

Run Size Forecast for Yakima River Adult Spring Chinook, 2006

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Summary

In 2005 the forecast was for a return of 14,500 adult (age-4 and age-5) spring chinook to the mouth of the Yakima River. The actual return in 2005 was estimated to be 8,080 adult spring chinook. The year 2005 marked the fifth year that adult spring chinook returned from the Cle Elum Supplementation and Research Facility (CESRF) and the first year that age-4 spring Chinook returned from an integrated spawning population (CESRF fish spawning with wild fish on the natural spawning grounds). Of the estimated 8,080 age-4 and age-5 fish in the 2005 return, approximately 900 (11%) were age-4 and age-5 returns from the 2001 and 2000 broods of CESRF releases.

Methods similar to those used in prior years were used to compute Yakima River spring chinook forecasts for 2006. Current projections are for the following returns to the Yakima River mouth:

Stock	Age-4	Age-5	Total Adults
Upper Yakima Natural	2,450	240	2,690
Upper Yakima CESRF	2,060	30	2,090
Naches/American Wild	800	1,090	1,890
Total Run	5,310	1,360	6,670
Total Wild/Natural	3,250	1,330	4,580
Total CESRF	2,060	30	2,090

As a cautionary note, forecasting fish runs is still not a very exact science. Similar methods used since 1997 show Yakima River spring Chinook forecasts to be accurate only to within +/- 37%. The total 2006 forecasted return of 6,670 adult spring Chinook is only 75% of the recent 10-year (1996-2005) average adult return of nearly 9,000 spring Chinook and less than half of the average return of 13,400 adult spring Chinook experienced since 2000.

Spring Chinook returns in 2005 were much lower than forecast throughout the Columbia River Basin. In the Yakima River Basin we detected a higher presence of the infectious agent for bacterial kidney disease in the 2001 brood, which may have impacted the survival of age-4 progeny which returned in 2005. Age-4 fish represent the vast majority (nearly 80% on average) of all fish returning to the Yakima River Basin. The disappointing returns in 2005 and the lower than average forecast for 2006 may also be indications that conditions in the ocean have declined somewhat from the optimal conditions which led, in part, to the banner runs experienced at the beginning of the decade.

Review of 2005 Yakima River spring Chinook return

The estimated spring Chinook return to the Yakima River mouth in 2005 was 8,080 (900 CESRF) adults and 680 (375 CESRF) jacks for a total return of 8,760 spring Chinook. Harvest was estimated at 470 adults and 5 jacks. Harvest consisted of approximately 460 wild/natural adults, 5 wild/natural jacks, 10 CESRF adults, and no CESRF jacks. Approximately 30 adults and 5 jacks were harvested below Prosser, with about 440 adults and no jacks harvested above Prosser Dam. All of the spring Chinook were taken in the tribal harvest since the disappointing return, especially for marked CESRF Chinook, precluded a non-Indian recreational fishery in 2005.

The final Prosser Dam counts were: 7,900 adults (740 CESRF), and 830 jacks (540 CESRF) for a total count of 8,730 spring Chinook. The final Roza Dam counts were: 5,600 adults (730 CESRF), and 750 jacks (540 CESRF) for a total count of 6,350 spring Chinook. A power outage affected video counting equipment in the left ladder at Prosser Dam from May 6-10, 2005, resulting in the need to interpolate counts for this period which unfortunately coincided with the peak run timing at Prosser. Age information from all available sampling data is used to reconstruct the river mouth run components, and to produce brood cohort tables for the forecast. Since age data from scale samples do not always agree with jack counts based on video or physical observations, adjustments are typically made during run reconstruction resulting in slight discrepancies between adult and jack river mouth run size estimates compared to Prosser Dam and harvest below Prosser Dam estimates, and between Prosser and Roza Dam estimates.

Estimated escapements were: 5,720 spring Chinook (with about 20% of the total escapement estimated to be returns from the CESRF) into the upper Yakima River subbasin, and 1,930 spring Chinook into the Naches River and its associated subbasins. A total of nearly 2,000 redds were counted in the upper Yakima River subbasin and 570 redds were counted in the Naches River and its associated subbasins. The count of only 15 redds in the Teanaway River, home of the Jack Creek CESRF acclimation site, was disappointing relative to past years and biologists are still working to determine what may have resulted in these relatively poor returns from the 2001 brood releases from Jack Creek. The count of 139 redds in the American River in 2005 compares to 54 and 392 redds, respectively, for the 2000-2001 parent years, indicating that American River wild spring Chinook were also likely impacted by factors which resulted in reduced productivity and disappointing overall returns to the Yakima and Columbia River basins for these brood years.

Forecast for 2006 Yakima River spring Chinook return

Age-4:age-3 and age-5:age-4 cohort ratios and regression relationships for wild/natural fish in the upper Yakima and Naches subbasins independently and for the aggregate Yakima River return were reviewed. The regression relationships have showed reasonable correlations between age classes and favorable hindcasting performance relative to the cohort ratios. Therefore, the regressions have been used in combination to develop a forecast for the 2006 spring Chinook return to the Yakima River. This method is the same as that used to forecast recent years' returns. Age-4 and age-5 upper Yakima River CESRF returns were forecasted using the 1997-2001 brood CESRF average age-4 to age-3 and age-5 to age-4 cohort ratios. Given these data, **the forecasts for 2006 spring Chinook returns to the Yakima River mouth are: 5,310 age-4 and 1,360 age-5 fish for a total projected return of 6,670 adult spring Chinook. The forecast includes projected returns of 4,580 wild/natural adult (69%) and 2,090 CESRF adult (31%) spring Chinook.**

This forecasting technique projected a return of 14,500 (age-4 and age-5) spring chinook to the Yakima River in 2005 compared to the actual return of 8,080 age-4 and age-5 fish. On average since 1997, the data indicate that this forecasting technique is only accurate to within about +/- 37% of the actual return. Note also that a variety of factors can affect the Yakima River mouth return rate of CESRF fish relative to their natural counterparts. These factors include: year-to-year variances in release numbers (see Table 11), mark-selective fisheries in the lower Columbia

River which target adipose-fin-clipped fish (all CESRF fish are adipose-clipped), and variances in freshwater and ocean survival.

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This report would not be possible without all of the hard work of Yakama Nation technicians, biologists, and fish culturists and the cooperation of Washington Department of Fish and Wildlife technicians and biologists associated with the Yakima-Klickitat Fisheries Project. These are the people who count fish from video tapes, read scales, take biological samples, conduct spawning ground surveys and the many other tasks associated with collecting, recording, and reporting all of the data that go into this report. I would like to acknowledge and thank these people for their efforts.

Table 1. Yakima River Spring Chinook Run (CESRF and wild/natural, Adults and Jacks combined) Reconstruction, 1982-Present.

Year	River Mouth Run Size ¹			Harvest		Harvest		Spawners		Est. Escapement		Redd Counts	
	Adults	Jacks	Total	Below Prosser	Prosser Count	Above Prosser	Below Roza ²	Roza Count	Roza Removals ³	Upper Y.R. ⁴	Naches ⁵	Upper Y.R.	Naches
1982	1,681	142	1,822	88	1,499	346	134	1,146	0	1,146	108	573	54
1983	1,231	210	1,441	72	867	12	118	1,007	0	1,007	232	360	83
1984	2,251	407	2,658	119	2,539	170	180	1,619	84	1,535	570	634	220
1985	4,109	451	4,560	321	4,239	544	247	2,428	97	2,331	1,020	860	427
1986	8,841	598	9,439	530	8,909	810	709	3,267	16	3,251	4,123	1,472	1,313
1987	4,187	256	4,443	359	4,084	158	269	1,928	194	1,734	1,729	903	677
1988	3,919	327	4,246	333	3,913	111	60	1,575	235	1,340	2,167	424	490
1989	4,640	274	4,914	560	4,354	187	135	2,515	184	2,331	1,517	915	541
1990	4,280	92	4,372	131	2,255	532	282	2,047	31	2,016	1,380	678	464
1991	2,802	104	2,906	27	2,879	5	131		40	1,583	1,121	582	460
1992	4,492	107	4,599	184	4,415	161	39	3,027	18	3,009	1,188	1,230	425
1993	3,799	118	3,917	44	3,873	85	56	1,869	0	1,869	1,863	637	554
1994	1,278	24	1,302	0	1,302	25	10	563	0	563	704	285	272
1995	525	141	666	0	666	79	9	326	0	326	252	114	104
1996	3,055	124	3,179	100	3,079	375	25	1,562	0	1,562	1,117	801	184
1997	2,909	84	2,993	0	2,993	575	20	1,445	261	1,184	953	413	339
1998	1,771	132	1,903	0	1,903	188	3	795	408	387	917	147	330
1999	1,435	1,346	2,781	8	2,773	596	55	1,704	738	966	418	212	186
2000	17,662	1,587	19,249	90	19,159	2,368	204	12,327	667	11,660	4,260	3,770	887
2001	21,217	2,039	23,256	1,793	21,463	2,838	286	12,516	718	11,798	5,823	3,260	1,192
2002	14,616	483	15,099	328	14,771	2,780	29	8,922	878	8,044	3,041	2,816	943
2003	4,883	2,074	6,957	59	6,898	381	83	3,842	584	3,258	2,592	868	935
2004	13,976	1,313	15,289	135	15,154	1,544	90	11,005	718	10,287	2,515	3,414	719
2005	8,080	678	8,758	34	8,724	440	0	6,352	635	5,717	1,932	1,996	573

1. River Mouth run size is the greater of the Prosser count plus lower river harvest or estimated escapement plus all known harvest and removals.
2. Estimated as the average number of fish per redd in the upper Yakima times the number of redds between the Naches confluence and Roza Dam.
3. Roza removals include harvest above Roza, hatchery removals, and/or natural broodstock removals.
4. Estimated escapement into the upper Yakima River is the Roza count less harvest or broodstock removals above Roza Dam except in 1991 when Upper Yakima River escapement is estimated as the (Prosser count - harvest above Prosser - Roza subtractions) times the proportion of redds counted in the upper Yakima.
5. Naches River escapement is estimated as the Prosser count less harvest above Prosser and the Roza counts, except in 1982, 1983 and 1990 when it is estimated as the upper Yakima fish/redd times the Naches redd count.

Table 2. Estimated Spring Chinook counts at Prosser Dam, 1982-Present.

Year	Adults			Jacks			Total Passage			Actual CESRF Percent	Forecast CESRF Percent
	CESRF	Wild/Nat. ²	Total	CESRF	Wild/Nat. ²	Total	Total	Wild/Nat. ²	CESRF		
1982			1,453			46	1,499				
1983			748			119	867				
1984			2,321			218	2,539				
1985			3,815			424	4,239				
1986			8,557			352	8,909				
1987			3,758			326	4,084				
1988			3,590			323	3,913				
1989			4,112			242	4,354				
1990			2,202			53	2,255				
1991			2,750			129	2,879				
1992			4,282			133	4,415				
1993			3,795			80	3,875				
1994			1,283			19	1,302				
1995			528			138	666				
1996			2,946			133	3,079				
1997			3,126			47	3,173				
1998			1,771			132	1,903				
1999			1,795			978	2,773				
2000	41 ¹	17,381	17,422	741	848	1,589	19,011	18,229			
2001	7,803	11,960	19,763	1,087	622	1,709	21,472	12,582	8,890	41.4%	38.0%
2002	7,393	6,661	14,054	369	348	717	14,771	7,009	7,762	52.5%	57.0%
2003	1,257	3,742	4,999	989	910	1,899	6,898	4,652	2,246	32.6%	20.6%
2004	4,195	10,218	14,413	170	571	741	15,154	10,789	4,365	28.8%	41.2%
2005	737	7,160	7,897	540	287	827	8,724	7,447	1,277	14.6%	17.7%

1. There were no CESRF adults returning in 2000. These are marked fish, presumably out-of-basin strays.
2. All fish prior to 2000 are assumed to be wild.

Table 3. Estimated Spring Chinook counts at Roza Dam, 1982-Present.
(total counts including fish collected and removed for broodstock)

Year	Adults			Jacks			Total Passage
	CESRF	Wild/Nat. ¹	Total	CESRF	Wild/Nat. ¹	Total	
1982			1,057			89	1,146
1983			860			147	1,007
1984			1,371			248	1,619
1985			2,189			239	2,428
1986			2,979			288	3,267
1987			1,854			74	1,928
1988			1,467			108	1,575
1989			2,375			141	2,515
1990			2,007			40	2,047
1991			No counts available				
1992			2,965			62	3,027
1993			1,795			74	1,869
1994			550			13	563
1995			256			70	326
1996			1,506			56	1,562
1997			1,396			49	1,445
1998			740			55	795
1999			879			825	1,704
2000		11,109	11,109	688	530	1,218	12,327
2001	6,180	5,010	11,190	990	336	1,326	12,516
2002	6,298	2,405	8,703	86	133	219	8,922
2003	1,151	784	1,935	1,133	774	1,907	3,842
2004	2,985	7,093	10,078	216	711	927	11,005
2005	726	4,876	5,602	540	210	750	6,352

1. All fish prior to 2000 are assumed to be wild.

Table 4. Spring Chinook Harvest (adults and jacks combined) in the Yakima River Basin, 1982-Present.

Year	Tribal		Non-Tribal		River Totals		Total	Harvest Rate ¹
	CESRF	Wild/Nat.	CESRF	Wild/Nat.	CESRF	Wild/Nat.		
1982	0	434	0	0	0	434	434	23.8%
1983	0	84	0	0	0	84	84	5.8%
1984	0	289	0	0	0	289	289	10.9%
1985	0	865	0	0	0	865	865	19.0%
1986	0	1,340	0	0	0	1,340	1,340	14.2%
1987	0	517	0	0	0	517	517	11.6%
1988	0	444	0	0	0	444	444	10.5%
1989	0	747	0	0	0	747	747	15.2%
1990	0	663	0	0	0	663	663	15.2%
1991	0	32	0	0	0	32	32	1.1%
1992	0	345	0	0	0	345	345	7.5%
1993	0	129	0	0	0	129	129	3.3%
1994	0	25	0	0	0	25	25	1.9%
1995	0	79	0	0	0	79	79	11.9%
1996	0	475	0	0	0	475	475	14.9%
1997	0	575	0	0	0	575	575	18.1%
1998	0	188	0	0	0	188	188	9.9%
1999	0	604	0	0	0	604	604	21.7%
2000	53	2,305	0	100	53	2,405	2,458	12.9%
2001	572	2,034	1,252	772	1,825	2,806	4,630	19.9%
2002	1,373	1,207	492	36 ²	1,865	1,243	3,108	20.6%
2003	64	376	0	0	64	376	440	6.3%
2004	157	844	569	109 ²	726	953	1,679	11.0%
2005	12	462	0	0	12	462	474	5.4%

1. Harvest rate is the river total harvest as a percentage of the river mouth run size given in Table 1.
2. Estimate of post-release mortality of unmarked fish.

Table 5. Yakima Basin spring Chinook redd count summary, 1981 – present.

Year	Upper Yakima River System ¹				Naches River System				
	Mainstem ²	Cle Elum	Teaway	Total	American	Naches ²	Bumping	Little Naches	Total
1981	237	57	0	294	72	64	20	16	172
1982	610	30	0	640	11	25	6	12	54
1983	387	15	0	402	36	27	11	9	83
1984	677	31	0	708	72	81	26	41	220
1985	795	153	3	951	141	168	74	44	427
1986	1,716	77	0	1,793	464	543	196	110	1,313
1987	968	75	0	1,043	222	281	133	41	677
1988	369	74	0	443	187	145	111	47	490
1989	770	192	6	968	187	200	101	53	541
1990	727	46	0	773	143	159	111	51	464
1991	568	62	0	630	170	161	84	45	460
1992	1,082	164	0	1,246	120	155	99	51	425
1993	550	105	1	656	214	189	88	63	554
1994	226	64	0	290	89	93	70	20	272
1995	105	12	0	117	46	25	27	6	104
1996	711	100	3	814	28	102	29	25	184
1997	364	56	0	420	111	108	72	48	339
1998	123	24	1	148	149	104	54	23	330
1999	199	24	1	224	27	95	39	25	186
2000	3,349	466	21	3,836	54	483	278	73	888
2001	2,932	386	21	3,339	392	436	257	107	1,192
2002	2,441	275	110	2,826	366	226	262	89	943
2003	772	87	31	890	430	228	216	61	935
2004	2,985	330	129	3,444	91	348	205	75	719
2005	1,694	287	15	1,996	139	203	163	68	573
Mean	1,014	128	14	1,156	158	186	109	48	502

¹ Yakima River redd counts include redds between the Naches River confluence and Roza Dam. In some years, water conditions preclude accurate counts in this reach and the number of redds is estimated using historical proportions for this reach.

² Including minor tributaries.

Table 6. Brood Table for Upper Yakima wild/natural stock.

Brood Year	Estimated Spawners	Estimated Yakima R. Mouth Returns				Returns/ Spawner
		Age-3	Age-4	Age-5	Total	
1982	1,280	324	4,016	411	4,751	3.71
1983	1,125	408	1,882	204	2,494	2.22
1984	1,715	92	1,348	139	1,578	0.92
1985	2,578	114	2,746	105	2,965	1.15
1986	3,960	171	2,574	149	2,893	0.73
1987	2,003	53	1,571	109	1,733	0.87
1988	1,400	53	3,138	132	3,323	2.37
1989	2,466	68	1,779	9	1,856	0.75
1990	2,298	79	566	0	645	0.28
1991	1,713	9	326	22	358	0.21
1992	3,048	87	1,861	95	2,043	0.67
1993	1,925	66	1,606	57	1,729	0.90
1994	573	60	737	92	890	1.55
1995	364	59	1,036	129	1,224	3.36
1996	1,657	1,059	12,882	630	14,571	8.79
1997	1,204	621	5,837	155	6,613	5.49
1998	390	434	2,803	147	3,383	8.68
1999	1,021 ¹	164	733	45	942	0.92
2000	11,864	869	7,780	126	8,776	0.74
2001	12,084	784	5,071		5,855	0.48
2002	8,073	224				
2003	3,341 ¹					
2004	10,377					
2005	5,717					

1. Approximately 45-50% of these fish were jacks.

Table 7. Brood Table for Naches/American wild stock.

Brood Year	Estimated Spawners	Estimated Yakima R. Mouth Returns					Returns/ Spawner
		Age-3	Age-4	Age-5	Age-6	Total	
1982	108	127	1,274	601	0	2,002	18.54
1983	232	190	1,257	1,257	8	2,713	11.68
1984	570	164	1,109	1,080	0	2,354	4.13
1985	1,020	213	667	931	0	1,811	1.77
1986	4,123	103	670	852	31	1,657	0.40
1987	1,729	39	231	400	0	669	0.39
1988	2,167	51	815	1,557	11	2,434	1.12
1989	1,517	39	332	371	0	741	0.49
1990	1,380	40	326	168	0	533	0.39
1991	1,121	10	32	144	127	314	0.28
1992	1,188	52	1,034	661	0	1,747	1.47
1993	1,865	53	603	817	17	1,489	0.80
1994	704	21	160	167	0	348	0.49
1995	223	73	201	498	0	771	3.46
1996	1,047	209	4,010	2,360	0	6,580	6.29
1997	1,133	220	4,645	1,377	0	6,242	5.51
1998	917	364	2,167	2,350	0	4,882	5.32
1999	418 ¹	185	375	283	0	843	2.02
2000	4,112	134	2,323	352		2,810	0.68
2001	5,832	146	1,627			1,773	0.30
2002	3,041	79					
2003	2,592						
2004	2,515						
2005	1,932						

1. Approximately 48% of these fish were jacks.

Table 8. Brood Table for Yakima River aggregate (wild/natural).

Brood Year	Estimated Spawners	Estimated Yakima R. Mouth Returns					Returns/ Spawner
		Age-3	Age-4	Age-5	Age-6	Total	
1982	1,388	451	5,290	1,012	0	6,753	4.86
1983	1,357	598	3,138	1,461	8	5,206	3.84
1984	2,285	256	2,457	1,219	0	3,932	1.72
1985	3,598	327	3,412	1,037	0	4,776	1.33
1986	8,083	274	3,244	1,000	31	4,550	0.56
1987	3,732	92	1,802	508	0	2,402	0.64
1988	3,567	104	3,953	1,689	11	5,757	1.61
1989	3,983	107	2,111	379	0	2,597	0.65
1990	3,678	119	892	168	0	1,178	0.32
1991	2,834	20	358	166	127	672	0.24
1992	4,236	140	2,894	756	0	3,790	0.89
1993	3,790	119	2,209	874	17	3,218	0.85
1994	1,277	81	897	260	0	1,238	0.97
1995	587	132	1,236	627	0	1,995	3.40
1996	2,704	1,268	16,892	2,990	0	21,151	7.82
1997	2,337	841	10,482	1,532	0	12,855	5.50
1998	1,307	798	4,970	2,498	0	8,265	6.32
1999	1,439 ¹	349	1,108	329	0	1,786	1.24
2000	15,976	1,003	10,103	479		11,585	0.73
2001	17,916	930	6,698			7,628	0.43
2002	11,113	303					
2003	5,933 ²						
2004	12,893						
2005	7,649						

1. Approximately 48% of these fish were jacks.

2. Approximately 33% of these fish were jacks.

Table 9. Brood Table for Cle Elum SRF Spring Chinook.

Brood Year	Estimated Spawners ¹	Estimated Yakima R. Mouth Returns				Returns/ Spawner
		Age-3	Age-4	Age-5	Total	
1997	261	741	7,753	176	8,670	33.22
1998	408	1,242	7,939	584	9,765	23.93
1999	738 ²	134	693	16	843	1.14
2000	567	1,071	3,528	69	4,668	8.23
2001	595	383	834		1,217	2.05
2002	629	375				
2003	441					
2004	597					
2005	526					

1. These are the total number of natural fish collected at Roza Dam and taken to the CESRF for production brood stock.
2. 357 or 48% of these fish were jacks.

Table 10. Forecasted versus Actual Return of Age-4 and Age-5 Fish.

Year	Forecast	Actual	Difference	AbsDiff
1997	3,300	3,090	6.8%	6.8%
1998	1,400	1,770	-20.9%	20.9%
1999	1,200	1,510	-20.5%	20.5%
2000	5,200	17,520	-70.3%	70.3%
2001	26,100	21,220	23.0%	23.0%
2002	21,780	14,620	49.0%	49.0%
2003	6,370	4,880	30.5%	30.5%
2004	19,160	13,980	37.1%	37.1%
2005	14,500	8,080	79.5%	79.5%
2006	6,670			
Average Error in forecast:			37.5%	

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Table 11. CESRF Smolt Releases by Brood Year¹

Brood Year	Migration Year	Total Release	Return Year for:		
			Age-3 (jack)	Age-4	Age-5
1997	1999	386,048	2000	2001	2002
1998	2000	589,683	2001	2002	2003
1999	2001	758,789	2002	2003	2004
2000	2002	834,285	2003	2004	2005
2001 ²	2003	370,236	2004	2005	2006
2002	2004	836,904	2005	2006	2007
2003	2005	824,692	2006	2007	2008

1. Release target is 720,000 to 810,000 smolts, but was intentionally reduced in start-up years of 1997 and 1998.
2. Approximately ½ of production destroyed due to high presence of agents causing Bacterial Kidney Disease (BKD).