Klamath River Fall Chinook Salmon Age-Specific Escapement, River Harvest, and Run Size Estimates, 2017 Run

Klamath River Technical Team
21 February 2018

Summary

The number of Klamath River fall Chinook Salmon returning to the Klamath River Basin (Basin) in 2017 was estimated to be:

	Run Size	
Age	*Number*	*Proportion*
2	21,903	0.41
3	23,187	0.43
4	7,125	0.13
5	1,526	0.03
Total	53,741	1.00

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

	Adults		
Sector	*Preseason Forecast*	*Postseason Estimate*	*Pre / Post*
Run Size	18,400	31,800	0.58
Fishery Mortality			
Tribal Harvest	800	1,900	0.42
Recreational Harvest	100	100	1.00
Drop-off Mortality	100	200	0.50
	1,000	2,200	0.45
Escapement			
Hatchery Spawners	6,000	11,200	0.54
Natural Area Spawners	11,400	18,500	0.62
	17,400	29,700	0.59

Introduction

This report describes the data and methods used by the Klamath River Technical Team (KRTT) to estimate age-specific numbers of fall Chinook Salmon returning to the Basin in 2017. The estimates provided in this report are consistent with the Klamath Basin Megatable (CDFW 2018) and with the 2018 forecast of ocean stock abundance (KRTT 2018).

Age-specific escapement estimates for 2017 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 Salmon (Goldwasser et al. 2001, Mohr 2006a, KRTT 2018). Cohort reconstruction enables forecasts to be developed for the current year's ocean stock abundance, ocean fishery contact rates, and percent of spawners expected in natural areas (KRTT 2018). 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 Salmon.

Methods

The KRTT 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) to estimate the numbers of fall Chinook Salmon in the 2017 run and to obtain the data from which the Klamath Basin Megatable totals and estimates of age composition were derived. The KRTT relied on surrogate data for estimating age composition where the sample of scales was insufficient, or 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 (Cook and Lord 1978, Cook 1983, Kimura and Chikuni 1987) 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 (for CWT fish) and unknown read ages for estimation of the escapement or harvest age composition is described in Appendix A.

For cases in which scales were believed to be non-representative of the age-2 component, the KRTT 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-2, 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, the length-frequency of known-age fish. 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). Age-specific numbers of fall Chinook Salmon that immigrated above WCW were estimated by applying the age composition from scales collected at the weir to the estimate of total abundance above the weir. Next, the age composition of returns to Trinity River Hatchery and 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.

Stream surveys in the Salmon River effectively ended early in the 2017 spawning season due to high flow events. Also because of these high flows, sampling of Wooley Creek was not possible. The alternative method used for estimation of adult escapement to the Salmon River Basin in 2017 is described in Appendix B.

The abundance estimate for the carcass survey in the upper Klamath mainstem from Iron Gate

Hatchery (IGH) to the Shasta River was generated using a hierarchical latent variable model. This method, applied by USFWS, was first used for the 2016 run. A description of this estimation approach is described in KRTT (2017), Appendix D.

There were two changes to the Klamath mainstem redd survey occurring below the Shasta River. First, the traditional survey area (Shasta River to Indian Creek) was extended downstream to Wingate Bar, an additional 11.2 kilometers. Second, carcass sampling in the mainstem Klamath River from IGH to Shasta River detected an unusually high prevalence of age-2 female Chinook. It was inferred that age-2 females likely constructed redds in the downstream redd survey area (Shasta River to Wingate Bar). A new method was developed to account for the presence of age-2 females that were assumed to construct redds in that area (Appendix C).

The specific protocols used to develop estimates of age composition for each sector are provided in Table 3. A summary of the KRTT methods specific to each sector is given in Appendix D for the Klamath River and Appendix E for the Trinity River.

Results

A total of 7,863 scales from 17 different sectors were aged for this analysis (Table 2). Of these, 785 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 F and G). Overall, the scale-based ages were generally accurate. Accuracy within the Trinity Basin was 100% for age-2 fish, 98% for age-3 fish, 100% for age-4 fish, and 67% for age-5 fish. Accuracy within the Klamath River Basin was 98% for age-2 fish, 97% for age-3 fish, 90% for age-4 fish, and 75% 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 versus 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 5 are presented in Appendix H.

Recreational fisheries for fall Chinook in the Basin were closed in 2017. A small amount of recreational harvest was estimated to have occurred based on illegal catch in the fall Chinook survey period (beginning on August 15) and fall run fish taken during the spring Chinook survey period (prior to August 15).

The final estimates of the 2016 Klamath Basin age composition are presented in Appendix I.

List of Acronyms and Abbreviations

ad-clipped	adipose fin removed
CDFW	California Department of Fish and Wildlife
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
MKWC	Mid-Klamath Watershed Council

M&U	Klamath River below Weitchpec: “middle” section (Hwy 101–Surpur Cr.) and “upper” section (Surpur Cr.—Trinity River)
NCRC	Northern California Resource Center
QVIR	Quartz Valley Indian Reservation
SCS	Siskiyou County Schools
SRCD	Siskiyou Resource Conservation District
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
WSP	AmeriCorps Watershed Stewards Program
YT	Yurok Tribe
YTFP	Yurok Tribal Fisheries Program

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Acknowledgements

The Klamath River Technical Team thanks the following individuals for their expert assistance in compiling and reviewing the data for this report: Wade Sinnen, Dan Troxel, Mary Claire Kier, Domenic Giudice, and Jennifer Simon of the California Department of Fish and Wildlife; LeRoy Cyr of the U.S. Forest Service; and Christian Romberger of the U.S. Fish and Wildlife Service. The Yurok Tribe and U.S. Fish and Wildlife Service performed the scale reading analysis for the Klamath River while the Hoopa Valley Tribe performed the scale reading analysis for the Trinity River. Scale collections were provided by the California Department of Fish and Wildlife, Hoopa Valley Tribe, U.S. Fish and Wildlife Service, U.S. Forest Service, and Yurok Tribe.

Table 1. Estimation and sampling methods used for the 2017 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, and marks. Bio-data collected from a systematic random sample of 20% of the fish. Additionally, all ad-clipped fish were bio-sampled.	CDFW, WSP
Trinity River Hatchery (TRH)	Direct count. All fish examined for fin-clips, tags, and marks. Bio-data collected from a systematic random sample of 25% of the fish.	CDFW, HVT
Natural Spawners		
Salmon River Basin	Redd surveys of the upper and lower mainstem and tributaries. Total redds estimated by extrapolating redds counted from surveys through JW 44 based on historical redd deposition rate since 1998. Wooley Creek redd count was estimated using the historical ratio of redds there versus the rest of the Salmon River basin (Appendix B). Total run based on expanded redd count (2*total redd count)/(1-proportion of jacks). Bio-data collected from all carcasses recovered.	CDFW, USFS, USFWS, KT, SRRC, SCS, WSP, MKWC, NCRC
Scott River Basin	Combination ARIS acoustic and video count above weir at river mile 18 and redd survey below the weir. Total run based on ARIS acoustic and video count through the weir and redd survey (Total run below the weir = (2*total redd count)/(1-proportion jacks)). Bio-data collected from all carcasses recovered.	CDFW, QVIR, USFS, KT, NCRC, SRCD, WSP
Shasta River Basin	Video count above weir. Bio-data collected from all carcasses upstream of video weir site, and a systematic random sample of carcasses stranded on weir.	CDFW, WSP
Bogus Creek Basin	Video count above weir and twice weekly direct carcass count below weir. Bio-data collected from a systematic random sample (1:2) of all carcasses observed during surveys above and below weir. Additionally, all ad-clipped fish were bio-sampled.	CDFW, WSP
Klamath River mainstem (IGH to Shasta R.)	Hierarchical Latent Variable Model from weekly carcass surveys. Bio-data collected from fresh carcasses.	USFWS, YT
Klamath River mainstem (Shasta R. to Wingate Bar)	Weekly redd surveys. Adult escapement was the sum of redds by adult females and total redds, assuming each redd also represents one adult male (Appendix C). Age-2 escapement was the sum of age-2 males and redds made by age-2 females.	USFWS, KT
Klamath Tributaries above Trinity	Periodic redd surveys. High flows precluded repeated surveys in some areas. Total run = (2*total redd count)/(1-proportion jacks) + live fish observed on last day surveyed. Jacks estimated from Klamath tributary scale-age data. Bio-data collected from all carcasses recovered.	USFS, CDFW, KT, YT, SRRC, MKWC, WSP
Blue Creek	Total estimated using the maximum count from dive surveys conducted between 7 November and 14 December. Bio-data was collected from all carcasses recovered.	YT
Trinity River (mainstem above WCW)	Mark-recapture (stratified Peterson); marks applied at WCW and recovered at TRH. All fish bio-sampled and scales collected from every Chinook in good condition. Natural area spawning escapement estimated by subtracting age-specific estimates of hatchery returns and recreational harvest above WCW from age-specific estimates of the total run upstream of WCW.	CDFW, HVT
Trinity River (mainstem below WCW)	Bi-weekly redd surveys. Total run = (2*total redd count)/(1-proportion jacks). Bio-data collected from all recovered carcasses.	HVT, USFWS
Trinity Tributaries (above Reservation; below WCW)	Periodic redd surveys. Total run = (2*total redd count)/(1-proportion jacks) + live fish observed on last day surveyed.	CDFW, USFS, HVT, WSP
Hoopa Reservation Tributaries	Periodic redd surveys. Total run = (2*total redd count)/(1-proportion jacks). Bio-data collected from all recovered carcasses.	HVT
Recreational Harvest		
Klamath River (below Hwy 101 bridge)	Jack and adult estimates based on access point creel survey during 2 randomly selected days per statistical week, two weekdays or weekend days on alternating weeks. Additional sampling occurred in JW 32 and 33. Bio-data collected during angler interviews.	CDFW
Klamath River (Hwy 101 to Weitchpec)	Jack and adult estimates based on access point creel survey during 2 randomly selected days per statistical week, two weekdays or weekend days on alternating weeks. Additional sampling occurred in JW 32 and 35. Bio-data collected during angler interviews.	CDFW
Klamath River (Weitchpec to IGH)	No survey. Ratio estimator was not used in 2017 due to closure of the fall-run fishery after 15 August.	CDFW
Trinity River Basin (above WCW)	No legal recreational harvest of Chinook Salmon in 2017 was allowed. No tags were returned by anglers from fish reported as harvested.	CDFW, HVT
Trinity River Basin (below WCW)	Roving access creel survey during three randomly selected days per statistical week stratified by weekdays (M-Th) and weekend (F-Su) days (1 weekday and 2 weekend). Bio-data collected during angler interviews.	HVT
Tribal Harvest		
Klamath River (below Hwy 101)	Daily harvest estimates based on effort and catch-per-effort surveys and a census of the elder net fishery. Bio-data collected during elder net harvest.	YT
Klamath River (Hwy 101 to Trinity mouth)	Daily harvest estimates based on effort and catch-per-effort surveys of incidental harvest in the steelhead fishery. No bio-data collected.	YT
Trinity River (net and hook-and-line)	Effort and catch-per-effort surveys during four randomly selected days per statistical week for the net fishery, and three randomly selected days for the hook-and-line fishery. Bio-data collected during net harvest interviews.	HVT
Trinity River (harvest weir)	Direct count of all harvested fish. Bio-data collected from all harvested fish.	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

[a] Bio-data generally includes: fork length, scale, sex, tags or marks, and CWT recovery from dead ad-clipped fish.

Table 2. Scale sampling locations and numbers of scales collected for the 2017 Klamath Basin fall Chinook age-composition assessment.

Sampling Location	Aged			Total Collected[c/]	Agency
	Unknown-age [a/]	Known-age [b/]	Total		
Hatchery Spawners					
Iron Gate Hatchery (IGH)	1,569	192	1,761	2,034	CDFW
Trinity River Hatchery (TRH)	1,017	309	1,326	1,410	HVT
Natural Spawners					
Salmon River Carcass Survey	75	0	75	78	CDFW
Scott River Carcass Survey	441	0	441	448	CDFW
Shasta River Carcass	82	0	82	256	CDFW
Bogus Creek	654	56	710	745	CDFW
Klamath River mainstem	585	50	635	1,168	USFWS
Upper Klamath River tributaries	36	0	36	39	USFS
Blue Creek Snorkel	4	0	4	4	YT
Willow Creek Weir	1,688	127	1,815	1,857	CDFW, HVT
Lower Trinity River Carcass	0	0	0	0	HVT
Hoopa Reservation tributaries	1	0	1	1	HVT
Other Trinity River tributaries	2	0	2	2	USFS
Recreational Harvest					
Lower Klamath River Creel	25	1	26	26	CDFW
Lower Trinity River Creel	2	1	3	3	HVT
Tribal Harvest					
Klamath River (below Hwy 101)	178	11	189	191	YT
Klamath River (Hwy 101 to Trinity R)	0	0	0	0	YT
Trinity River (net and hook-and-line)	468	32	500	516	HVT
Trinity River (harvest weir)	83	6	89	89	HVT
TOTAL	6,910	785	7,695	8,867	

a/ Scales from non-ad-clipped fish and ad-clipped fish without CWTs, mounted and read.
b/ Scales from all mounted and aged ad-clipped CWT fish; non-random CWT fish used for validation but not age composition.
c/ Scales collected from the area.

Table 3. Age-composition methods used for the 2017 Klamath Basin fall Chinook run assessment.

Sampling Location	Age Composition Method
Hatchery Spawners	
Iron Gate Hatchery (IGH)	Jack/adult structure from scale-age analysis.
Trinity River Hatchery (TRH)	Jack/adult structure from scale-age analysis.
Natural Spawners	
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.
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 Wingate Bar)	Surrogate: Klamath mainstem (IGH to Shasta R.) age structure. Sex-specific age-2 components described in Appendix C. Adult structure from scale-age analysis.
Klamath tributaries (above Trinity R.)	Jack/adult structure from scale-age analysis.
Blue Creek	Jacks estimated through direct observation. Adult age structure from scale-age analysis.
Trinity River (above WCW)	Jack/adult structure derived from subtracting age-specific TRH counts and recreational harvest estimate above WCW from the age-specific total run estimate above WCW derived from scale-age analysis.
Trinity River (mainstem below WCW)	Surrogate: jack/adult structure from Trinity River (above WCW).
Trinity Tributaries (above Reservation to WCW)	Surrogate: jack/adult structure from Trinity River (above WCW).
Hoopa Reservation Tributaries	Surrogate: jack/adult structure from Trinity River (above WCW).
Recreational Harvest	
Klamath River (below Hwy 101 bridge)	Jack/adult structure from scale-age analysis.
Klamath River (Hwy 101 to Weitchpec)	Surrogate: jack/adult structure from Klamath River recreational harvest (below Hwy 101 bridge).
Klamath River (Weitchpec to IGH)	No harvest estimated. Fishery closed.
Trinity River Basin (above WCW)	No harvest estimated. Fishery closed.
Trinity River Basin (below WCW)	Jack/adult structure from scale-age analysis.
Tribal Harvest	
Klamath River (below Hwy 101)	Jack/adult structure from scale-age analysis.
Klamath River (Hwy 101 to Trinity mouth)	Surrogate: jack/adult structure from Klamath River recreational harvest (below Hwy 101 bridge).
Trinity River (net and hook-and-line)	Jack/adult structure from scale-age analysis.
Trinity River (harvest weir)	Jack/adult structure from scale-age analysis.
Ich Disease Monitoring	
Klamath-Trinity Basin	No additional fish harvested for disease monitoring.

Table 4a. 2017 Klamath River Basin scale validation matrices.

Number

Read Age	Known Age 2	3	4	5	Total
2	60	4	0	0	
3	0	243	9	0	
4	1	3	79	1	
5	0	0	0	3	
Total	61	250	88	4	403

Percentage

Read Age	Known Age 2	3	4	5
2	0.98	0.02	0.00	0.00
3	0.00	0.97	0.10	0.00
4	0.02	0.01	0.90	0.25
5	0.00	0.00	0.00	0.75
Total	1.00	1.00	1.00	1.00

Table 4b. 2017 Trinity River Basin scale validation matrices.

Number

Read Age	Known Age 2	3	4	5	Total
2	167	2	0	0	
3	0	267	0	0	
4	0	4	29	2	
5	0	0	0	4	
Total	167	273	29	6	475

Percentage

Read Age	Known Age 2	3	4	5
2	1.00	0.01	0.00	0.00
3	0.00	0.98	0.00	0.00
4	0.00	0.01	1.00	0.33
5	0.00	0.00	0.00	0.67
Total	1.00	1.00	1.00	0.00

Table 5. Age composition of the 2017 Klamath Basin fall Chinook run. 2/14/2018

Escapement & Harvest	AGE 2	3	4	5	Total Adults	Total Run
Hatchery Spawners						
Iron Gate Hatchery (IGH)	3,193	5,800	1,620	23	7,443	10,636
Trinity River Hatchery (TRH)	1,863	3,487	244	39	3,770	5,633
Hatchery Spawner subtotal	**5,056**	**9,287**	**1,864**	**62**	**11,213**	**16,269**
Natural Spawners						
Salmon River Basin	327	724	495	119	1,338	1,665
Scott River Basin	307	1,933	79	257	2,269	2,576
Shasta River Basin	6,618	782	2,022	483	3,287	9,905
Bogus Creek Basin	848	1,565	274	35	1,874	2,722
Klamath River mainstem (IGH to Shasta R)	1,735	2,379	560	66	3,005	4,740
Klamath River mainstem (Shasta R to Indian Cr)	587	728	169	20	917	1,504
Klamath Tributaries (above Trinity River)	154	527	299	176	1,002	1,156
Blue Creek	45	23	117	0	140	185
Klamath Basin subtotal	10,621	8,661	4,015	1,156	13,832	24,453
Trinity River (mainstem above WCW)	5,586	3,642	620	170	4,432	10,018
Trinity River (mainstem below WCW)	129	84	14	4	102	231
Trinity Tributaries (above Reservation; below WCW)	96	63	10	3	76	172
Hoopa Reservation tributaries	90	59	11	2	72	162
Trinity Basin subtotal	5,901	3,848	655	179	4,682	10,583
Natural Spawners subtotal	**16,522**	**12,509**	**4,670**	**1,335**	**18,514**	**35,036**
Total Spawner Escapement	**21,578**	**21,796**	**6,534**	**1,397**	**29,727**	**51,305**
Recreational Harvest						
Klamath River (below Hwy 101 bridge)	26	16	27	4	47	73
Klamath River (Hwy 101 to Weitchpec)	10	6	10	1	17	27
Klamath River (Weitchpec to IGH)	0	0	0	0	0	0
Trinity River Basin (above WCW)	0	0	0	0	0	0
Trinity River Basin (below WCW)	6	1	6	0	7	13
Subtotals	**42**	**23**	**43**	**5**	**71**	**113**
Tribal Harvest						
Klamath River (below Hwy 101)	65	152	51	2	205	270
Klamath River (Hwy 101 to Trinity mouth)	7	4	7	0	11	18
Trinity River (net and hook-and-line)	112	1,096	445	112	1,653	1,765
Trinity River (harvest weir)	82	7	0	0	7	89
Subtotals	**266**	**1,259**	**503**	**114**	**1,876**	**2,142**
Total Harvest	**308**	**1,282**	**546**	**119**	**1,947**	**2,255**
Totals						
Harvest and Escapement	21,886	23,078	7,080	1,516	31,674	53,560
Recreational Angling Dropoff Mortality 2.04%	1	0	1	0	1	2
Tribal Net Dropoff Mortality 8.7%	16	109	44	10	163	179
Klamath-Trinity Basin Ich disease testing	0	0	0	0	0	0
Total River Run	**21,903**	**23,187**	**7,125**	**1,526**	**31,838**	**53,741**

Table 6. Age proportion of the 2017 Klamath Basin fall Chinook run.

Escapement & Harvest	AGE 2	3	4	5
Hatchery Spawners				
Iron Gate Hatchery (IGH)	0.30	0.55	0.15	0.00
Trinity River Hatchery (TRH)	0.33	0.62	0.04	0.01
Hatchery Spawner subtotal	0.31	0.57	0.11	0.00
Natural Spawners				
Salmon River Basin	0.20	0.43	0.30	0.07
Scott River Basin	0.12	0.75	0.03	0.10
Shasta River Basin	0.67	0.08	0.20	0.05
Bogus Creek Basin	0.31	0.57	0.10	0.01
Klamath River mainstem (IGH to Shasta R)	0.37	0.50	0.12	0.01
Klamath River mainstem (Shasta R to Indian Cr)	0.39	0.48	0.11	0.01
Klamath tributaries (above Trinity River)	0.13	0.46	0.26	0.15
Yurok Reservation tributaries	0.24	0.12	0.63	0.00
Klamath Basin subtotal	0.43	0.35	0.16	0.05
Trinity River (mainstem above WCW)	0.56	0.36	0.06	0.02
Trinity River (mainstem below WCW)	0.56	0.36	0.06	0.02
Trinity tributaries (above Reservation)	0.56	0.37	0.06	0.02
Hoopa Reservation tributaries	0.56	0.36	0.07	0.01
Trinity Basin subtotal	0.56	0.36	0.06	0.02
Natural Spawners subtotal	0.47	0.36	0.13	0.04
Total Spawner Escapement	0.42	0.42	0.13	0.03
Recreational Harvest				
Klamath River (below Hwy 101 bridge)	0.36	0.22	0.37	0.05
Klamath River (Hwy 101 to Weitchpec)	0.37	0.22	0.37	0.04
Klamath River (Weitchpec to IGH)	-	-	-	-
Trinity River Basin (above WCW)	-	-	-	-
Trinity River Basin (below WCW)	0.46	0.08	0.46	0.00
Subtotals	0.37	0.20	0.38	0.04
Tribal Harvest				
Klamath River (below Hwy 101)	0.24	0.56	0.19	0.01
Klamath River (Hwy 101 to Trinity mouth)	0.39	0.22	0.39	0.00
Trinity River (net and hook-and-line)	0.06	0.62	0.25	0.06
Trinity River (harvest weir)	0.92	0.08	0.00	0.00
Subtotals	0.12	0.59	0.23	0.05
Total Harvest	0.14	0.57	0.24	0.05
Totals				
Harvest and Escapement	0.41	0.43	0.13	0.03
Recreational Angling Dropoff Mortality 2.04%	0.50	0.00	0.50	0.00
Tribal Net Dropoff Mortality 8.7%	0.09	0.61	0.25	0.06
Total River Run	0.41	0.43	0.13	0.03

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 of known-age *a* fish plus the unknown age portion of the escapement times the estimated age *a* proportion (bias-corrected):

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

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: Estimation of Salmon River adult escapement, accounting for a shortened survey and a lack of sampling in Wooley Creek.

In 2017, the Salmon River redd survey was effectively ended during Julian week 44 (the week ending on 4 November 2017); large flows resulted in very sparse additional surveys. In the Salmon River system, additional spawning typically occurs after Julian week 44, and this spawning activity was insufficiently sampled. Additionally, no sampling was performed on Wooley Creek in 2017, and the total Salmon River escapement estimate reported annually includes fish spawning in Wooley Creek. To derive an adult spawner estimate given these sampling shortfalls in the Salmon River watershed, we employed methods previously developed by the KRTT to account for scenarios when sampling effort was either low or lacking altogether (KRTT 2009, 2011, 2017).

To account for the lack of sampling after Julian week 44 in the Salmon River, 2017 redd deposition data up to and including Julian week 44, and the cumulative distributions of redd deposition from past years were used to estimate redds in 2017 (KRTT 2011). Redd deposition data for years 1998-2016 (but excluding 2010 and 2016, where survey effort was also low) indicated that the maximum proportion of new redds counted up to, and including, Julian week 44 was $p = 0.9066$. The KRTT discussed whether a mean, minimum, or maximum proportion of redd deposition (across years with appropriate data) at Julian week 44 would be most representative of 2017 conditions. The team decided that the maximum proportion would be most appropriate because observations from other neighboring sectors suggested early run timing and spawning in 2017.

In 2017, 556 redds were enumerated through Julian week 44 ($R_{inc} = 556$) and the total number of redds in the Salmon River (R), not including Wooley Creek, was estimated to be:

$$R = \frac{R_{inc}}{p} = \frac{556}{0.9066} = 613.$$

To account for the lack of sampling in Wooley Creek, we applied a method previously described in KRTT (2009). The ratio of the mean number of total redds in the Salmon River basin (including Wooley Creek $\overline{T}$) to the mean number of redds in the Salmon River (excluding Wooley Creek $\overline{S}$) was computed using data from 1996-2016 (but excluding 2008 and 2016 when Wooley Creek was not sampled):

$$\lambda = \frac{\overline{T}}{\overline{S}} = \frac{1124.95}{1030.63} = 1.09.$$

The total number of redds in the Salmon River Basin (R_{tot}), accounting for both a shortened survey and a lack of sampling in Wooley Creek, is therefore

$$R_{tot} = R \times \lambda = 613 \times 1.09 = 669,$$

which allows for the estimation of adult escapement (E) to the Salmon River basin, assuming two adult fish per redd:

$$E = R_{tot} \times 2 = 669 \times 2 = 1{,}338.$$

References

KRTT (Klamath River Technical Team). 2009. Klamath River fall Chinook age-specific escapement, river harvest, and run size estimates, 2008 run. Available from the Pacific Fishery Management Council, 7700 NE Ambassador Place, Suite 101, Portland, OR 97220-1384.

KRTT (Klamath River Technical Team). 2011. Klamath River fall Chinook age-specific escapement, river harvest, and run size estimates, 2010 run. Available from the Pacific Fishery Management Council, 7700 NE Ambassador Place, Suite 101, Portland, OR 97220-1384.

KRTT (Klamath River Technical Team). 2017. Klamath River fall Chinook age-specific escapement, river harvest, and run size estimates, 2016 run. Available from the Pacific Fishery Management Council, 7700 NE Ambassador Place, Suite 101, Portland, OR 97220-1384.

Appendix C. Estimation of escapement in the mainstem Klamath River below the Shasta River

An unusual presence of jills (age-2 females) was observed in the mainstem Klamath River carcass survey (Iron Gate Dam to Shasta River) in 2017. To account for the presence of age-2 females we introduced an alternative method for estimating escapement from redd data in the Klamath River mainstem below the Shasta River.

Separating redds made by jills from redds made by adult females

Scale ages from mainstem Klamath River carcasses revealed that 53.4% of males and 8.2% of females were age-2. To isolate redds constructed by *adult* (age-3+) females (R_a), we multiply the total redd count (R) by the proportion of adult females ($\hat{P}_{f,a}$):

$$\hat{R}_a = R * \hat{P}_{f,a} = 478 * 0.918 = 439.$$

Likewise, to isolate redds constructed by age-2 females (R_2), we multiply the redd count (R) by the proportion of age-2 females ($\hat{P}_{f,2}$):

$$\hat{R}_2 = R * \hat{P}_{f,2} = 478 * 0.082 = 39.$$

Adult Escapement Estimate

Assuming each redd also represents one adult male salmon (i.e., $R = N_{m,a}$), R_a was added to R to estimate adult escapement (N_a):

$$\hat{N}_a = \hat{R}_a + R = 439 + 478 = 917.$$

Where $\hat{R}_a$ represents the number of adult females (one adult female per redd constructed by an adult female) and R represents the number of adult males (since one adult male is assumed to be associated with each redd, regardless of the age of the female that constructed the redd).

Age-2 Escapement Estimate

We then use the age-2 male proportion ($\hat{P}_{m,2}$) determined from scales and the assumed adult male escapement ($\hat{N}_{m,a}$; equal to R) to estimate jack escapement ($\hat{N}_{m,2}$):

$$\hat{N}_{m,2} = \frac{\hat{N}_{m,a}}{\left(1 - \hat{P}_{m,2}\right)} - \hat{N}_{m,a} = \frac{478}{(1 - 0.534)} - 478 = 548.$$

The total male *and* female age-2 escapement ($\hat{N}_2$) estimate is then:

$$\hat{N}_2 = \hat{N}_{m,2} + \hat{R}_2 = 548 + 39 = 587.$$

Appendix D. Klamath River – 2017 details.

Iron Gate Hatchery (IGH)
Escapement to IGH is a direct count of the number of fall Chinook Salmon entering the hatchery over the duration of the spawning season. A systematic random bio-sample[a] was obtained from every fifth Chinook Salmon returning to IGH in 2017. Heads were also collected for CWT analysis from all ad-clipped fish not included in the systematic sample. A total of 1,761 scale samples were aged, of which 192 were from known-age CWT fish. Scale-based age compositions were used to apportion all age classes.

Bogus Creek
Escapement was estimated by summing carcasses encountered during spawning ground surveys below the video weir and videography counts above the weir. Spawning ground surveys are also conducted upstream of the weir to collect bio-samples. Bio-samples were obtained at a 1:2 systematic random sampling rate and from every (i.e., non-random) ad-clipped fish encountered. A total of 710 scale samples were aged, of which 56 were from known-age CWT fish. Scale-based age compositions were used to apportion all age classes.

Shasta River
Escapement was estimated by videography as the net count of fish moving upstream (total observed moving upstream minus total moving downstream). Bio-samples were collected from all carcasses encountered during surveys in the lower seven miles of the Shasta River, five reaches in the upper Shasta River mainstem, Yreka Creek, Big Springs Creek, Little Springs Creek, and Parks Creek. Bio-samples were also obtained from a 1:5 systematic sample of carcasses, and all ad-clipped fish not falling within the systematic sample, that washed back onto the counting weir. A total of 256 scale samples were aged, 82 of which were from spawning ground surveys and none of which were from known-aged fish. Scale-based age compositions from 82 scale samples collected during spawning ground surveys were used to apportion all age classes.

Scott River
Independent estimates from above and below the weir were combined to estimate total escapement. Escapement above the weir was estimated using videography as the net count of fish moving upstream, supplemented by ARIS acoustic counts during one 14-day high flow event. Species proportions observed by videography prior to and after ARIS deployment were used to estimate Chinook Salmon counts by ARIS. Due to insufficient recaptures (0) of marked carcasses (11) for implementing a Cormack-Jolly-Seber estimator, adult escapement below the weir was estimated by total redd count (redds X 2). Spawning ground surveys were also conducted upstream of the weir to collect bio-samples. Bio-samples were obtained from all non-deteriorated carcasses recovered above and below the weir. A total of 441 scale samples were aged, of which none were from known-age fish. Scale-based age compositions were used to apportion all age classes.

Salmon River
Redd surveys were used to estimate escapement in 2017; insufficient marks and recoveries prevented the use of mark-recapture estimators. River flows prevented comprehensive redd surveys beyond Julian week 44, and no surveys were conducted in Wooley Creek. To account for incomplete sampling, adult escapement was estimated using methods described in Appendix B. Bio-samples were obtained from all recovered carcasses. A total of 75 scale samples were aged, none of which were from known-age CWT fish. Scale-based age compositions were used to apportion jack and adult age classes.

[a] Biological samples ("bio-samples") of live fish or carcasses generally included: sex, fork length, tags or marks, a scale sample, and CWT recovery codes from adipose fin-clipped fish.

Klamath River Tributaries
Adult escapement was estimated by expanding the total redd count (redds X 2) and adding the number of live fish observed during the final survey in each tributary. A total of 36 scale samples were aged, none of which were from known-age CWT fish. Total escapement (including jacks) was estimated by expanding the adult estimate by the scale-based age-2 proportion. Scale-based age compositions were used to apportion all age classes.

Klamath River Mainstem
A hierarchical latent variable model based on weekly carcass counts and mark-recapture data was used to estimate escapement in the upper reach (IGH to Shasta River). A total of 635 scale samples were aged, 50 of which were from known-age CWT fish. Scale-based age proportions were used to assign all age classes.

For the lower reach (Shasta River to Wingate Bar), escapement was estimated from redd surveys. A large proportion of age-2 females, based on scale aging, was observed among carcasses in the upper reach, which led to the estimation methods described in Appendix C. Age assignments were based on sex-specific age proportions from scales collected in the upper reach.

Lower Klamath River Creel
Total harvest was estimated by combining creel census estimates from the two sub-areas (above the Highway 101 Bridge to Weitchpec and below the Highway 101 Bridge to the mouth). All harvest occurring in the two days preceding the fall Chinook fishery closure (JW 33) were included, as well as half of the estimated harvest from the week preceding the closure (JW 32). These harvested fish were included in the fall harvest because one fall CWT was recovered in JW 33 and one spring CWT was recovered in JW 31. Based on expansion of one illegally harvested fish sampled in the creel survey, four additional fish were estimated to have been harvested during the fishery closure. A total of 26 scale samples were aged, of which one was from known-age CWT fish. Scale-based age proportions from these 26 samples were used to apportion all age classes.

Upper Klamath River Recreational Fishery

No harvest was estimated in the upper Klamath River recreational fishery due to the complete closure of the fishery. The usual ratio estimator was not applied to the fall fish harvested before the closure because this was deemed to be the beginning of the fall run and therefore fall run fish were not expected to be available for harvest in the upper sector. The four fish illegally harvested were not expanded to the upper river because there was no evidence that illegal harvest occurred in the upper sector.

Yurok Tribal Estuary Fishery (Klamath mouth to Hwy 101)
Yurok harvest in this sub-area was estimated by summing census counts from the elder net fishery and estimates of incidental harvest from the steelhead angler fishery. Harvest in the steelhead angler fishery was estimated from daily effort and catch-per-effort analyses. A total of 189 scale samples were aged, of which 11 were from known-age CWT fish. Scale-based age composition was used to apportion all age classes.

Yurok Tribal Fishery Above Hwy 101
Yurok harvest in this sub-area was estimated by daily effort and catch-per-effort analyses as incidental harvest in the steelhead angler fishery. No scale samples were collected in this sector. Scale-based age composition from the lower Klamath River creel was used as a surrogate to apportion all age classes.

Blue Creek
Total run was estimated as the peak count from surveys conducted between 7 November and 14 December 2017. Age-2 composition was estimated through direct observation. Adult age proportions were estimated using four scale samples collected during the dive surveys.

Appendix E. Trinity River – 2017 details.

Trinity River Hatchery (TRH)
Escapement to TRH is a direct count of the number of fall Chinook Salmon entering the hatchery over the duration of the spawning season. Sampling for scales was conducted in a systematic (1:4) random manner including ad-clipped and non-ad-clipped fish. A total of 1,326 scale samples were aged, of which 309 samples were from known-age CWT fish. Scale samples were used to apportion the hatchery return into age classes.

Upper Trinity River Recreational Harvest
The fall-run Chinook fishery was closed on 31 August 2017 in the Trinity River. Fish were tagged with reward and non-reward tags to be returned by anglers. Tags returned by anglers were used to estimate total harvest. Seventy-eight reward and five non-reward tags were returned from incidental catch and release in the steelhead fishery, and zero harvest was estimated.

Lower Trinity River Creel
A roving creel survey was implemented in the Trinity River downstream of WCW. A total of three scale samples were aged, of which one was from a known-age CWT fish. Scales were used to apportion the age structure in this sector.

Trinity River Natural Escapement (above WCW)
Total run was estimated using a Petersen mark-recapture estimator, stratified by jacks and adults. The methods used for estimating age structure within the Trinity River run above WCW were similar to those used in the population estimate, apportioned into three general recovery areas: Trinity River Hatchery, Trinity basin natural spawning escapement above WCW, and recreational harvest. Bio-samples were collected from all Chinook Salmon at WCW in good condition, yielding 1,815 scale samples used from program-marked fall Chinook, 127 of which were ad-clipped. Validation of WCW scales was accomplished with known-age fish recovered throughout all sectors of the Trinity River.

The age structure for fish passing above WCW was estimated using scales collected at WCW and TRH. Age-specific abundances for all fish passing upstream of WCW were estimated from scales collected at WCW. Next, age-specific abundances of fish returning to TRH and fish harvested in the recreational fishery were estimated. Finally, age-specific abundances from TRH and the recreational fishery were subtracted from age-specific abundances of fish passing upstream of WCW to yield age-specific abundances of fish returning to natural spawning areas upstream of WCW.

Trinity Mainstem Natural Escapement (below WCW)
Total escapement was estimated by expanding total redd counts (redds X 2) from surveys conducted bi-weekly as conditions allowed, and applying the jack proportion from the upper Trinity River natural escapement. The upper Trinity River natural escapement age structure was used as a surrogate to apportion all ages. No scales were collected in this sector.

Trinity Tributaries (above Reservation; below WCW)
Total escapement was estimated by expanding the total redd count (redds X 2), applying the jack proportion from the upper Trinity River natural escapement sector to the expanded redd count, and then adding the number of live fish observed during the final survey in each tributary. Two scale samples were collected, neither of which were from known-age fish. The upper Trinity River natural escapement age structure was used to apportion all ages.

Hoopa Reservation Tributaries
Total escapement was estimated by expanding the total redd count (redds X 2) and applying the age-2 proportion in the upper Trinity River natural escapement sector to the expanded redd count. One scale sample was recovered from an unknown-age carcass. The upper Trinity River natural escapement age structure was used to apportion all ages.

Hoopa Valley Tribal Harvest (net and hook-and-line)
Hoopa Valley Tribal harvest is a composite of the gill net and hook-and-line fisheries prosecuted by Tribal members. A total of 500 scale samples were aged, of which 32 were from known-age fish. Scale age proportions were used to apportion all ages.

Hoopa Valley Tribal Harvest (harvest weir)
Direct harvest of Chinook measuring less than 56 cm. Scale samples taken from all harvested fish. A total of 89 scale samples were aged, of which six were from known-age fish. Scale age proportions were used to apportion all ages.

Appendix F. 2017 Klamath age analysis.

Unknown scales age composition as read

	AGE 2	AGE 3	AGE 4	AGE 5	TOTAL
BOGUS	210	372	66	6	654
IGH	497	843	227	2	1,569
SALMON	15	34	22	4	75
SCOTT	57	323	28	33	441
SHASTA	54	8	17	3	82
MAINSTEM	217	292	70	6	585
UR TRIBS	5	17	10	4	36
LRC EST	9	6	9	1	25
LRC UP	0	0	0	0	0
YTFP EST	46	98	33	1	178
YTFP M&U	0	0	0	0	0
BLUE CRK	0	1	3	0	4
	1,110	1,994	485	60	3,649

Unknown scales corrected age proportions (Kimura method)

	AGE 2	AGE 3	AGE 4	AGE 5	TOTAL
BOGUS	0.3171	0.5751	0.0955	0.0122	1.0
IGH	0.3133	0.5372	0.1478	0.0017	1.0
SALMON	0.1963	0.4351	0.2975	0.0711	1.0
SCOTT	0.1192	0.7503	0.0307	0.0998	1.0
SHASTA	0.6682	0.0789	0.2041	0.0488	1.0
MAINSTEM	0.3690	0.5013	0.1160	0.0137	1.0
UR TRIBS	0.1337	0.4585	0.2596	0.1481	1.0
LRC EST	0.3626	0.2073	0.3768	0.0533	1.0
LRC UP	0.3626	0.2073	0.3768	0.0533	1.0
YTFP EST	0.2538	0.5462	0.1925	0.0075	1.0
YTFP M&U	0.3626	0.2073	0.3768	0.0533	1.0
BLUE CRK	0.0000	0.1652	0.8348	0.0000	1.0

Known CWT ages [a/]

	AGE 2	AGE 3	AGE 4	AGE 5	TOTAL
BOGUS	11	47	22	2	82
IGH	464	1,120	333	8	1,925
SALMON	0	0	0	0	0
SCOTT	0	0	0	0	0
SHASTA	1	1	1	0	3
MAINSTEM	7	31	16	2	56
UR TRIBS	0	0	0	0	0
LRC	0	1	0	0	1
YTFP EST	1	14	2	0	17
YTFP M&U	0	0	0	0	0
BLUE CRK	0	0	0	0	0
	484	1,214	374	12	2,084
Breakout within strata					
Bogus1	4	25	14	2	45
Bogus2	7	22	8	0	37
LRC - lo	0	1	0	0	1
LRC - mid	0	0	0	0	0
YTFP MID-UP	TRUE	0	0	0	0

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

Appendix G. 2017 Trinity age analysis.

WCW = Willow Ck. Weir — *Cwt Age*

Scale Ages		no cwt age	2	3	4	5	Total
	Scale unreadable	33	0	2	0	0	35
	2	809	55	1	0	0	865
Scale	3	752	0	66	0	0	818
Ages	4	112	0	1	2	1	116
129	5	15	0	0	0	1	16
1688		1721	55	70	2	2	1850

LOWTRINREC = Lower Trinity Recreational — *Cwt Age*

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

HUPAHARV = Hoopa Tribal Net Harvest plus Tribal Hook-and-Line — *Cwt Age*

Scale Ages		no cwt age	2	3	4	5	Total
	Scale unreadable	14	0	3	0	0	17
	2	32	2	0	0	0	34
Scale	3	284	0	19	0	0	303
Ages	4	132	0	1	10	0	143
35	5	20	0	0	0	0	20
468		482	2	23	10	0	517

TRH = Trinity River Hatchery — *Cwt Age*

Scale Ages		no cwt age	2	3	4	5	Total
	Scale unreadable	31	1	5	2	0	39
	2	343	105	1	0	0	449
Scale	3	615	0	180	0	0	795
Ages	4	54	0	2	17	1	74
317	5	5	0	0	0	3	8
1017		1048	106	188	19	4	1365

LOWTRINTRIBS = Lower Trinity Tribs - Includes samples taken by U — *Cwt Age*

Scale Ages		no cwt age	2	3	4	5	Total
	Scale unreadable	0	0	0	0	0	0
	2	0	0	0	0	0	0
Scale	3	3	0	0	0	0	3
Ages	4	0	0	0	0	0	0
0	5	0	0	0	0	0	0
3		3	0	0	0	0	3

NO DATA

0 — *Cwt Age*

Scale Ages		no cwt age	2	3	4	5	Total
	Scale unreadable						
	2						
Scale	3						
Ages	4						
0	5						
0		0	0	0	0	0	0

HVTSELECTHARV = Hoopa Tribal Weir Harvest — *Cwt Age*

Scale Ages		no cwt age	2	3	4	5	Total
	Scale unreadable	0	0	0	0	0	0
	2	77	5	0	0	0	82
Scale	3	6	0	1	0	0	7
Ages	4	0	0	0	0	0	0
6	5	0	0	0	0	0	0
83		83	5	1	0	0	89

NO DATA

0 — *Cwt Age*

Scale Ages		no cwt age	2	3	4	5	Total
	Scale unreadable						
	2						
Scale	3						
Ages	4						
0	5						
0		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.)

VALIDATION MATRIX		2	3	4	5	
	2	167	2	0	0	
	3	0	267	0	0	
4x4	4	0	4	29	2	
	5	0	0	0	4	0.98

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

	2	3	4	5
2	1.0000	0.0073	0.0000	0.0000
3	0.0000	0.9780	0.0000	0.0000
4	0.0000	0.0147	1.0000	0.3333
5	0.0000	0.0000	0.0000	0.6667

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

# known scales	129	35	1	317			0	6
# unknown scales	1688	468	2	1017			3	83

Age	Willow Creek Weir WCW	Hoopa Tribal NET HARV	Lower Trinity REC HARV	TRH HATCHERY	Lower Trinity Mainstem	Upper Trinity REC HARV	Upper Trin NATURAL	Lower Trin Tribs
2	0.4759	0.0638	0.5000	0.3327	0.0000	-	0.5576	0.0000
3	0.4555	0.6205	0.0000	0.6183	0.0000	0.0000	0.3636	1.0000
4	0.0552	0.2516	0.5000	0.0416	0.0000	1.0000	0.0619	0.0000
5	0.0133	0.0641	0.0000	0.0074	0.0000	0.0000	0.0169	0.0000
	1.00000	1.00000	1.00000	1.00000	0.00000	1.00000	1.00000	1.00000

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

	2	3	4	5
2	1.0000	-0.0075	0.0000	0.0000
3	0.0000	1.0225	0.0000	0.0000
4	0.0000	-0.0150	1.0000	-0.5000
5	0.0000	0.0000	0.0000	1.5000

CWTS Age	Willow Creek Weir WCW	Hoopa Tribal NET HARV	Lower Trinity REC HARV	TRH HATCHERY	Lower Trinity CARCASS	(Estimated) Upper Trinity REC HARV	(Estimated) Upper Trinity NATURAL	Hoopa Hook&Line
2	0	2	0	385	0	0	471	0
3	0	23	1	740	0	0	116	0
4	0	10	0	59	0	0	9	0
5	0	0	0	6	0	0	1	0
	0	35	1	1190	0	0	597	0
# unknown ads	0	3	0	31	0	0	0	0
# total ads	0	38	1	1221	0	paper CWTs		0

WCW scales

Age	WCW no cwts	known age cwts scales	Total age all scales	WCW age proportions
2	803	0	803	0.4759
3	769	0	769	0.4555
4	93	0	93	0.0552
5	23	0	23	0.0133
	1688	0	1688	1.0000

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

	Total Run
Rec above WCW	0
TRH	5633
Naturals	10018
Total	15651

Age	WCW proportions	TRH + Rec above WCW+Natural Escapement	Apportioned Natural Escapement minus TRH #s minus above WCW creel #s	Proportions
2	0.4759	7449	5586	0.5576
3	0.4555	7129	3642	0.3636
4	0.0552	864	620	0.0619
5	0.0133	209	170	0.0169
		15651		

Appendix H. 2017 Klamath Basin fall Chinook age-composition calculation worksheet.

2/14/2018

Hatchery spawners	# Grilse	# Adults	Total Run	CALCULATED AGE 2	3	4	5	Total	SCALE AGE PROPORTIONS (unknowns)	2	3	4	5	Total	Unk. Age Scales Read	Redd Surveys Redds	Live	Video	Carcass
Iron Gate Hatchery (IGH)	3193	7443	10636	3193	5800	1620	23	10636	scales	0.31330	0.53721	0.14778	0.00170	1.0	1,569				
									IGH cwts	464	1120	333	8	1925					
Trinity River Hatchery (TRH)	1863	3770	5633	1863	3487	244	39	5633	scales	0.33274	0.61831	0.04158	0.00737	1.0	1017				
Hatchery spawner subtotal:	5056	11213	16269	5056	9287	1864	62	16269	TRH cwts	385	740	59	6	1190					
	prop. hatchery grilse		0.311			proportion hatchery		0											
Natural Spawners																			
Trinity River mainstem above WCW	5586	4432	10018	5586	3642	620	170	10018	scales	0.55757	0.36356	0.06193	0.01693	1.0	1688				
Trinity River mainstem below WCW	129	102	231	129	84	14	4	231	Up T main	0.55757	0.36356	0.06193	0.01693	1.0	0	51			
Salmon River Basin (includes Wooley Cr)	327	1338	1665	327	724	495	119	1665	scales	0.19626	0.43508	0.29755	0.07111	1.0	75	669			
Scott River	307	2269	2576	307	1933	79	257	2576	scales	0.11920	0.75029	0.03073	0.09977	1.0	441	131		2279	
									Scott CWT	0	0	0	0	0					
Shasta River	6618	3287	9905	6618	782	2022	483	9905	scales	0.66823	0.07890	0.20409	0.04878	1.0	82			9905	
									Shasta CWT	1	1	1	0	3					
Bogus Creek	848	1874	2722	848	1565	274	35	2722	scales	0.31710	0.57514	0.09553	0.01223	1.0	654			2224	498
									Bogus CWT	11	47	22	2	82					
Mainstem Klamath (IGH to Shasta R)	1735	3005	4740	1735	2379	560	66	4740	scales	0.36897	0.50131	0.11604	0.01368	1.0	585				
									KR main CWT	7	31	16	2	56					
Mainstem Klamath (Ash Cr to Wingate Bar)	587	917	1504	587	728	169	20	1504	Up K main	adults	0.79443	0.18389	0.02167	1.0	IGH to Shasta	478			
Main basin subtotals:	16,137	17224	33,361	16,137	11,837	4,233	1154	33361											
Klamath Tributaries																			
Aiken Cr	0	0	0	0	0	0	0	0	scales	0.13375	0.45851	0.25960	0.14815	1.0	36	0	0		
Beaver Cr	6	42	48	6	22	12	8	48	scales	0.13375	0.45851	0.25960	0.14815	1.0	36	21	0		
Bluff Cr	0	0	0	0	0	0	0	0	scales	0.13375	0.45851	0.25960	0.14815	1.0	36				
Boise Cr	3	22	25	3	11	6	5	25	scales	0.13375	0.45851	0.25960	0.14815	1.0	36	11	0		
Camp Cr	43	275	318	43	146	83	46	318	scales	0.13375	0.45851	0.25960	0.14815	1.0	36	132	13		
Clear Cr	20	129	149	20	68	39	22	149	scales	0.13375	0.45851	0.25960	0.14815	1.0	36	63	4		
Dillon Cr	13	84	97	13	44	25	15	97	scales	0.13375	0.45851	0.25960	0.14815	1.0	36	42	0		
Elk Cr	8	54	62	8	28	16	10	62	scales	0.13375	0.45851	0.25960	0.14815	1.0	36	22	11		
Ft. Goff Cr	0	0	0	0	0	0	0	0	scales	0.13375	0.45851	0.25960	0.14815	1.0	36	0	0		
Grider Cr	6	42	48	6	22	12	8	48	scales	0.13375	0.45851	0.25960	0.14815	1.0	36	21	0		
Horse Cr	2	12	14	2	6	4	2	14	scales	0.13375	0.45851	0.25960	0.14815	1.0	36	6	0		
Independence Cr	0	0	0	0	0	0	0	0	scales	0.13375	0.45851	0.25960	0.14815	1.0	36	0	0		
Indian Cr	16	105	121	16	55	31	19	121	scales	0.13375	0.45851	0.25960	0.14815	1.0	36	50	6		
Irving Cr	0	0	0	0	0	0	0	0	scales	0.13375	0.45851	0.25960	0.14815	1.0	36	0	0		
Perch Cr	0	0	0	0	0	0	0	0	scales	0.13375	0.45851	0.25960	0.14815	1.0	36				
Red Cap Cr	31	199	230	31	105	60	34	230	scales	0.13375	0.45851	0.25960	0.14815	1.0	36	99	1		
Rock Cr	3	18	21	3	10	5	3	21	scales	0.13375	0.45851	0.25960	0.14815	1.0	36	9	0		
Slate Cr	1	8	9	1	4	2	2	9	scales	0.13375	0.45851	0.25960	0.14815	1.0	36	4	0		
Swillup Cr	0	0	0	0	0	0	0	0	scales	0.13375	0.45851	0.25960	0.14815	1.0	36				
Thompson Cr	2	12	14	2	6	4	2	14	scales	0.13375	0.45851	0.25960	0.14815	1.0	36	6	0		
Ti Cr	0	0	0	0	0	0	0	0	scales	0.13375	0.45851	0.25960	0.14815	1.0	36	0	0		
Ukonom Cr	0	0	0	0	0	0	0	0	scales	0.13375	0.45851	0.25960	0.14815	1.0	36				
Other (China, Rogers, Seiad)	0	0	0	0	0	0	0	0	scales	0.13375	0.45851	0.25960	0.14815	1.0	36	0	0		
Pine Cr (formerly in Hoopa tribs)	0	0	0	0	0	0	0	0	scales	0.13375	0.45851	0.25960	0.14815	1.0	36				
Klamath trib subtotal:	154	1002	1156	154	527	299	176	1156								486	35		
Trinity Tributaries																			
Horse Linto Cr	58	46	104	58	38	6	2	104	Up T main	0.55757	0.36356	0.06193	0.01693	1.0	3	23	0		
Cedar Cr (trib to Horse Linto)	38	30	68	38	25	4	1	68	Up T main	0.55757	0.36356	0.06193	0.01693	1.0	3	15	0		
Other (Willow & Madden creeks in Up TR nat estim)	0	0	0	0	0	0	0	0	Up T main	0.55757	0.36356	0.06193	0.01693	1.0	3				
Trinity trib subtotal:	96	76	172	96	63	10	3	172								38			
Non-reservation trib subtotal:	250	1078	1328	250	590	309	179	1328											
Reservation Tributaries-Hoopa Valley																			
Campbell Cr	0	0	0	0	0	0	0	0	Up T main	0.55757	0.36356	0.06193	0.01693	1.0	3	0			
Hostler Cr	0	0	0	0	0	0	0	0	Up T main	0.55757	0.36356	0.06193	0.01693	1.0	3	0			
Mill Cr	40	32	72	40	26	5	1	72	Up T main	0.55757	0.36356	0.06193	0.01693	1.0	3	16			
~~Pine Cr.~~ (moved in 2007 to Klam tribs)																			
Soctish Cr	0	0	0	0	0	0	0	0	Up T main	0.55757	0.36356	0.06193	0.01693	1.0	3	0			
Supply Cr	40	32	72	40	26	5	1	72	Up T main	0.55757	0.36356	0.06193	0.01693	1.0	3	16			
Tish Tang Cr	10	8	18	10	7	1	0	18	Up T main	0.55757	0.36356	0.06193	0.01693	1.0	3	4			
Other (Hospital Cr.)	0	0	0	0	0	0	0	0	Up T main	0.55757	0.36356	0.06193	0.01693	1.0	3	0			
HVT reservation trib subtotal:	90	72	162	90	59	11	2	162								36			
							2												
Reservation Tributaries-Yurok																			
Blue Cr	45	140	185	45	23	117	0	185	scales	**count**	0.16519	0.83481	0.00000	1.0	4				
										0.243									
Reservation tributaries subtotal:	135	212	347	135	82	128	2	347											
Natural spawner subtotal:	16522	18514	35036	16522	12509	4670	1335	35036											
Total spawners:	**21578**	**29727**	**51305**	**21578**	**21796**	**6534**	**1397**	**51305**											
Angler Harvest																			
Klamath River (below Hwy 101)	26	47	73	26	16	27	4	73	scales	0.36263	0.20727	0.37677	0.05333	1.0	25				
									est-LRC CWT	0	1	0	0	1					
Klamath River (Hwy 101 to Weitchpec)	10	17	27	10	6	10	1	27	Creel - estuary	0.36263	0.20727	0.37677	0.05333	1.0	0				
									mid-LRC CWT	0	0	0	0	0					
		Upper Klam ratio estimator							SURROGATE - Iron Gate+Bogus+Klamath Mainstem Weighted Totals							IGH+BOG+Kmain			
									IGH+Bog+Klam	5776	9744	2454	124	18098		18098			
Klamath River (Weitchpec to IGH)	0	0	0	0	0	0	0	0		0.3192	0.5384	0.1356	0.0069	1.0		0	0		
not applying ratio estimator this year - doesn't apply to illegal harvest									SURROGATE - Trinity Rec. Harvest below WCW - adults only										
Trinity River (above Willow Cr. Weir)	0	0	0	0	0	0	0	0	TR LRC	count	0.00000	1.00000	0.00000	1.0					
									don't use paper TR CWTs in age calculations										
Trinity River (below Willow Cr. Weir)	6	7	13	6	1	6	0	13	scales	0.50000	0.00000	0.50000	0.00000	1.0	2				
									TR-low CWT	0	1	0	0	1					
Angler harvest subtotal:	42	71	113	42	23	43	5	113											
Tribal Harvest																			
Klamath River (Estuary)	65	205	270	65	152	51	2	270	scales	0.2538	0.5462	0.1925	0.0075	1.0	178				
									YTFP EST CWT	1	14	2	0	17		Yurok harvest			
Klamath River (101 to Trinity R)	7	11	18	7	4	7	0	18	Creel - estuary	0.36263	0.20727	0.37677	0.05333	1.0	0	2	MidKlm		
									YTFP MU CWT	0	0	0	0	0		16	UpKlm		
Trinity River (net and hook-and-line)	112	1653	1765	112	1096	445	112	1765	net scales	0.06383	0.62047	0.25159	0.06410	1.0	468				
									HVT net CWT	2	23	10	0	35					
Trinity River (harvest weir)	82	7	89	82	7	0	0	89	weir scales	0.92718	0.07282	0.00000	0.00000	1.0	83				
									HVT weir CWT	5	1	0	0	6					
Tribal harvest subtotal:	266	1876	2142	266	1259	503	114	2142											
Total harvest:	**308**	**1947**	**2255**	**308**	**1282**	**546**	**119**	**2255**											
Totals																			
Harvest and Escapement	21886	31674	53560	21886	23078	7080	1516	53560											
Angling drop-off mortality (2.04%)	1	1	2	1	0	1	0	2	0.0204	angling drop-off mortality rate on harvest									
Net drop-off mortality (8.7%)*	16	163	179	16	109	44	10	179	0.0870	net drop-off mortality rate on harvest									
Ich Disease Testing (Tribal)																			
Klamath River	0	0	0	0	0	0	0	0	Klam CWTs	0	0	0	0	0					
Trinity River	0	0	0	0	0	0	0	0	YTFP MU scales	0.3626	0.2073	0.3768	0.0533	1.0000					
Total disease testing:	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	HVT scales	0.0638	0.6205	0.2516	0.0641	1.0000					
									Trin CWTs	0	0	0	0	0					
Total in-river run	**21903**	**31838**	**53741**	**21903**	**23187**	**7125**	**1526**	**53741**											

Appendix I. Final age composition of the 2016 Klamath Basin fall Chinook run. 2/1/2018

Escapement & Harvest	AGE 2	3	4	5	Total Adults	Total Run
Hatchery Spawners						
Iron Gate Hatchery (IGH)	151	1,683	715	38	2,436	2,587
Trinity River Hatchery (TRH)	401	722	412	8	1,142	1,543
Hatchery Spawner subtotal	**552**	**2,405**	**1,127**	**46**	**3,578**	**4,130**
Natural Spawners						
Salmon River Basin	26	676	356	0	1,032	1,058
Scott River Basin	139	1	1,375	0	1,376	1,515
Shasta River Basin	135	536	2,218	0	2,754	2,889
Bogus Creek Basin	38	245	585	0	830	868
Klamath River mainstem (IGH to Shasta R)	38	236	471	1	708	746
Klamath River mainstem (Shasta R to Indian Cr)	121	732	1,462	0	2,194	2,315
Klamath Tributaries (above Trinity River)	30	237	929	52	1,218	1,248
Blue Creek	27	42	210	12	264	291
Klamath Basin subtotal	554	2,705	7,606	65	10,376	10,930
Trinity River (mainstem above WCW)	1,260	1,936	1,340	76	3,352	4,612
Trinity River (mainstem below WCW)	35	53	37	2	92	127
Trinity Tributaries (above Reservation; below WCW)	21	31	22	2	55	76
Hoopa Reservation tributaries	24	36	25	1	62	86
Trinity Basin subtotal	1,340	2,056	1,424	81	3,561	4,901
Natural Spawners subtotal	**1,894**	**4,761**	**9,030**	**146**	**13,937**	**15,831**
Total Spawner Escapement	**2,446**	**7,166**	**10,157**	**192**	**17,515**	**19,961**
Recreational Harvest						
Klamath River (below Hwy 101 bridge)	31	129	672	0	801	832
Klamath River (Hwy 101 to Weitchpec)	91	15	3	6	24	115
Klamath River (Weitchpec to IGH)	24	227	185	4	416	440
Trinity River Basin (above WCW)	0	34	6	0	40	40
Trinity River Basin (below WCW)	16	25	4	0	29	45
Subtotals	**162**	**430**	**870**	**10**	**1,310**	**1,472**
Tribal Harvest						
Klamath River (below Hwy 101)	121	413	2,611	161	3,185	3,306
Klamath River (Hwy 101 to Trinity mouth)	19	163	977	84	1,224	1,243
Trinity River (Hoopa Reservation)	20	342	378	31	751	771
Subtotals	**160**	**918**	**3,966**	**276**	**5,160**	**5,320**
Total Harvest	**322**	**1,348**	**4,836**	**286**	**6,470**	**6,792**
Totals						
Harvest and Escapement	2,768	8,514	14,993	478	23,985	26,753
Recreational Angling Dropoff Mortality 2.04%	3	9	18	0	27	30
Tribal Net Dropoff Mortality 8.7%*	14	81	353	25	459	473
Klamath River Ich disease testing (Yurok Tribe)	2	15	89	7	111	113
Total River Run	**2,787**	**8,619**	**15,453**	**510**	**24,582**	**27,369**

* Net drop-off mortality includes fish collected by tribes for Ich testing.