

Klamath River Fall Chinook Salmon Age-Specific Escapement, River Harvest, and Run Size Estimates, 2008 Run

Klamath River Technical Advisory Team
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Executive Summary

The number of Klamath River fall Chinook returning to the Klamath River Basin (Basin) in 2008 was estimated to be:

<i>Age</i>	<i>Run Size</i>	
	<i>Number</i>	<i>Proportion</i>
2	25,338	0.26
3	18,648	0.19
4	50,187	0.52
5	1,737	0.02
Total	95,910	1.00

Preseason forecasts of the number of fall Chinook adults returning to the Basin and the corresponding post-season estimates are:

<i>Sector</i>	<i>Adults</i>		
	<i>Preseason Forecast</i>	<i>Postseason Estimate</i>	<i>Pre / Post</i>
<i>Run Size</i>	115,400	70,600	1.63
<i>Fishery Mortality</i>			
Tribal Harvest	27,000	22,300	1.21
Recreational Harvest	22,500	1,900	11.84
Drop-off Mortality	2,800	2,000	1.40
	52,300	26,200	2.00
<i>Escapement</i>			
Hatchery Spawners	22,400	13,600	1.65
Natural Area Spawners	40,700	30,900	1.32
	63,100	44,500	1.42

Introduction

This report describes the data and methods used by the Klamath River Technical Advisory Team (KRTAT) to estimate age-specific numbers of fall Chinook returning to the Basin in 2008. The estimates provided in this report are consistent with the Klamath Basin Megatable (CDFG 2009) and with the 2009 forecast of ocean stock abundance (KRTAT 2009).

Age-specific escapement estimates for 2008 and previous years, coupled with the coded-wire tag (CWT) recovery data from Basin hatchery stocks, allow for a cohort reconstruction of the hatchery and natural components of Klamath River fall Chinook (KRTAT 2009, Mohr 2006a, Goldwasser et

al. 2001). Cohort reconstruction results enable forecasts to be developed for the current year's ocean stock abundance, ocean fishery contact rates, and percent of spawners expected in natural areas (KRTAT 2009). These forecasts are necessary inputs to the Klamath Ocean Harvest Model (Mohr 2006b); the model used by the Pacific Fishery Management Council to forecast the effect of fisheries on Klamath River fall Chinook.

Methods

The KRTAT obtained estimates of abundance and age composition separately for each sector of harvest and escapement. Random and nonrandom sampling methods of various types were used throughout the Basin (Table 1; see Appendix H for adjustments to the 2008 Salmon River escapement estimation methodology) to obtain the data from which the Klamath Basin Megatable totals and estimates of age composition were derived. The KRTAT relied on surrogate data where the sample of scales was insufficient for estimation of age composition, or was altogether lacking, within a particular sector.

Estimates of age composition were based on random samples of scales (Table 2) whenever possible. Generally, each scale was aged independently by two trained readers. In cases of disagreement, a third read was used to arbitrate. Statistical methods (Kimura and Chikuni 1987, Cook and Lord 1978, Cook 1983) were used to correct the reader-assigned age composition estimates for potential bias based on the known-age vs. read-age validation matrices. The method used to combine the random sample's known ages (CWT fish) and unknown read ages for estimation of the escapement age-composition is described in Appendix A.

In cases where scales were believed to be non-representative of the age-two component, the KRTAT relied on analysis of length-frequency histograms. In these cases, all fish less than or equal to a given fork-length "cutoff" were assumed to be age-two, and all fish greater than the cutoff length were assumed to be adults. The cutoff value varied by sector, and was based on location of the length-frequency nadir and, if appropriate, known-age (CWT) length-frequencies. As before, scales were used to estimate the age composition of adults (Appendix A).

An indirect method was used to estimate age composition for natural spawners in the Trinity River above the Willow Creek Weir (WCW). The number of age-two fall Chinook that immigrated above WCW was estimated using a Peterson mark-recapture estimator for fish less than or equal to 57 cm. Age-specific numbers of adult (greater than 57 cm) fall Chinook that immigrated above the WCW were estimated by applying the age composition from scales collected at the weir to the estimate of adult abundance above the weir. Next, the age composition of returns to Trinity River Hatchery and of the harvest above WCW were estimated. The age composition of natural spawners above the weir was then estimated as the age-specific abundances above the WCW, minus the age-specific hatchery and harvest totals.

The specific protocols used to develop estimates of age composition for each sector are provided in Table 3. A summary of the KRTAT minutes specific to each sector is given in Appendix B for the Klamath River and Appendix C for the Trinity River.

Results

A total of 11,097 scales from 15 different sectors were aged for this analysis (Table 2). Of these, 978 were from known-age (CWT) fish. Known-age scales provide a direct check, or "validation," of accuracy of the scale-based age estimates (Tables 4a and 4b, Appendices D and E). Overall, the scale-based ages were generally accurate. For the Trinity River, accuracy was 98% for age-2 fish, 100% for age-3 fish, 99% for age-4 fish, and 100% for age-5 fish. For the Klamath River the accuracy was 93% for age-2 fish, 92% for age-3 fish, 95% age-4 fish, and 50% for age-5 fish. The statistical bias-adjustment methods employed are intended to correct for scale-reading bias, but the

methods assume that the known-age vs. read-age validation matrices are themselves well estimated (Kimura and Chikuni 1987).

Table 5 presents estimates of age-specific returns to Basin hatcheries and spawning grounds, as well as Basin harvest by Tribal and recreational fisheries and the drop-off mortality associated with those fisheries. Table 6 displays the Table 5 estimates as proportions. Calculations underlying the results summarized in Table 1 are presented in Appendix F.

New methods were used to estimate Salmon River escapement in 2008, owing to the inability to sample Wooley Creek because of forest fires (Appendix G).

The final estimates of the 2007 Klamath Basin age composition were slightly modified from the preliminary age composition. Final estimates are presented in Appendix H.

List of Acronyms and Abbreviations

ad-clipped	adipose fin removed
CDFG	California Department of Fish and Game
CWT	coded-wire tag
EST	Klamath River estuary
FL	fork length
HVT	Hoopa Valley Tribe
IGH	Iron Gate Hatchery
KRTAT	Klamath River Technical Advisory Team
KRTT	Klamath River Technical Team
KT	Karuk Tribe
LRC	Lower Klamath River Creel
M&U	Klamath River below Weitchpec: “middle” section (Hwy 101–Surpur Ck) and “upper” section (Surpur Ck—Trinity River)
SCS	Siskiyou County Schools
SRRC	Salmon River Restoration Council
TRH	Trinity River Hatchery
UR TRIBS	Upper Klamath River Tributaries
USFS	U.S. Forest Service
USFWS	U.S. Fish and Wildlife Service
WCW	Willow Creek Weir
YT	Yurok Tribe
YTFP	Yurok Tribal Fisheries Program

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Klamath River Technical Advisory Team Participants

California Department of Fish and Game
Melodie Palmer-Zwahlen
Wade Sinnen

Hoopa Valley Tribe
George Kautsky
Billy C. Matilton

KMZ Ocean Recreational Fishery
Jerry Barnes

National Marine Fisheries Service
Michael O'Farrell

U.S. Fish and Wildlife Service
Joe Polos

Yurok Tribe
Desma Williams

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Table 1. Estimation and sampling methods used for the 2008 Klamath River fall Chinook run assessment.

Sampling Location	Estimation and Sampling Methods	Agency
Hatchery Spawners		
Iron Gate Hatchery (IGH)	Direct count. All fish examined for fin-clips, tags, marks. Systematic random sample ~10% bio-sampled for fork-length (FL), scales, sex, and all ad-clipped fish bio-sampled.	CDFG
Trinity River Hatchery (TRH)	Direct count. All fish bio-sampled for FL, fin-clips, marks, sex. Scales collected from ~20% of all fish by systematic random sampling of ad- and non-ad-clipped fish.	CDFG, HVT
Natural Spawners		
Salmon River Basin	Redd count twice weekly. Adults = 2 * redd counts+live fish observed on last survey; total run = adults/(1-jack% from scale sample proportion). Bio-data (scales, FLs, marks) collected from carcasses. Could not use mark-recapture methods because high flow event during peak of run. Wooley Creek could not be surveyed due to forest fires. Total run increased by 8.08% (average contribution of Wooley Creek to Salmon River escapement 1998-2007 based on redd counts) to account for spawning escapement in Wooley Creek.	CDFG,USFS,YT, KT, SRRC, SCS
Scott River Basin	Video count above weir at river mile 21, and mark-recapture carcass estimate (Schaefer) below weir with reaches surveyed twice weekly. Bio-data (scales, FLs, marks, sex) collected from all carcasses.	CDFG, SCS
Shasta River Basin	Video count above weir. Bio-data (scales, FLs, sex, marks) collected from carcasses upstream of video weir site 1-day per week and mortalities stranded on weir.	CDFG, SCS
Bogus Creek Basin	Video count above weir and daily direct carcass count below weir. Systematic random sample (1:4) bio-sampled for FL, scales, sex, and all ad-clipped fish bio-sampled.	CDFG, YT
Klamath River mainstem (IGH to Shasta R)	Petersen mark-recapture carcass estimate. River sections are surveyed weekly. Bio-data (scales, FLs, marks) collected from fresh carcasses.	USFWS, YT
Klamath River mainstem (Shasta R to Indian Cr)	Redd count based on weekly surveys. Adults = 2 * redd counts; total run = adults/(1-%jacks estimated in IGH to Shasta reach).	USFWS, KT
Klamath Tributaries (above Trinity, including Pine Creek)	Periodic redd surveys, once every 10 days. Adults=2 * redd counts+live fish observed on last day surveyed. Total Run=adults/(1-%jacks estimated for Shasta, Scott, and Salmon surrogate).	USFS,CDFG
Blue Creek	Weekly surveys. Jacks and adults estimated as the peak count of successive weekly snorkel surveys.	YT
Trinity River (mainstem above WCW)	Petersen mark-recapture run-size estimate stratified for jacks and adults; marks applied at WCW, recaptured at TRH. All fish bio-sampled (FL, marks, fin-clips). Scales taken at WCW in systematic random sample (1:2). Total natural escapement calculated from WCW run size minus TRH return minus recreational harvest.	CDFG, HVT
Trinity River (mainstem below WCW)	Weekly redd surveys. Adults = 2 * redd counts. Total run = adults/(1-%jacks estimated for upper Trinity natural escapement).	HVT
Trinity Tributaries (above Reservation; below WCW)	Redd surveys. Adults = 2 * redd counts. Total run = adults/(1-%jacks estimated for upper Trinity natural escapement).	CDFG
Hoopa Reservation Tributaries	Redd surveys. Adults = 2 * redd counts. Total run = adults/(1-%jacks estimated for upper Trinity natural escapement).	HVT
Recreational Harvest		
Klamath River (below Hwy 101 bridge)	Jack and adult estimates based on access point creel survey during three randomly selected days per statistical week. Bio-data (scales, FLs, marks, fin-clips) collected during angler interviews.	CDFG
Klamath River (Hwy 101 to Weitchpec)	Jack and adult estimates based on access point creel survey during three randomly selected days per statistical week. Bio-data (scales, FLs, marks, fin-clips) collected during angler interviews.	CDFG
Klamath River (Weitchpec to IGH)	No survey, used ratio of adult harvest (lower river : upper river) from 1999-2002 to estimate adult harvest. Total harvest = adults/(1-%jacks estimated for IGH and Bogus weighted average).	CDFG
Trinity River Basin (above WCW)	Jack and adult harvest estimates based on estimated harvest rates from recovery of reward tags (applied at WCW) multiplied by WCW jack and adult run sizes.	CDFG
Trinity River Basin (below WCW)	Roving access creel survey during three randomly selected days per statistical week stratified by weekdays and weekend days (1 weekday and 2 weekend). Bio-data (scales, FLs, marks, fin-clips) collected during angler interviews.	HVT
Tribal Harvest		
Klamath River (below Hwy 101)	Daily harvest estimates based on effort and catch-per-effort surveys. Bio-data (FLs, scales, fin-clips, marks) collected during net harvest interviews.	YT
Klamath River (Hwy 101 to Trinity mouth)	Daily harvest estimates based on effort and catch-per-effort surveys. Bio-data (FLs, scales, fin-clips, marks) collected during net harvest interviews.	YT
Trinity River (Hoopa Reservation)	Two-stage effort and catch-per-effort surveys. Bio-data (FLs, scales, fin-clips) collected during net harvest interviews.	HVT
Fishery Dropoff Mortality		
Recreational Angling Dropoff Mortality 2.04%	Not directly estimated. Assumed rate relative to fishery impacts = .02; relative to fishery harvest = .02/(1-.02).	KRTAT
Tribal Net Dropoff Mortality 8.7%	Not directly estimated. Assumed rate relative to fishery impacts = .08; relative to fishery harvest = .08/(1-.08).	KRTAT

Table 2. Scale sampling locations and numbers of scales collected for the 2008 Klamath Basin fall Chinook age-composition assessment.

Sampling Location	Scales collected			Total	Agency
	Read		Not read ^{c/}		
	Unknown-age ^{a/}	Known-age ^{b/}			
<u>Hatchery Spawners</u>					
Iron Gate Hatchery (IGH)	1,075	489	258	1,822	CDFG
Trinity River Hatchery (TRH)	797	213	29	1,039	HVT
<u>Natural Spawners</u>					
Salmon River Carcass Survey	297	0	5	302	CDFG
Scott River Carcass Survey	1,107	0	17	1,124	CDFG
Shasta River Carcass	203	1	786 ^{d/}	990	CDFG
Bogus Creek Weir	658	31	12	701	CDFG
Klamath River mainstem	888	0	37	925	USFWS
Upper Klamath River tributaries	0	0	0	0	USFS
Blue Creek Snorkle	47	0	0	47	YT
Willow Creek Weir	879	41	18	938	CDFG, HVT
Lower Trinity River Carcass	0	0	0	0	HVT
Lower Trinity River tributaries	5	0	0	5	HVT
<u>Recreational Harvest</u>					
Lower Klamath River Creel	767	26	25	818	CDFG
Lower Trinity River Creel	19	1	0	20	HVT
<u>Tribal Harvest</u>					
Klamath River (below Hwy 101)	1,179	99	3,404	4,682	YT
Klamath River (Hwy 101 to Trinity R)	1,437	17	109	1,563	YT
Trinity River (Hoopa Reservation)	761	60	8	829	HVT
TOTAL	10,119	978	4,708	15,805	

a/ Scales from non-ad-clipped fish and ad-clipped fish without CWTs, mounted and read.

b/ Scales from all mounted and read ad-clipped CWT fish; non-random CWT fish used for validation but not age composition.

c/ Scales mounted and not read or scales not mounted.

d/ Includes scales collected from "washbacks" at the weir. These scales were read but not used for age-composition analysis due to over-representation of age-two fish.

Table 3. Age-composition methods used for the 2008 Klamath Basin fall Chinook run assessment.

Sampling Location	Age Composition Method
<u>Hatchery Spawners</u>	
Iron Gate Hatchery (IGH)	Jack/adult structure from scale-age analysis.
Trinity River Hatchery (TRH)	Jacks (<58cm) from length frequency and adult structure from scale-age analysis.
<u>Natural Spawners</u>	
Salmon River Basin	Jack/adult structure from scale-age analysis.
Scott River Basin	Jack/adult structure from scale-age analysis.
Shasta River Basin	Jack/adult structure from scale-age analysis of carcass scale samples only.
Bogus Creek Basin	Jack/adult structure from scale-age analysis.
Klamath River mainstem (IGH to Shasta R)	Jack/adult structure from scale-age analysis.
Klamath River mainstem (Shasta R to Indian Cr)	Surrogate: Klamath mainstem (IGH to Shasta R) age-structure.
Klamath tributaries (above Reservation)	Surrogate: Unweighted average age structure from the Shasta, Scott and Salmon Rivers.
Blue Creek	Jacks estimated by direct observation. Adult structure from scale-age analysis.
Trinity River (above WCW) ^{a/}	Direct estimate of jack (<58cm) component using Petersen M-R and adult age structure from scale-age analysis.
Trinity River (mainstem below WCW)	Surrogate: Mainstem natural spawners above WCW age-structure.
Trinity Tributaries (above Reservation to WCW)	Surrogate: Mainstem natural spawners above WCW age-structure.
Hoopa Reservation Tributaries	Surrogate: Mainstem natural spawners above WCW age-structure.
<u>Recreational Harvest</u>	
Klamath River (below Hwy 101 bridge)	Jack/adult structure from scale-age analysis.
Klamath River (Hwy 101 to Weitchpec)	Jack/adult structure from scale-age analysis.
Klamath River (Weitchpec to IGH)	Surrogate: IGH and Bogus Creek weighted age composition.
Trinity River Basin (above WCW)	Jack component based on estimated jack harvest. Surrogate: Adult age composition from Trinity River Basin Recreational Harvest (below WCW).
Trinity River Basin (below WCW)	Jack/adult structure from scale-age analysis.
<u>Tribal Harvest</u>	
Klamath River (below Hwy 101)	Jack/adult structure from scale-age analysis.
Klamath River (Hwy 101 to Trinity mouth)	Jack/adult structure from scale-age analysis.
Trinity River (Hoopa Reservation)	Jack/adult structure from scale-age analysis.

a/ The jack proportion determined by scale ages at WCW was substantially higher than in recovery areas above WCW (TRH and mainstem carcass survey). As a result, estimates of jack and adult abundance were determined by a stratified Petersen estimate, where jacks and adults were estimated separately. Typically, the total abundance of both jacks and adults has been determined using an unstratified Petersen estimate.

Table 4a. 2008 Klamath River Basin scale validation matrices.

<u>Number</u>		Known Age				
		2	3	4	5	
Read Age	2	238	3	1	0	Total 821
	3	18	303	11	0	
	4	0	25	220	1	
	5	0	0	0	1	
Total		256	331	232	2	

<u>Percentage</u>		Known Age				
		2	3	4	5	
Read Age	2	0.93	0.01	0.00	0.00	Total 1.00
	3	0.07	0.92	0.05	0.00	
	4	0.00	0.08	0.95	0.50	
	5	0.00	0.00	0.00	0.50	
Total		1.00	1.00	1.00	1.00	

Table 4b. 2008 Trinity River Basin scale validation matrices.

<u>Number</u>		Known Age				
		2	3	4	5	
Read Age	2	43	0	0	0	Total 315
	3	1	109	2	0	
	4	0	0	159	0	
	5	0	0	0	1	
Total		44	109	161	1	

<u>Percentage</u>		Known Age				
		2	3	4	5	
Read Age	2	0.98	0.00	0.00	0.00	Total 1.00
	3	0.02	1.00	0.01	0.00	
	4	0.00	0.00	0.99	0.00	
	5	0.00	0.00	0.00	1.00	
Total		1.00	1.00	1.00	0.00	

Table 5. Age composition of the 2008 Klamath Basin fall Chinook run.

Escapement & Harvest	2	3	AGE 4	5	Total Adults	Total Run
Hatchery Spawners						
Iron Gate Hatchery (IGH)	2,130	5,530	3,551	21	9,101	11,231
Trinity River Hatchery (TRH)	800	1,485	2,961	5	4,451	5,251
Hatchery Spawner subtotal	2,930	7,015	6,512	26	13,552	16,482
Natural Spawners						
Salmon River Basin	650	431	1,286	32	1,749	2,399
Scott River Basin	1,228	167	3,227	51	3,445	4,673
Shasta River Basin	3,621	1,222	1,456	63	2,741	6,362
Bogus Creek Basin	1,565	1,076	1,911	14	3,001	4,566
Klamath River mainstem (IGH to Shasta R)	834	960	3068	33	4,060	4,894
Klamath River mainstem (Shasta R to Indian Cr)	365	415	1341	14	1,770	2,135
Klamath Tributaries (above Trinity, including Pine Creek)	1,073	396	1,416	33	1,845	2,918
Blue Creek	89	76	242	91	409	498
Klamath Basin subtotal	9,425	4,743	13,947	330	19,020	28,445
Trinity River (mainstem above WCW)	6,997	2,444	7,962	78	10,483	17,480
Trinity River (mainstem below WCW)	399	139	454	4	598	997
Trinity tributaries (above Reservation)	160	56	182	2	240	400
Hoopla Reservation tributaries	390	136	444	4	584	974
Trinity Basin subtotal	7,946	2,775	9,042	88	11,905	19,851
Natural Spawners subtotal	17,371	7,518	22,989	418	30,925	48,296
Total Spawner Escapement	20,301	14,533	29,501	444	44,477	64,778
Recreational Harvest						
Klamath River (below Hwy 101 bridge)	521	36	99	7	141	662
Klamath River (Hwy 101 to Weitchpec)	3,358	219	633	44	896	4,254
Klamath River (Weitchpec to IGH)	160	285	236	1	523	683
Trinity River Basin (above WCW)	139	44	181	0	225	364
Trinity River Basin (below WCW)	75	14	65	0	78	153
Subtotals	4,253	598	1,214	52	1,863	6,116
Tribal Harvest						
Klamath River (below Hwy 101)	302	2,546	14,102	1,062	17,710	18,012
Klamath River (Hwy 101 to Trinity mouth)	187	445	2,122	70	2,636	2,823
Trinity River (Hoopla Reservation)	152	234	1,667	12	1,913	2,065
Subtotals	641	3,225	17,891	1,144	22,259	22,900
Total Harvest	4,894	3,823	19,105	1,196	24,122	29,016
Totals						
Harvest and Escapement	25,195	18,356	48,606	1,640	68,599	93,794
Recreational Angling Dropoff Mortality 2.04%	87	12	25	1	38	125
Tribal Net Dropoff Mortality 8.7%	56	280	1,556	99	1,935	1,991
Total River Run	25,338	18,648	50,187	1,737	70,572	95,910

Table 6. Age proportion of the 2008 Klamath Basin fall Chinook run.

Escapement & Harvest	AGE			
	2	3	4	5
<u>Hatchery Spawners</u>				
Iron Gate Hatchery (IGH)	0.19	0.49	0.32	0.00
Trinity River Hatchery (TRH)	0.15	0.28	0.56	0.00
Hatchery Spawner subtotal	0.18	0.43	0.40	0.00
<u>Natural Spawners</u>				
Salmon River Basin	0.27	0.18	0.54	0.01
Scott River Basin	0.26	0.04	0.69	0.01
Shasta River Basin	0.57	0.19	0.23	0.01
Bogus Creek Basin	0.34	0.24	0.42	0.00
Klamath River mainstem (IGH to Shasta R)	0.17	0.20	0.63	0.01
Klamath River mainstem (Shasta R to Indian Cr)	0.17	0.19	0.63	0.01
Klamath Tributaries (above Trinity, including Pine Creek)	0.37	0.14	0.49	0.01
Blue Creek	0.18	0.15	0.49	0.18
Klamath Basin subtotal	0.33	0.17	0.49	0.01
Trinity River (mainstem above WCW)	0.40	0.14	0.46	0.00
Trinity River (mainstem below WCW)	0.40	0.14	0.46	0.00
Trinity tributaries (above Reservation)	0.40	0.14	0.46	0.00
Hoopla Reservation tributaries	0.40	0.14	0.46	0.00
Trinity Basin subtotal	0.40	0.14	0.46	0.00
Natural Spawners subtotal	0.36	0.16	0.48	0.01
Total Spawner Escapement	0.31	0.22	0.46	0.01
<u>Recreational Harvest</u>				
Klamath River (below Hwy 101 bridge)	0.79	0.05	0.15	0.01
Klamath River (Hwy 101 to Weitchpec)	0.79	0.05	0.15	0.01
Klamath River (Weitchpec to IGH)	0.23	0.42	0.35	0.00
Trinity River Basin (above WCW)	0.38	0.12	0.50	0.00
Trinity River Basin (below WCW)	0.49	0.09	0.42	0.00
Subtotals	0.70	0.10	0.20	0.01
<u>Tribal Harvest</u>				
Klamath River (below Hwy 101)	0.02	0.14	0.78	0.06
Klamath River (Hwy 101 to Trinity mouth)	0.07	0.16	0.75	0.02
Trinity River (Hoopla Reservation)	0.07	0.11	0.81	0.01
Subtotals	0.03	0.14	0.78	0.05
Total Harvest	0.17	0.13	0.66	0.04
<u>Totals</u>				
Harvest and Escapement	0.27	0.20	0.52	0.02
Recreational Angling Dropoff Mortality 2.04%	0.70	0.10	0.20	0.01
Tribal Net Dropoff Mortality 8.7%	0.03	0.14	0.78	0.05
Total River Run	0.26	0.19	0.52	0.02

Appendix A: Estimation of escapement age-composition from a random sample containing known-age (CWT) and unknown read-age fish.

Denote the escapement at age as $\{N_a, a = 2, 3, 4, 5\}$, $N = \sum N_a$, and for the random sample of size $(n + m)$ fish, denote the following quantities:

- known-age fish: number at age $\{n_a, a = 2, 3, 4, 5\}$, $n = \sum n_a$, $p_a = n_a / n$.
- unknown read-age fish: number at age $\{m_a, a = 2, 3, 4, 5\}$, $m = \sum m_a$, $r_a = m_a / m$.
- bias-corrected unknown read-age proportions: $\{r_a^*, a = 2, 3, 4, 5\}$, $r_A^* = r_3^* + r_4^* + r_5^*$.
- age-2 proportion as estimated by size-frequency: s_2 .

1. Age 2–5 escapement by scales. Estimate N_a as the sample known-age a fish plus the unknown age portion of the escapement times the estimated age a proportion (bias-corrected):

$$N_a = np_a + (N - n)r_a^*, \quad a = 2, 3, 4, 5.$$

2. Age-2 escapement by size-frequency, age 3–5 escapement by scales. Estimate N_2 as the total escapement times the size-frequency based estimated age-2 proportion. Estimate N_a for $a = 3, 4, 5$ as the sample known-age a fish plus the unknown age portion of the adult escapement times the age a proportion among adults (bias-corrected):

$$N_a = \begin{cases} Ns_2, & a = 2 \\ np_a + [N(1 - s_2) - n(1 - p_2)](r_a^* / r_A^*), & a = 3, 4, 5 \end{cases}$$

Appendix B. Klamath River – 2008 Details.

Iron Gate Hatchery

A systematic random bio-sample^a was obtained from every tenth Chinook returning to IGH in 2008. Additionally every ad-clip fish not occurring in the random sample was bio-sampled as nonrandom. A representative sub-sample was obtained by systematically discarding every third scale sample packet obtained in the random 1:10 bio-sample collected at IGH. Scale-based age composition was used to apportion all age classes. Age composition was estimated from a total of 1,564 scales of which 489 came from known-age, CWT fish.

Bogus Creek

Total run was estimated by summing carcasses encountered below the video weir and videography (since 2002) counts above the weir. Biological samples were obtained from all areas using a systematic random sample of 1:4. Additionally, biological data were obtained from a non-random collection of every ad-clipped fish encountered. Age composition was estimated from a total of 689 scales of which 31 came from known-age, CWT fish.

Shasta River

Total run estimated by videography (since 1998) while bio-samples were collected from all recovered carcasses for surveys in the lower 7 miles on public and private lands where access is granted. An additional 6 miles of valley area were surveyed on Nature Conservancy and adjoining Busk Ranch properties. Bio-samples were also obtained from all fish that washed back onto the counting weir. Age composition was estimated from a total of 204 scales of which 1 came from known-age, CWT fish.

Scott River

Total escapement was obtained using a Schaefer carcass mark-recapture estimator for reaches below a resistance board weir installed near Jones Beach river mile 21. Videography was used to estimate the population above the weir augmented with carcass surveys above the weir for biological samples. Bio-samples were obtained from all carcasses encountered. Age composition was estimated from a total of 1,107 scales of which none were from known-age, CWT fish.

Salmon River

In past years, carcass mark-recapture was used to estimate total fall Chinook spawners in Salmon River. However, surveys were suspended due to high flows over two weeks in early November coinciding with the peak spawning period. This resulted in poor recoveries for carcasses marked just prior to the high flow event. The total run estimate was generated by redd surveys conducted prior to these high flows and surveys conducted after flows receded. Age composition was estimated from a total of 297 scales of which none were from known-age, CWT fish.

Klamath River Tributaries (above Reservation)

The adult run estimate was obtained by multiplying total redd counts by two and adding the total of live fish observed during the final survey in each tributary. Due to insufficient collection of scales, Chinook from these tributaries were apportioned by age using a surrogate of un-weighted average proportions estimated for the Salmon, Shasta, and Scott rivers combined.

Klamath River Mainstem

For the upper reach (IGH to Shasta River section), the total population was estimated by combined Petersen K-sample (multiple mark, multiple recapture). Age composition was estimated from a total of 888 scales of which none were from known-age, CWT fish.

^a Biological samples ("bio-samples") of live fish or carcasses generally included: sex, fork length, tags or marks, and CWT recovery from ad-clipped fish.

Redds were multiplied by two to estimate the adult run in the lower reach (Shasta to Indian Creek section). The scale-age proportion from the upper reach were used as a surrogate to estimate jacks and assign adult age proportions.

Lower Klamath River Creel

The total harvest was estimated by creel census for the combined area (above Highway 101 bridge to Weitchpec, and Highway 101 bridge to mouth). Age composition was estimated from a total of 793 scales of which 26 were from known-age, CWT fish.

Upper Klamath River Recreational Fishery

There was no creel census in this sub-area in 2008. Harvest data were available from creel census of the lower and upper river fisheries in 1999 through 2002. The ratio of average total adult harvest (upper river recreational harvest plus lower river recreational harvest) versus average adult harvest in the lower area for these years (ratio = 1.504) was used to estimate total Klamath river recreational harvest in 2008, given the estimated lower river harvest. The upper river harvest was then calculated indirectly by subtracting the lower river harvest from the total harvest. The number of jacks and adult age assignments were estimated by applying the scale-based age proportions obtained from the weighted average age composition of Bogus Creek and IGH combined.

Yurok Tribal Estuary Fishery (Klamath mouth to Hwy 101)

Yurok harvest in the estuary area was estimated by hourly stratified effort and catch per effort methods. The fishery was closed on Wednesdays and Thursdays and between the hours of 10 PM and 8 AM on fishing days. Age composition was estimated from a total of 1,278 scales, of which 99 were from known-age, CWT fish.

Yurok Tribal Above 101

Yurok harvest in this sub area was estimated by daily effort and catch per effort estimation. The fishery was closed on Wednesdays and Thursdays. Age composition was estimated from a total of 1,454 scales, of which 17 were from known-age, CWT fish.

Blue Creek

Peak count for jacks and adults from snorkel surveys and adult age-structure derived from scale samples. A total of 47 scales were used of which none were from known-age, CWT fish.

Appendix C. Trinity River – 2008 Details.

Trinity River Hatchery (TRH)

Sampling for scales was conducted in a systematic (1:5) random manner. Ad-clipped and non-ad-clipped fish were selected with equal probability. A total of 1,010 scales were aged of which 213 scales came from known-age, CWT fish. The jack component was estimated based on a < 58 cm cut off for age-2 fish. Scale samples were used to apportion the adult hatchery return into age classes.

Upper Trinity River Recreational Harvest

The general method for estimating the upper Trinity recreational harvest depends on the application of reward/non-reward program tags at the Willow Creek Weir (WCW) and subsequently returned by anglers. The harvest of jacks and adults was estimated using harvest rate estimates based on returns of WCW program tags and the total run estimated above WCW. The adult age-proportions estimated for the Lower Trinity River Creel were used as a surrogate for the adult component.

Lower Trinity River Creel

Roving creel census implemented in Trinity River below the WCW. A total of 20 scales were aged of which 1 was from known-age, CWT fish. Total harvest was apportioned by age using the scale-age proportions.

Upper Trinity River Natural Escapement

The natural escapement in the upper Trinity River above WCW was estimated by subtracting the age-specific returns to TRH and age-specific recreational harvest above WCW from the total estimated run above WCW. Total run above WCW was estimated using a stratified Petersen mark-recapture estimator for jacks (< 58 cm) and adults, separately. The age structure of the run was estimated using the jack run estimate and the adult age-composition from the scales collected at WCW applied to the adult run portion. A total of 920 scales were aged of which 41 were from known-age, CWT fish.

Lower Trinity River Natural Escapement:

The Lower Trinity natural escapement estimation area included total spawners estimated in both main-stem and tributary sub-areas (redds X 2). No scales were collected from the mainstem, and only 5 scales were collected from the tributary sub-area. Ages were apportioned using the "Upper Trinity Natural Escapement" proportions as a surrogate.

Hoopa Valley Tribal Harvest

Hoopa Valley Tribal harvest is a composite of the gillnet and hook-and-line fisheries prosecuted by Tribal members. A total of 821 scales were aged of which 60 were from known-age, CWT fish. The total harvest was apportioned by age using these scale-age proportions.

Appendix D. 2008 Klamath age analysis

Unknown scales age composition as read					
	AGE 2	AGE 3	AGE 4	AGE 5	TOTAL
BOGUS	213	169	275	1	658
IGH	197	510	367	1	1,075
SALMON	76	62	157	2	297
SCOTT	274	93	734	6	1,107
SHASTA (no weir)	108	46	48	1	203
MAINSTEM	145	195	545	3	888
UR TRIBS	0	0	0	0	0
LRC	565	83	115	4	767
YTFP EST	24	196	924	35	1,179
YTFP M&U	96	263	1,060	18	1,437
BLUE CRK	20	5	16	6	47
	1718	1622	4241	77	7658
Unknown scales corrected age proportions (Kimura method)					
	AGE 2	AGE 3	AGE 4	AGE 5	TOTAL
BOGUS	0.3440	0.2324	0.4206	0.0030	1.0
IGH	0.1909	0.4870	0.3202	0.0019	1.0
SALMON	0.2710	0.1795	0.5361	0.0135	1.0
SCOTT	0.2627	0.0358	0.6907	0.0108	1.0
SHASTA (no weir)	0.5693	0.1920	0.2289	0.0099	1.0
MAINSTEM	0.1708	0.1942	0.6282	0.0068	1.0
UR TRIBS					
LRC	0.7912	0.0497	0.1487	0.0104	1.0
YTFP EST	0.0169	0.1397	0.7840	0.0594	1.0
YTFP M&U	0.0669	0.1558	0.7523	0.0251	1.0
BLUE CRK	0.4255	0.1064	0.3404	0.1277	1.0
Known CWT ages ^{a/}					
	AGE 2	AGE 3	AGE 4	AGE 5	TOTAL
BOGUS	10	25	9	0	44
IGH	119	399	177	1	696
SALMON	0	0	0	0	0
SCOTT	0	0	0	0	0
SHASTA	0	1	0	0	1
MAINSTEM	3	15	13	0	31
UR TRIBS	0	0	0	0	0
LRC	14	12	6	0	32
YTFP EST	0	50	94	1	145
YTFP M&U	0	9	19	0	28
BLUE CRK	0	0	0	0	0
	146	511	318	2	977
<u>Breakout within strata</u>					
Bogus1	3	9	7	0	19
Bogus2	7	16	2	0	25
LRC - lo	0	3	1	0	4
LRC - mid	14	9	5	0	28
YTFP MID	0	5	5	0	10
YTFP UP	0	4	14	0	18

^{a/} Table includes known-age fish whose scales were not mounted / read.

Appendix E. 2008 Trinity age analysis

WCW = Willow Ck. Weir

		Cwt Age					Total
		no cwt	2	3	4	5	
Scale Ages	unreadable	17	0	1	0	0	18
	2	501	7	0	0	0	508
	3	111	0	17	1	0	129
	4	265	0	0	16	0	281
	5	1	0	0	0	0	2
		879	7	18	17	0	938

LOWTRINREC = Lower Trinity Recreational

		Cwt Age					Total
		no cwt	2	3	4	5	
Scale Ages	unreadable	1	0	0	0	0	1
	2	9	1	0	0	0	10
	3	2	0	0	0	0	2
	4	8	0	0	0	0	8
	5	0	0	0	0	0	0
		20	1	0	0	0	21

HUPAHARV = Hoopa Tribal Net Harvest plus Tribal Hook-and-Line

		Cwt Age					Total
		no cwt	2	3	4	5	
Scale Ages	unreadable	8	0	0	0	0	8
	2	56	1	0	0	0	57
	3	93	0	13	1	0	107
	4	608	0	0	44	0	652
	5	4	0	0	0	1	5
		761	1	13	45	1	829

TRH = Trinity River Hatchery

		Cwt Age					Total
		no cwt	2	3	4	5	
Scale Ages	unreadable	24	0	3	2	0	29
	2	113	34	0	0	0	147
	3	229	1	79	0	0	309
	4	454	0	0	99	0	553
	5	1	0	0	0	0	1
		821	35	82	101	0	1039

LOWTRINTRIBS = Lower Trinity Tribs

		Cwt Age					Total
		no cwt	2	3	4	5	
Scale Ages	unreadable	0	0	0	0	0	0
	2	2	0	0	0	0	2
	3	0	0	0	0	0	0
	4	2	0	0	0	0	2
	5	1	0	0	0	0	1
		5	0	0	0	0	5

UPKLAMREC Upper Klamath Recreational

not sampled in 08

		Cwt Age					Total
		no cwt	2	3	4	5	
Scale Ages	unreadable						
	2						
	3						
	4						
	5						
		0	0	0	0	0	0

LOWTRINMAINSTEM = Lower Trinity Mainstem

		Cwt Age					Total
		no cwt	2	3	4	5	
Scale Ages	unreadable	0	0	0	0	0	0
	2	0	0	0	0	0	0
	3	0	0	0	0	0	0
	4	0	0	0	0	0	0
	5	0	0	0	0	0	0
		0	0	0	0	0	0

TribesAboveHoopa

NO DATA

		Cwt Age					Total
		no cwt	2	3	4	5	
Scale Ages	unreadable						
	2						
	3						
	4						
	5						
		0	0	0	0	0	0

POOLED data from all areas: Scale age-CWT age matrix.
(Includes only fish with both scale age and CWT known age.)

		Cwt Age					Total
		no cwt	2	3	4	5	
4x4	2	43	0	0	0	0	43
	3	1	109	2	0	0	112
	4	0	0	159	0	0	159
	5	0	0	0	0	1	1
							0.99047619

(B)
Scale-CWT age matrix of proportions of column sums.

		Cwt Age					Total
		no cwt	2	3	4	5	
4x4	2	0.9773	0.0000	0.0000	0.0000	0.0000	0.9773
	3	0.0227	1.0000	0.0124	0.0000	0.0000	1.0351
	4	0.0000	0.0000	0.9876	0.0000	0.0000	0.9876
	5	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000

Corrected Scale age proportion vectors for scale-aged 2 - 5 fish.

known scales	41	60	1	213	0	315
unknown scales	879	761	19	797	5	2461

Correction Matrix for ages 2,3,4,5 .
(Inverse of Scale-CWT age proportion matrix.)

		Cwt Age					Total
		no cwt	2	3	4	5	
4x4	2	1.0233	0.0000	0.0000	0.0000	0.0000	1.0233
	3	-0.0233	1.0000	-0.0126	0.0000	0.0000	0.9641
	4	0.0000	0.0000	1.0126	0.0000	0.0000	1.0126
	5	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000

UNKNOWN CWTs

		Cwt Age					Total
		no cwt	2	3	4	5	
Age	2	0	1	1	149	5	156
	3	0	13	0	340	10	363
	4	0	45	0	575	17	637
	5	0	1	0	0	0	1
		0	60	1	1064	32	955

WCW scales

		Cwt Age					Total
		no cwt	2	3	4	5	
Age	2	513	0	513	0.5832	0.0000	513
	3	96	0	96	0.1092	0.0000	96
	4	268	0	268	0.3053	0.0000	268
	5	2	0	2	0.0023	0.0000	2
		879	0	879			879

Total Adults only

Natural Escapement, Trinity basin above WCW: Apportioned to age structure.

		Cwt Age					Total
		no cwt	2	3	4	5	
Rec above WCW	225 CDFG						
	4451 Megatable						
	10483 Megatable						
	15159						

		Cwt Age					Total
		no cwt	2	3	4	5	
TRH + Rec above WCW+Natural Escapement	3973						
	11103						
	83						
	15159						

Apportioned Natural Escapement

minus TRH #s minus above WCW creel #s

		Cwt Age					Total
		no cwt	2	3	4	5	
Escapement	2444						
	7962						
	78						
	0.2331						
	0.7595						

Appendix F. 2008 Klamath Basin fall Chinook age-composition calculation worksheet.

	# Grilse	# Adults	Total Run	CALCULATED AGE					SCALE AGE PROPORTIONS (unknowns)					Scales read or	Length Freq & Redd counts		
Hatchery spawners				2	3	4	5	Total	2	3	4	5	Total				
Iron Gate Hatchery (IGH)	2130	9101	11231	2130	5530	3551	21	11231	scales	0.1909	0.4870	0.3202	0.0019	1.0	1,075	<=59cm	
Trinity River Hatchery (TRH)	800	4451	5251	800	1485	2961	5	5251	IGH cwt	119	399	177	1	696			
Hatchery spawner subtotal:	2930	13552	16482	2930	7015	6512	26	16482	scales	count	0.3238	0.6747	0.0015	1.000	797	<=57cm act count	
	0.152							proportion hatchery	0.172	0.16	0.37	0.63	0.00				
Natural Spawners									stratified jack estimate								
Trinity River mainstem above WCW	6997	10483	17480	6997	2444	7962	78	17480	scales	0.40029	0.23311	0.75949	0.00740	1.0		Live Redds adults	
Trinity River mainstem below WCW	399	598	997	399	139	454	4	997	0.40029	0.23311	0.75949	0.00740	1.0	TR above WCW	299		
Salmon River Basin (includes Wooley Cr)	650	1749	2399	650	431	1286	32	2399	scales	0.27101	0.17946	0.53606	0.01347	1.0	297	779 54	
Scott River	1228	3445	4673	1228	167	3227	51	4673	scales	0.26268	0.03583	0.69065	0.01084	1.0	1,107	<=60cm	
Shasta River	3621	2741	6362	3621	1222	1456	63	6362	scales	0.56932	0.19196	0.22887	0.00985	1.0	203	<=59cm	
									Shasta CWT	0	1	0	0	1			
Bogus Creek	1565	3001	4566	1565	1076	1911	14	4566	scales	0.34397	0.23237	0.42062	0.00304	1.0	658	<=62cm	
									Bogus CWT	10	25	9	0	44			
Main stem Klamath (IGH to Shasta R)	834	4060	4894	834	960	3068	33	4894	scales	0.17083	0.19423	0.62818	0.00676	1.0	888	<=59cm	
										3	15	13	0	31	31		
Main stem Klamath (Shasta R to Indian Cr)	365	1770	2135	365	415	1341	14	2135	Upper main	0.17083	0.19423	0.62818	0.00676	1.0	Upper Klam main	885 redds	
subtotal:	15,659	27,847	43,506	15,659	6,854	20,705	289	43,506	Unweighted Salmon Scott Shasta (SSS) - SURROGATE					1.0			
	Surrogate			Iron Gate+Bogus Weighted Totals (up Klam creel surrogate)	3695	6605	5462	34	15797	SSS	0.36767	0.13575	0.48519	0.01139	1.0		Live Redds adults
Klamath Tributaries																	
Aiken Cr.	0	0	0	0	0	0	0	0	SSS	0.36767	0.13575	0.48519	0.01139		0		
Beaver Cr.	209	360	569	209	77	276	6	569	SSS	0.36767	0.13575	0.48519	0.01139		180		
Bluff Cr.	0	0	0	0	0	0	0	0	SSS	0.36767	0.13575	0.48519	0.01139		0		
Boise Cr.	12	20	32	12	4	15	0	32	SSS	0.36767	0.13575	0.48519	0.01139		10		
Camp Cr.	206	354	560	206	76	272	6	560	SSS	0.36767	0.13575	0.48519	0.01139		177		
Clear Cr.	98	168	266	98	36	129	3	266	SSS	0.36767	0.13575	0.48519	0.01139		84		
Dillon Cr.	37	63	100	37	14	48	1	100	SSS	0.36767	0.13575	0.48519	0.01139		31	1	
Elk Cr.	113	194	307	113	42	149	3	307	SSS	0.36767	0.13575	0.48519	0.01139		97		
Grider Cr.	29	50	79	29	11	38	1	79	SSS	0.36767	0.13575	0.48519	0.01139		25		
Horse Cr.	8	14	22	8	3	11	0	22	SSS	0.36767	0.13575	0.48519	0.01139		7		
Independence Cr.	0	0	0	0	0	0	0	0	SSS	0.36767	0.13575	0.48519	0.01139		0		
Indian Cr.	63	108	171	63	23	83	2	171	SSS	0.36767	0.13575	0.48519	0.01139		54		
Irving Cr.	0	0	0	0	0	0	0	0	SSS	0.36767	0.13575	0.48519	0.01139		0		
Perch Cr.	0	0	0	0	0	0	0	0	SSS	0.36767	0.13575	0.48519	0.01139		0		
Red Cap Cr.	217	373	590	217	80	286	7	590	SSS	0.36767	0.13575	0.48519	0.01139		186	1	
Rock Cr	17	29	46	17	6	22	1	46	SSS	0.36767	0.13575	0.48519	0.01139		14	1	
Slate Cr	2	4	6	2	1	3	0	6	SSS	0.36767	0.13575	0.48519	0.01139		2		
Seiad	0	0	0	0	0	0	0	0	SSS	0.36767	0.13575	0.48519	0.01139		0		
Thompson Cr.	26	44	70	26	9	34	1	70	SSS	0.36767	0.13575	0.48519	0.01139		22		
Ti Cr.	0	0	0	0	0	0	0	0	SSS	0.36767	0.13575	0.48519	0.01139	0.63	0		
Pine Cr (previously in Trin Tribs)	37	64	101	37	14	49	1	101	SSS	0.36767	0.13575	0.48519	0.01139		32		
Klamath Tribs subtotal	1073	1845	2918	1073	396	1416	33	2918			0.21468	0.76731	0.01801		921	3	
Trinity Tributaries									SURROGATE Trinity River Mainstem								
Horse Linto Cr.	112	168	280	112	39	128	1	280	scales	0.40029	0.23311	0.75949	0.00740	1.0	84	redds	
Cedar Cr (trib to Horse Linto)	48	72	120	48	17	55	1	120	scales	0.40029	0.23311	0.75949	0.00740	1.0	36	redds	
subtotal	160	240	400	160	56	182	2	400									
Non-Reservation Misc. tribs sub total	1233	2085	3318	1233	452	1598	35	3318									
Reservation Tributaries-Hoopa Valley																	
Campbell Cr.	0	0	0	0	0	0	0	0	scales	0.40029	0.23311	0.75949	0.00740	1.0	0	Live Redds adults	
Hostler	0	0	0	0	0	0	0	0	scales	0.40029	0.23311	0.75949	0.00740	1.0	0		
Mill	240	360	600	240	84	273	3	600	scales	0.40029	0.23311	0.75949	0.00740	1.0	180		
Pine Cr. (moved in 2007 to Klam tribs)	0	0	0	0	0	0	0	0	scales	0.40029	0.23311	0.75949	0.00740	1.0	0		
Soctish	9	14	23	9	3	11	0	23	scales	0.40029	0.23311	0.75949	0.00740	1.0	7		
Supply Cr.	140	210	350	140	49	159	2	350	scales	0.40029	0.23311	0.75949	0.00740	1.0	105		
Tish Tang Cr.	0	0	0	0	0	0	0	0	scales	0.40029	0.23311	0.75949	0.00740	1.0	0		
Others	0	0	0	0	0	0	0	0	scales	0.40029	0.23311	0.75949	0.00740	1.0	292		
subtotal	390	584	974	390	136	444	4	974	scales	0.40029	0.23311	0.75949	0.00740	1.0		Live Redds adults	
Reservation Tributaries-Yurok																	
Blue Cr.	89	409	498	89	76	242	91	498	all ages							Redds adults	
									scales	count	0.18519	0.59259	0.22222	1.00	47	220 217	
reservation tributaries subtotal	479	993	1472	479	212	686	95	1472									
Natural spawner subtotal:	17371	30925	48296	17371	7518	22989	419	48296									
Total spawner subtotal:	20301	44477	64778	20301	14533	29501	445	64778									
Angler Harvest																	
Klamath River (below Hwy 101)	521	141	662	521	36	99	7	662	LRC scales	0.79117	0.04974	0.14865	0.01043	1.00	767	<=62cm	
									LRC cwt	0	3	1	0	4			
Klamath River (Hwy 101 to Weitchpec)	3358	896	4254	3358	219	633	44	4254	LRC scales	0.79117	0.04974	0.14865	0.01043	1.00		<=62cm	
									LRC cwt	14	9	5	0	28			
Klamath River (Weitchpec to IGH)	160	523	683	160	285	236	1	683		0.23393	0.41814	0.34575	0.00217	1.00	Surrogate IGH+Bogus weighted		
											0.370						
Trinity River (above Willow Cr. Weir)	139	225	364	139	44	181	0	364	h rate	0.17262	0.82738	0.00000	1.00	Surrogate adults -lowr creel			
									upper cwt	5	10	17	0	27	papercwt		
Trinity River (below Willow Cr. Weir)	75	78	153	75	14	65	0	153	scales	0.48470	0.08895	0.42635	0.00000	1.00	19		
									lower cwt	1	0	0	0	1			
Angler harvest subtotal:	4,253	1,863	6,116	4,253	598	1,214	51	6,116									
Tribal Harvest																	
Klamath River (Estuary)	302	17710	18012	302	2546	14102	1062	18012	scales	0.0169	0.1397	0.7840	0.0594	1	1		

Appendix G: Estimation of Salmon River escapement in 2008, with accounting for missing Wooley Creek surveys.

Customarily, the escapement estimate for the Salmon River includes an escapement estimate made in Wooley Creek, based on redd surveys. In 2008, redd surveys were not conducted in Wooley Creek due to forest fire activity in the area. To account for the missing Wooley Creek redd counts, we used the ratio of total redds in the Salmon River basin (including Wooley Creek) to redds in the Salmon River (excluding Wooley Creek) to estimate the total number of redds expected if Wooley Creek were sampled.

Define the total number of redds in the Salmon River basin as T , and the number of redds in the Salmon River (excluding Wooley Creek) as S . The predicted total number of fall run redds in the Salmon River basin in 2008 is defined as

$$T_{2008} = S_{2008} \times \frac{\text{mean}(T)}{\text{mean}(S)},$$

where *mean* denotes the arithmetic mean for the years 1997-2007. Using this relationship,

$$T_{2008} = \frac{1015}{933} \times 779 = 848 \text{ redds, with an estimated 69 redds from Wooley Creek.}$$

Total Salmon River basin adult escapement is estimated by multiplying the total redds by 2 and adding the number of adults counted alive on the last day of surveys. In 2008, 54 adults were counted on the last survey day, and the final estimate of adult escapement in the Salmon Basin is $(848 \times 2) + 54 = 1749$.

Appendix H. Age composition of the 2007 Klamath River fall Chinook run (finalized Feb 03, 2009).

Escapement & Harvest	2	3	AGE 4	5	Total Adults	Total Run
<u>Hatchery Spawners</u>						
Iron Gate Hatchery (IGH)	180	16,528	381	59	16,969	17,149
Trinity River Hatchery (TRH)	33	17,545	473	63	18,081	18,114
Hatchery Spawner subtotal	213	34,073	854	122	35,050	35,263
<u>Natural Spawners</u>						
Salmon River Basin	55	1,004	373	0	1,377	1,432
Scott River Basin	11	3,397	1,097	0	4,494	4,505
Shasta River Basin	27	1,855	146	8	2,009	2,036
Bogus Creek Basin	64	4,513	144	20	4,677	4,741
Klamath River mainstem (IGH to Shasta R)	33	5,009	466	15	5,490	5,523
Klamath River mainstem (Shasta R to Indian Cr)	8	1,299	121	4	1,424	1,432
Klamath Tributaries (above Trinity, including Pine Creek)	26	1,136	276	2	1,414	1,440
Blue Creek	8	109	232	66	407	415
Klamath Basin subtotal	232	18,322	2,855	115	21,292	21,524
Trinity River (mainstem above WCW)	831	36,003	2,828	149	38,980	39,811
Trinity River (mainstem below WCW)	1	54	4	0	58	59
Trinity tributaries (above Reservation)	5	227	18	1	246	251
Hoopla Reservation tributaries	2	87	7	0	94	96
Trinity Basin subtotal	839	36,371	2,857	150	39,378	40,217
Natural Spawners subtotal	1,071	54,693	5,712	265	60,670	61,741
Total Spawner Escapement	1,284	88,766	6,566	387	95,720	97,004
<u>Recreational Harvest</u>						
Klamath River (below Hwy 101 bridge)	20	969	105	23	1,097	1,117
Klamath River (Hwy 101 to Weitchpec)	218	1,953	212	46	2,211	2,429
Klamath River (Weitchpec to IGH)	19	1,620	40	6	1,667	1,686
Trinity River Basin (above WCW)	89	835	101	0	936	1,025
Trinity River Basin (below WCW)	23	357	44	0	401	424
Subtotals	369	5,734	502	76	6,312	6,681
<u>Tribal Harvest</u>						
Klamath River (below Hwy 101)	16	14,323	8,194	958	23,475	23,491
Klamath River (Hwy 101 to Trinity mouth)	5	1,302	456	42	1,800	1,805
Trinity River (Hoopla Reservation)	0	1,919	337	42	2,298	2,298
Subtotals	21	17,544	8,987	1,042	27,573	27,594
Total Harvest	390	23,278	9,489	1,118	33,885	34,275
<u>Totals</u>						
Harvest and Escapement	1,674	112,044	16,055	1,505	129,605	131,279
Recreational Angling Dropoff Mortality 2.04%	8	117	10	2	129	137
Tribal Net Dropoff Mortality 8.7%	2	1,525	781	91	2,397	2,399
Total River Run	1,684	113,686	16,846	1,599	132,131	133,815