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TECHNICAL REPORT 04-1

Identification of Columbia Basin Sockeye Salmon Stocks in 2003

Jeffrey K. Fryer

March 18, 2004

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ABSTRACT

In 2003, samples of adult Columbia Basin sockeye salmon, *Oncorhynchus nerka*, were collected at Bonneville Dam as well as at Tumwater Dam on the Wenatchee River and Wells Dam in the mid-Columbia River downstream of the Okanogan River. Tumwater and Wells dams were chosen to provide samples of sockeye salmon from the two principle stocks of Columbia Basin sockeye salmon, which originate from the Wenatchee and Okanogan basins. Age composition was estimated from the sampled sockeye salmon passing the three dams. Five-year-old fish were estimated to comprise 28% of the Bonneville Dam mixed-stock, 16% of the Okanogan stock, and 92% of the Wenatchee stock. Four-year-old fish were estimated to comprise 38% of the mixed-stock sockeye salmon migrating past Bonneville Dam, 57% of the Okanogan stock migrating past Wells Dam, and 1% of the Wenatchee stock migrating past Tumwater Dam. Three-year-old fish were estimated to comprise 25% of the Bonneville Dam mixed-stock, 27% of the Okanogan stock and none of the Wenatchee stock. Six-year-old fish were estimated to comprise 8% of the Bonneville Dam mixed-stock, 3% of the Okanogan stock and 7% of the Wenatchee stock. For the first time in 18 years of CRITFC Columbia River sockeye salmon studies, the age composition of the Okanogan stock and Wenatchee stock differed sufficiently to differentiate stocks at Bonneville Dam by age alone rather than using scale pattern analysis techniques on common age classes. We estimated that 84% of the sockeye salmon passing Bonneville Dam were of Okanogan origin while 16% were of Wenatchee stock.

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INTRODUCTION

Sockeye salmon, *Oncorhynchus nerka,* is one of the species of Pacific salmon native to the Columbia River Basin. Before white settlers developed the region, it is estimated the Columbia Basin supported an annual sockeye salmon run averaging over three million fish (Northwest Power Planning Council 1986, Fryer 1995). Since the mid-1800's, however, this sockeye salmon population has severely declined. The estimated number of sockeye salmon entering the Columbia River over the six years from 1994-1999 averaged only 21,700 fish per year (DART 2003). Sockeye salmon runs increased to 93,391 fish in 2000 and 114,945 fish in 2001 before declining to 49,608 in 2002 and 39,291 in 2003 (DART 2003).

The Columbia Basin sockeye salmon run was once composed of at least eight principal stocks (Fulton 1970, Fryer 1995). Today, only two major stocks remain[1] (Figure 1). From the 1960's through the early 1990's, both stocks were entirely naturally produced, originating in the Wenatchee River-Lake Wenatchee System (Wenatchee stock) and in the Okanogan River-Osoyoos Lake System (Okanogan stock). In recent years, enhancement programs in both systems have been initiated that capture returning adults, spawn the adults in hatcheries, and raise the offspring in net pens located in the rearing lakes before release (Hays 1992, Wells Project Coordinating Committee 1992). The Okanogan enhancement program was terminated following the 2000 release. These two Columbia Basin sockeye salmon rearing areas differ markedly (Allen and Meekin 1980, Mullan 1986). Lake Wenatchee is oligotrophic, with relatively deep, cold, and biologically unproductive waters. Conversely, Osoyoos Lake has the shallow, warm, and agriculturally enriched waters characteristic of eutrophic lake habitats.

Reliable estimates of the overall run composition of Columbia Basin sockeye salmon stocks and the biological and migratory characteristics of each

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1 A small run of sockeye salmon return to the Snake River and are listed as endangered under the Endangered Species Act. These fish are almost entirely hatchery origin and adipose fin clipped. While an estimated 39,291 sockeye salmon passed Bonneville Dam in 2003, only 37 (0.1%) passed Ice Harbor Dam on the Snake River.

Figure 1. Map of the Columbia Basin Bonneville, Ice Harbor, Priest, Rock Island, Rocky Reach, Tumwater, Wells, and Chief Joseph dams, and the two major sockeye salmon production areas.

A PDF file to replace this page can be found in stk-id/sockeye/reportfigures 2001map.pdf still applies.

stock are useful for run-reconstruction studies permitting accurate population size predictions, escapement monitoring, establishing spawner-recruit relationships, and developing discrete stock approaches to Columbia River mainstem harvest management. The Pacific Salmon Treaty (PST), ratified by the United States and Canada in 1985 (PST 1985), requires that certain Pacific salmon populations be monitored to determine the influence of Treaty-imposed ocean harvest regulations on *transboundary* stocks. Some Okanogan-stock sockeye salmon originating in Canadian waters but migrating through, and harvested in, the United States portion of the Columbia River constitutes such a stock. Stock identification research would aid in estimation of the proportion and abundance of Canadian-origin sockeye salmon caught within the United States. This study, begun in 1987 (Schwartzberg and Fryer 1988), was initiated to provide such information.

In previous years, scale pattern analysis (SPA) has been the method of study used for our stock identification research (Fryer and Kelsey 2001, 2002, 2003; Fryer et al. 1992; Fryer and Schwartzberg 1991, 1993, 1994; Schwartzberg and Fryer 1988, 1989, 1990). Scale pattern analysis was used to estimate the stock composition of fish of age classes that were found in both the Okanogan and Wenatchee stocks. However, in 2003, all age classes were found overwhelmingly in one stock or the other, thus age alone was sufficient to differentiate Okanogan and Wenatchee fish at Bonneville Dam.

This report presents estimates of the age and length-at-age composition of adult Columbia Basin sockeye salmon at Bonneville Dam in 2003. This report also presents age and length-at-age composition estimates from the Wenatchee stock collected at Tumwater Dam on the Wenatchee River and the Okanogan stock collected at Wells Dam. Data collected from our mid-Columbia sampling program was used to estimate stock composition of the Bonneville Dam mixed-stock in 2003.

METHODS

Sample Design

Sockeye salmon were sampled at Bonneville Dam (river km 235) one to two days per statistical week[2] in conjunction with a summer chinook salmon sampling program (Whiteaker et al. 2004). Sockeye salmon were sampled at Wells Dam in conjunction with a Washington Department of Fish and Wildlife (WDFW) summer chinook brood stock collection program, while sampling at Tumwater Dam was done in conjunction with another WDFW research project. The desired total sample size for age composition estimates at each site was a minimum of 500 fish at Bonneville Dam, and 400 fish at Tumwater and Wells dams. In previous study years, these minimum sample numbers have resulted in acceptable levels of precision and accuracy (Fryer 1995) (d=0.05, α=0.10). Smaller sample sizes are normally sufficient at Tumwater and Wells dams because the age composition tends to be more skewed towards one or two age classes than at Bonneville Dam. Daily counts of 2003 fish passage at fish ladders were obtained from DART (2003) for Bonneville and Wells dams and from WDFW (Todd Miller, WDFW**,** December 10, 2003 e-mail) for Tumwater Dam.

A stratified sampling method that weighted weekly age and length-at-age estimates by actual migratory timing was used to obtain composite estimates for the Wenatchee and Okanogan known-stocks as well as the Bonneville mixed-stock (Cochran 1977).

Sampling Methods

Data and scales from mixed sockeye salmon stocks (or mixed-stocks) were obtained from fish sampled at the Bonneville Dam Adult Fish Facility,

2 Statistical weeks are sequentially numbered calendar-year weeks. Excepting the first and last week of most years, weeks are seven days long, beginning on Sunday and ending on Saturday. In 2003 for example, Statistical Week 24 began on June 8 and ended on June 14.

located on the mainstem Columbia River. Each stock was also sampled in terminal areas to obtain representative scale samples for each of the two Columbia Basin sockeye salmon groups (or known-stocks). Wenatchee stock data and scales were collected at Tumwater Dam on the Wenatchee River (river km 53), and Okanogan stock data and scales were obtained at Wells Dam on the mainstem Columbia River (river km 830).

Fish were trapped and anesthetized. Each fish was then sampled for scales, measured for fork length, inspected for markings and/or tag information and noted for other pertinent biological information (Whiteaker et al. 2004). At Tumwater and Wells dams, inspection for biological information was not as extensive as at Bonneville Dam due to the need to handle fish quickly to allow our project to be run concurrently with broodstock collection and research projects being conducted by other parties. All fish were revived in freshwater and returned to the exit fishway. Four scales per fish were collected to minimize the sample rejection rate. The gender of specimens collected at Bonneville Dam could not be determined because all were in the earliest stages of sexual maturation. The gender of some specimens collected at Tumwater and Wells dams could be determined, and was recorded but this data is not included in this report.

Length Measurements

Fork lengths were measured to the nearest 0.5 cm at Bonneville, Wells, and Tumwater dams. Mean lengths and standard deviations were calculated for each age class, by weekly sampling period, and for the composite sample. Composite samples were weighted by weekly run size.

Age Determination

Scales were selected, mounted, and pressed according to methods described in Clutter and Whitesel (1956) and the International North Pacific Fisheries Commission (1963). Individual samples were visually examined and categorized using well-established scale age-estimation methods (Gilbert 1913, Borodin 1924, Van Oosten 1929). A sample of scales was brought to John

Sneva of the Washington Department of Fish and Wildlife for corroboration of age estimates.

The European method for fish age description (Koo 1955) is used in this report. The number of winters a fish spent in freshwater (not including the winter of egg incubation) is described by an Arabic numeral followed by a period. The numeral following the period indicates the number of winters a fish spent in the ocean. Total age, therefore, is equal to one plus the sum of both numerals.

Weekly age composition estimates were compiled and weighted by weekly run size to estimate overall age composition at Bonneville, Wells, and Tumwater dams.

Stock Composition

Unlike previous years, when some age classes (usually Age 1.2) at Bonneville Dam had to be separated by stock using scale pattern analysis, in 2003 age alone was sufficient to for differentiation as all age classes were found almost exclusively in either the Wenatchee stock or the Okanogan stock.

RESULTS

Sample Sizes

Final sample sizes used for age and length-at-age composition estimates were 373 Bonneville mixed-stock, 195 Wenatchee known-stock, and 250 Okanogan known-stock. Of the original 389 sockeye salmon sampled at Bonneville Dam, 4% of the total sample was rejected and not classified by age because of unreadable scales. For the same reason, 3% of the 202 Wenatchee, and 3% of the 258 Okanogan samples were rejected.

Age Composition

The predominant age class for both the Bonneville mixed-stock and the Okanogan known stock was Age 1.2 (Table 1 and 2). The predominant age class for the Wenatchee known-stock was Age 1.3 (Table 3). The two known stocks displayed very different age compositions; while the Wenatchee known stock was comprised almost entirely of Age 1.3 fish, the Okanogan known stock had four different age classes (Age 1.1, 1.2, 2.1, and 3.1) that each comprised 5% or greater of the run.

Two of the fish sampled at Bonneville Dam were adipose clipped, which represented 1.2% of the entire run. These fish are most likely from the Wenatchee Eastbank supplementation program, although the remote possibility does exist that fish from the Snake River program may also be included. Both ad-clipped fish sampled were of Age 1.3. One fish was sampled with a left ventral fin clip. This fish was sampled in Week 26 and was 51 cm in length and identified as being of Age 1.3.

Table 1. Weekly and cumulative age composition Columbia Basin sockeye salmon sampled at Bonneville Dam in 2003.

					Age Composition by Brood Year and Age Class									
Statistical Week	Sampling Date	Number Sampled	Number Ageable	Weekly Run Size	2000	1999		1998			1997			1996
					1.1	1.2	2.1	1.3	2.2	3.1	2.3	3.2	4.1	3.3
24	6/12	11	11	1843[a]	0.091	0.818		0.091						
25	6/17	30	30	5832	0.100	0.467	0.067	0.167		0.133		0.033	0.033	
26	6/24, 6/26	70	68	15165	0.132	0.338	0.044	0.235		0.103	0.015	0.044	0.088	
27	7/1, 7/2, 7/3	134	127	9795	0.315	0.276	0.094	0.094		0.173	0.008	0.016	0.024	
28	7/8, 7/9, 7/10	131	124	4266	0.621	0.113	0.048	0.032	0.008	0.121	0.008	0.016	0.024	0.008
29	7/15, 7/17	13	13	2390[b]	0.615	0.077	0.077	0.077		0.154				
Cumulative		389	373	39291	0.254	0.324	0.060	0.152	0.001	0.125	0.009	0.028	0.048	0.001

a Weekly run size includes fish numbers from Week 22 - 24. Sampling began in Week 24.
b Weekly run size includes fish numbers from Weeks 29 - 37. Sampling ended in Week 29.

Table 2. Weekly and cumulative age composition of Okanogan sockeye salmon stocks sampled at Wells Dam in 2003.

					Age Composition by Brood Year and Age Class							
Statistical Week	Sampling Date	Number Sampled	Number Ageable	Weekly Run Size	2000	1999		1998			1997	
					1.1	1.2	2.1	1.3	2.2	3.1	3.2	4.1
28	7/7	80	78	12674[a]	0.167	0.718	0.038			0.064		0.013
29	7/14	120	118	10603	0.280	0.390	0.085			0.178		0.068
30	7/21	45	43	4493	0.372	0.372	0.023	0.023		0.186	0.023	
31	7/28	13	11	1604[b]	0.727	0.182				0.091		
Cumulative		258	250	29374	0.270	0.517	0.051	0.004	0.000	0.125	0.004	0.030

a Weekly run size includes fish numbers from Weeks 26 – 28. Sampling started in Week 28.
b Weekly run size includes fish numbers from Weeks 31 – 39. Sampling ended in Week 31.

Table 3. Weekly and cumulative age composition of Wenatchee sockeye salmon stocks sampled at Tumwater Dam in 2003.

					Age Composition by Brood Year and Age Class			
Statistical Week	Sampling Date	Number Sampled	Number Ageable	Weekly Run Size	1999 1.2	1998 1.3	1997 2.3	1997 1.4
30	7/22, 7/23	183	178	4482[a]	0.006	0.927	0.062	0.006
31	7/29, 7/30	19	17	592[b]	0.059	0.824	0.118	
Cumulative		202	195	5074	0.012	0.915	0.069	0.005

a Weekly run size includes fish numbers from Weeks 28 – 30. Sampling started in Week 30.
b Weekly run size includes fish numbers from Weeks 31 – 40. Sampling ended in Week 31.

Fin-clipped fish were not found in the sample collected at Wells Dam. Video counts of fish at Tumwater Dam found that 7.4% of the fish were adipose-clipped (Todd Miller, WDFW, December 10, 2003 e-mail). However, fin-clipped fish were not sampled at Tumwater Dam by our crew as fin-clipped fish were being used for other research.

Length Composition

Mean fork lengths for age classes with significant numbers of fish were similar for fish sampled at Bonneville, Tumwater, and Wells dams (Tables 4-6). Mean fork lengths of Age 1.1, 1.2, 2.1, and 3.1 fish sampled at Bonneville Dam differed by less than 1 cm from those sampled at Wells Dam. The mean fork length of Age 1.3 fish sampled at Tumwater Dam was 1.4 cm greater than those sampled at Bonneville Dam; however many fish sampled at Tumwater Dam, had well-developed secondary sexual characteristics, including the development of an elongated snout in the males, which would result in an increase in fork length.

Classification of Mixed-Stock Samples

In previous years, the Bonneville mixed stock sample was classified using differences in age composition between the stocks and using scale pattern analysis to differentiate age classes which made up a significant component of both stocks (Fryer and Kelsey 2001, 2002, 2003; Fryer et al. 1992; Fryer and Schwartzberg 1991, 1993, 1994; Schwartzberg and Fryer 1988, 1989, 1990). In 2003, all age classes could be differentiated into stock without using scale pattern analyses. Given the fact that no fish of Age 1.1, 2.1, 2.2, 3.1, and 3.2 were found in the Wenatchee known-stock sample but were found in the Okanogan known-stock sample, fish of these age classes at Bonneville Dam were allocated to the Okanogan stock. Age 1.2 made up less than 1% of the Wenatchee known-stock sample, so fish of this age class at Bonneville Dam were allocated to the Okanogan stock. Similarly, Age 1.3 fish made up less than 1% of the Okanogan stock, so these fish were allocated to the Wenatchee stock. Since no fish in the Wenatchee sample returned after one year in saltwater, or

Table 4. Length-at-age estimates for Columbia Basin sockeye salmon stocks sampled at Bonneville Dam in 2003. Composite estimates are weighted by weekly run size.

	Brood Year and Age Class									
	2000	1999		1998			1997			1996
	1.1	1.2	2.1	1.3	2.2	3.1	2.3	3.2	4.1	3.3
Statistical Week 24										
Mean Fork Length (cm)	37.50	49.83		60.00						
Maximum	37.5	52.0		60.0						
Minimum	37.5	48.5		60.0						
Standard Deviation	--	1.15		--						
Sample Size	1	9		1						
Statistical Week 25										
Mean Fork Length (cm)	39.17	50.11	43.75	56.80		48.50		52.00	49.00	
Maximum	40.0	56.0	44.5	58.5		51.0		52.0	49.0	
Minimum	38.5	44.0	43.0	54.0		45.5		52.0	49.0	
Standard Deviation	0.76	2.90	1.06	1.75		2.92		--	--	
Sample Size	3	14	2	5		4		1	1	
Statistical Week 26										
Mean Fork Length (cm)	40.00	51.39	43.67	57.28		50.36	59.50	53.33	50.42	
Maximum	41.5	54.0	45.0	61.0		54.00	59.5	54.0	56.00	
Minimum	37.0	48.0	43.0	50.5		45.00	59.5	52.5	46.00	
Standard Deviation	1.46	1.64	1.15	3.13		3.25	--	0.76	3.50	
Sample Size	9	22	3	16		7	1	3	6	
Statistical Week 27										
Mean Fork Length (cm)	40.50	50.63	41.82	57.42		51.07	59.00	51.75	53.83	
Maximum	51.0	57.0	46.5	61.0		54.00	59.0	54.5	63.00	
Minimum	36.0	43.0	38.0	52.0		47.00	59.0	49.0	48.00	
Standard Deviation	3.58	2.52	2.64	2.39		2.08	--	3.89	8.04	
Sample Size	39	35	11	12		22	1	2	3	
Statistical Week 28										
Mean Fork Length (cm)	39.56	50.64	44.83	60.25	50.50	50.27	57.00	54.75	51.67	59.00
Maximum	46.0	55.0	47.0	63.0	50.5	55.00	57.0	55.5	53.00	59.0
Minimum	34.0	45.0	43.0	58.5	50.5	43.00	57.0	54.0	51.00	59.0
Standard Deviation	2.17	2.74	1.37	2.02	--	3.45	--	1.06	1.15	--
Sample Size	75	14	6	4	1	15	1	2	3	1
Statistical Week 29										
Mean Fork Length (cm)	38.00	49.50	41.00	53.00		50.00				
Maximum	41.0	49.5	41.0	53.0		50.00				
Minimum	36.0	49.5	41.0	53.0		50.00				
Standard Deviation	2.00	--	--	--		0.00				
Sample Size	7	1	1	1		2				
2003 Composite										
Mean Fork Length (cm)	39.76	50.64	42.98	57.53	50.50	50.48	58.50	53.13	51.38	59.00
Maximum	51.0	57.0	47.0	63.0	50.5	55.0	59.5	55.5	63.0	59.0
Minimum	34.0	43.0	38.0	50.5	50.5	43.0	57.0	49.0	46.0	59.0
Standard Deviation	2.64	2.34	2.38	2.78	--	2.75	1.32	2.00	4.31	--
Sample Size	134	95	23	39	1	50	3	8	13	1

Table 5. Length-at-age estimates for Wenatchee sockeye salmon stocks sampled at Tumwater Dam in 2003. Composite estimates are weighted by weekly run size.

	1999	1998	1997	
	1.2	1.3	1.4	2.3
Statistical Week 30				
Mean Fork Length (cm)	54.00	58.43	57.50	61.00
Maximum	58.0	63.5	57.5	61.0
Minimum	50.0	50.0	57.5	61.0
Standard Deviation	5.66	2.30	--	--
Sample Size	2	176	1	1
Statistical Week 31				
Mean Fork Length (cm)	52.00	57.77		57.00
Maximum	52.0	62.0		57.0
Minimum	52.0	52.5		57.0
Standard Deviation	--	2.46		--
Sample Size	1	15		1
2003 Composite				
Mean Fork Length (cm)	53.33	58.96	57.50	59.00
Maximum	58.0	63.5	57.5	61.0
Minimum	50.0	50.0	57.5	57.0
Standard Deviation	4.16	2.31	--	2.83
Sample Size	3	191	1	2

Table 6. Length-at-age estimates for Okanogan sockeye salmon stocks sampled at Wells Dam in 2003. Composite estimates are weighted by weekly run size.

	Brood Year and Age Class						
	2000	1999		1998			1997
	1.1	1.2	2.1	1.3	2.2	3.1	3.2
Statistical Week 28							
Mean Fork Length (cm)	39.12	51.96	43.67		50.00	48.60	
Maximum	40.5	55.0	47.0		51.5	50.5	
Minimum	37.5	48.5	42.0		48.5	46.5	
Standard Deviation	0.74	1.55	2.89		2.12	1.82	
Sample Size	13	56	3		2	5	
Statistical Week 29							
Mean Fork Length (cm)	39.30	50.74	44.00		51.22	49.95	
Maximum	43.0	55.5	52.5		52.5	53.5	
Minimum	36.0	45.0	42.0		49.5	45.0	
Standard Deviation	1.60	2.44	3.12		1.12	2.42	
Sample Size	33	46	10		9	21	
Statistical Week 30							
Mean Fork Length (cm)	38.84	51.81	41.50	60.50		51.13	52.50
Maximum	43.0	56.5	41.5	60.5		55.50	52.5
Minimum	35.5	47.5	41.5	60.5		47.50	52.5
Standard Deviation	1.89	2.83	--	--		2.95	--
Sample Size	16	16	1	1		8	1
Statistical Week 31							
Mean Fork Length (cm)	39.00	54.50				54.50	
Maximum	40.5	55.0				54.50	
Minimum	36.0	54.0				54.50	
Standard Deviation	1.56	0.71				--	
Sample Size	8	2				1	
2003 Composite							
Mean Fork Length (cm)	39.13	51.52	43.75	60.50	51.00	50.16	52.50
Maximum	43.0	56.5	52.5	60.5	52.5	55.5	52.5
Minimum	35.5	45.0	41.5	60.5	48.5	45.0	52.5
Standard Deviation	1.53	2.21	2.91	--	1.30	2.61	--
Sample Size	70	120	14	1	11	35	1

spent more than two years in freshwater, all Age 4.1 and 3.3 fish were also allocated to the Okanogan stock. The sole Age 2.2 fish was allocated to the Wenatchee stock since, in past years, that age class has been far more common in that stock than in the Okanogan stock. After weighting weekly stock composition estimates by weekly run size (Table 7), the percentage of sockeye of Wenatchee origin at Bonneville Dam was 16% (σ=3%) while the percentage of Okanogan origin was 84% (σ=5%).

Table 7. Weekly and cumulative stock composition estimates (mean and standard deviation) of Columbia Basin sockeye salmon at Bonneville Dam in 2003.

Classification of Sockeye Salmon of all ages					
		Sample Classification (%)			
Statistical Week	Sample size	Wenatchee		Okanogan	
		Mean	Std. Dev.	Mean	Std. Dev.
24	11	9	9	91	14
25	30	17	7	83	14
26	68	25	5	75	9
27	127	10	3	90	7
28	124	5	2	95	7
29	12	8	8	92	21
Population Estimate	**372**	**16**	**3**	**84**	**5**

DISCUSSION

The 2003 Columbia Basin sockeye salmon run of 39,375 fish at Bonneville Dam was the smallest since 1999. The run was notable for the very different age composition of its Wenatchee and Okanogan components. For the first time in the 18 years of this study, it was possible to differentiate the two stocks at Bonneville Dam by age alone. In all other years Age 1.2 and/or Age 1.3 fish have been found in large numbers in both Wenatchee and Okanogan stocks, resulting in the use of scale pattern analysis techniques to differentiate these age groups by stock.

The 2003 return was also unusual in that, like 2002, three and four freshwater fish (ages 3.1, 3.2, 3.3, 4.1) were observed at Bonneville and Wells dams. Fish of these age groups comprised an estimated 19.4% of the run at Bonneville Dam and 17.1% of the run at Wells Dam. Again this year, fish of these age classes likely originated upstream of Wells Dam for no fish were collected at Tumwater Dam that spent more than two years in freshwater or fewer than two years in saltwater. Whether these fish originated from Lake Osoyoos, or may be kokanee originating from elsewhere upstream of Wells Dam is unknown. In 2004, we hope to collect genetic samples from fish collected at Wells Dam and possibly from fish collected at Bonneville Dam as well. The resulting genetic profile can be compared to that of Okanogan sockeye as well as kokanee stocks upstream of Wells Dam.

A commonly used method to determine the percentage of Columbia Basin sockeye salmon by stock is to use the split in upstream dam counts. Using the count at Rocky Reach Dam of 30,355 sockeye salmon (which presumably are Okanogan stock), and the difference in Rocky Reach and Rock Island counts of 4,424 fish[3], the proportion of the run in the mid-Columbia of Okanogan origin was

3 These are the fish that presumably comprise the Wenatchee stock, however the estimated number of sockeye salmon passing Tumwater Dam in 2003 based on video counts was 5,074 fish (Todd Miller, WDFW, December 10, 2003 e-mail).

87.3%, compared to 84% estimated by this report. In most years, our stock composition estimate has been very similar to that offered by dam count splits.

As in 2002, sockeye salmon fisheries were minimal in 2003 due to the low run size. The estimated harvest in Zone 6 (between Bonneville and McNary dams) tribal fisheries was 1090 fish (January 9, 2004 e-mail from Stuart Ellis, CRITFC). Sockeye salmon are also harvested in tribal fisheries upstream of Wells Dam. In 2003, three sockeye salmon were harvested in the Chief Joseph Dam snag fishery, while 46 fish were harvested in an Okanogan River sockeye net fishery (January 24, 2004 e-mail from Chris Fisher, Confederated Tribes of the Colville Indian Reservation). An estimated 20 sockeye were harvested in Okanagan Band tribal Lake Osoyoos gill net and Okanagan River snag fisheries (February 17, 2004 e-mail from Howie Wright, Okanagan Nation Alliance).

Research on Columbia Basin sockeye salmon will continue in 2004 and we will continue to develop an age, length-at-age, and stock composition data-base for this population. Data obtained from this program may be useful to monitor the impact of future main-stem Columbia fisheries, supplementation programs in the Wenatchee basin, as well as sockeye salmon stock recovery efforts in other Columbia River subbasins.

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