	0	7	10	4	4	4	0	12	22		
	WE	0	5	0	3	8	3	3	2	2	10	18		
July	WD	0	6	0	6	12	4	4	4	0	12	24		
	WE	0	5	0	5	10	4	4	2	0	10	20		
August	WD	1	6	0	6	13	5	6	2	0	13	26		
	WE	0	5	0	4	9	4	3	2	0	9	18		
September	WD	0	3	0	5	8	6	2	1	0	9	17		
	WE	0	6	0	3	9	3	3	3	0	9	18		
Total		1	39	0	39	79	33	29	20	2	84	163		
% of scheduled							100%						106%	103%

¹ Six Food, Social, and Ceremonial (FSC) days are also included in the total survey days. The survey teams also conducted creel data in addition to FSC data on those days.

² Five additional survey days were added on in September (two boat surveys and three shore surveys).

Angler Activity Patterns

As described in the Methods Section (above), low sample sizes required interview data to be pooled across months and access methods, resulting in the six angler activity patterns estimates (2 day types × 3 river strata) shown in Figure 5. Angler activity patterns in River Stratum One (Ferry Island to Lakelse) differed markedly from those in the rest of the study area, with fewer anglers active in the early afternoon and evening. In general, weekday anglers were active for a greater portion of the day than weekend anglers, especially in River Stratum Two and Three.

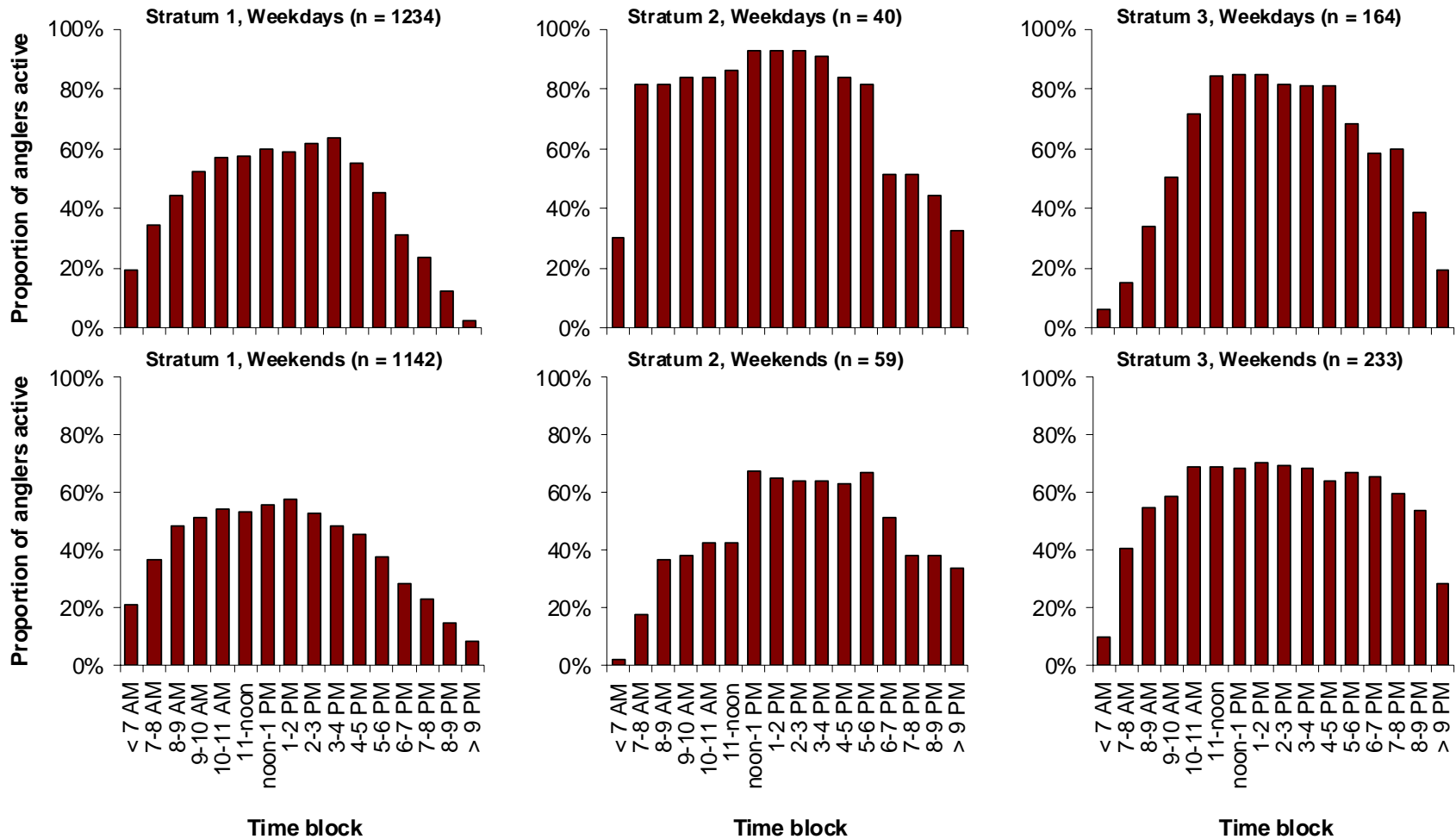


Figure 5. Angler activity patterns, by day type and river stratum, from interview data collected from 3 June to 27 September 2012.

Catch Per Effort Estimates

In order to obtain adequate sample sizes for CPE estimation, interview data were pooled over day type. In most cases, the pooled number of interviews was ≥ 3 (Table 4). Three exceptions were made. First, sample sizes precluded reliable estimation of CPE for any stratum within the month of June, thus data were pooled over river-strata and access method. Second, CPE data were pooled over access method in late August and September due to low interview counts obtained from boats after 6 Aug. Lastly, CPE for boat-based angler fishing in River Stratum Three in July was based on July boat angler data from River Stratum Two and Three combined.

After pooling (as described above), CPE estimates were calculated for each species by month, river stratum and access method (Table 6). Month appeared to have had a strong effect on CPE for all species (Figure 6). For example, no fish of any species were caught in June. CPE peaked in July for Chinook salmon, Sockeye salmon and 'other' fish. Whereas, catch rates peaked later in the summer for Coho salmon, Pink salmon and Steelhead. Due to sample size limitations ($n = 13$), no among-month differences were statistically significant after the Bonferroni adjustment (Table 7).

There were no significant effects of river stratum or access method on CPE for any species (Table 7).

The retention per effort rates (i.e., the rate of fish harvest, with units of 'fish per unit effort', where released fish were excluded) are shown for each species by month, river stratum and access method in Table 8. Steelhead, Pink salmon and 'other' fish were infrequently kept. As per the fishing regulation, Chinook salmon caught in the 'Ferry Island to Lakelse' stratum after 6 August were never harvested.

Table 6. Catch per effort (CPE) estimates (fish per angler-hour) for six fish taxa (with Chinook adults and jacks reported separately), by month, river stratum and access method. Variance in parentheses.

Month	River Stratum	Access Method	Chinook salmon		Coho salmon	Sockeye salmon	Pink salmon	Steelhead	Other
			adults	jacks					
June	Pooled	Pooled	0	0	0	0	0	0	0
1 July - 6 Aug	Ferry Island to Lakelse	Boat	0.023 (0.004)	0.007 (0.001)	0.006 (0.000)	0.090 (0.153)	0.000 (0.000)	0.007 (0.003)	0.001 (0.001)
		Shore	0.011 (0.005)	0.007 (0.001)	0.004 (0.001)	0.143 (0.310)	0.003 (0.004)	0.002 (0.004)	0.002 (0.002)
	Lakelse to Exstew	Boat	0.005 (0.001)	0.019 (0.001)	0	0.019 (0.000)	0	0.005 (0.000)	0.015 (0.000)
		Shore	0.013 (0.014)	0.020 (0.001)	0.001 (0.000)	0.027 (0.001)	0	0.021 (0.003)	0.003 (0.000)
	Exstew to China Bar	Boat	0.003 (0.001)	0.011 (0.001)	0	0.011 (0.000)	0	0.006 (0.000)	0.008 (0.000)
		Shore	0.010 (0.000)	0.001 (0.000)	0.002 (0.000)	0.003 (0.001)	0.007 (0.002)	0.023 (0.012)	0.002 (0.001)
7-31 Aug	Ferry Island to Lakelse	Pooled	0.003 (0.001)	0.002 (0.003)	0.062 (0.046)	0.061 (0.141)	0.060 (0.137)	0.075 (0.042)	0.001 (0.000)
	Lakelse to Exstew	Pooled	0.001 (0.000)	0.004 (0.000)	0.038 (0.026)	0.007 (0.000)	0.089 (1.671)	0.060 (0.032)	0.004 (0.000)
	Exstew to China Bar	Pooled	0.001 (0.000)	0.001 (0.000)	0.029 (0.027)	0.004 (0.003)	0.033 (0.137)	0.069 (0.029)	0.002 (0.002)
September	Ferry Island to Lakelse	Pooled	0.001 (0.000)	0	0.033 (0.136)	0.006 (0.001)	0.023 (0.009)	0.091 (0.070)	0
	Lakelse to Exstew	Pooled	0	0	0.032 (0.001)	0	0.004 (0.000)	0.052 (0.014)	0
	Exstew to China Bar	Pooled	0	0.001 (0.000)	0.016 (0.004)	0.002 (0.001)	0.002 (0.000)	0.040 (0.019)	0

Table 7. Statistical tests of the effect of month, river stratum, and access method on median catch per effort (CPE) estimates for the 6 taxa surveyed (with Chinook adults and jacks reported separately). *P*-values that are underlined are less than 0.05, but none are statistically significant after the Bonferroni adjustment.

Taxon	Month (no June)		River Stratum (no June)		Access Method (July)	
	χ_2^2	<i>P</i>	χ_2^2	<i>P</i>	χ_1^2	<i>P</i>
Chinook adults	8.7	<u>0.013</u>	1.3	0.526	0.4	0.513
Chinook jacks	6.6	<u>0.037</u>	0.9	0.626	0.0	0.827
Coho	8.7	<u>0.013</u>	1.6	0.456	0.4	0.507
Pink	7.7	<u>0.021</u>	0.5	0.776	1.3	0.246
Sockeye	4.9	0.084	4.8	0.092	0.0	0.827
Steelhead	8.4	<u>0.015</u>	0.2	0.926	0.4	0.513
Other	6.5	<u>0.039</u>	2.6	0.271	0.4	0.513

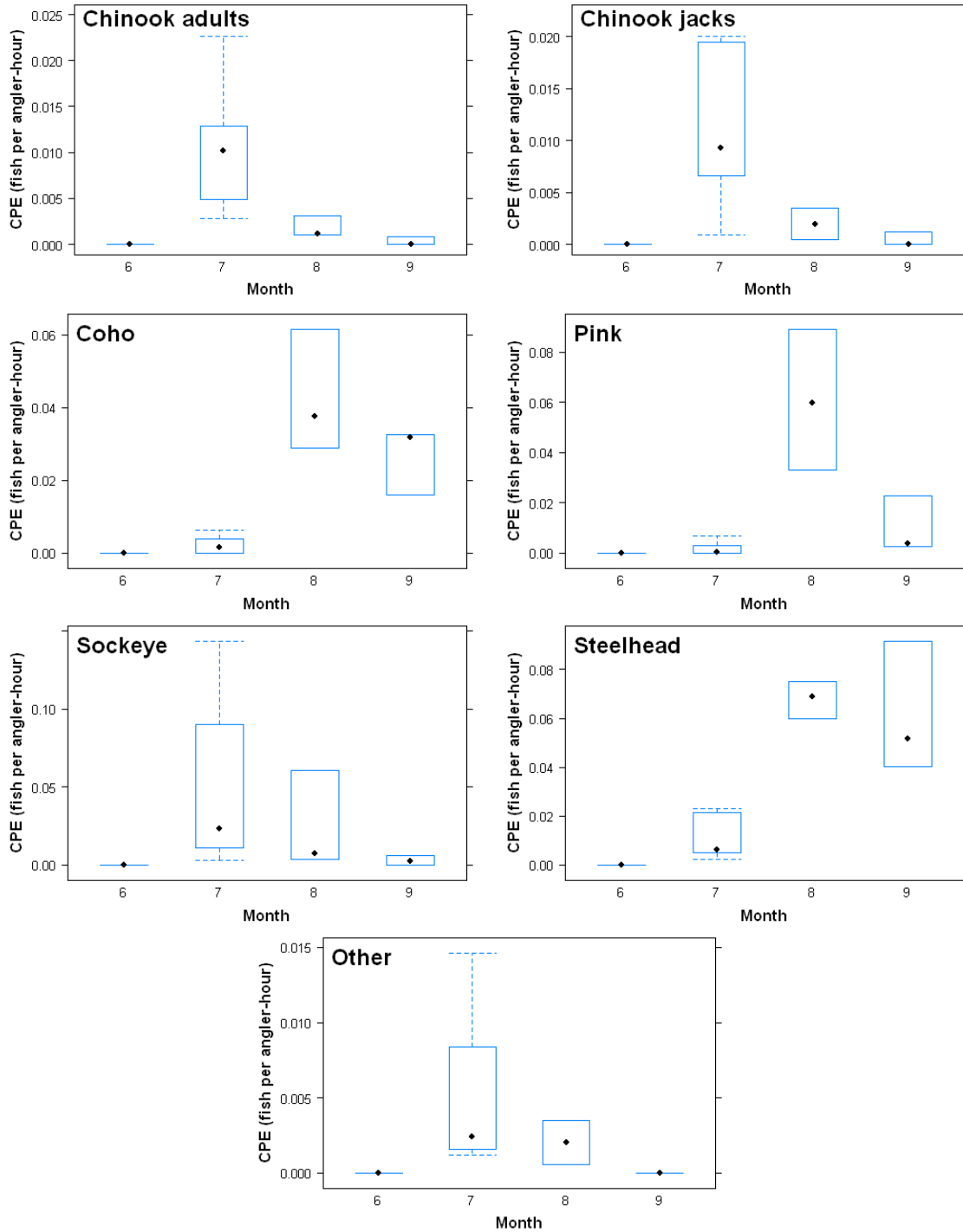


Figure 6. Box-whisker plots showing the distribution of CPE estimates for each month, by taxon (with Chinook adults and jacks reported separately). On the X-axis, months are shown using a numeric shorthand as follows: “6” = June; “7” = 1 July - 6 August; “8” = 7-31 August; and “9” = September. Samples sizes were 1, 6, 3 and 3 for the four months, respectively.

Table 8. Retention per effort (CPE of harvested fish) rates for six fish taxa (with Chinook adults and jacks reported separately), by month, river stratum and access method. Variance in parentheses.

Month	River Stratum	Access Method	Chinook salmon		Coho salmon	Sockeye salmon	Pink salmon	Steelhead	Other
			adults	jacks					
June	Pooled	Pooled	0	0	0	0	0	0	0
1 July - 6 Aug	Ferry Island to Lakelse	Boat	0.016 (0.002)	0.007 (0.001)	0.005 (0.000)	0.068 (0.085)	0	0	0.001 (0.001)
		Shore	0.008 (0.003)	0.006 (0.001)	0.003 (0.001)	0.123 (0.224)	0.001 (0.003)	0	0.001 (0.002)
	Lakelse to Exstew	Boat	0.005 (0.001)	0.019 (0.001)	0	0.019 (0.000)	0	0.005 (0.000)	0.015 (0.000)
		Shore	0.013 (0.014)	0.004 (0.000)	0.001 (0.000)	0.016 (0.000)	0	0	0
	Exstew to China Bar	Boat	0.003 (0.001)	0.011 (0.001)	0	0.011 (0.000)	0	0.003 (0.000)	0.008 (0.000)
		Shore	0.008 (0.000)	0.001 (0.000)	0.002 (0.000)	0.002 (0.001)	0.004 (0.000)	0	0
7-31 Aug	Ferry Island to Lakelse	Pooled	0	0	0.032 (0.022)	0.050 (0.128)	0.003 (0.003)	0.000 (0.000)	0
	Lakelse to Exstew	Pooled	0.001 (0.000)	0.001 (0.000)	0.025 (0.004)	0	0.004 (0.000)	0	0
	Exstew to China Bar	Pooled	0.001 (0.000)	0.001 (0.000)	0.028 (0.027)	0.003 (0.001)	0.006 (0.032)	0	0
September	Ferry Island to Lakelse	Pooled	0	0	0.014 (0.001)	0.005 (0.001)	0.001 (0.001)	0	0
	Lakelse to Exstew	Pooled	0	0	0.020 (0.001)	0	0	0	0
	Exstew to China Bar	Pooled	0	0.001 (0.000)	0.013 (0.004)	0.002 (0.001)	0.001 (0.000)	0.001 (0.000)	0

Angler Effort Estimates

Over the 4 month study period, a total of 79 effort surveys were conducted, covering River Stratum One, Two and Three a total of 43, 42 and 41 times, respectively. Of the 79 surveys, 45 were conducted on weekdays, and 34 on weekend/holidays (Appendix 3). The total angling effort was estimated for each month, day type, river stratum and access method (Table 9).

Table 9. Effort estimates (angler-hours per month), by month, day type, river stratum and access method. Standard errors in parentheses.

Month	Day Type	Access Method	River Stratum			Total
			Ferry Island to Lakelse	Lakelse to Exstew	Exstew to China Bar	
June	Weekday	Boat	0	0	0	0 (0)
		Shore	92 (59)	0	0	92 (59)
	Weekend	Boat	0	0	0	0 (0)
		Shore	0	0	0	0 (0)
1 July - 6 Aug	Weekday	Boat	2,271 (1,366)	0	505 (258)	2,776 (1,390)
		Shore	14,895 (8,745)	2,077 (1,423)	5,183 (3,429)	22,155 (9,500)
	Weekend	Boat	2,219 (765)	499 (220)	547 (368)	3,265 (877)
		Shore	10,938 (3,689)	1,479 (703)	2,971 (1,320)	15,388 (3,980)
7-31 Aug	Weekday	Boat	140 (95)	81 (46)	43 (30)	264 (110)
		Shore	8,868 (4,655)	3,799 (1,990)	9,169 (5,162)	21,836 (7,231)
	Weekend	Boat	207 (220)	299 (302)	85 (50)	591 (377)
		Shore	2,163 (2,326)	959 (1,119)	3,786 (1,530)	6,908 (3,001)
September	Weekday	Boat	131 (86)	0	206 (201)	337 (218)
		Shore	2,506 (1,611)	1,069 (740)	5,848 (4,246)	9,423 (4,602)
	Weekend	Boat	0	0	392 (227)	392 (227)
		Shore	1,880 (1,468)	165 (143)	6,902 (3,008)	8,946 (3,350)
Overall Total			46,309 (11,155)	10,427 (2,906)	35,637 (8,358)	92,373 (14,239)

There was a strong statistically significant effect of month on angler effort (Table 10). The median daily angling effort in June (0 angler hours per day) was significantly lower than those estimated for all other months (1 July - 6 Aug: 729 hours per day; 7-31 August: 210 hours per day; September: 112 hours per day; Figure 7). In fact, the *total* effort estimated for the month of June (92 angler hours; Table 9) was less than the median *daily* angler effort estimated for any subsequent month.

The level of shore-based angling effort (median 690 angler hours per day) was significantly greater than that from boats (29 angler hours per day; Figure 7). There were no significant effects of day type or river stratum on fishing effort (Table 10).

Table 10. Statistical tests of the effect of month, day type, river stratum and access method on median daily effort estimates during the study period. *P*-values that are in bold are statistically significant after the Bonferroni adjustment.

Effect Test	χ^2	df	<i>P</i>
Month	23.7	3	<.0001
Day Type	0.1	1	0.818
River Stratum	2.8	2	0.249
Access Method	11.1	1	0.001

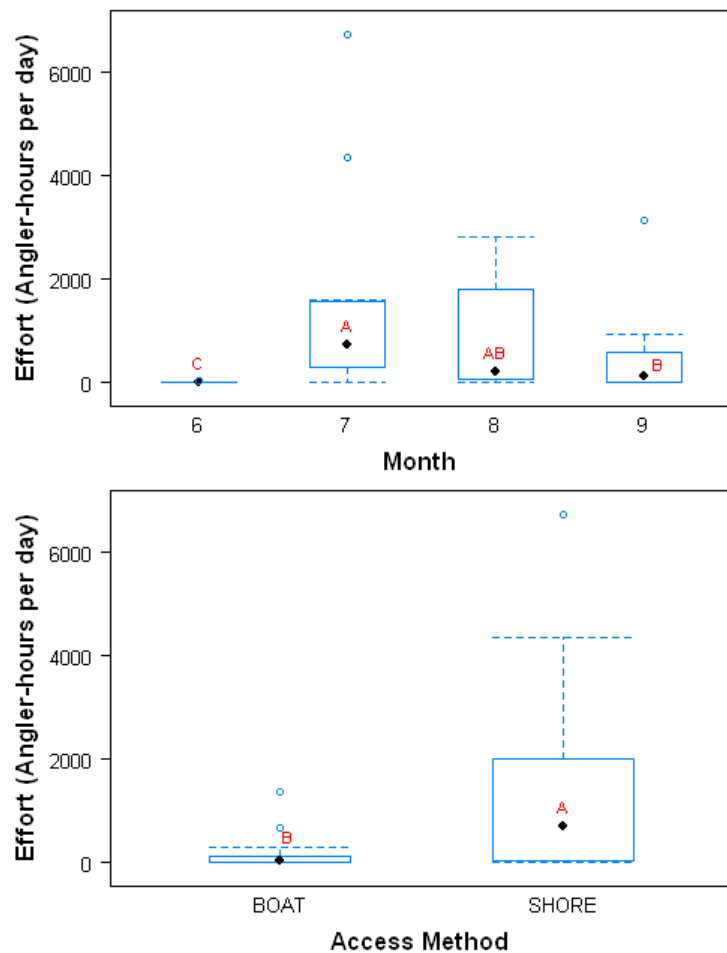


Figure 7. Box-whisker plots showing the distribution of daily effort estimates for each month or access method. Letters indicate statistically significant differences among months (i.e., months that share a letter in common are not significantly different) or access methods. On the X-axis, months are shown using a numeric shorthand as follows: “6” = June; “7” = 1 July - 6 August; “8” = 7-31 August; and “9” = September. Samples size was 12 for each month, or 24 for each access method.

Catch Estimates

Estimates of total monthly catch (Table 11) were generated by calculating $E \times CPE$, and then summing over day types and access methods. Sockeye salmon was the most abundantly caught fish (5,079, SE = 804). Steelhead was the second most commonly caught species (3,446, SE = 421), followed by Pink (1,848, SE = 902) and Coho salmon (1,825, SE = 308). Chinook salmon catches totaled 571 adults (SE = 108) and 387 jacks (SE = 58).

There were strong effects of month on catch per day for all species, and all were statistically significant after the Bonferroni adjustment (Table 12, Figure 8). For Chinook salmon, the highest catch days were in July and August. In July and the first week of August, 90% of the overall adult Chinook salmon catch was caught, along with 83% of the total Chinook jacks. In the last three weeks of August, 10% of the adult Chinook catch was caught, and 12% of the Chinook jacks. In contrast, Chinook salmon catches in June and September were negligible. No Chinook salmon were caught in June, and only 4 adults and 17 jacks were caught in September (Table 11). Sockeye salmon catches followed a similar pattern to those of Chinook salmon. No Sockeye salmon were caught in June. In July and the first week of August, 84% of the total Sockeye salmon catch was made. 15% was caught in the last three weeks of August, and 1% in September (Table 11). The highest catches of Steelhead, Coho and Pink salmon were in the last three weeks of August (when 60-85% of the species-specific catches were made). Steelhead and Coho salmon catches remained high in September (22-29% of the species-specific catches; Figure 8).

For no species did catch per day vary significantly with river stratum or access method (Table 12).

Harvest (Retention) Estimates

Estimates of total monthly harvest are shown in Table 13 and Figure 9. Sockeye salmon, which was the most abundantly caught fish, was also the most retained species (4,235 fish harvested, SE = 688) and the most likely species to be retained (83% of the catch retained). Steelhead was the least frequently harvested species, with only 17 fish harvested (0.5% of total Steelhead catch). The harvested Steelhead estimate was based on 3 interviews during which 12 anglers reported a total of 3 retained Steelhead, likely because they were unaware of the regulations or could not distinguish between Steelhead and other species. Chinook and Coho salmon were harvested 68-74% of the time. Consistent with the fishing regulations, no Chinook salmon were harvested in Stratum One (Ferry Island to Lakelse) on or after 7 August. Pink salmon were retained only 12% of the time.

There were strong effects of month on Chinook salmon harvest per day (Table 14, Figure 9). The highest Chinook salmon harvests were in July and August. In July and the first week of August, 95% of the overall adult Chinook salmon harvest was kept, along with 92% of the total Chinook jacks. In the last three weeks of August, 5% of the adult and jack Chinook harvest was kept. No Chinook adults were harvested in June since no fish were caught. In September, all Chinook adults were caught in the closed area, and hence released (Table 13). For 'other' fish species, there was a statistically significant difference in harvest (fish per day) among months (Table 14), but the *post-hoc* pairwise tests did not reveal any

significantly differing pairs of months (Figure 9). After the Bonferroni adjustment was made, there were no other statistically significant effects of month, river stratum or access method (Table 14).

Biosampling

Scale samples were obtained from 28 (87.5%) of the 32 Chinook salmon observed during angler interviews. These samples were delivered to DFO for analysis but the sample size was too small to provide any meaningful results, so no ages were determined.

None of the 28 biosampled Chinook salmon were marked with an adipose fin clip.

Table 11. Estimated catch (harvest + release) of six fish taxa (with Chinook adults and jacks reported separately) in three geographic strata, by month. Catches are rounded to the closest whole number. Standard errors in parentheses.

Month	River Stratum	Chinook salmon		Coho salmon	Sockeye salmon	Pink salmon	Steelhead	Other
		adults	jacks					
June	Ferry Island to Lakelse	0	0	0	0	0	0	0
	Lakelse to Exstew	0	0	0	0	0	0	0
	Exstew to China Bar	0	0	0	0	0	0	0
1 July - 6 Aug	Ferry Island to Lakelse	383 (83)	223 (46)	132 (41)	4103 (764)	82 (61)	94 (66)	46 (41)
	Lakelse to Exstew	48 (65)	81 (19)	5 (9)	107 (24)	0	79 (33)	17 (11)
	Exstew to China Bar	81 (23)	20 (6)	16 (4)	35 (23)	55 (44)	193 (100)	24 (23)
7-31 Aug	Ferry Island to Lakelse	35 (15)	23 (27)	700 (188)	690 (241)	681 (237)	855 (215)	6 (4)
	Lakelse to Exstew	6 (4)	18 (7)	193 (107)	36 (14)	458 (796)	307 (129)	18 (6)
	Exstew to China Bar	13 (5)	7 (4)	377 (164)	47 (51)	431 (341)	903 (227)	27 (36)
Sept	Ferry Island to Lakelse	4 (3)	0	147 (119)	28 (10)	103 (38)	413 (130)	0
	Lakelse to Exstew	0	0	39 (16)	0	5 (5)	64 (47)	0
	Exstew to China Bar	0	17 (8)	216 (73)	33 (25)	33 (11)	539 (169)	0
Overall Total		571 (108)	387 (58)	1825 (308)	5079 (804)	1848 (902)	3446 (421)	139 (61)

Table 12. Statistical tests of the effect of month, river stratum and access method on median catch-per-day (harvest + release) estimates for the 6 taxa surveyed (with Chinook adults and jacks reported separately). *P*-values that are underlined are less than 0.05, but only those in bold are statistically significant after the Bonferroni adjustment.

Species	Month		River Stratum		Access Method	
	χ^2_3	<i>P</i>	χ^2_2	<i>P</i>	χ^2_1	<i>P</i>
Chinook adults	17.6	0.001	1.8	0.408	1.2	0.268
Chinook jacks	16.1	0.001	0.1	0.950	1.1	0.294
Coho	12.9	0.005	1.4	0.505	4.6	<u>0.033</u>
Pink	13.3	0.004	1.7	0.426	3.7	0.055
Sockeye	14.3	0.003	1.9	0.380	2.2	0.141
Steelhead	13.0	0.005	0.5	0.792	6.0	<u>0.014</u>
Other	19.9	0.000	0.0	0.989	1.2	0.267

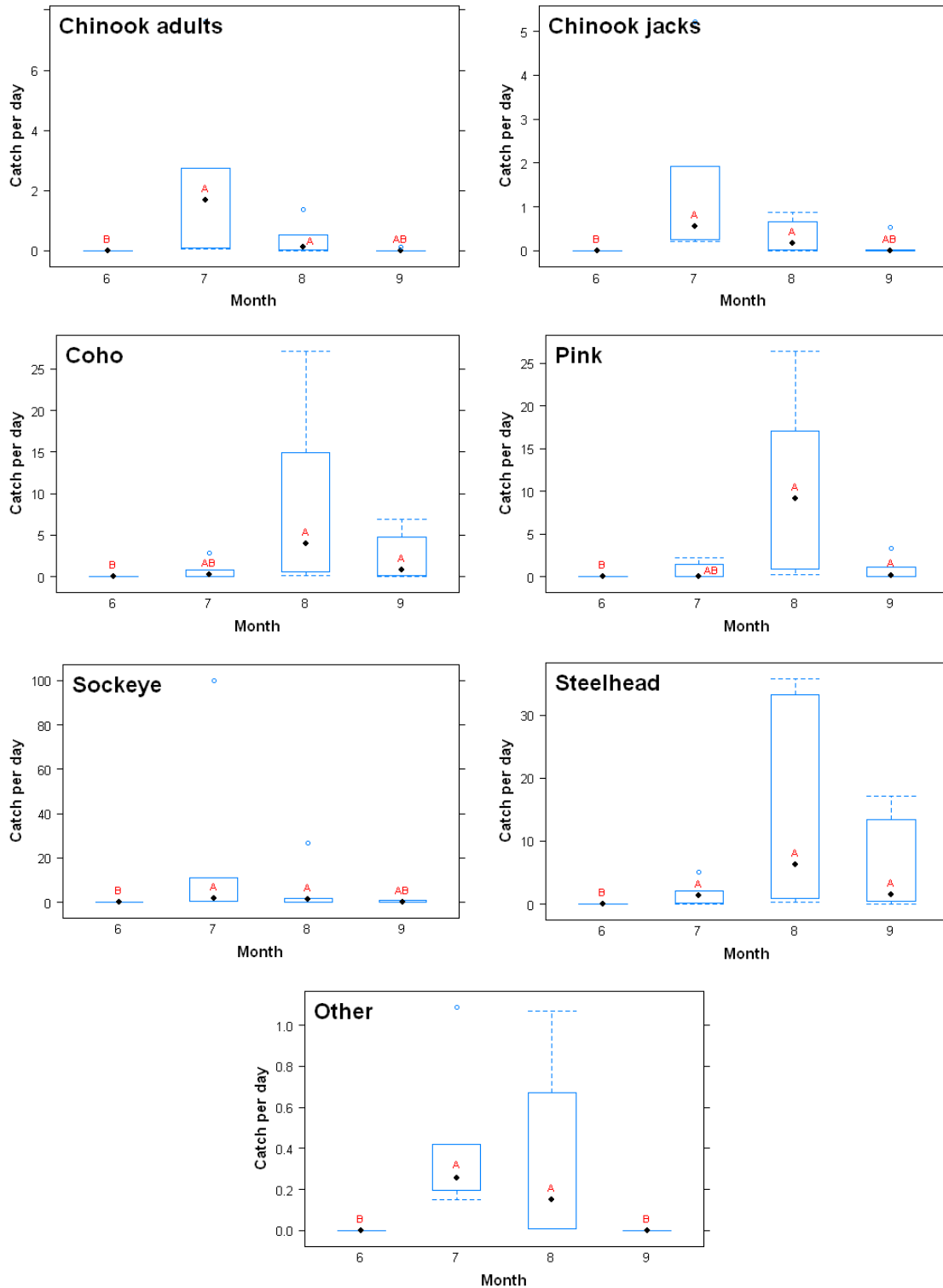


Figure 8. Box-whisker plots showing the distribution of catch-per-day estimates (harvest + release) for each month, by taxon (with Chinook adults and jacks reported separately). Within a taxon, letters indicate statistically significant differences among months. Months are shown using a numeric shorthand as follows: “6” = June; “7” = 1 July - 6 August; “8” = 7-31 August; and “9” = September. Samples sizes were 6 per taxon per month.

Table 13. Estimated harvest of six fish taxa (with Chinook adults and jacks reported separately) in three geographic strata, by month. Numbers are rounded to the closest whole number. Standard errors in parentheses.

Month	River Stratum	Chinook salmon		Coho salmon	Sockeye salmon	Pink salmon	Steelhead	Other
		adults	jacks					
June	Ferry Island to Lakelse	0	0	0	0	0	0	0
	Lakelse to Exstew	0	0	0	0	0	0	0
	Exstew to China Bar	0	0	0	0	0	0	0
1 July - 6 Aug	Ferry Island to Lakelse	287 (68)	190 (41)	111 (37)	3487 (651)	32 (55)	0	38 (41)
	Lakelse to Exstew	48 (65)	25 (6)	5 (9)	66 (13)	0	2 (2)	7 (3)
	Exstew to China Bar	65 (17)	20 (6)	16 (4)	27 (21)	31 (11)	3 (3)	9 (4)
7-31 Aug	Ferry Island to Lakelse	0	0	361 (108)	565 (217)	39 (29)	3 (2)	0
	Lakelse to Exstew	6 (4)	6 (4)	126 (46)	0	18 (10)	0	0
	Exstew to China Bar	13 (5)	7 (4)	364 (162)	34 (35)	81 (161)	0	0
Sept	Ferry Island to Lakelse	0	0	64 (18)	24 (10)	4 (9)	0	0
	Lakelse to Exstew	0	0	24 (13)	0	0	0	0
	Exstew to China Bar	0	8 (4)	174 (66)	33 (25)	8 (5)	8 (3)	0
Overall Total		420 (95)	256 (42)	1245 (216)	4235 (688)	213 (174)	17 (6)	54 (41)

Table 14. Statistical tests of the effect of month, river stratum and access method on median harvest-per-day estimates for six fish taxa surveyed (with Chinook adults and jacks reported separately). *P*-values that are underlined are less than 0.05, but only those in bold are statistically significant after the Bonferroni adjustment.

Species	Month		River Stratum		Access Method	
	χ^2	<i>P</i>	χ^2	<i>P</i>	χ^2	<i>P</i>
Chinook adults	18.3	0.000	0.3	0.858	0.3	0.584
Chinook jacks	15.1	0.002	1.3	0.522	0.2	0.666
Coho	12.0	<u>0.008</u>	1.3	0.530	5.1	<u>0.024</u>
Pink	11.2	<u>0.011</u>	2.5	0.291	3.3	0.069
Sockeye	11.4	<u>0.010</u>	4.8	0.091	1.2	0.268
Steelhead	2.5	0.475	1.5	0.480	0.4	0.544
Other	13.7	0.003	0.6	0.751	0.9	0.351

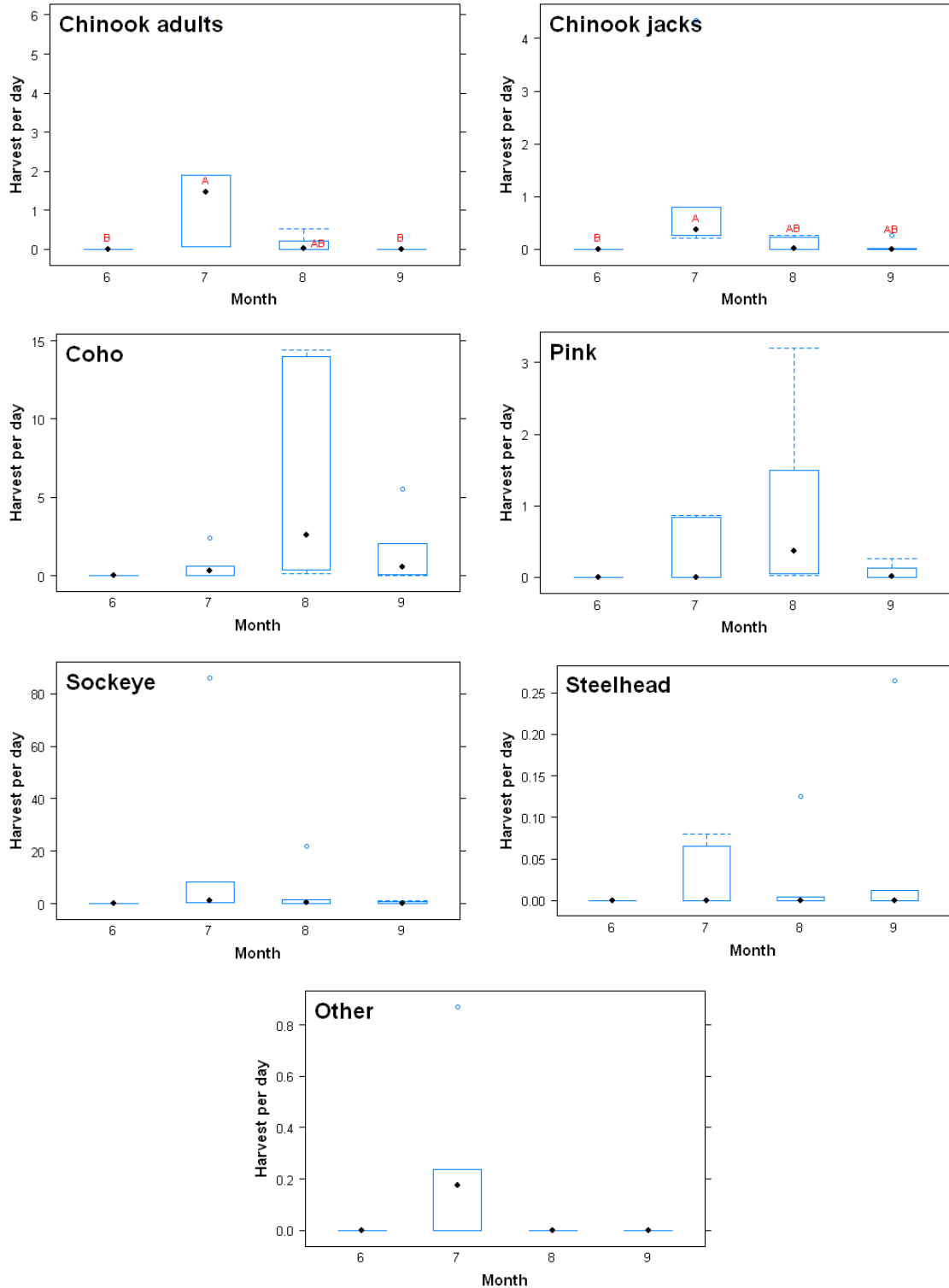


Figure 9. Box-whisker plots showing the distribution of harvest estimates for each month, by taxon (with Chinook adults and jacks reported separately). Within a taxon, letters indicate statistically significant differences among months. Months are shown using a numeric shorthand as follows: “6” = June; “7” = 1 July - 6 August; “8” = 7-31 August; and “9” = September. Samples sizes were 6 per taxon per month.

DISCUSSION

Comparison of the catch and fishing effort estimates derived from the 2003 creel survey data (Tallman 2004) with those derived for a similar period in 2010 (Robichaud and English 2011), 2011 (Robichaud and English, 2012) and 2012 revealed some substantial differences (Table 15, Table 16). The total angler effort estimates for the June-August period in 2010 and 2011 were remarkably similar, both only 42% of the comparable effort estimate for 2003. The effort for the same time period in 2012 was 73,275 angler hours, or 36% that observed in 2003 (85-86% that in 2010/11). The decrease in fishing effort in 2012 cannot be attributed solely to the poor fishing conditions in June. Effort was also reduced during the '1 July to 6 August' period in 2012 (43,584 angler-hours) relative to 2011 (54,213 angler-hours; Figure 10).

Pink salmon catches in 2010-2012 were a fraction of those reported in 2003. CPE for Pink salmon in 2010, 2011 and 2012 was only 39%, 66% and 24% of the 2003 estimate, respectively.

Coho and Sockeye salmon and Steelhead CPE estimates have increased in each year of study. Compared to estimates from 2003, CPE estimates from 2010 had increased by 378%, 242%, and 278% for Coho salmon, Sockeye salmon and Steelhead, respectively. In 2011, these estimates had further increased over those in 2010 by 155%, 149%, and 132%. Data analyzed for this report showed that CPE continued to increase, with 2012 estimates being higher than those from 2011 by 121%, 208%, and 131%, respectively. These increased catch rates may indicate increasing returns of the upper Skeena stocks, but they could also be explained by increasing susceptibility (due to changes in water clarity, or in timing and size of freshet), or changes in angler behavior (change in species targeted, improved techniques, etc.).

CPE for Chinook salmon in 2012 was notably lower than those estimated in any previous year (23-26% of the estimates from previous years). This, despite the belief that 2010 Chinook salmon catch was likely underestimated (Robichaud and English 2011). Field crews indicated that river conditions were poor for anglers throughout June. Mean river level in June 2012 was 8.2 m, higher than that observed in any previous study year (6.2 m in 2003, 5.7 m in 2010, and 7.5 m in 2011). June flows in 2012 averaged 3,830 m³/s, and peaked at 6,184 m³/s on 25 June. In 2011, flows peaked earlier (3 June) and at a lower rate 5,197 m³/s (Environment Canada 2012). It is possible that poor Chinook salmon fishing early in the year may have affected angler behavior (effort expended, species targeted) in the later parts of the summer.

The estimate of angler effort was substantially lower in 2010 (Robichaud and English 2011), 2011 (Robichaud and English 2012) and 2012 as compared to 2003 (Tallman 2004). The average number of anglers observed fishing in 2012 over all strata was 98 anglers per day (Table 17). This is similar to the average of 103 and 101 anglers/day observed in 2010 and 2011, respectively, but markedly lower than in 2003, when daily counts of shore-based frequently exceeded 250 anglers on a single day. Unfortunately, a precise estimate of the average number of anglers observed each day in 2003 cannot be readily derived from the Tallman (2004) report because activity patterns were not provided. Using Tallman's (2004)

reported average trip length (4.5 h; likely biased low), and his reported effort estimate of 203,587 angler hours, we calculated that, on average, 595 anglers would have been fishing each day over the 76 day study period in 2003. Even if the average trip length in 2003 was similar to that in 2011, over 300 anglers per day would be required to produce the effort estimate reported in Tallman (2004). Angler counts were also conducted between 9 July and 1 August 2006 by the Kitsumkalum catch monitoring crew and the average of 18 complete counts of the study area was 276 anglers per day (Kitsumkalum Fisheries 2006). Therefore, it appears that the number of anglers participating in the lower Skeena recreational fishery between 2010 and 2012 was substantially lower than in 2003 and 2006.

Table 15. Comparison of the catch and effort estimates for the 2003, 2010, 2011 and 2012 creel surveys for the same spatial strata and fishing periods.

Period/ River Stratum	Angler-hours	Catch (Harvest + Release) by Salmon Species				
		Chinook	Coho	Sockeye	Pink	Steelhead
June - August 2003						
Ferry Island to Lakelse	106,717	2,910	177	1,631	2,145	685
Lakelse to Exstew	55,996	2,477	253	122	12,036	488
Exstew to China Bar	40,875	1,342	127	108	5,282	241
Total	203,588	6,729	557	1,861	19,463	1,414
June - August 2010						
Ferry Island to Lakelse	40,317	1,452	526	1,857	2,610	812
Lakelse to Exstew	13,857	626	72	19	344	234
Exstew to China Bar	31,216	643	285	14	239	602
Total	85,390	2,720	883	1,890	3,192	1,647
June - August 2011						
Ferry Island to Lakelse	43,468	1,610	515	2,605	1,270	714
Lakelse to Exstew	18,071	557	427	171	2,808	785
Exstew to China Bar	24,441	368	440	58	1,311	684
Total	85,980	2,536	1,381	2,834	5,389	2,183
June - August 2012						
Ferry Island to Lakelse	41,792	419	832	4,793	763	949
Lakelse to Exstew	9,193	54	198	143	458	386
Exstew to China Bar	22,289	94	393	82	486	1,095
Total	73,275	567	1,423	5,018	1,706	2,430

Table 16. Comparison of the average CPE estimates (derived from values in Table 15) for the 2003, 2010, 2011 and 2012 creel surveys for the same spatial strata and fishing periods.

Period/ River Stratum	CPE by Salmon Species				
	Chinook	Coho	Sockeye	Pink	Steelhead
June - August 2003					
Ferry Island to Lakelse	0.027	0.002	0.015	0.020	0.006
Lakelse to Exstew	0.044	0.005	0.002	0.215	0.009
Exstew to China Bar	0.033	0.003	0.003	0.129	0.006
Total	0.033	0.003	0.009	0.096	0.007
June - August 2010					
Ferry Island to Lakelse	0.036	0.013	0.046	0.065	0.020
Lakelse to Exstew	0.045	0.005	0.001	0.025	0.017
Exstew to China Bar	0.021	0.009	0.000	0.008	0.019
Total	0.032	0.010	0.022	0.037	0.019
June - August 2011					
Ferry Island to Lakelse	0.037	0.012	0.060	0.029	0.016
Lakelse to Exstew	0.031	0.024	0.009	0.155	0.043
Exstew to China Bar	0.015	0.018	0.002	0.054	0.028
Total	0.029	0.016	0.033	0.063	0.025
June - August 2012					
Ferry Island to Lakelse	0.010	0.020	0.115	0.018	0.023
Lakelse to Exstew	0.006	0.022	0.016	0.050	0.042
Exstew to China Bar	0.004	0.018	0.004	0.022	0.049
Total	0.008	0.019	0.068	0.023	0.033

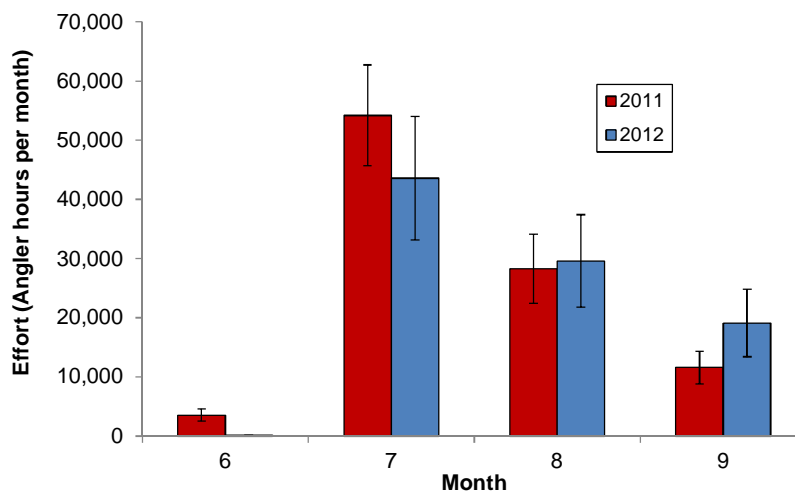


Figure 10. Total effort estimates (angler-hours) for each month in 2011 and 2012. On the X-axis, months are shown using a numeric shorthand as follows: “6” = June; “7” = 1 July - 6 August; “8” = 7-31 August; and “9” = September.

Table 17. Estimates of the average length of a fishing trip and average number of anglers fishing each day by river stratum and month in 2012.

Average trip length (h)	River Stratum			Total
	Ferry Island to Lakelse	Lakelse to Exstew	Exstew to Kwinitza	
Month				
June *	-	-	-	-
July	6.3	9.6	11.3	6.8
August	6.8	8.3	9.0	7.5
September	7.7	5.0	9.3	8.3
Overall Total	6.7	8.4	9.4	7.4

* No completed trips

Average anglers/day	River Stratum			Total
	Ferry Island to Lakelse	Lakelse to Exstew	Exstew to Kwinitza	
Month				
June *	0	0	0	0
July	155	14	26	195
August	54	20	47	121
September	20	8	48	76
Average	57	11	30	98

* used July trip lengths

One notable occurrence in 2012 was the much lower estimate of the boat-based angler effort compared to 2011. However, discussions with field crews indicated that the method used to assign anglers to a fishing method (boat vs. shore) was not consistent between 2011 and 2012. In 2011, anglers who used boats to access areas for shore-based fishing were enumerated as boat-based anglers during the on-water angler counts. In 2012, only those anglers that were fishing in a boat were enumerated as boat-based anglers. Fortunately, the CPUE estimates were similar for boat-based and shore-based anglers in 2012 so the total catch estimates should be comparable for each year. The 2012 method for classifying angler effort was the correct method and was applied in a consistent manner for all sampling periods in 2012. Therefore, the precipitous drop in boat-based angler effort that was recorded in late August and in September is likely real and reflects the difference between a fishery that targets Chinook salmon and one targeting other salmon species. During the peak of the Chinook salmon fishery in late July in Stratum One, anglers with boats will often fish from their boats while anchored off-shore. After the closure of the Chinook salmon fishery in Stratum One on 7 August 2012, most anglers were observed fishing from shore because shore-based fishing techniques are usually more effective than boat-based techniques for catching Steelhead, Sockeye and Coho salmon. The 2011 effort estimates also showed a substantial drop in the boat-based effort in Stratum One after the closure of the Chinook salmon fishery. However, most of the August and September 2011 'boat-based' effort, and a substantial portion of the June-July 2011 'boat-based' effort should have been classified as shore-based angler effort.

Precision of the Results

Typical of creel surveys, this creel analysis produced estimates with a relatively low level of precision. The imprecision clouds statistical analyses, and reduces our ability to confidently draw strong conclusions from the results. For example, Coho salmon harvest varied markedly among months, as would be expected based in its run-timing, yet variances were high enough to render the statistical test inconclusive. In this study, any statistically significant results that were observed are therefore very conclusive, as these effects were strong enough to be observed above-and-beyond the inherent variance.

To understand the imprecision, it is important to know that the variance in the catch estimates result from two factors: 1) large variability in CPE; and 2) the sampling error. In the present study, both factors played important roles in generating uncertainty in the estimates, and each is discussed below.

When sample sizes are large, the main factor affecting the precision of the catch estimate is the variability in CPE. Catch rates tend to follow a negative binomial distribution, where most catches are of zero fish; and the larger the catch the rarer the event. If the fish were uniformly distributed and anglers had equal experience and ability, there would be considerably less variability in the CPE estimates. However, day-to-day changes in abundance of the target species, fishing effort and weather or river conditions typically results in a wide range of outcomes for each fishing event. This variability translates into wide confidence limits around the catch estimates for each species.

Sampling error is the other main source of estimation error. As with any sampling program, the confidence you have in your final estimate is greater when a larger proportion of population has been sampled. With catches expected to be widely variable, it follows that the precision of estimates drawn from a small number of samples would be low. One solution is to pool data among categories, but this is not ideal since we know *a priori* that catch rates differ among months and river strata. The other solution is to increase interviewing and survey effort. However, personnel and budget limitations restrict most recreational creel surveys to sample less than 20% of the total fishing effort.

Accuracy of the Results

The accuracy of our creel methodology is only as good as that of the data provided by the anglers to the interviewers. In this study, 467 (39%) of the 1205 salmon and Steelhead reported as kept during angler interviews were recorded as observed by the interviewer. Incomplete data forms or misunderstandings associated with how to complete the data forms accounted for a notable portion of the 'unobserved' catch. For example: 128 (10%) of the kept fish were on data forms for which the "Catch Seen" field was blank.

There were other concerns with regard to accuracy and completeness of the interview and effort survey data forms, although much improved over previous years. Still, interviewers on occasion completed their survey forms in interesting and inconsistent ways, and some effort was required to massage their data into a workable format. Most of these problems were

resolved through meetings and telephone conversations with the surveyors to review data forms, fill in missing fields or discard interviews with unreliable information.

The major issues associated with the accuracy of the 2012 creel survey results were associated with the completion of the site-specific shore-and boat-based daily tally sheets, interviewers record the number of angler interviewed, and the number that were seen but not interviewed. Problems associated with these forms included: 1) angler counts recorded on the tally sheets did not match counts derived from the interviews conducted; 2) tally sheets were left blank or not submitted; and 3) multiple interviewers at one location confused the issue of how many anglers were seen but not interviewed.

RECOMMENDATIONS

Before a 2013 study, several aspects of the data collection should be emphasized to field crews. Specifically:

1. Ensure that the importance of catch inspection and biosampling is emphasized.
2. Data forms should be submitted to the local program supervisor and checked within a few days of collection so any problems can be asked before any questionable forms are fresh in the memory of the field technicians.
3. Surveyors at boat launch sites need to determine the primary fishing method (boat-based or shore-based) for each boat trip interview. This is important for distinguishing between boat-based and shore-based CPE and assigning the correct CPE estimates to the effort estimates for these two fishing methods.
4. Field crews need to put more effort into measuring length, recording adipose clips and obtaining scale samples from every Chinook salmon observed during their surveys. These data should be submitted to the Kitsumkalum office on a weekly basis. Sampling rates and data submission were very good in 2010 but poor in 2011 and 2012.
5. Ensure proper training is conducted with all staff, even if they are hired in-season. Proper training is an essential component to delivering complete data.

ACKNOWLEDGEMENTS

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APPENDICES

Appendix 1. Data forms.

Lower Skeena River Creel Survey 2012				Form:					
Surveyor:		Zone #:		Year 2012					
Location of Int:				Date: Month/Day					
Day Type: Weekend or Weekday (circle)				Time: am or pm					
# Anglers (Lines) in Today's Party:									
Residence: Skeena Watershed <input type="checkbox"/> B.C. <input type="checkbox"/> Rest of Canada <input type="checkbox"/> U.S. <input type="checkbox"/> Other <input type="checkbox"/>									
Type of Fishing: Boat <input type="checkbox"/> Shore <input type="checkbox"/> Guided: Y / N									
Method: Botton Bouncing <input type="checkbox"/> Fly Casting <input type="checkbox"/> Spin Casting <input type="checkbox"/> Still Fishing <input type="checkbox"/> Other <input type="checkbox"/>									
Gear Type: Spin+Glow <input type="checkbox"/> SG+Bait <input type="checkbox"/> Fly <input type="checkbox"/> Spoon <input type="checkbox"/> Spinners <input type="checkbox"/> Wool <input type="checkbox"/> Bait <input type="checkbox"/> Other <input type="checkbox"/>									
Times lines were in the water ** TODAY									
	Before 7		10 - 10:59		2 - 2:59		6 - 6:59		
	7 - 7:59		11 - 11:59		3 - 3:59		7 - 7:59		
	8 - 8:59		12 - 12:59		4 - 4:59		8 - 8:59		
	9 - 9:59		1 - 1:59		5 - 5:59		After 9		
Zone Fished:	Site 1		Site 2		Site 3				
River Location Fished:									
Hours Fished:									
Today's Catch:	Kept	Rel.	Kept	Rel.	Kept	Rel.			
	Chinook adult								
	Chinook jack								
	Coho								
	Sockeye								
	Pink								
	Steelhead								
	Other								
Target Species:	CN	CO	SK	PK	STHD				
Completed Trip? :	Y	or	N	Catch seen? :	Y	or	N	or	N/A
Times lines were in the water ** YESTERDAY				Yesterday's Zone:					
	Before 7		10 - 10:59		2 - 2:59		6 - 6:59		
	7 - 7:59		11 - 11:59		3 - 3:59		7 - 7:59		
	8 - 8:59		12 - 12:59		4 - 4:59		8 - 8:59		
	9 - 9:59		1 - 1:59		5 - 5:59		After 9		
Do you plan to fish tomorrow? Y / N									
Comments:									

Lower Skeena River Angling Effort Survey Form - 2012

Surveyor (s): _____ Form Number: _____

Weather: _____

Date: _____

	# shore anglers observed	# boat anglers observed	# Boats observed	Start Time	End Time
(Zone 1) - Ferry Island to Lakelse Confluence					
Upper Ferry Is.					
Lower Ferry Is.					
Power Line Bar					
Cottonwoods					
Hells Gate Bar					
Alberta Bar (below mouth of Kalum)					
Kraut Bar					
New Remo Bar					
Old Remo Bar					
Chicken Bar					
Turd Island					
Lakelse Confluence					
(Zone 2) - Lakelse Confluence to Exstew Confluence					
Delta Bar					
17 Mile Bar (Shames R. top)					
18 Mile Bar (Shames R. bottom)					
Esker Bar					
Shames Bar (Konaham)					
Exstew Bar					
(Zone 3) - Exstew Confluence to China Bar					
Gitnadoix Bar					
28 Mile Bar (bottom of Andesite)					
Andesite Bar (river right)					
Exchamsiks Mouth (river left)					
Salvus Bar (river right)					
Kasiks River					
China Bar					
Kwinitsa					
Comments:	_____				

Lower Skeena River Boat-based Interview Tally Form - 2012

Surveyor (s): _____ Form #:

Weather _____

Date: _____

Shore Anglers		Boat Anglers	
# anglers observed	# anglers interviewed	# anglers observed	# anglers interviewed

(Zone 1) - Ferry Island to Lakelse Confluence

Upper Ferry Is.					
Lower Ferry Is.					
Power Line Bar					
Cottonwoods					
Hells Gate Bar					
Alberta Bar (below mouth of Kalum)					
Kraut Bar					
New Remo Bar					
Old Remo Bar					
Chicken Bar					
Turd Island					
Lakelse Confluence					

(Zone 2) - Lakelse Confluence to Exstew Confluence

Delta Bar					
17 Mile Bar (Shames R. top)					
18 Mile Bar (Shames R. bottom)					
Esker Bar					
Shames Bar (Konaham)					
Exstew Bar					

(Zone 3) - Exstew Confluence to China Bar

Gitnadoix Bar					
28 Mile Bar (bottom of Andesite)					
Andesite Bar (river right)					
Exchamsiks Mouth (river left)					
Salvus Bar (river right)					
Kasiks River					
China Bar					
Kwinitsa					

Comments: _____

Lower Skeena River Creel Survey - Daily Tally Form Date: _____

Surveyor: _____

Interview Location 1: _____ Survey Period: Start: _____ End: _____

# Anglers Interviewed	# Anglers Not Interviewed		# Anglers Interviewed	# Anglers Not Interviewed		# Anglers Interviewed	# Anglers Not Interviewed		# Anglers Interviewed	# Anglers Not Interviewed	
		Before 7			10 - 10:59			2 - 2:59			6 - 6:59
		7 - 7:59			11 - 11:59			3 - 3:59			7 - 7:59
		8 - 8:59			12 - 12:59			4 - 4:59			8 - 8:59
		9 - 9:59			1 - 1:59			5 - 5:59			After 9

Comments: _____

Interview Location 2: _____ Survey Period: Start: _____ End: _____

# Anglers Interviewed	# Anglers Not Interviewed		# Anglers Interviewed	# Anglers Not Interviewed		# Anglers Interviewed	# Anglers Not Interviewed		# Anglers Interviewed	# Anglers Not Interviewed	
		Before 7			10 - 10:59			2 - 2:59			6 - 6:59
		7 - 7:59			11 - 11:59			3 - 3:59			7 - 7:59
		8 - 8:59			12 - 12:59			4 - 4:59			8 - 8:59
		9 - 9:59			1 - 1:59			5 - 5:59			After 9

Comments: _____

Appendix 2. Proposed survey schedule and actual shifts worked.

JUNE - proposed												JUNE - actual															
Boat Survey						Shore Survey						Boat Survey						Shore Survey									
		Kwinita		Kalum		Terrace		China Bar		Survey Team				Kwinita		Kalum		Terrace		China Bar		Survey Team					
Date	Day	AM	PM	AM	PM	AM	PM	AM	PM	DR	DN	RB	WB	RM	AM	PM	AM	PM	AM	PM	AM	PM	DR	DN	RB	WB	RM
1	F																										
2	Sa																										
3	Su			B		FK				F	B	B	S	S			B		FK			F	B	B	S	S	
4	M		B							F	B	B			B							F	B	B			
5	T		B			FK				F	B	B	S	S			B		FK			F	B	B	S	S	
6	W			B		FK				O	B	B	S	S			B		FK			O	B	B	S	S	
7	Th																										
8	F			B						O	B	B					B					O	B	B			
9	Sa			B		FK					B	B	S	S	S				FK				S	S	S	S	
10	Su	B					C				B	B	S	S	S					C			S	S	S	S	
11	M			B		FK					B	B	S	S			B		FK				B	B	S	S	
12	T					FK							S	S					FK					S	S		
13	W						C			O			S	S						C		O		S	S		
14	Th																										
15	F		B				FSC			O	B	B	FSC	FSC	B				FSC			O	B	B	FSC	FSC	
16	Sa		B			FK					B	B	S	S	B				FK				B	B	S	S	
17	Su			B		FK					S	B	B	S			B		FK				S	B	B	S	
18	M		B			FK					S	B	B	S	B				FK				S	B	B	S	
19	T			B						O		B	B				B					O		B	B		
20	W			FSC								FSC	FSC				FSC							FSC	FSC		
21	Th	Aboriginal Day													Aboriginal Day												
22	F					FK				O	S			S					FK			O	S			S	
23	Sa		B				C				S	B	B	S	B				C				S	B	B	S	
24	Su			B		FK					S	B	B	S			B		FK				S	S	S	S	
25	M		B			FK				O	S	B	B	S	B				FK			O	S	S	S	S	
26	T			B			C				S	B	B	S			B			C			S	S	S	S	
27	W																		FK								
28	Th		B			FK					S	B	B	S	B								S	S	S	S	
29	F						C			O	S			S					C			O	S			S	
30	Sa		B			FK					S	B	B	S	B				FK				S	B	B	S	
Weekday		6		5		4		4		3		0				3		6		4		4		3		0	
Weekend		4		4		3		3		2		0		11		20		19		18		19					
FSC ¹		0		0		1		0		0		1		0		0		0		1		0		0		0	

¹ FSC (Food, Social and Cermonial) surveys days are also included in the total survey days. The survey teams collected creel data, as well as, FSC data on those days.

Appendix 2 continued.

JULY - proposed															JULY - actual																
		Boat Survey					Shore Survey										Boat Survey					Shore Survey									
Date	Day	Kwinitsa		Kalum		Terrace		China Bar		Survey Team					Kwinitsa	Kalum		Terrace		China Bar		Survey Team									
		AM	PM	AM	PM	AM	PM	AM	PM	DR	DN	RB	WB	RM	AM	PM	AM	PM	AM	PM	AM	PM	DR	DN	RB	WB	RM				
1	Su			B		FK					B	B	S	S			B		FK				B	B	S						
2	M		B				FK						S	S	B				FK						S	S					
3	T			B				C		O	B	B	S	S			B			C		O	B	B	S						
4	W		B																												
5	Th												S	S											S	S					
6	F					FK				O			S	S				FK				O			S	S					
7	Sa		B					C					S	S	B				C						S	S					
8	Su			B		FK					B	B	S	S			B		FK			O	B	B	S	S					
9	M		B			FK				O			S	S	B			FK				O			S	S					
10	T			B			FK				B	B	S	S			B			FK			B	B	S	S					
11	W		B																												
12	Th																														
13	F							C		O			S	S					C			O			S	S					
14	Sa			B		FK					B	B	S	S			B		FK				B	B	S	S					
15	Su		B			FK									B			FK						S							
16	M			B		FK						B	B				B		FK					S	B	B	S				
17	T		B				FK				S			S	B			FK					S			S					
18	W			B				C			S	B	B	S			B			C			S	B	B						
19	Th																														
20	F									O												O									
21	Sa		B			FK									B			FK					S								
22	Su			B		FK						B	B				B		FK				S	B	B	S					
23	M		B					C											C				S								
24	T			B								B	B				B							B	B						
25	W																														
26	Th					FK												FK					S			S					
27	F		FSC				FK			O		FSC	FSC						FK			O	S	FSC	FSC	S					
28	Sa			B				C				B	B				B			C			S	B	B	S					
29	Su		B			FK							S	S				FK							S	S					
30	M			B		FK					B	B	S	S			B			FK			B	B	S	S					
31	T																														
	Weekday		5		6	4	4	4	0								5	6	4	4	4	0									
	Weekend		5		5	4	4	2	0	6	1	11	18	4			5	5	4	4	2	0	6	22	11	18	14				
	FSC ¹		1	0	0	0	0	0	0	0	0	1	1	0			1	0	0	0	0	0	0	0	1	1	0				

¹ FSC (Food, Social and Cermonial) surveys days are also included in the total survey days. The survey teams collected creel data, as well as, FSC data on those days.

Appendix 2 continued.

AUGUST - proposed															AUGUST - actual																		
		Boat Survey				Shore Survey				Survey Team									Boat Survey				Shore Survey				Survey Team						
		Kwinitsa		Kalum		Terrace		China Bar		DR	DN	RB	WB	AY	Kwinitsa		Kalum		Terrace		China Bar		DR	DN	RB	WB	NS	AY					
Date	Day	AM	PM	AM	PM	AM	PM	AM	PM						AM	PM	AM	PM	AM	PM	AM	PM											
1	W																																
2	Th				B				C								B			C													
3	F		B				FK			O					B			B		FK			O										
4	Sa				B		FK										B		FK														
5	Su		B				FK				B	B			B				FK				B	B									
6	M		B								B	B					B						B	B									
7	T																																
8	W		B				FK			O	B	B	S	S					FK			O				S	S						
9	Th						FK						S	S	B				FK				B	B	S		S						
10	F			FSC					C	O	FSC	FSC				FSC				C	O	FSC	FSC										
11	Sa				B		FK										B		FK														
12	Su		B				FK								B				FK														
13	M				B	FSC					FSC			FSC			B	FSC								FSC	FSC						
14	T		B									B	B										B	B									
15	W				B												B																
16	Th						FK			O									FK			O											
17	F						FK			O										FK		O											
18	Sa		B						C						B						C												
19	Su				B		FK								B				FK														
20	M		B				FK												FK														
21	T				B												B																
22	W																																
23	Th						FK			O									FK			O											
24	F				B		FK			O							B			FK		O											
25	Sa		B				FK								B				FK														
26	Su				B				C		B	B					B				C			B	B								
27	M														B								B	B									
28	T		B				FSC						FSC	FSC	B				FSC						FSC		FSC						
29	W				B		FK			O							B		FK			O	B	B									
30	Th		B				FK				B	B							FK														
31	F																																
Weekday		6		6	4	5	2	0							6		6	4	5	2	0												
Weekend		5		4	4	3	2	0	8	5	6	3	2		5		4	4	3	2	0	8	7	7	2	0	2						
FSC ¹		0	1	0	1	1	0	0	0	2	1	1	2		0	1	0	1	1	0	0	0	1	1	1	1	1	2					

¹ FSC (Food, Social and Cermonial) surveys days are also included in the total survey days. The survey teams collected creel data, as well as, FSC data on those days.

Appendix 2 continued.

SEPTEMBER - proposed													SEPTEMBER - actual																				
Boat Survey						Shore Survey						Survey Team					Boat Survey						Shore Survey						Survey Team				
Date	Day	Kwinitsa		Kalum		Terrace		China Bar		DR	DN	RB	WB	AY	Kwinitsa		Kalum		Terrace		China Bar		SK	DN	RB	WB	AY						
		AM	PM	AM	PM	AM	PM	AM	PM						AM	PM	AM	PM	AM	PM	AM	PM											
1	Sa		B					C							B							C											
2	Su				B		FK										B		FK														
3	M		B			FK									B			FK															
4	T				B		FK			O							B		FK				O										
5	W		B			FK									B			FK															
6	Th																																
7	F																																
8	Sa		B				FK								B			FK															
9	Su				B		FK										B		FK														
10	M		B				FK			O					B			FK					O										
11	T				B			C									B			C													
12	W				B		FK										B		FK														
13	Th																																
14	F																																
15	Sa				B			C		S	B	B	S				B			C			B	B	S	S							
16	Su		B				FK								B			FK															
17	M				B		FK					B	B				B		FK				B	B									
18	T																																
19	W																																
20	Th																B		FK				B	B									
21	F		B				FK					B	B		B			FK					B	B									
22	Sa				B		FK			S	B	B	S		B			FK					B	B	S	S							
23	Su									O					B					C		O	B	B	S								
24	M									O																							
25	T									O																							
26	W																																
27	Th																		FK														
28	F																																
29	Sa																																
30	Su																																
Weekday			3		4		3	3	1	0					3		5	6	2	1	0												
Weekend			4		4		3	3	2	0	5	2	4	4	2		6	3	3	3	3	0	3	6	6	3	2						
FSC ¹			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0						

¹ FSC (Food, Social and Cermonial) surveys days are also included in the total survey days. The survey teams collected creel data, as well as, FSC data on those days.

Appendix 3. Boat-based effort data, including angler counts (by access method) and survey dates and times.

Day Type	Date	Survey timing and Duration						Angler Counts						Overall Total		
		Zone 1		Zone 2		Zone 3		Zone 1		Zone 2		Zone 3			Boat Total	Shore Total
		Start	End	Start	End	Start	End	Boat	Shore	Boat	Shore	Boat	Shore			
WE	3 Jun	16:24	17:14	17:14	18:00			0	0	0	0	0	0	0	0	
WD	4 Jun					18:15	15:58					0	0	0	0	
WD	5 Jun	15:22	16:15	16:15	17:15			0	3	0	0			0	3	
WD	6 Jun	14:47	15:40	15:40	16:30			0	0	0	0			0	0	
WD	8 Jun	14:18	15:16	15:16	15:45			0	0	0	0			0	0	
WD	11 Jun	15:52	16:54	16:54	17:45			0	0	0	0			0	0	
WD	15 Jun					17:01	15:40					0	0	0	0	
WE	16 Jun					15:38	17:18					0	0	0	0	
WE	17 Jun	14:09	14:45	14:45	15:25			0	0	0	0			0	0	
WD	18 Jun					17:00	15:43					0	0	0	0	
WD	19 Jun	14:05	14:36	14:36	15:05			0	0	0	0			0	0	
WD	20 Jun	14:04	14:37	14:37	15:03			0	0	0	0			0	0	
WE	23 Jun					16:03	14:41					0	0	0	0	
WE	24 Jun	14:32	15:00	15:00	15:10	15:15	15:39	0	0	0	0	0	0	0	0	
WD	25 Jun	13:41	14:11	14:11	14:25	14:25	14:54	0	0	0	0	0	0	0	0	
WD	26 Jun	13:35	14:04	14:04	14:20	14:20	14:43	0	0	0	0	0	0	0	0	
WD	28 Jun	9:00	9:30	9:30	9:45	9:45	10:00	0	0	0	0	0	0	0	0	
WE	30 Jun					16:45	14:46					0	0	0	0	
WE	1 Jul	14:03	15:12	15:12	16:10			0	0	0	0			0	0	
WE	2 Jul					14:40	16:20					0	0	0	0	
WD	3 Jul	14:38	15:35	15:35	16:35			0	7	0	0			0	7	
WD	4 Jul					15:30	16:47					0	2	0	2	
WE	7 Jul					15:22	16:30					0	2	0	2	
WE	8 Jul	13:52	14:50	14:50	15:49			18	33	12	0			30	33	
WD	9 Jul					15:00	17:00					5	5	5	10	
WD	10 Jul	14:35	15:47	15:47	16:44			0	16	0	4			0	20	
WD	11 Jul					15:20	17:13					0	5	0	5	
WE	14 Jul	13:52	14:55	14:55	15:58			24	28	3	4			27	32	
WE	15 Jul					16:37	14:33					1	9	1	9	
WD	16 Jul	14:34	15:33	15:33	15:48			1	22	0	12			1	34	
WD	17 Jul					16:22	14:45					0	0	0	0	
WD	18 Jul	15:08	15:40	15:40	16:16			2	41	0	4			2	45	
WE	21 Jul					16:48	14:39					2	26	2	26	
WE	21 Jul	14:52	16:16					8	99					8	99	
WE	22 Jul	14:11	14:56	14:56	15:31			17	143	2	11			19	154	
WD	23 Jul					16:20	14:49					3	16	3	16	
WD	24 Jul	14:22	14:59	14:59	15:27			12	124	0	23			12	147	
WD	27 Jul					16:21	15:00					0	27	0	27	
WE	28 Jul	14:01	14:45	14:45	15:25	15:25	16:00	13	108	4	18	0	2	17	128	
WE	29 Jul					15:35	17:41					21	20	21	20	
WD	30 Jul	14:27	15:25	15:25	16:25			15	88	0	2			15	90	
WD	2 Aug	13:08	14:07	14:07	15:12			29	60	0	8			29	68	
WD	3 Aug					14:21	16:08					5	57	5	57	
WE	4 Aug	13:28	14:32	14:32	15:30			27	84	0	32			27	116	
WE	5 Aug					13:58	16:03					2	59	2	59	
WE	6 Aug	12:34	16:43	16:43	17:45			16	62	0	5			16	67	

...continued

Appendix 3 continued.

Day Type	Date	Survey timing and Duration						Angler Counts								
		Zone 1		Zone 2		Zone 3		Zone 1		Zone 2		Zone 3		Boat Total	Shore Total	Overall Total
		Start	End	Start	End	Start	End	Boat	Shore	Boat	Shore	Boat	Shore			
WD	9 Aug					14:10	15:56					0	51	0	51	51
WD	10 Aug	7:14	8:12	8:12	9:15			0	25	0	15			0	40	40
WE	11 Aug	13:08	14:06	14:06	15:04			3	39	0	21			3	60	63
WE	12 Aug					14:10	15:45					4	47	4	47	51
WD	13 Aug	14:04	15:02	15:02	16:03			0	41	2	17			2	58	60
WD	14 Aug					13:47	15:50					0	45	0	45	45
WD	15 Aug	13:30	14:27	14:27	15:25			0	42	0	13			0	55	55
WE	18 Aug					14:20	16:55					0	42	0	42	42
WE	19 Aug					13:42	15:47					0	51	0	51	51
WD	20 Aug					14:00	15:50					0	44	0	44	44
WD	21 Aug	13:32	14:25	14:25	15:28			0	57	0	20			0	77	77
WD	24 Aug	13:50	14:40	14:40	15:50			4	34	0	24			4	58	62
WE	25 Aug					13:47	15:25					1	51	1	51	52
WE	26 Aug	13:07	14:11	14:11	15:20			3	26	8	7			11	33	44
WD	27 Aug					14:25	15:50					0	22	0	22	22
WD	28 Aug					13:51	15:21					1	20	1	20	21
WD	29 Aug	13:05	14:02	14:02	15:18			0	33	0	5			0	38	38
WE	1 Sep					12:55	14:35					0	71	0	71	71
WE	2 Sep	12:03	13:02	13:02	14:02			0	22	0	3			0	25	25
WE	3 Sep					12:58	14:25					3	40	3	40	43
WD	4 Sep	12:47	13:45	13:45	14:40			2	25	0	0			2	25	27
WD	5 Sep					12:47	14:20					3	18	3	18	21
WE	8 Sep					13:14	14:46					8	37	8	37	45
WE	9 Sep	12:24	13:20	13:20	14:22			0	17	0	0			0	17	17
WD	10 Sep					13:13	14:42					0	22	0	22	22
WD	11 Sep	12:14	13:10	13:10	14:10			0	11	0	3			0	14	14
WD	12 Sep	12:40	13:31	13:31	14:25			1	17	0	8			1	25	26
WE	15 Sep	12:10	13:05	13:05	14:05			0	6	0	1			0	7	7
WE	16 Sep					13:10	14:54					2	64	2	64	66
WD	17 Sep	12:05	13:04	13:04	14:10			0	6	0	12			0	18	18
WD	20 Sep	13:08	14:02	14:02	15:10			0	0	0	2			0	2	2
WD	21 Sep					12:35	14:10					0	31	0	31	31
WE	23 Sep					12:20	14:09					3	28	3	28	31

Date Range	Number of Surveys Performed			Average Angler Counts								
	Zone 1	Zone 2	Zone 3	Zone 1		Zone 2		Zone 3		Boat	Shore	Overall
				Boat	Shore	Boat	Shore	Boat	Shore	Total	Total	Total
1 - 30 June	12	12	10	0.0	0.3	0.0	0.0	0.0	0.0	0.0	0.3	0.3
1 July - 6 Aug	15	14	14	12.1	61.0	1.5	8.8	2.8	16.4	16.4	86.2	102.6
7 - 31 Aug	8	8	9	1.3	37.1	1.3	15.3	0.7	41.4	3.2	93.8	97.0
1 - 30 Sept	8	8	8	0.4	13.0	0.0	3.6	2.4	38.9	2.8	55.5	58.3
Total	43	42	41	4.5	30.7	0.7	6.5	1.6	22.3	6.8	59.5	66.3

Appendix 4. Shore-based interview stints, including angler interview counts, by access method.

Day Type	Date	Survey Stints			Angler Interviews								Overall Total	
		Zone 1	Zone 2	Zone 3	Zone 1		Zone 2		Zone 3		Boat	Shore		
		Start	Start	Start	Boat	Shore	Boat	Shore	Boat	Shore	Total	Total		
WE	3 Jun	1			3	0						3	0	3
WD	5 Jun	1			0	0						0	0	0
WD	6 Jun	1			0	0						0	0	0
WE	9 Jun	1		1	0	1			0	0		0	1	1
WE	10 Jun	1	1	1	0	0	0	0	0	0		0	0	0
WD	11 Jun	1			0	0						0	0	0
WD	12 Jun	1			0	0						0	0	0
WD	13 Jun	1	1	1	0	0	0	0	0	0		0	0	0
WD	15 Jun	1	1	1	0	0	0	0	0	0		0	0	0
WE	16 Jun	1			0	0						0	0	0
WE	17 Jun	1			0	0						0	0	0
WD	18 Jun	1			0	0						0	0	0
WD	22 Jun	1			0	0						0	0	0
WE	23 Jun			1					0	0		0	0	0
WE	24 Jun	1			0	0						0	0	0
WD	25 Jun	1			0	0						0	0	0
WD	26 Jun	1		1	0	0			0	0		0	0	0
WD	27 Jun	1			0	0						0	0	0
WD	29 Jun	1		1	0	0			0	0		0	0	0
WE	30 Jun	1			0	2						0	2	2
WE	1 Jul	1			0	7						0	7	7
WE	2 Jul	2			0	22						0	22	22
WD	3 Jul	1		1	0	0			0	0		0	0	0
WD	6 Jul	1			0	5						0	5	5
WE	7 Jul	1	1	1	0	13	0	5	0	1		0	19	19
WE	8 Jul	2			0	27						0	27	27
WD	9 Jul	2			2	37						2	37	39
WD	10 Jul	3			3	18						3	18	21
WD	11 Jul	1			0	2						0	2	2
WD	13 Jul	2	1	1	0	20	0	0	0	0		0	20	20
WE	14 Jul	2			25	62						25	62	87
WD	16 Jul	2			11	14						11	14	25
WD	17 Jul	2			17	23						17	23	40
WD	18 Jul			1					0	0		0	0	0
WE	21 Jul	1			7	17						7	17	24
WE	22 Jul	2			80	0						80	0	80
WD	23 Jul			1					0	0		0	0	0
WD	26 Jul	2			1	30						1	30	31
WD	27 Jul	2			36	13						36	13	49
WE	28 Jul			2					0	15		0	15	15
WE	29 Jul	2			24	51						24	51	75
WD	30 Jul	2			48	56						48	56	104
WD	2 Aug	2	2	2	20	22	0	7	0	42		20	71	91
WD	3 Aug	2			57	82						57	82	139
WE	4 Aug	2			17	34						17	34	51
WE	5 Aug	2			58	70						58	70	128

...continued

Appendix 4 continued.

Day Type	Date	Survey Stints			Angler Interviews								Overall Total
		Zone 1 Start	Zone 2 Start	Zone 3 Start	Zone 1		Zone 2		Zone 3		Boat Total	Shore Total	
WD	8 Aug	2			6	25					6	25	31
WD	9 Aug	2			25	39					25	39	64
WD	10 Aug	2	1	2	6	11	0	1	0	41	6	53	59
WE	11 Aug	2			8	26					8	26	34
WE	12 Aug	2			51	15					51	15	66
WD	13 Aug	2			6	9					6	9	15
WD	16 Aug	2			15	9					15	9	24
WD	17 Aug	2			24	7					24	7	31
WE	18 Aug	2	2	2	0	18	0	9	0	42	0	69	69
WE	19 Aug	2			64	71					64	71	135
WD	20 Aug	2			2	13					2	13	15
WD	23 Aug	2	2		0	20	0	7			0	27	27
WD	24 Aug	2			34	28					34	28	62
WE	25 Aug	2	2		0	17	0	6			0	23	23
WE	26 Aug	2	2	2	3	17	0	5	0	32	3	54	57
WD	28 Aug	2			5	68					5	68	73
WD	29 Aug	2			4	18					4	18	22
WD	30 Aug	2	1		3	53	0	2			3	55	58
WE	1 Sep	2	2	2	0	11	0	7	0	61	0	79	79
WE	2 Sep	2			2	31					2	31	33
WE	3 Sep	2			8	7					8	7	15
WD	4 Sep	2			0	29					0	29	29
WD	5 Sep	2			0	7					0	7	7
WE	8 Sep	2			3	33					3	33	36
WE	9 Sep	2			0	4					0	4	4
WD	10 Sep	2			0	32					0	32	32
WD	11 Sep	2		2	0	6			0	26	0	32	32
WD	12 Sep	2			0	4					0	4	4
WE	15 Sep	2	2	2	0	2	0	2	0	58	0	62	62
WE	16 Sep	2			1	20					1	20	21
WD	17 Sep	2			0	4					0	4	4
WD	20 Sep	2			0	2					0	2	2
WD	21 Sep	2			4	14					4	14	18
WE	22 Sep	2			0	3					0	3	3
WE	23 Sep	1		1	0	1			0	31	0	32	32
WD	27 Sep	2			0	0					0	0	0

Date Range	Number of Stints			Average Angler Counts						Boat Total	Shore Total	Overall Total
	Zone 1	Zone 2	Zone 3	Zone 1		Zone 2		Zone 3				
1 - 30 June	19	3	7	0.2	0.2	0.0	0.0	0.0	0.0	0.2	0.2	0.3
1 July - 6 Aug	41	4	9	17.7	27.2	0.0	4.0	0.0	8.3	17.7	39.5	57.1
7 - 31 Aug	36	10	6	14.2	25.8	0.0	5.0	0.0	38.3	14.2	69.1	83.3
1 - 30 Sept	35	4	7	1.0	11.7	0.0	4.5	0.0	44.0	1.0	60.2	61.2
Total	131	21	29	8.8	16.7	0.0	3.6	0.0	16.6	8.8	37.0	45.7