

CHINOOK SALMON SPORT CATCH
ON THE HOH AND QUEETS RIVERS
FROM 1984 CREEL CENSUS

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METHODS

Total catch of chinook salmon was estimated by creel census using techniques similar to those used by the Washington Department of Game (WDG 1978) in their annual steelhead catch estimates. Its principal features are angler interviews to estimate catch per effort and counts of anglers and boats to estimate total effort. The total catch was estimated by multiplying the catch per effort by the total estimated effort. The total effort was estimated by multiplying the average instantaneous effort by the number of hours available for fishing. The average instantaneous effort was estimated from daily counts of anglers or boats in selected index areas, expanded by a formula to estimate total effort. The expansion factor was based on the relation between total effort, as determined by aerial counts made several times over the season, and index effort, obtained by simultaneous counts on the ground using the regular daily procedure. The hours available for fishing were estimated by determining how many days in the season the river was low enough for fishing, and multiplying by the number of daylight hours per day. The catch was divided into adults and jacks based on scale analysis.

Field Procedure

Catch per effort data was obtained by visiting the various fishing areas and asking anglers (1) whether or not they had used a boat to reach their fishing area, (2) whether they had completed their fishing trip for the day, (3) how many hours they had been fishing that day, and (4) how many chinook they had caught. Interviews were conducted on each weekend day and on about 60 percent of the weekdays, chosen at random. Virtually all chinook were measured and scales were taken.

Index effort counts were obtained by visiting a set number of major fishing sites accessible with a two-wheel drive vehicle twice each creel census day at randomly chosen hours. Bank anglers and boat trailers were counted within a standardized area each visit. Total effort counts were made with a helicopter on nine occasions over the season on the Hoh and eight occasions on the Queets. During these flights, all bank anglers and all fishing boats were counted, while at the same time an index count was being made on the ground.

Stratification

Catch was estimated separately by month, day of week (weekdays or weekends, with weekends including Federal holidays), and fishery type (bank or boat). Boat anglers were defined as those who used a boat or raft to reach their fishing spots, and bank anglers

were those who did not.

When one month's data were not considered sufficient, months were combined, but only if the fishing regulations were the same for both months. Sufficiency of angler hours per stratum was established based on the theory that variability of catch per effort decreases with increasing numbers of angler hours interviewed. The desired minimum levels of effort per stratum were set at 100 angler hours for the Hoh bank fishery, 350 angler hours for the Hoh boat fishery, 30 angler hours for the Queets bank fishery, and 100 hours for the Queets boat fishery. These levels were set by plotting catch per effort against angler hours for each statistical week over the season, and visually determining the level of effort at which the range of observed values of catch per effort noticeably decreased in relation to lower levels of effort.

Catch per Unit Effort

Catch per effort for a given stratum was calculated as the total chinook catch reported, divided by the total angler hours. We generally used only the data for fishing trips that had been completed, as opposed to trips still in progress. We preferred data from completed trips because the inclusion of incomplete trips could have underestimated the actual catch per effort. This preference was based on our observations that in this study and in the case of our Hoh winter steelhead creel census, catch per effort from incomplete trips was usually less than catch per effort from completed trips. Moreover the catch on the present study may not have been distributed randomly over the fishing trip, but rather concentrated toward the end of the trip. Such was the case in the Hoh 1984-85 winter steelhead fishery, when about 20% of the fish were caught in the last 10% of the fishing trip. This may also be expected to occur in the chinook fishery, although no data was collected to verify this. To the degree that the distribution of catch over time spent fishing was skewed toward the end of the fishing trip, a random sample of the incomplete trips would underestimate the true catch per effort.

Despite this potential bias, combination of complete and incomplete trip data was necessary in a few strata where there were not enough angler hours reported from completed trips alone to get an adequate estimate of catch per effort. These instances are noted for the Hoh in Appendix I Table 2 and for the Queets in Appendix II Table 2.

Angler Effort

The total fishing effort, in angler hours for each stratum, was calculated as the mean expanded instantaneous effort, in anglers, times the total hours in the stratum available for fishing. Mean

expanded instantaneous effort was computed over the number of days selected for creel census and fishable by bank or by boat, respectively. The number of such days per stratum is shown for the Hoh in Appendix I Table 2 and for the Queets in Appendix II Table 2. Determination of fishable days is explained below in a separate section.

Expansion of daily instantaneous index effort was based on the relation between simultaneous index counts made by car from the bank and total counts made from a helicopter. The expansion factor in the boat fishery also included the ratio of anglers per boat, as estimated from angler interviews. Because of the limited number of data points, one index expansion formula was applied throughout the entire season.

To expand the index effort we applied a linear model to the Hoh bank fishery and the Queets bank and boat fisheries. We applied a log-log transformation to the data from the Hoh boat fishery. Appendix I Table 3 and Appendix II Table 3 show the details of this method for the Hoh and Queets, respectively. The linear models were chosen because either (1) they gave a higher coefficient of correlation than log or square root transformation of one or both variables; or (2) the range of index effort over the season was much greater than the range of index effort during helicopter flights. This second condition was based on our experience that a straight line is usually the best-fitting model, and that a non-linear model is more likely than a linear model to lead to serious bias if extrapolated far beyond the data points upon which it is derived.

We considered the line to pass through the origin for the three linear models, because either (1) the probability of the line not passing through the origin was statistically insignificant at the 5% level, or else (2) the y-intercept was so close to zero as to appear insignificant for the purpose of index expansion (for example, if the line suggested -0.2 total anglers where there were 0 index anglers). We calculated the slope as the sum of total effort divided by the sum of index area effort (that is, (total bank anglers)/(index bank anglers) or (total boats)/(index boat trailers)). We did not perform this test on the non-linear model because the interpretation of a line passing through the origin was not intuitively clear in that case.

Determination of Fishable Days

The hours available for fishing were calculated as the hours per day of daylight multiplied by the number of fishable days in the stratum. Hours per day of daylight were calculated as the average of day lengths listed in anglers' tide tables for each month or combination of months.

Fishable days were considered those when the river was low enough for fishing. We considered this level to be represented by a

stage of less than 6.3 feet for the Hoh bank fishery, 5.1 feet for the Hoh boat fishery, 12.1 feet for the Queets bank fishery, and 9.6 feet for the Queets boat fishery. These levels were calculated as the average between the highest stage at which the river was fished and the next higher stage at which no index effort had been observed over the season. Stage was taken as either the mean of the gage heights taken at the start of the index counts, or, for days when no creel census was conducted, as the height recorded by the USGS for 12:00 noon that day. Nearly all unfishable days occurred in October or November. Data for these months appear in Appendix I Table 4 for the Hoh and Appendix II Table 4 for the Queets.

Scale Analysis

Scales and fork lengths were obtained from virtually all chinook inspected during angler interviews. For the purpose of catch estimates, all two-year-olds were classified as jacks and all older fish were considered adults. Data on age composition appear in Appendix I Table 5 for the Hoh and Appendix II Table 5 for the Queets.

RESULTS

Hoh

A total of 450 chinook were caught between May 25 and November 30, 1984 in the Hoh River system (Table 1). Of these, 279 were adults and 171 were jacks. Most of the adults were caught between May and July and later in October or November. In contrast, the largest part of the jacks was caught in September. Catch for each stratum of analysis is presented in Appendix I Table 1. Supporting data are presented in Appendix I Tables 2 through 5.

Table 1. Estimate of chinook sport catch on the Hoh River, 1984.

Month	Total catch(a)	Adults(b)	Jacks(b)
May-Jun	97	80	17
July	83	67	16
Aug	74	27	47
Sept	81	17	64
Oct-Nov	115	88	27
Total	450	279	171

(a) Data from Appendix I Table 1.

(b) Based on scale analysis data from Appendix I Table 5.

Queets

A total of 445 chinook were caught between May 25 and November 30, 1984 in the Queets River system (Table 2). Of these, 278 were adults and 167 were jacks. Most of the adults were caught in October and November. In contrast, the largest part of the jacks was caught in August and September. Catch for each stratum of analysis is presented in Appendix II Table 1. Supporting data are presented in Appendix II Tables 2 through 5.

Table 2. Estimated chinook catch on the Queets River, 1984.

Month	Total catch(a)	Adults(b)	Jacks(b)
May-Jun	23	14	9
July	77	45	32
Aug-Sept	157	50	107
Oct-Nov	188	169	19
Total	445	278	167

(a) Data from Appendix II Table 1.

(b) Data based on scale analysis from Appendix II Table 5. Determination for May-June and July is from combined age composition from May through July.

REFERENCES

Washington Department of Game. 1978. Steelhead program progress report. June 30, 1978. Washington State Department of Game, Olympia, Washington.

APPENDIX I : HOH CREEL CENSUS DATA

Appendix I Table 1. Hoh River chinook sport catch estimate, 1984.

Month	Day of Week	Type	Estimated Anglers per Day (a)	Fishable Days	Hours in Day	Catch per Angler Hour (a)	Estimated Catch
May-Jun	WD	Bank	4.38	25	16.0	0.0073	13
		Boat	4.24	24	16.0	0.0260	42
	WE	Bank	9.10	12	16.0	0.0077	13
		Boat	11.73	12	16.0	0.0130	29
July	WD	Bank	8.82	21	15.7	0.0017	5
		Boat	7.65	21	15.7	0.0179	45
	WE	Bank	22.19	10	15.7	0.0008	3
		Boat	14.87	10	15.7	0.0130	30
Aug	WD	Bank	6.75	23	14.4	0.0054	12
		Boat	6.10	23	14.4	0.0047	9
	WE	Bank	11.16	8	14.4	0.0032	4
		Boat	19.80	8	14.4	0.0214	49
Sept	WD	Bank	2.07	19	12.6	0.0	0
		Boat	5.67	18	12.6	0.0125	16
	WE	Bank	10.88	11	12.6	0.0055	8
		Boat	16.34	7	12.6	0.0395	57
Oct-Nov	WD	Bank	1.96	31 (b)	10.0	0.0297	18
		Boat	6.30	17 (b)	10.0	0.0477	51
	WE	Bank	3.35	15 (b)	10.0	0.0198	10
		Boat	8.49	8 (b)	10.0	0.0527	36
Total							450

(a) Data from Appendix I Table 2.

(b) Data from Appendix I Table 4.

Appendix I. Table 2. Hoh River angler interview and angler count data.

Month	Day of Week	Type	Days of Reported Effort	Reported Catch	Reported Angler Hours	Fishable Days with Index Counts	Instantaneous Expanded Angler Count
May-Jun	WD	Bank	13	2	275.5 (a)	13	4.38
		Boat	9	7	269.5	12	4.24
	WE	Bank	9	2	260.0	12	9.10
		Boat	10	8	614.0	12	11.73
July	WD	Bank	9	1	583.5	13	8.82
		Boat	9	11	613.0	13	7.65
	WE	Bank	10	1	1,183.0	10	22.19
		Boat	10	17	1,312.5	10	14.87
Aug	WD	Bank	13	3	558.0	13	6.75
		Boat	9	2	423.0	13	6.10
	WE	Bank	8	2	622.0	8	11.16
		Boat	8	21	983.5	8	19.80
Sept	WD	Bank	14	0	140.5	10	2.07
		Boat	8	3	240.5	10	5.67
	WE	Bank	10	4	724.5	11	10.88
		Boat	9	41	1,037.5	11	16.34
Oct-Nov	WD	Bank	18	3	102.0 (a)	18	1.96
		Boat	6	16	335.5	10	6.30
	WE	Bank	12	3	151.5 (a)	13	3.35
		Boat	6	17	322.5	7	8.49

(a) Data from incomplete and complete angler trips combined, to obtain sufficient sample size.

Appendix I Table 3. Expansion of Hoh River angler effort.

Date	Bank		Boat	
	Index	Total	Index	Total
6-23	5	4	8	15
7-7	19	14	11	15
7-17	5	6	1	2
7-29	17	17	4	12
8-4	14	27	10	13
9-1	20	41	4	13
10-20	6	7	6	8
10-22	1	5	0	1
11-17	4	5	0	1
Correlation	0.817		0.865	
Probability	LT 0.05		LT 0.05	
Formula	$Y = 1.38 X$		$Y = 1.1 e^{** 1.15 \ln (X + 1)}$	
Anglers per boat	--		2.16	
Expansion Factor	1.38		$2.38 e^{** 1.15 \ln (X + 1)}$	

Appendix I Table 4. Hoh River fishable days, October and November 1984.

Day	October				November			
	Day of Week	Stage	Fishable		Day of Week	Stage	Fishable	
			Bank	Boat			Bank	Boat
1	D	2.8	Y	Y	D	7.8	N	N
2	D	3.4	Y	Y	D	6.5	N	N
3	D	2.9	Y	Y	E	9.7	N	N
4	D	3.5	Y	Y	E	7.9	N	N
5	D	3.6	Y	Y	D	6.5	N	N
6	E	3.4	Y	Y	D	5.8	Y	N
7	E	4.8	Y	Y	D	6.7	N	N
8	E	10.9	N	N	D	5.7	Y	N
9	D	7.8	N	N	D	5.3	Y	N
10	D	8.1	N	N	E	5.3	Y	N
11	D	6.6	N	N	E	5.2	Y	N
12	D	6.9	N	N	E	5.8	Y	N
13	E	6.3	N	N	D	6.4	N	N
14	E	5.6	Y	N	D	5.6	Y	N
15	D	5.2	Y	N	D	5.0	Y	N
16	D	4.9	Y	Y	D	4.8	Y	Y
17	D	4.6	Y	Y	E	4.6	Y	Y
18	D	4.4	Y	Y	E	5.2	Y	N
19	D	4.2	Y	Y	D	5.4	Y	N
20	E	4.1	Y	Y	D	5.4	Y	N
21	E	4.0	Y	Y	D	4.9	Y	Y
22	D	3.8	Y	Y	E	4.6	Y	Y
23	D	3.8	Y	Y	D	5.8	Y	N
24	D	4.1	Y	Y	E	5.6	Y	N
25	D	6.7	N	N	E	5.2	Y	N
26	D	5.0	Y	N	D	5.7	Y	N
27	E	4.6	Y	Y	D	5.5	Y	N
28	E	4.8	Y	Y	D	6.6	N	N
29	D	4.5	Y	Y	D	5.9	Y	N
30	D	4.9	Y	Y	D	5.7	Y	N
31	D	4.4	Y	Y	-	-	-	-

(a) Estimated.

Appendix I Table 7. Scale analysis of Hoh River sport caught chinook, 1984.

Month	Age (a)					Total
	2	3	4	5	6	
May-Jun	3 (17.6)	4 (23.5)	1 (5.9)	3 (17.6)	6 (35.3)	17
July	6 (19.4)	7 (22.6)	4 (12.9)	8 (25.8)	6 (19.4)	31
Aug	19 (63.3)	7 (23.3)	2 (6.7)	1 (3.3)	1 (3.3)	30
Sept	34 (79.1)	3 (10.0)	3 (10.0)	3 (10.0)	0 (0.0)	43
Oct-Nov	6 (23.1)	4 (15.4)	7 (26.9)	8 (30.8)	1 (3.8)	26

(a) All individuals were age-0 outmigrants.

APPENDIX II: QUEETS CREEL CENSUS DATA

Appendix II Table 1. Queets River chinook sport catch estimate, 1984.

Month	Day of Week	Type	Estimated Anglers per Day (a)	Fishable Days	Hours in Day	Catch per Angler Hour (a)	Estimated Catch
May-Jun	WD	Bank	2.03	25	16.0	0.0	0
		Boat	1.37	25	16.0	0.0315	17
	WE	Bank	2.67	12	16.0	0.0	0
		Boat	3.20	12	16.0	0.00945	6
July	WD	Bank	2.94	21	15.7	0.0448	43
		Boat	2.80	21	15.7	0.0	0
	WE	Bank	4.54	10	15.7	0.0188	13
		Boat	3.96	10	15.7	0.0233	14
Aug-Sept	WD	Bank	4.46	42	13.5	0.0236	60
		Boat	2.03	42	13.5	0.0298	34
	WE	Bank	5.82	19	13.5	0.0180	27
		Boat	4.68	19	13.5	0.0315	38
Oct-Nov	WD	Bank	2.92	40 (b)	10.0	0.0207	24
		Boat	2.13	22 (b)	10.0	0.0571	27
	WE	Bank	5.90	15 (b)	10.0	0.0673	60
		Boat	6.70	8 (b)	10.0	0.0914	49,
Total							412

(a) Data from Appendix II Table 2.

(b) Data from Appendix II Table 4.

Appendix II Table 2. Queets River interview and angler count data.

Month	Day of Week	Type	Days of Reported Effort	Reported Catch	Reported Angler Hours	Fishable Days with Index Counts	Instantaneous Expanded Angler Count
May-Jun	WD	Bank	6	0	103.0 (a)	7	2.03
		Boat	3	2	63.5	7	1.37
	WE	Bank	8	0	106.0 (a)	9	2.67
		Boat	7	3	289.0	9	3.20
July	WD	Bank	8	4	88.5	12	2.94
		Boat	6	0	153.0	12	2.80
	WE	Bank	6	2	68.3	10	4.54
		Boat	9	6	299.5	10	3.96
Aug-Sept	WD	Bank	13	6	261.0	13	4.46
		Boat	10	13	299.5	13	2.03
	WE	Bank	12	3	210.5	10	5.82
		Boat	11	10	433.5	10	4.68
Oct-Nov	WD	Bank	10	3	69.0	17	2.92
		Boat	4	4	70.0 (a)	9	2.13
	WE	Bank	9	4	68.0	13	5.90
		Boat	5	35	331.5	7	6.70

(a) Data from incomplete and complete angler trips combined, to obtain larger sample size.

Appendix II Table 3. Expansion of Queets River angler effort.

Date	Bank		Boat	
	Index	Total	Index	Total
6-23	2	1	1	2
7-7	3	1	1	1
7-17	0	1	0	0
7-29	5	15	2	2
8-4	0	5	3	3
10-20	3	7	14	15
10-22	1	5	4	4
11-17	0	5	2	1
Correlation	0.624		0.993	
Probability	GT 0.05		LT 0.01	
Formula	Y = 2.86 X		Y = 1.04 X	
Anglers per boat	--		2.32	
Expansion Factor	2.86		2.41	

Appendix II Table 4. Queets River fishable days October and November, 1984.

Day	October				November			
	Day of Week	Stage	Fishable		Day of Week	Stage	Fishable	
			Bank	Boat			Bank	Boat
1	D	6.1	Y	Y	D	8.3	Y	Y
2	D	6.1	Y	Y	D	11.4	Y	N
3	D	6.1	Y	Y	E	16.6	N	N
4	D	6.4	Y	Y	E	12.5	N	N
5	D	7.1	Y	Y	D	11.3	Y	N
6	E	6.6	Y	Y	D	10.0	Y	N
7	E	13.4	N	N	D	12.0	Y	N
8	E	15.0	N	N	D	10.3	Y	N
9	D	11.8	Y	N	D	10.0	Y	N
10	D	12.4	N	N	E	9.4	Y	Y
11	D	10.9	Y	N	E	11.5	Y	N
12	D	10.3	Y	N	E	10.4	Y	N
13	E	10.4	Y	N	D	11.6	Y	N
14	E	10.1	Y	N	D	10.0	Y	N
15	D	9.4	Y	Y	D	9.3	Y	Y
16	D	8.9	Y	Y	D	8.9	Y	Y
17	D	8.5	Y	Y	E	8.5	Y	Y
18	D	8.1	Y	Y	E	10.0	Y	N
19	D	7.9	Y	Y	D	10.6	Y	N
20	E	7.7	Y	Y	D	10.4	Y	N
21	E	7.6	Y	Y	D	9.4	Y	Y
22	D	7.4	Y	Y	E	8.9	Y	Y
23	D	7.3	Y	Y	D	10.8	Y	N
24	D	7.3	Y	Y	E	9.7	Y	N
25	D	11.6	Y	N	E	9.7	Y	N
26	D	9.3	Y	Y	D	9.2	Y	Y
27	E	8.6	Y	Y	D	10.0	Y	N
28	E	9.2	Y	Y	D	12.2	N	N
29	D	8.7	Y	Y	D	11.0	Y	N
30	D	8.7	Y	Y	D	10.8	Y	N
31	D	8.8	Y	Y	-	-	-	-

Appendix II Table 5. Scale analysis of Queets River sport caught chinook, 1984.

Month	Age (a)					Total
	2	3	4	5	6	
May-July	7 (41.2)	7 (41.2)	2 (11.8)	0 (0.0)	1 (5.9)	17
Aug-Sept	15 (68.2)	3 (13.6)	2 (10.0)	2 (10.0)	0 (0.0)	22
Oct-Nov	4 (10.0)	6 (15.0)	8 (20.0)	22 (55.0)	0 (0.0)	40

(a) All individuals were age-0 outmigrants.