2009 Run Size Estimates and 2010 Run Size Forecast for Klickitat River Adult Spring Chinook

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Summary

For 2009 the forecast was for a return of 2,000 adult (age-4 and age-5) spring Chinook to the Klickitat River. The actual return in 2009 was estimated with run reconstruction methods to be about 1,500 age-4 and age-5 spring Chinook, with about 85% of the return estimated to be of Klickitat Hatchery origin. Substantially higher run size estimates resulted from mark-recapture methods.

Regressions for the years 1990-2005 (excluding 2001) were used to project 2010 returns of age-4 and age-5 spring Chinook from 2009 returns of 1241 age-3 and 1285 age-4 fish, respectively. **This method projects a 2010 return of approximately 4500 adult spring Chinook to the Klickitat River including about 4000 age-4 and 500 age-5 fish.** We also reviewed 1984-2005, 1994-2005, and 1990-2000, and 1990-2005 cohort ratio and regression forecast data as possible predictors. Table 1 gives the forecasts from these various methods with the 1990-2005 (excluding 2001) regression forecast highlighted in **bold**. High jack numbers are resulting in a higher forecast as compared to the last few years.

Table 1. 2010 Klickitat River Spring Chinook Predictors

	'84-05	R^2	'94-05	R^2	'90-00	R^2	'90-00 & '02-05	R^2	'90-05	R^2
Age-4										
Ratio	6318		5113		5698		5888		5638	
Regression	2853	0.16	3168	0.51	4158	0.76	***3990***	0.73	3214	0.56
Age-5										
Ratio	789		504		625		601		588	
Regression	596	0.42	456	0.58	480	0.56	***480***	0.57	475	0.57
Total										
Ratio	7107		5617		6323		6488		6225	
Regression	3450		3624		4638		***4471***		3689	

In addition, a regression model was evaluated that used jacks (age-3 fish) and a NOAA ocean conditions ranking during juvenile outmigration as possible predictors of returning adult numbers. This method resulted in a predicted 2010 return of approximately 4000 adult spring Chinook to the Klickitat. Although this model appeared to perform similarly to the above methods for the period 2000-2009, regression statistics for the jack and ocean rank model did not indicate a significant relationship (ANOVA F statistic = 2.60, p = 0.14) nor a high proportion of variation in actual returns explained (R^2 = 0.43). Additional evaluation of this or other alternate methods may be warranted. High jack numbers in 2009 and possible changes in spring Chinook age composition may lead to poor performance in the prediction methods used to date.

Review of 2009 Klickitat River spring Chinook return

The estimated spring Chinook return using run reconstruction methods (harvest plus hatchery and natural escapement) to the Klickitat River mouth in 2009 was over 3,000 fish including over 1,500 jacks and mini-jacks and about 1,500 adult spring Chinook (Table 2). A substantially higher run size was estimated using mark-recapture methods, by capturing and floy tagging fish at the Lyle Falls adult trap and subsequently recapturing fish at the Klickitat Hatchery. This method resulted in an estimate of approximately 6500 jacks and adults returning to Lyle Falls (95% confidence interval of 5800 to 7400), with 90% being hatchery

fish, and somewhere between 22% and 45% being jacks (jack percentages from Lyle adult trap and Klickitat Hatchery returns, respectively). Population estimate and confidence intervals were made using the Lincoln-Peterson estimator with modification for small sample size.

Harvest was estimated to be 650 total spring Chinook (300 adults) in the sport fishery (Table 3), and 184 fish (123 adults) in the tribal ceremonial and subsistence fishery at Lyle Falls (Table 4). Because estimates indicated that all adults harvested in the 2009 tribal fishery were hatchery fish, age composition from adults sampled in the mark-selective sport fishery was assumed to apply to the tribal fishery. Escapement to the Klickitat Hatchery was 322 mini-jack, 784 jack, and 930 adult spring Chinook (Table 5). A total of 70 spring Chinook redds were observed in spawning ground surveys in 2009 and the natural spawning escapement was estimated to be 210 fish using an estimate of 3 fish per redd (Table 6). The fish per redd estimate was based on a review of 2002-2004 adult plants and redd observations above Castile Falls in the upper Klickitat River as well as a review of 1982-2006 fish per redd data for spring Chinook in the Yakima Basin. Observed age composition for unmarked spring Chinook sampled at the Lyle Falls adult trap was assumed to represent the natural spawner escapement.

Jacks (3-year-olds) and mini-jacks (2-year-olds) comprised a substantially higher-than-average percentage of the total return this year. There was also a substantial return of larger-than-average size 3-year-olds (over 600 mm fork length).

Finally, Table 7 gives brood year productivity estimates for Klickitat spring Chinook for the years 1984 to present. These are the data used to derive the cohort ratio and regression estimates given in Table 1.

Table 2. Klickitat River spring chinook run by return year.

Return Year	Age 2	3	4	5	6	Total	Adult Total 1/
1977	*	371				904	533
1978	*	154				1,682	1,528
1979	*	2,921				3,772	851
1980	*	955				2,640	1,685
1981	441	193				3,162	2,528
1982	236	70				3,544	3,238
1983	817	173				3,407	2,417
1984	201	64	489	305	--	1,588	1,323
1985	152	94				1,094	848
1986	204	262				1,578	1,112
1987	341	111				2,134	1,682
1988 *2/*	143	273	1,819	2,108	2	4,345	3,929
1989 *3/*	291	508	4,486	762	6	6,053	5,254
1990 *4/*	795	399	766	1,797	20	3,777	2,583
1991	1,604	246	973	500	4	3,327	1,477
1992	736	131	1,000	527	13	2,407	1,540
1993	923	44	1,640	1,998	64	4,669	3,702
1994	1,935	78	146	790	22	2,971	958
1995	1,476	271	465	193	38	2,443	696
1996	56	113	1,034	117	5	1,325	1,156
1997	540	52	1,147	704	10	2,453	1,861
1998	3,193	148	316	333	53	4,043	702
1999	165	560	523	204	1	1,453	728
2000	3,730	383	2,450	258	0	6,821	2,708
2001	5,648	420	531	586	9	7,194	1,126
2002	3,071	817	2,313	236	0	6,437	2,549
2003	3,863	610	2,769	1,197	0	8,439	3,966
2004	313	852	1,818	1,172	4	4,159	2,994
2005	231	137	1,298	83	47	1,796	1,428
2006	76	140	1,186	408	9	1,819	1,603
2007	30	159	519	559	0	1,267	1,078
2008	202	460	879	237	0	1,777	1,115
2009 *5/*	322	1,241	1,285	232	0	3,080	1,517

1/ Adult totals prior to 1988 include some jacks.
2/ Includes 120 (age 3) Carson stock.
3/ Includes 4,121 (age 4) Carson stock.
4/ Includes 1,088 (age 5) Carson stock.
5/ Preliminary.

Table 3. Klickitat River spring chinook sport harvest by return year.

Return Year	Age 2	3	4	5	6	Total	Adult Total
1977		0	0			9	9
1978		0	46			312	266
1979		0	31			120	89
1980		0	5			11	6
1981		0	69			221	152
1982		0	45			477	432
1983		0	156	142	141 *	439	283
1984		0	14	218	109 *	341	327
1985		0	50	99	82 *	231	181
1986		0	4	15	9 *	28	24
1987		0	38	151	9 *	198	160
1988 *1/*		0	29	104	144 *	277	248
1989 *2/*		0	97	788	43	0 928	831
1990 *3/*		0	36	107	247	2 392	356
1991		0	36	98	41	0 175	139
1992		0	0	92	31	0 123	123
1993		0	28	145	138	0 311	283
1994		0	0	0	48	3 51	51
1995		0	13	0	0	0 13	0
1996		0	39	124	19	0 182	143
1997		2	9	142	123	5 281	270
1998		0	7	5	5	4 21	14
1999		0	56	50	26	0 132	76
2000		0	222	360	35	0 617	395
2001		0	82	62	62	0 206	124
2002		0	157	366	7	0 530	373
2003		0	152	532	225	0 909	757
2004		0	239	374	181	0 794	555
2005		0	31	382	0	21 434	403
2006		0	22	189	37	0 248	226
2007		0	6	36	37	0 79	73
2008 *4/*		24	47	90	31	0 192	121
2009		0	350	262	38	0 650	300

1/ Includes 12 (age 3) Carson stock.
2/ Includes 769 (age 4) Carson stock.
3/ Includes 204 (age 5) Carson stock.
4/ Preliminary Catch Record Card estimates.

** All 6's included in the 5's column.*

Table 4. Klickitat River spring chinook tribal harvest by return year.

Return Year	Age 2	3	4	5	6	Total	Adult Total	
1977						86	86	*1/*
1978			72			712	640	
1979						0	0	
1980						61	61	*1/*
1981			78			500	422	
1982						1,343	1,343	*1/*
1983						1,462	1,462	*1/*
1984						427	427	*1/*
1985			35			570	535	
1986			61			522	461	
1987						347	347	*1/*
1988	*2/*	0	85	511	594	0	1,190	1,105	
1989	*3/*	0	85	928	24	0	1,037	952	
1990	*4/*	0	113	436	984	9	1,542	1,429	
1991		0	93	396	167	0	657	563	
1992		0	25	292	168	4	489	464	
1993		0	6	480	692	28	1,206	1,200	
1994		0	11	16	159	7	193	182	
1995		0	4	94	39	7	144	140	
1996		0	24	142	23	0	189	165	
1997		0	33	88	76	3	200	167	
1998		0	31	53	54	28	166	135	
1999		0	55	48	27	0	130	75	
2000		0	129	977	74	0	1,180	1,051	
2001		0	1	170	170	0	341	340	
2002		0	45	407	7	0	459	414	
2003		0	12	642	341	0	995	983	
2004		0	5	384	187	0	576	571	
2005	*5/*	0	18	381	0	25	424	406	
2006	*5/*	0	20	381	74	0	475	455	
2007	*5/*	0	8	130	134	0	272	264	
2008	*5/6/*	0	148	367	105	0	620	472	
2009	*5/*	0	61	107	16	0	184	123	

1/ Jacks included.
2/ Includes 38 (age 3) Carson stock.
3/ Includes 763 (age 4) Carson stock.
4/ Includes 563 (age 5) Carson stock.
5/ Preliminary.
6/ Age composition derived from Lyle adult trap age data (due to mark-selective sport fish

Note: Tribal harvest age composition derived from the sport fishery age composition unless otherwise noted.

Table 5. Klickitat Hatchery spring chinook escapement by return year.

Return Year	Age 2	3	4	5	6	Total	Adult Total
1977	*	371				983	312
1978	*	36				508	472
1979	*	2,890				3,582	692
1980	*	950				2,505	1,555
1981	441	46				2,196	1,709
1982	236	25				1,611	1,350
1983	817	17				1,443	609
1984	201	50	271	196	0	718	467
1985	152	9				214	53
1986	204	197				886	485
1987	341	75				1,279	863
1988 *1/*	143	109	691	776	1	1,720	1,468 *2/*
1989 *3/*	291	228	2,686	486	4	3,695	3,176 *4/*
1990 *5/*	795	243	184	388	2	1,612	574
1991	1,604	113	421	113	0	2,251	534
1992	736	102	495	140	0	1,473	635
1993	923	8	945	834	10	2,720	1,789
1994	1,935	58	113	506	10	2,622	629
1995	1,476	221	323	134	27	2,181	484
1996	56	34	520	51	3	664	574
1997	538	6	534	294	1	1,373	829
1998	3,193	62	146	155	12	3,568	313
1999	165	355	337	120	1	978	458
2000	3,530	22	671	75	0	4,298	746
2001	5,648	311	204	146	0	6,309	350
2002 *6/*	3,071	432	828	36	0	4,367	864
2003 *7/*	3,863	268	799	285	0	5,215	1,084
2004 *7/*	313	473	595	453	3	1,837	1,051
2005 *8/*	231	88	454	39	1	813	494
2006 *8/*	76	94	475	205	0	850	680
2007 *8/*	30	129	278	167	0	604	445
2008 *8/*	178	228	279	52	0	737	331
2009 *8/*	322	784	866	64	0	2,036	930

1/ Includes 65 (age 3) Carson stock.
2/ Includes 73 adults and 2 jacks of Klickitat stock and 3 jacks of Carson stock distributed to YIN.
3/ Includes 2,559 (age 4) Carson stock.
4/ Includes 39 adult males and 44 jacks of Klickitat stock and 1,001 (age 4) of Carson stock distributed to YIN.
5/ Includes 321 (age 5) Carson stock.
6/ Excludes 165 males, 275 females, and 170 jacks released above Castille Falls.
7/ Excludes 122 males, 440 females, and 98 jacks released above Castille Falls.
8/ Mini jacks assumed to be two year olds.

Table 6. Klickitat River spring chinook natural spawn escapement by return year.

Return Year	Age 2	3	4	5	6	Total	Adult Total
1977						126	126
1978						150	150
1979						70	70
1980						63	63
1981						245	245
1982						113	113
1983						63	63
1984						102	102
1985						79	79
1986						142	142
1987						312	312
1988 *1/*	0	50	513	594	1	1,158	1,108
1989 *2/*	0	98	84	209	2	393	295
1990 *3/*	0	7	39	178	7	231	224
1991	0	4	58	179	4	245	241
1992	0	4	121	188	9	322	318
1993	0	2	70	334	26	432	430
1994	0	9	17	77	2	105	96
1995	0	33	48	20	4	105	72
1996	0	16	248	24	2	290	274
1997	0	4	383	211	1	599	595
1998	0	48	112	119	9	288	240
1999	0	94	88	31	0	213	119
2000	200	10	442	74	0	726	516
2001	0	26	95	208	9	338	312
2002 *4/*	0	183	712	186	0	1,081	898
2003 *5/*	0	178	796	346	0	1,320	1,142
2004 *6/*	0	135	465	351	1	952	817
2005 *7/*	0	0	81	44	0	125	125
2006 *8/*	0	4	141	92	9	246	242
2007 *8/*	0	16	74	222	0	312	296
2008 *8/*	0	37	143	49	0	228	191
2009 *9/*	0	46	49	115	0	210	164

1/ Includes 5 (age 3) Carson Stock. Estimate includes 1,000 fish that spawned below the hatchery.
2/ Includes 30 (age 4) Carson stock.
3/ Includes 0 (age 5) Carson stock.
4/ Includes 165 males, 275 females, and 170 jacks released above Castile Falls.
5/ Includes 122 males, 440 females, and 98 jacks released above Castile Falls.
6/ Includes 195 males, 320 females, and 85 jacks released above Castile Falls.
7/ No biological sampling available. Used Klickitat Hatchery unmarked age comp (only unmarked morts sampled from spawning grounds)
8/ Used Lyle adult trap age sample information and assumed all unmarked fish were wild/natural
9/ Used Lyle adult trap adult/jack proportion and adult age information and assumed all unmarked fish were wild/natural

Note: Age composition for 1990-1993 derived from scale samples taken from naturally spawning spring chinook. Population estimates are derived using redd counts applied to an expansion formula. Age 2 fish are generally not well sampled during spawner surveys and are probably underrepresented in most years.

Table 7. Productivity (Returns per Age 4/5/6 Spawner) of Klickitat spring chinook by brood year.

Brood	Est. Adult Spawners			Estimated Total Returns					
Year	Hat.	Wild	Total	Age-3	Age-4	Age-5	Age-6	Total	R:S
1984	467	102	569	111	1819	762	20	2712	4.77
1985	53	79	132	273	4486	1797	4	6560	49.70
1986	485	142	627	508	766	500	13	1787	2.85
1987	863	312	1175	399	973	527	64	1963	1.67
1988	1468	1108	2576	246	1000	1998	22	3266	1.27
1989	3176	295	3471	131	1640	790	38	2599	0.75
1990	574	224	798	44	146	193	5	388	0.49
1991	534	241	775	78	465	117	10	670	0.86
1992	635	318	953	271	1034	704	53	2062	2.16
1993	1789	430	2219	113	1147	333	1	1594	0.72
1994	629	96	725	52	316	204	0	572	0.79
1995	484	72	556	148	523	258	9	938	1.69
1996	574	274	848	560	2450	586	0	3596	4.24
1997	829	595	1424	383	531	236	0	1150	0.81
1998	313	240	553	420	2313	1197	4	3934	7.11
1999	458	119	577	817	2769	1172	47	4805	8.33
2000	746	516	1262	610	1818	83	9	2520	2.00
2001	350	312	662	852	1298	408	0	2558	3.86
2002	864	898	1762	137	1186	559	0	1882	1.07
2003	1084	1142	2226	140	519	237	0	896	0.40
2004	1051	817	1868	159	879	232		1270	0.68
2005	494	125	619	460	1285				
2006	680	242	922	1241					
2007	445	296	741						
2008	331	191	522						
2009	930	164	1094						
Mean									2.33