2004 Salmon River Creel Survey

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An instantaneous-access site creel survey was conducted on the Salmon River in 2004 for a twelve week period from the day after Labor Day through the last weekend in November. Annual surveys which ran from mid-October through November have been done on the Salmon River since 1997 that were primarily aimed at assessing the steelhead fishery. This survey is the first since 1992 to cover the September and early October time frame to assess the Pacific salmon fishery. The purpose of this survey was to estimate angler effort, catch, and harvest of trout and salmon species.

Methods

Data collection

Survey agents sampled 50 days from 7 September to 28 November. We used 4 agents with staggered shifts to cover the morning counts and interviews which continued until ½ hour after sunset. Twenty-five sites were sampled for vehicle counts, angler counts, boat counts and/or drift-boat trailer counts, and angler interviews (Figure 1). Angler counts were necessary in the Village of Pulaski and in the estuary because anglers were not confined to designated parking areas. Angler counts were also done in the lower fly fishing area in Altmar because anglers used various parking lots for both conventional shore fishing and the special regulations fly fishing area. Boat counts were done in the estuary. Survey agents interviewed 2,554 angler parties.

Survey counts were done twice each day during the early part of the survey when days were longer and once daily as day length shortened. Angler interviews were done later in the day to interview anglers that had fished for several hours. Interviews consisted of a series of questions posed to angler parties (a party is all of the anglers associated with a vehicle, boat or drift-boat) returning to access sites after fishing. Site, date, time of the interview, residence, number of anglers per vehicle or drift-boat, start time, time taken for breaks, trip status (complete, incomplete), fishing method, species targeted, and fish kept and released were recorded. Time spent interviewing anglers at individual sites was at the discretion of the agents and was roughly proportional to activity at a given site.

Effort and catch/harvest data were stratified by week and the catch/harvest data were also stratified by fishing type (conventional regulations shore access, drift-boat, special regulations catch and release fly fishing, tributary, and the estuary boat fishery) to produce estimates of angler effort, catch, and harvest of trout and salmon. A detailed description of the statistical analyses used in this report are provided in Appendix 1. All statistical analyses were done with SAS rel. 8.0 (SAS Institute 1999).

Results and Discussion

Effort

The overall estimated effort was 90,825 ± 6,075 angler days (Table 1). Shore access fishermen on the conventional regulations portion of the main stem of the river accounted for 80% of the effort. The special regulations fly fishing catch and release

areas were the only other segment of the fishery to account for more than 10% of the effort. The

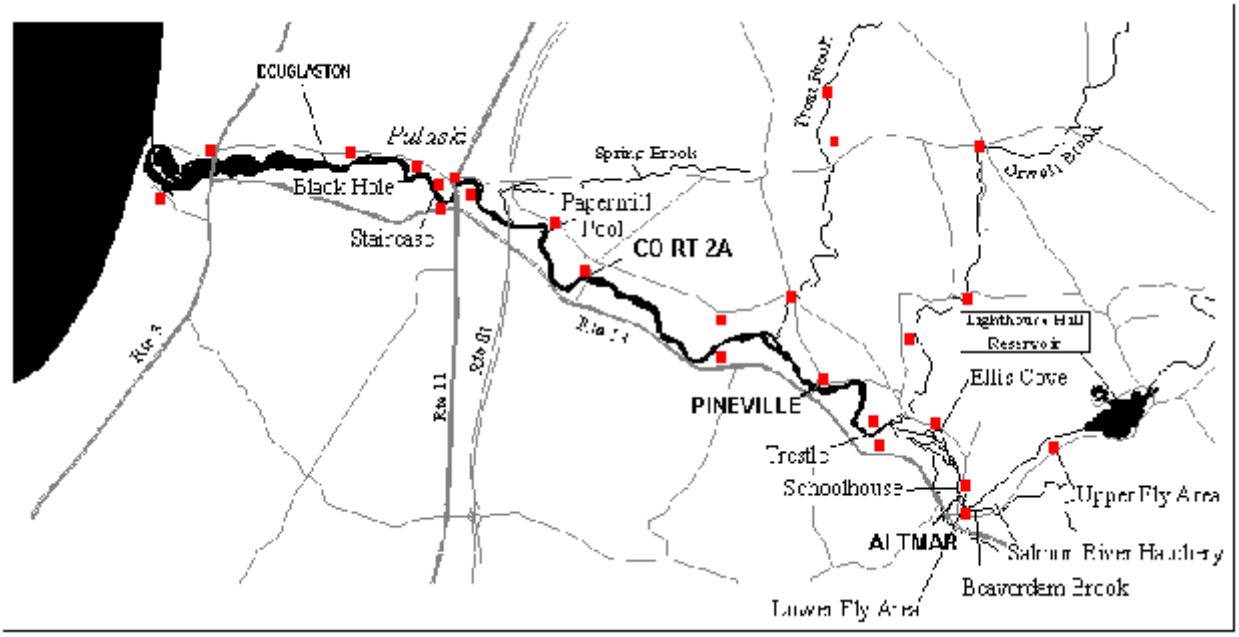

Figure 1. 2004 Salmon River access site creel survey sites.

Table 1. Estimated angler effort from the 2004 Salmon River creel census.

Fishing Type	Effort (angler hours)	1.96 se	Mean trip length (hours)	Estimated Angler Days	1.96 se
Shore	458,909	33,112	6.36	72,142	6,029
Drift Boat	17,012	1,256	6.98	2,436	180
Special Regs Fly	69,448	4,567	6.30	11,021	725
Estuary Boat	16,910	2,685	5.21	3,245	515
Tributary	11,146	1,316	5.08	2,196	259
Total[1]	573,423	38,353	6.31	90,825	6,075

1 - Note that total for angler days does not add exactly due to rounding errors.

1992 survey had a different time frame which included Labor Day weekend but ended on 1 November (Bishop 1993). Despite the shorter time frame, the estimated effort from 1992 was 104,000 angler days, similar to that observed in 2004. A survey done in 1989 which ran from 17 August through 4 December estimated effort at 180,000 angler days (Connelly et al. 1990). Using data from the 1984 Great Lakes Angler Survey (NYSDEC 1984), they also estimated effort in 1984 for the same time period (late August through November/December) at 112,000 angler days. Similarly, effort in the Lake Ontario boat fishery peaked in 1990 (Eckert 2005), but has not

declined on the Salmon River to the extent (if at all) it has on the lake from 1992 to 2004. A summary of the various survey efforts on the Salmon River are provided in Table 2.

Table 2. Summary statistics for the various creel surveys conducted on the Salmon River since 1984.

			Chinook salmon		Steelhead	
Year	Dates	Angler Days	Catch	Harvest	Catch	Harvest
1984	Sept - Nov [1]	107,306	143,244	83,784	15,529	8,359
1989	Aug 17 - Dec 4	180,400	150,100	69,200	8,150	4,350
1992	Sept 3 - Nov 1	103,900	80,300	55,900	-	-
1997	Oct 20 - Nov 30	7,061	-	-	1,543	554
1998	Oct 19 - Nov 29	7,009	-	-	2,830	523
1999	Oct 18 - Nov 28	11,372	-	-	4,751	1,010
2000	Oct 16 - Nov 26	11,231	-	-	2,870	806
2001	Oct 15 - Nov 25	12,563	-	-	3,660	746
2002	Oct 21 - Dec 1	9,381	-	-	2,743	555
2003	Oct 20 - Nov 30	6,183	-	-	1,960	357
2004	Sept 7 - Nov 28	90,825	85,251	24,360	6,924	1,314

1- The 1984 survey ran September through May on the tributaries but September through November are presented here for comparison

The weekly distribution of effort in 2004 is illustrated in Figure 2. This effort pattern is very similar to those observed in past surveys with the peak occurring in early October, concurrent with the peak of the chinook salmon run followed by a lower, relatively stable level of effort aimed primarily at steelhead.

Catch and Harvest

Chinook salmon accounted for the majority of the catch and harvest. The catch and harvest rates for chinook salmon were 0.15 and 0.04 fish/angler hour, respectively, resulting in estimates for catch and harvest of 85,250 and 24,360, respectively (Table 3). Chinook salmon catch and harvest in the 2004 Lake Ontario boat fishery were 92,042 and 51,443, respectively (Eckert 2005). Steelhead was the second most abundant species in the catch. Chinook salmon dominated the catch through October but steelhead became the focus of the fishery by the first week in November (Figures 3 and 4). Brown trout and coho salmon were minor components of the fishery. Atlantic salmon, which along with Skamania steelhead provide a low intensity summer fishery, were extremely rare in the fall fishery.

Catch and harvest estimates for the different segments of the fishery are provided in Table 3 for chinook salmon and steelhead. Catch rates for both species were highest in the Salmon River tributaries, likely due to their smaller size and increased visibility and vulnerability of fish. Catch rates in the catch and release fly fishing areas and the drift boat fishery were also relatively high. Possible reasons for this are that all of the fish caught in the fly areas were released and available to be caught again, and drift boat fishermen are often associated with guides who are very familiar with the river and fishing techniques. Catch and

harvest estimates for the estuary boat fishery for chinook and steelhead lack precision (i.e., 1.96 standard errors were larger than the estimates). This segment of the fishery proved difficult to sample and, as a result, fewer parties were interviewed.

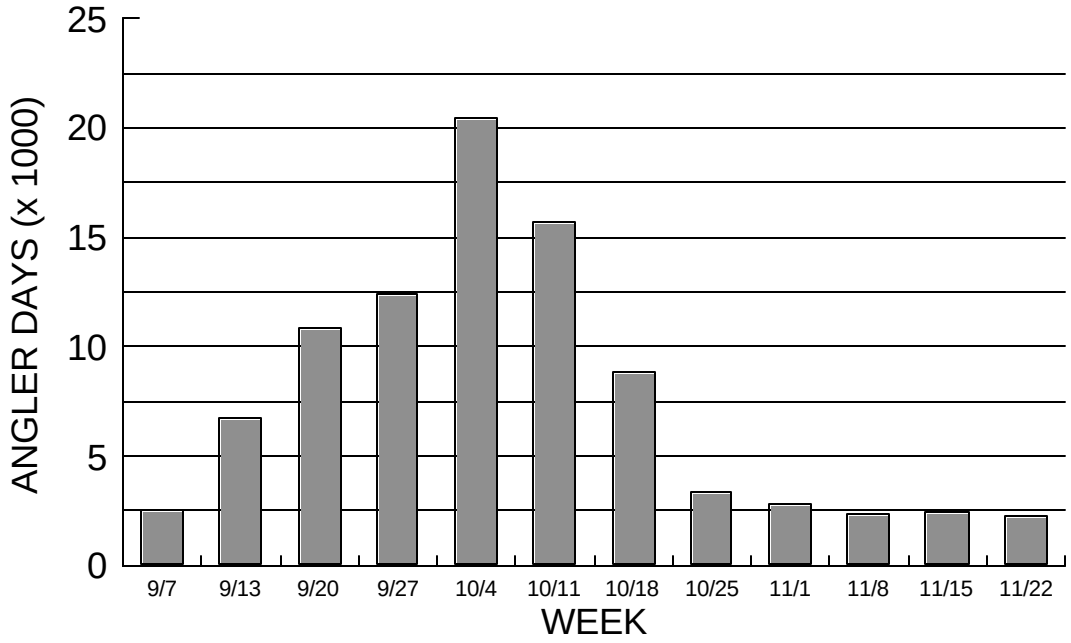

Figure 2. Weekly estimates of effort (angler days) from the 2004 Salmon River creel census.

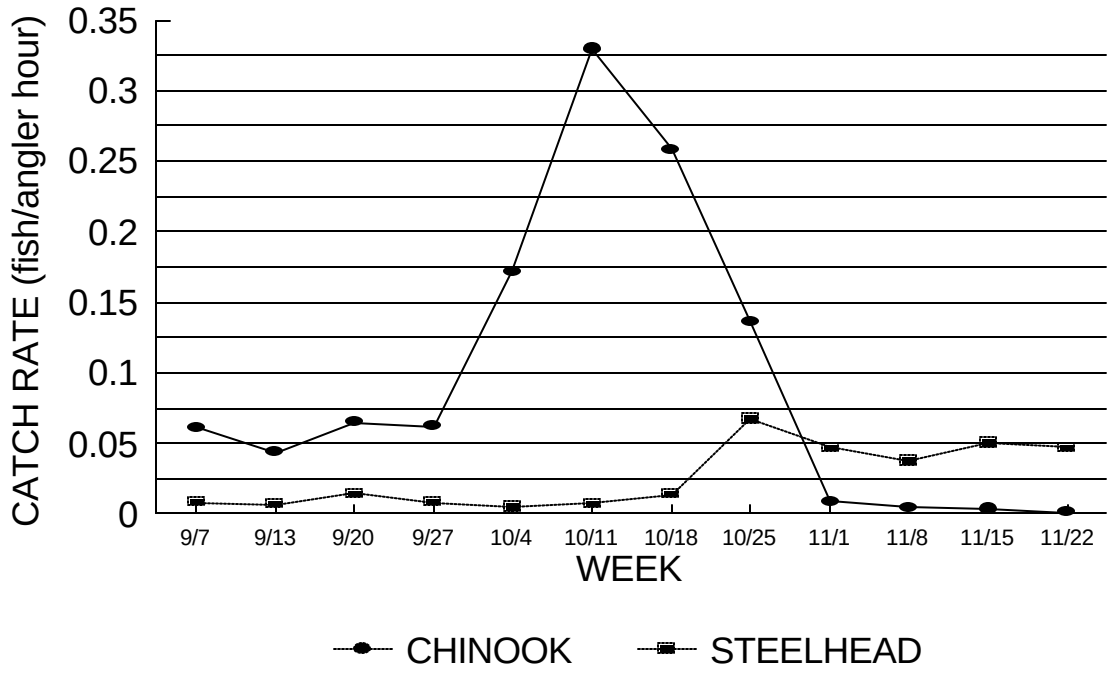

Figure 3. Catch rates for chinook salmon and steelhead by week from the 2004 Salmon River creel census.

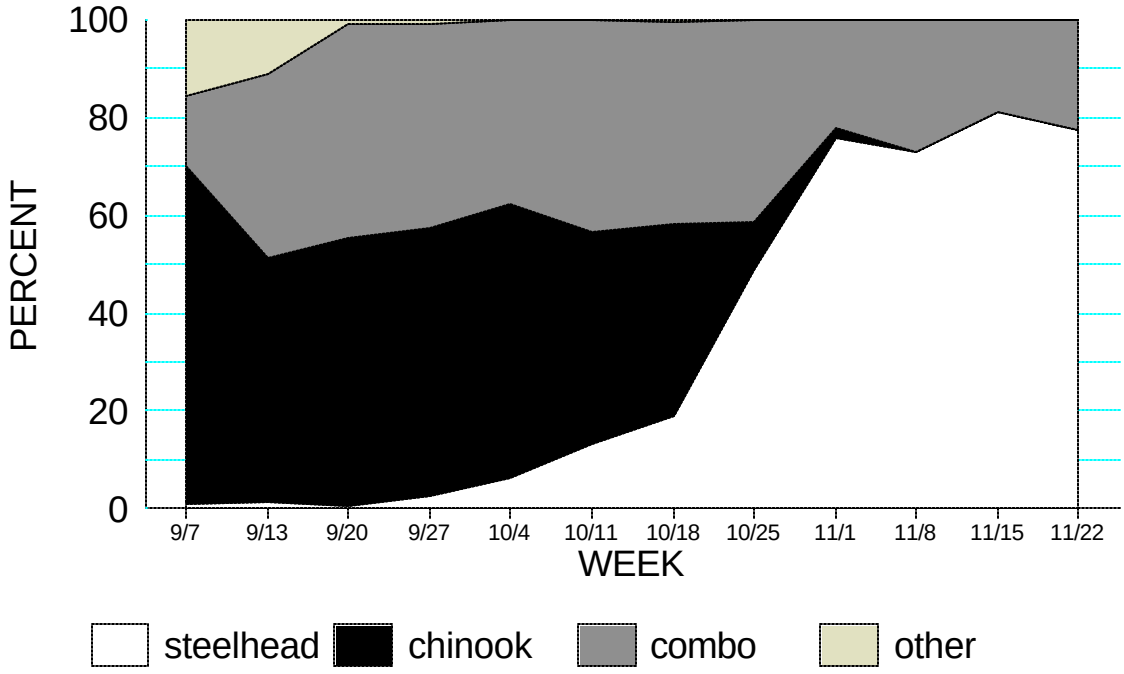

Figure 4. Species targeted by week from the 2004 Salmon River creel survey.

The complexion of the fishery has changed markedly since the 1992 survey with the banning of snagging in 1995, the establishment of year-round baseflows in 1996 stemming from the Federal Energy Regulatory Commissions's licensing of the hydro-electric facility and more restrictive tackle regulations enacted in October of 2004. Despite these changes, the estimated catch of chinook salmon in 2004 (85,251) was very similar to the catch in 1992 (80,300) but lower than that in 1989 (150,000). Anglers harvested 46%, 70% and 29% of their chinook salmon catches in 1989, 1992 and 2004, respectively. Reasons for these differences are unclear but perhaps anglers were more inclined to release foul hooked fish in 2004.

Anecdotal accounts from steelhead fishermen suggest that steelhead returns have declined markedly since the 1980s. A comparison of catch and harvest rates for the month of November from the various Salmon River surveys provide some historical perspective. The catch and harvest rates from the 1984 survey were clearly higher than those from more recent years (Figure 5). The catch rate in 1989 (0.06 fish/angler hour) is quite similar to that seen in some of the better years in the 1997-2003 time period. A major difference, however, is that the anglers harvested about one half of the steelhead they caught in 1989 compared to a much lower percentage of their catches in more recent years. Had anglers continued harvesting a larger portion of their catches in more recent years, the catch rates would certainly have been further depressed. Anglers harvested only 12 % of the steelhead that they caught in November of 2004 indicating a high level of support for catch and release fishing for this species.

Tributary steelhead anglers see catch and release fishing as an opportunity to conserve fish and fishing opportunity. They recently requested, and received, a reduction in the daily limit of steelhead in the tributaries from three fish to one.

Table 3. Estimated catch and harvest from the 2004 Salmon River creel census.

Species	Fishing Type	Estimat Catch Ra (fish/ang hour)	1.96 s	Estimat Catch	1.96 se	Estimat Harvest F (fish/ang hour)	1.96 s	Estimat Harves	1.96 se
Chinook salm	Shore	0.1295	0.0153	59,424	8,239	0.0470	0.0047	21,576	2,669
	Drift Boat	0.1708	0.0346	2,905	626	0.0794	0.0166	1,350	299
	Special Regs	0.2811	0.0779	19,523	5,561	-	-	-	-
	Estuary Boat	0.0602	0.0827	1,018	1,412	0.0356	0.0430	602	735
	Tributary	0.5241	0.0162	5,842	713	0.1385	0.0510	1,543	597
	All Types[1]	0.1487	0.0159	85,251	10,772	0.0425	0.0040	24,360	2,837
Steelhead	Shore	0.0096	0.0015	4,402	775	0.0022	0.0006	988	307
	Drift Boat	0.0344	0.0082	585	146	0.0141	0.0051	239	89
	Special Regs	0.0221	0.0060	1,536	430	-	-	-	-
	Estuary Boat	0.0122	0.0232	206	395	0.0000	0.0000	0	0
	Tributary	0.0580	0.0128	646	162	0.0000	0.0000	0	0
	All Types[1]	0.0121	0.0016	6,924	1,014	0.0023	0.0006	1,314	336
Brown trout	All Types	0.0059	0.0010	3,372	639	0.0007	0.0003	405	190
Coho salmon	All Types	0.0042	0.0011	2,416	633	0.0011	0.0004	634	237
Atlantic salmo	All Types	0.0003	0.0002	197	117	0.0000	0.0000	0	0

1-Note that the sums of the catches and harvests for individual fishing types do not ad

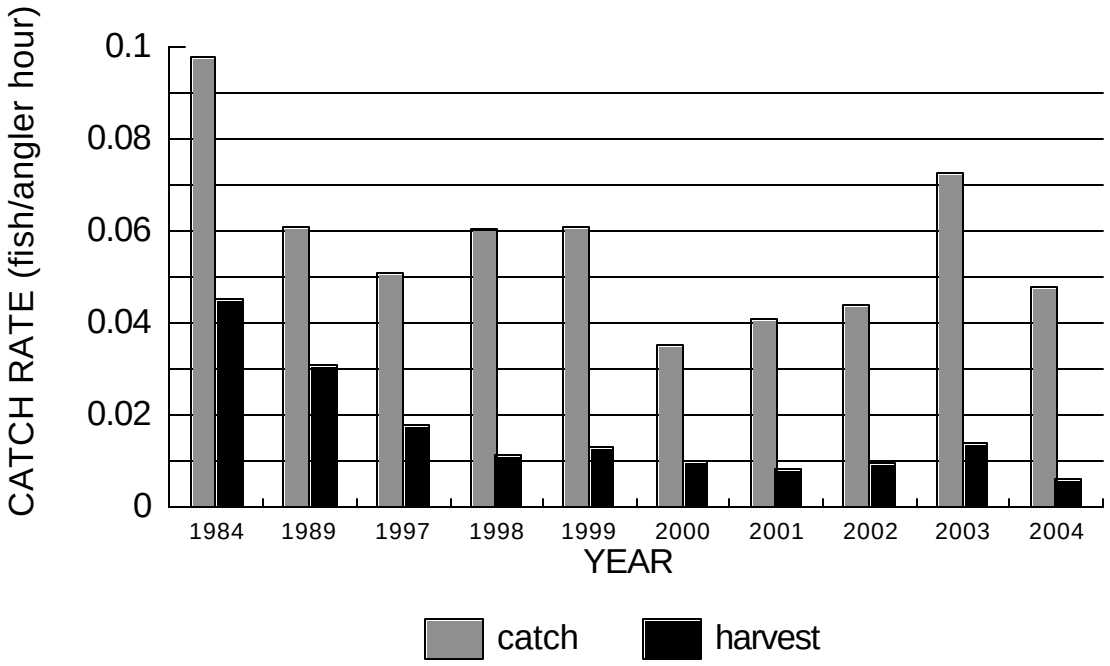

Figure 5. Catch and harvest rates for steelhead on the Salmon River during the month of November for 1984, 1989 and 1997 through 2004.

The reduced limit became effective for all Lake Ontario tributaries, except the Lower Niagara River, in October of 2004.

Residences of Anglers

Residents of New York accounted for about 1/3 of the effort (Figure 6). Parties from New Jersey, Pennsylvania, and the New England states (Connecticut, New Hampshire, Massachusetts and Vermont) collectively accounted for the majority of the remainder of the effort. We also interviewed parties from Holland, Ireland and the Czech Republic. The composition of resident and non-resident anglers in the 2004 census was remarkably similar those observed in steelhead creel surveys conducted annually from 1997 through 2003.

Acknowledgments

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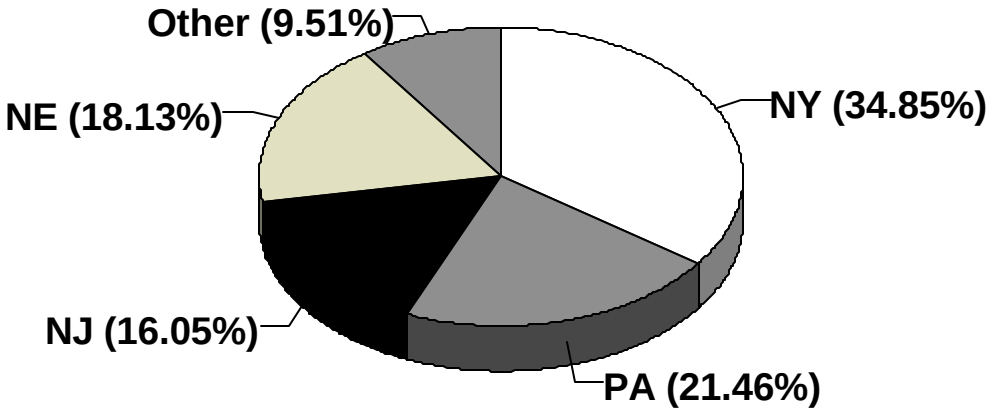

Figure 6. Residences of anglers interviewed in the 2004 Salmon River creel census. (NE represents the combined New England states of Connecticut, Massachusetts, New Hampshire and Vermont).

Appendix 1. Formulae for computation of the 2004 Salmon River creel census.

Angler Effort

Estimates of effort were done using "instantaneous" counts of anglers, vehicles, driftboat trailers and boats in the estuary. Means of the counts were used for days when multiple counts occur. Effort data were stratified by week. Daily estimates of angler effort (angler hours) were calculated as follows:

$$\hat{H}_{j,h} = \left[A_t + A_e + (V_{sr} + V_{uf} + V_t - Db) \cdot P_{sh} + Db \cdot P_{db} + B_e \cdot P_{be} \right]_{j,h} \cdot daylength_{j,h}$$

where:

$\hat{H}_{j,h}$ = the number of angler hours on day j in stratum h

A_t = the number of anglers counted in Pulaski

A_e = the number of shore access anglers counted in the estuary

V_{sr} = the number of vehicles counted along the main stem of the Salmon River including those counted at the lower fly area in Altmar and excluding those counted in Pulaski, the upper fly fishing area and those attached to driftboat trailers

V_{uf} = the number of vehicles counted at the upper fly fishing area.

V_t = the number of vehicles counted at the tributary access points

Db = the number of driftboat trailers counted. Note: the $(V_{sr} + V_{uf} + V_t - Db)$ term accounts for one pickup vehicle per driftboat being left in a downstream parking area

P_{sh} = the mean size of shore access parties (anglers/vehicle)

P_{db} = the mean size of driftboat parties

B_e = the number of boats counted in the estuary

P_{be} = the mean party size (anglers/boat) for boat access fishermen in the estuary

$daylength_j$ = the number of hours from ½ hour before sunrise to ½ hour after sunset on day j.

The estimator for mean angler hours for all days sampled in stratum h is:

$$\hat{H}_h = \frac{\sum_{j=1}^{n_h} \hat{H}_{j,h}}{n_h}$$

n_h = the number of days sampled in stratum h

and the stratum variance is:

$$s_h^2 = \frac{\sum_{j=1}^{n_h} (\hat{H}_{j,h} - \hat{H}_h)^2}{n_h - 1}$$

and the variance of $\hat{H}_h$ is:

$$\text{var}(\hat{H}_h) = \frac{s_h^2}{n_h}\left(\frac{N_h - n_h}{N_h}\right)$$

where N_h is the total number of days in stratum *h* and $\left(\frac{N_h - n_h}{N_h}\right)$ is the finite population correction factor,

and the standard error of $\hat{H}_h$ is:

$$SE\left(\hat{H}_h\right) = \sqrt{\text{var}\left(\hat{H}_h\right)}$$

The estimated total for all angler hours is:

$T_H = \sum_{h=1}^{L} N_h\left(\hat{H}_h\right)$ where *L* is the total number of stratum and the variance of the total is:

$$\text{var}\left(T_H\right) = \sum_{h=1}^{L} N_h^2 \,\text{var}\left(\hat{H}_h\right)$$

and the standard error of the total is:

$$SE\left(T_H\right) = \sqrt{\text{var}(T_H)}$$

The effort estimates were partitioned by fishing type into boat fishing in the estuary, shore access and driftboat fishing in the normal regulations portion of the main stem, fishing in the tributaries, and fishing in the special regulations catch and release fly fishing only areas. This was done for descriptive purposes as well as providing appropriate weighting factors for stratification of the catch data.

Driftboat effort was calculated by taking the number of drift boat trailers counted and multiplying by the mean size of driftboat party (from the interview forms). Special regulations fly fishing effort was estimated by multiplying the number of vehicles in the upper fly fishing parking area by the mean size of shore fishing parties (again, from the interview forms) and adding the number of anglers counted in the lower fly fishing area in Altmar. Note that the overall estimate of angler effort accounts for special regulations area fly fishermen with vehicle counts only. We had to count the anglers in the lower fly fishing area for the estimate of effort for the special regulations fly fishing areas, however, because there was no way to know whether vehicles parked in Altmar belonged to anglers fishing the fly fishing area or the normal regulations area of the river. We also had to count anglers in Pulaski and in the estuary because they did not all park in designated lots. Similar partitions of the data allowed us to estimate boat effort in the estuary and effort in the

tributaries. Angler days were estimated by dividing the estimates for angler hours by the mean lengths of completed trips for each fishing type and for the overall estimate.

Catch and Harvest

Catch and harvest data were stratified the same as the effort data (by week) and additionally by 5 fishing types: shore access (normal regulations section of the river), special regulations fly fishing, driftboat fishing, boat fishing in the estuary, and tributary fishing. Mean catch and harvest rates were calculated as follows with a ratio of means estimator recommended by Jones et al. (1995) for access site creel surveys. A discussion of ratio estimators and stratified sampling can be found in Scheaffer et al. 1996.

The catch/harvest rate estimator $(\hat{R})$ is:

$$\hat{R} = \frac{\bar{y}_{st}}{\bar{x}_{st}} \qquad \text{where:}$$

$$\bar{y}_{st} = \frac{\sum_{h=1}^{L} N_h \bar{y}_h}{N} \quad \text{and} \quad \bar{x}_{st} = \frac{\sum_{h=1}^{L} N_h \bar{x}_h}{N}$$

where:

$\bar{y}_h$ = mean number of fish caught or harvested by all parties interviewed in stratum h

$\bar{x}_h$ = mean number of angler hours fished for all parties interviewed in stratum h, and

$$N_h = \frac{T_{Dh}(angler\ hours) \cdot n_h(parties)}{\sum_{i=1}^{n_h} P(angler\ hours)}$$

is the estimated number of parties in stratum h where:

N_h = estimate of total parties in stratum h,

$T_{Hh}(angler\ hours)$ = estimated total angler hours in stratum h,

$n_h(parties)$ = number of parties interviewed in stratum h,

$\sum_{i=1}^{n_h} P(angler\ hours)$ = sum of the angler hours represented by each party i interviewed in stratum h,

$N = \sum_{h=1}^{L} N_h$ = total estimated parties for all strata

and the variance of $\hat{R}$ is:

$$V(\hat{R}) = \frac{\sum_{h=1}^{L} \left(\frac{N_h (N_h - n_h)}{n_h} \right) \left(\text{var}(y_h) - 2\hat{R}\,\text{cov}(xy_h) + \hat{R}^2\,\text{var}(x_h) \right)}{N^2\,\bar{x}_{st}^2}$$

where:

$\text{var}(y_h)$ = the sample variance of the numbers of fish caught or harvested by interviewed parties in stratum *h*,

$\text{var}(x_h)$ = the sample variance of the number of angler hours fished by interviewed parties in stratum *h*, and

$$\text{cov}(xy_h) = \frac{\sum_{i=1}^{n_h} (x_{i,h} - \bar{x}_h)(y_{i,h} - \bar{y}_h)}{(n_h - 1)} = \left(\frac{1}{n_h - 1} \right) \left(\sum_{i=1}^{n_h} x_{i,h}\, y_{i,h} - \frac{\sum_{i=1}^{n_h} x_{i,h} \sum_{i=1}^{n_h} y_{i,h}}{n_h} \right)$$

is the sample covariance of x and y in stratum *h*, and the standard error of $\hat{R}$ is: $SE(\hat{R}) = \sqrt{V(\hat{R})}$

Catch and harvest were estimated by multiplying the rates by the estimates of angler hours. Variances were calculated using the formula for variance of a product from Mood et al. (1963):

$$V(xy) = x^2 V(y) + y^2 V(x) + V(x)V(y)$$

where: x = catch or harvest rate (fish/angler hour) and y = effort (angler hours).

and the standard error of the estimated rate is: $SE(xy) = \sqrt{V(xy)}$

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