WASHINGTON DEPARTMENT OF FISH AND WILDLIFE

Fish Program: Science Division

Supplementation Research Team

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To: Chuck Peven

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Subject: 2004 Upper Columbia River Summer Chinook Spawning Ground Surveys

Summer Chinook salmon spawning ground surveys in the Methow and Okanogan river basins began in 1956. Spawning survey methodology has ranged from aerial peak counts to comprehensive total ground counts initiated in 1990. The Washington Department of Fish and Wildlife Supplementation Research Team (SRT) has been conducting spawning ground surveys in tributaries above Wells Dam and in the Chelan River since 1998.

Spawning ground surveys were conducted by raft or foot within historical spawning survey reaches (Murdoch and Miller 1999). Weekly aerial surveys were conducted on the Okanogan and Similkameen rivers to delineate specific areas for subsequent ground surveys. In low density spawning areas, redds were individually flagged and numbered sequentially. Areas of mass spawning were mapped. Redds were plotted and numbered sequentially.

All summer Chinook carcasses found during surveys were examined and sampled. Biological information collected from carcasses included recovery reach location, sex, fork length, post orbital to hypural plate (POH) length, scales, and number of eggs retained by females. Snouts were collected from all adipose fin-clipped and fish of unknown origin. Carcass surveys were conducted after spawning had ended to ensure a representative sample of the spawning population was collected. Efforts were made to ensure the number of carcasses sampled within a reach were in similar proportion to the number of redds within the reach with a target of sampling 20% of the estimated population. Stock structure (i.e., length at age and age composition) and coded wire tag information from carcasses will be reported in a future document when the data becomes available.

Spawning escapement estimates were calculated using the total ground redd counts multiplied by the male-to-female ratio of all fish encountered during the collection of the Methow/Okanogan hatchery broodstock at the east ladder trap of Wells Dam. We assumed the male-to-female ratio of the broodstock was equal to that of the naturally spawning population and females only constructed one redd. The redd expansion factor in 2004 was 2.27 fish per redd (M. Tonseth, WDFW, personal communication).

Methow River

Spawning activity was not observed in likely spawning location the week of 19 September and comprehensive surveys were not conducted. However, the following week during the first week surveys were conducted, extensive spawning activity was observed in reaches M3 - M5. The actual start of spawning likely occurred towards the end of week of 19 September. During the survey period, we experienced one freshet that prevented surveys from being conducted in reaches M3-M7 due to poor visibility, as a result of a landslide in the Chewuch River. The increase in discharge was not sufficient to erase summer Chinook redds made before the increase in discharge and redds constructed during this event were counted the following week. No other problems were encountered during the survey period. The 973 redds enumerated during ground surveys on the Methow River were only 59.9% of the total redds counted in 2003 (Table 1; Attachment A).

Table 1. The number of summer Chinook redds located during spawning ground surveys in the Methow River in 2004.

Survey Week	Historical reach (river kilometer)							Total redds
	M1 (0.0-25.0)	M2 (25.0-45.9)	M3 (45.9-63.6)	M4 (63.6-75.8)	M5 (75.8-84.2)	M6 (84.2-87.2)	M7 (87.2-90.2)	
09/26	0	0	122	31	66	1	0	220
10/03	7	139	93	49	36	2	0	326
10/10	33	89	83	28	44	2	4	283
10/17*	11	32	--	--	--	--	--	43
10/24	36	48	8	1	6	0	0	99
10/31	2	0	0	0	0	0	0	2
11/07	0	0	--	--	--	--	0	0
11/14	0	--	--	--	--	--	--	0
Total	89	308	306	109	152	5	4	973

*Reaches M7-M3 not surveyed due to water clarity.

Based on the number of redds found during the first week of surveys, spawning activity likely started the towards he end of week of 19 September, which also comports with the historical start of spawning (Figure 1). Redd construction peaked the week of 3 October. Historically, spawning begins in the upper reaches and proceeds to the lower reaches as the season progresses. This year spawning began at approximately the same time on the entire river with the exception of a small increase in activity in the lower reaches during the week of 24 October (Table 1). Once spawning had ended in the middle and upper reaches (M3-M7), the week of 31 October, no further surveys were conducted.

Spawning distribution in 2004 was significantly ($P < 0.001$) different than the recent six-year average (Figure2). A lower proportion of redds were found in Reach M1 and a higher proportion of redds were found in reaches M2 and M4. The spatial redd distribution may have shifted upstream due to the higher than normal volume of water during 2004 spawning period that subsequently increased the amount of spawning habitat.

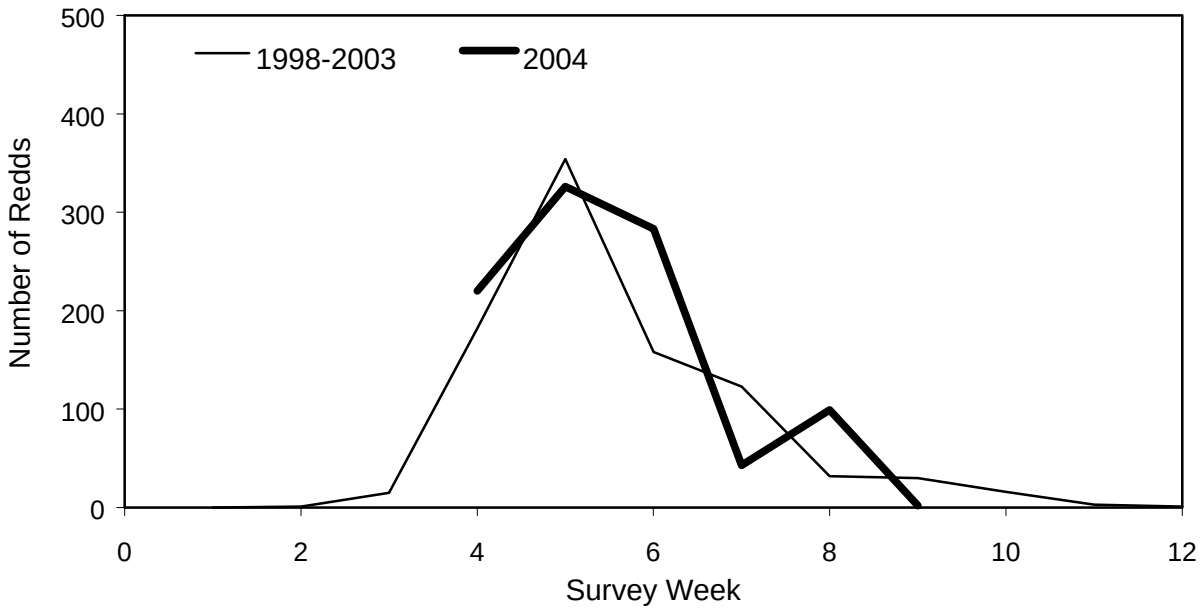

Figure 1. The number of summer Chinook redds found in the Methow River in 2004 and the 1998-2003 average.

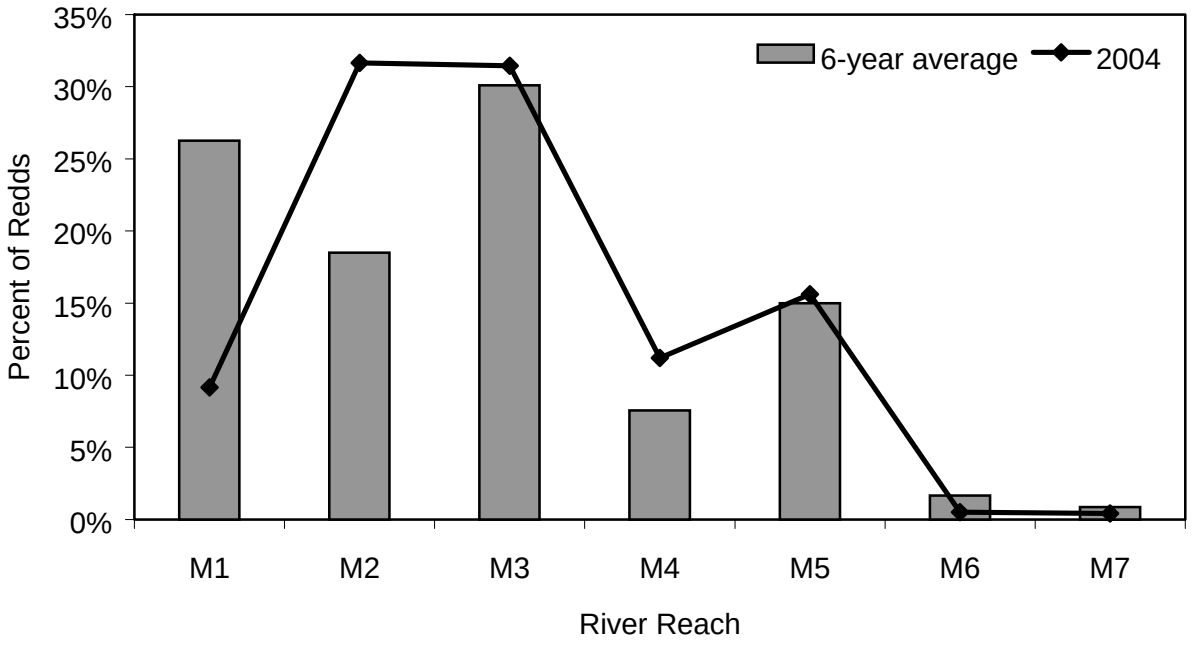

Figure 2. Methow summer Chinook redd distribution in 2004 redds and the six year average (1998-2004).

During spawning ground surveys, 578 salmon carcasses were sampled (Figure 3). Of all carcasses sampled, adipose fin-clipped fish comprised 23.2% (*N = 134*). Following the week of 24 October, adipose fin-clipped fish comprised 29.9% (*N = 72*) of carcasses sampled. A majority of the hatchery fish recovered during the secondary peak in spawning are believed to have originated from Wells and Turtle Rock Fish Hatchery releases. This hypothesis is based on coded wire tag (CWT) recoveries from a similar peak in spawning observed in 2001, 2002 and 2003. A greater proportion of the hatchery fish were recovered in the lower reaches, while higher proportions of adipose present fish that are presumably naturally produced were recovered in the upper reaches. A similar analysis will be conducted after CWTs are decoded and fish from the Methow summer Chinook (Carlton Program) can be separated. A total of 299 female carcasses retained intact body cavities and were examined for egg voidance. The mean (SD) egg voidance was 99.8 (1.0)%. An additional seven females (2.1%) were sampled that died before spawning. Male carcass recoveries comprised 42.6% (*N = 246*) of the total carcasses sampled.

The estimated Methow River summer Chinook spawning escapement was 2,209 fish (973 redds x 2.27 fish/redd). The 2004 spawning escapement decreased 43.8% compared to spawning escapement in 2003.

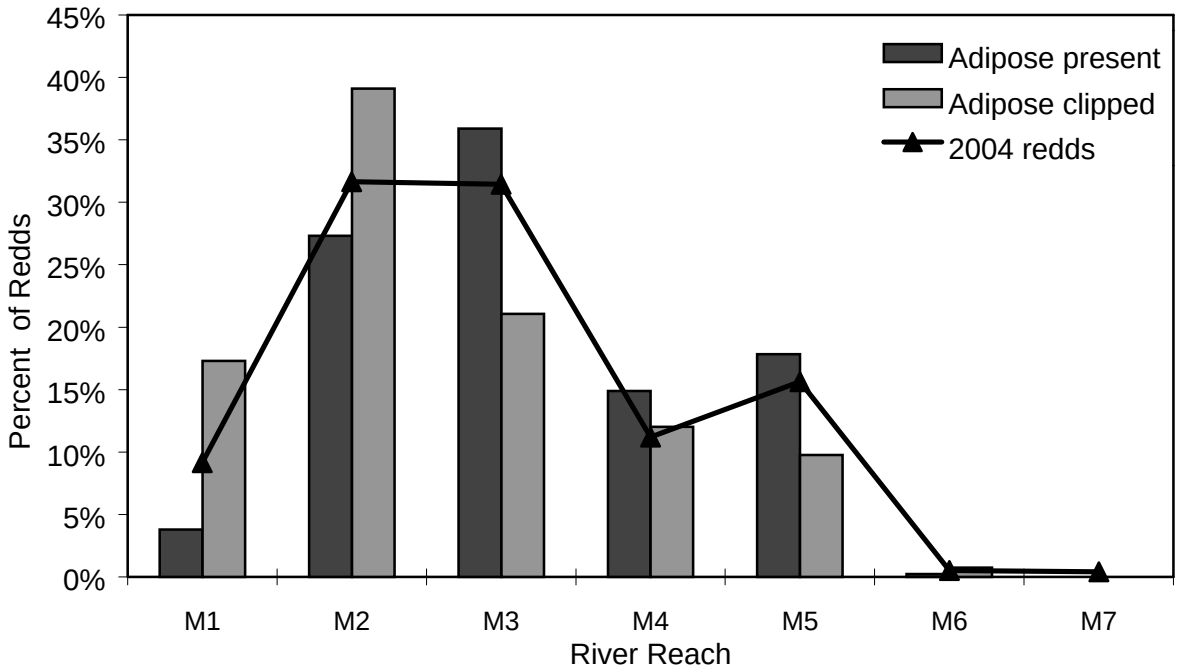

Figure 3. Methow River summer Chinook carcass and redd distribution in 2004.

<u>Okanogan River</u>

The number of redds counted during spawning ground surveys was 1,327 (Table 2). Redd counts in 2004 increased 28.2% from the previous record of 1,035 redds in 2003. The peak aerial count was 98.7% (*N* =1,310) of total ground counts (See Attachment A). Only 34 redds were identified during aerial counts that were not verified and enumerated by ground crews. In 2004, the temporal distribution between reaches was different to that observed in previous years when

spawning began in the upper reaches and progressed to the lower reaches over a longer period of time (Murdoch and Miller 1999). Specifically, peak spawning occurred in three of the reaches during the same week. Spawning activity began the week of 3 October and peaked the week of 10 October (Figure 4). The majority of redds (85%) were found in the upper reaches (O5-O6). The lowest reach (O1) had a total of four redds, similar to what has been counted previously (Murdoch and Miller 1999).

Table 2. Number of summer Chinook redds located within historical reaches during ground surveys on the Okanogan River in 2004.

Survey Week	Historical reach (river kilometer)						Total redds
	O1 (0.0-27.2)	O2 (27.2-41.9)	O3 (41.9-49.4)	O4 (49.4-65.4)	O5 (65.4-91.4)	O6 (91.4-129.6)	
09/26*	0	0	0	0	0	0	0
10/03	0	0	0	0	147	157	304
10/10	0	10	51	18	171	296	546
10/17	0	10	36	12	168	132	358
10/24	3	5	6	5	27	20	66
10/31	1	5	7	29	4	1	47
11/07	0	0	1	0	5	--	6
11/14	--	0	0	--	--	--	0
Total	4	30	101	64	522	606	1,327

* Aerial surveys counts

Spawning distribution in 2004 was significantly ($P < 0.001$) different than the recent six year average (Figure 5). The proportion of redds in the upper reaches (O5-O6) was higher than expected. As was the case in the Methow River, an upstream shift in the spatial redd distribution may have been due to an above normal river discharge during spawning, which increased the amount of available spawning habitat.

During spawning ground surveys 488 salmon carcasses were sampled. Of the carcasses sampled adipose-fin clipped fish comprised 21.3% (N =104). A total of 201 female carcasses with intact body cavities were examined for egg voidance. Mean (SD) egg voidance was 99.8 (0.7)%. An additional two females (1%) were recovered that had died before spawning. Male carcass recoveries comprised 49.0% (N =238). A higher proportion of hatchery fish were recovered in the lower reaches (Figure 6).

The estimated summer Chinook spawning escapement in the Okanogan River was 3,012 fish (1,327 redds x 2.27 fish/redd). The 2004 spawning escapement increased 16.8% compared to spawning escapement in 2003.

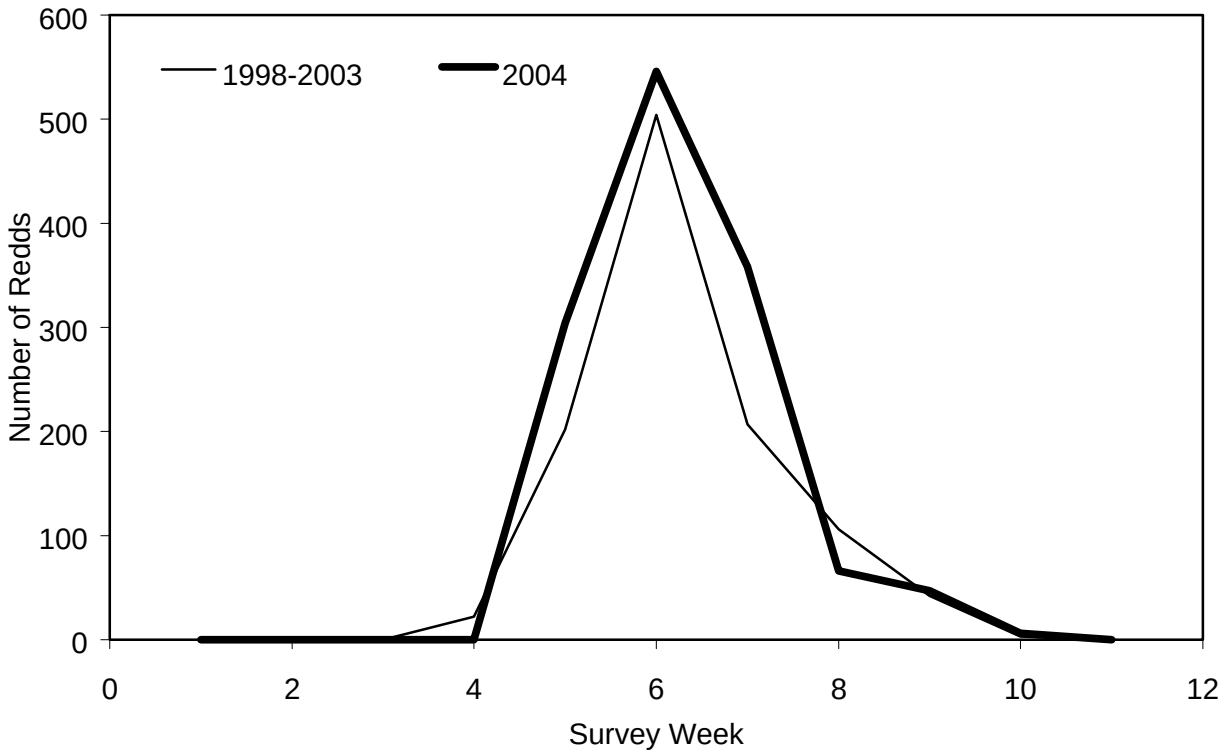

Figure 4. The number of summer Chinook redds found in the Okanogan River in 2004 and the 1998-2003 average.

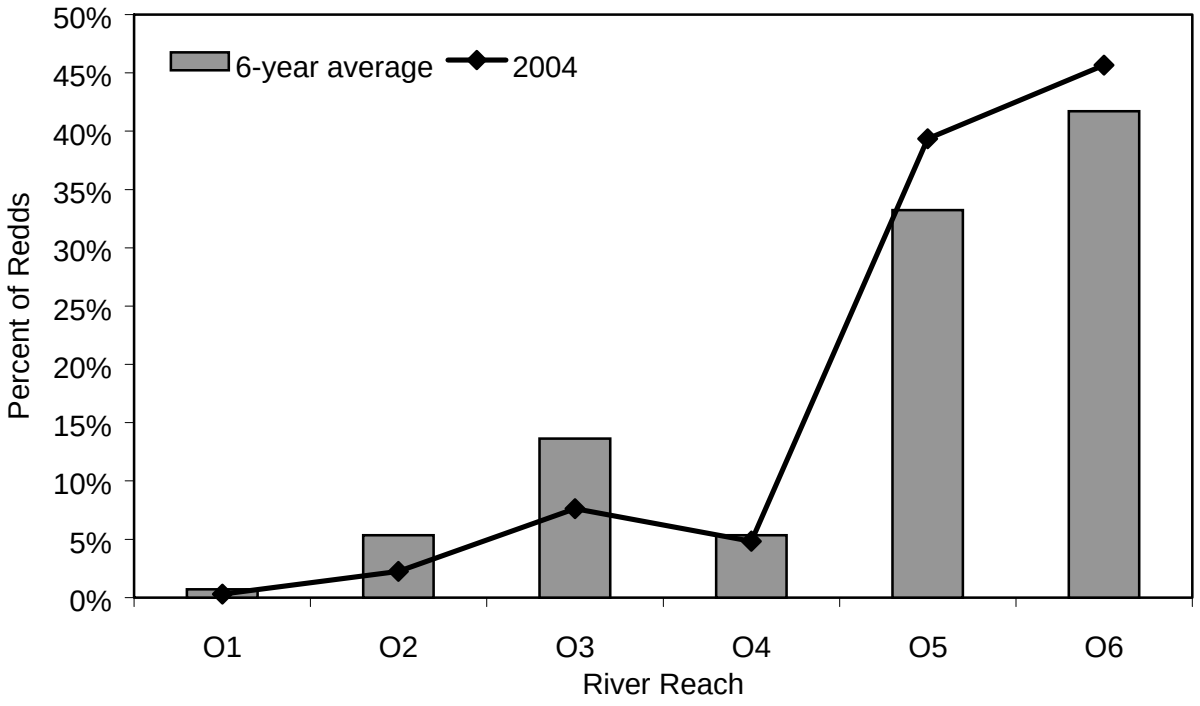

Figure 5. Okanogan summer Chinook redd distribution in 2004 redds and the six year average (1998-2004).

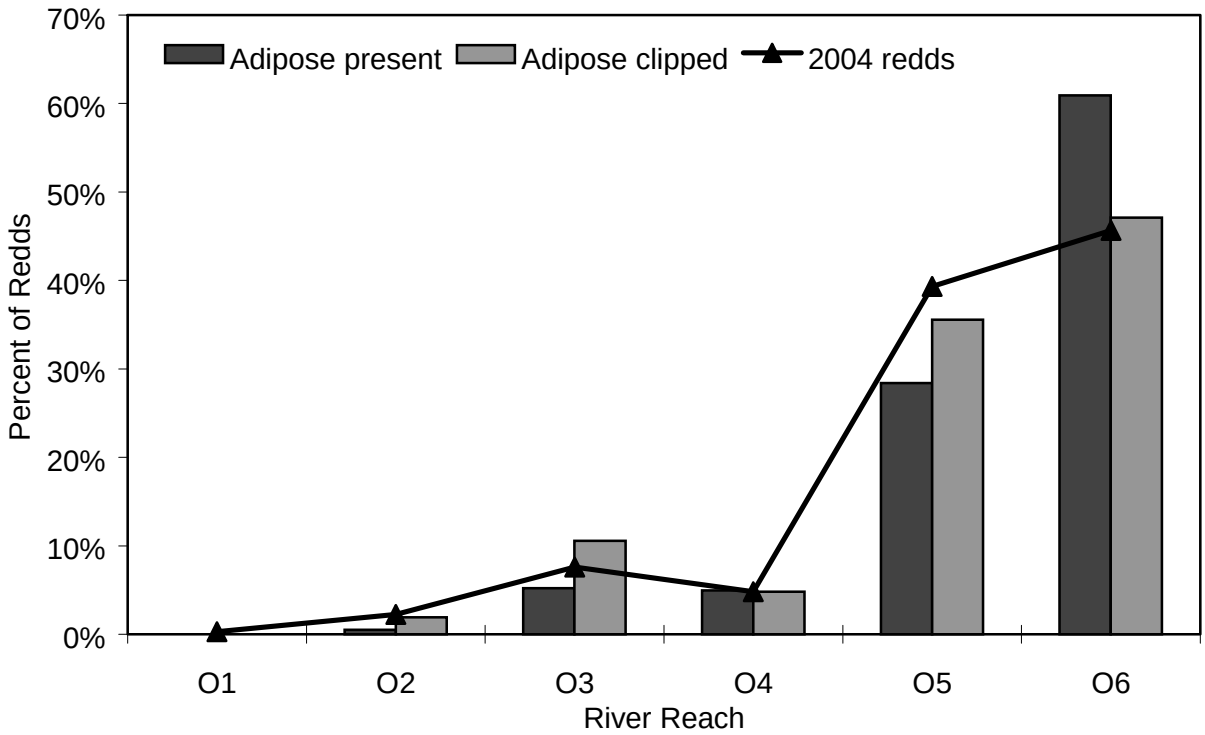

Figure 6. Okanogan River summer Chinook carcass and redd distribution in 2004.

Similkameen River

In 2004, the number of redds enumerated in the Similkameen River was 1,660. The 2004 total redd count was 77.2% greater than the 378 redds enumerated in 2003 (Table 3). The peak aerial count was 128.1% (*N =2,127*) of total ground counts (Attachment A). Aerial counts were very difficult to accurately enumerate due to the high density of redds. Spawning activity began the week of 3 October with peak spawning also occurring during the week (Figure 7). The spawning period in the Similkameen River was also more contracted in 2004.

Spawning distribution in 2004 was significantly ($P < 0.001$) different than the recent six year average (Figure 8). The majority of redds (83.3%) were found in the lowest reach of the Similkameen River (S1). The proportion of redds found in S1 was greater than previously observed. This may have also been due to a greater amount of spawning habitat as a result of an above normal river discharge during the spawning period.

During spawning ground surveys, 1,599 salmon carcasses were sampled (Figure 9). Of the carcasses sampled, adipose-fin clipped fish comprised 15.8% (*N = 252*). A total of 859 female carcasses with intact body cavities were examined for egg voidance. Mean (SD) egg voidance was 99.7 (1.5)%. An additional 2 females (0.1%) were recovered that had died before spawning. Male carcass recoveries comprised 46.2% (*N = 739*) of the total carcasses sampled. Despite the acclimation pond being located in the middle of reach S1, no difference in the spatial distribution of hatchery and adipose present fish was found.

The estimated summer Chinook spawning escapement in the Similkameen River was 3,768 fish (1,660 redds x 2.27 fish/redd). The 2004 estimated spawning escapement increased 75.7% from 2003.

Table 3. The number of summer Chinook redds located within historical reaches during spawning ground surveys on the Similkameen River in 2004.

Survey week	Historical reach (river kilometer)		
	S1 (0.0-2.9)	S2 (2.9-9.1)	Total redds
09/26*	16	0	0
10/03	560	118	694
10/10	392	60	452
10/17	429	54	483
10/24	26	5	31
10/31	0	0	0
11/07	0	0	0
Total	1,423	237	1,660

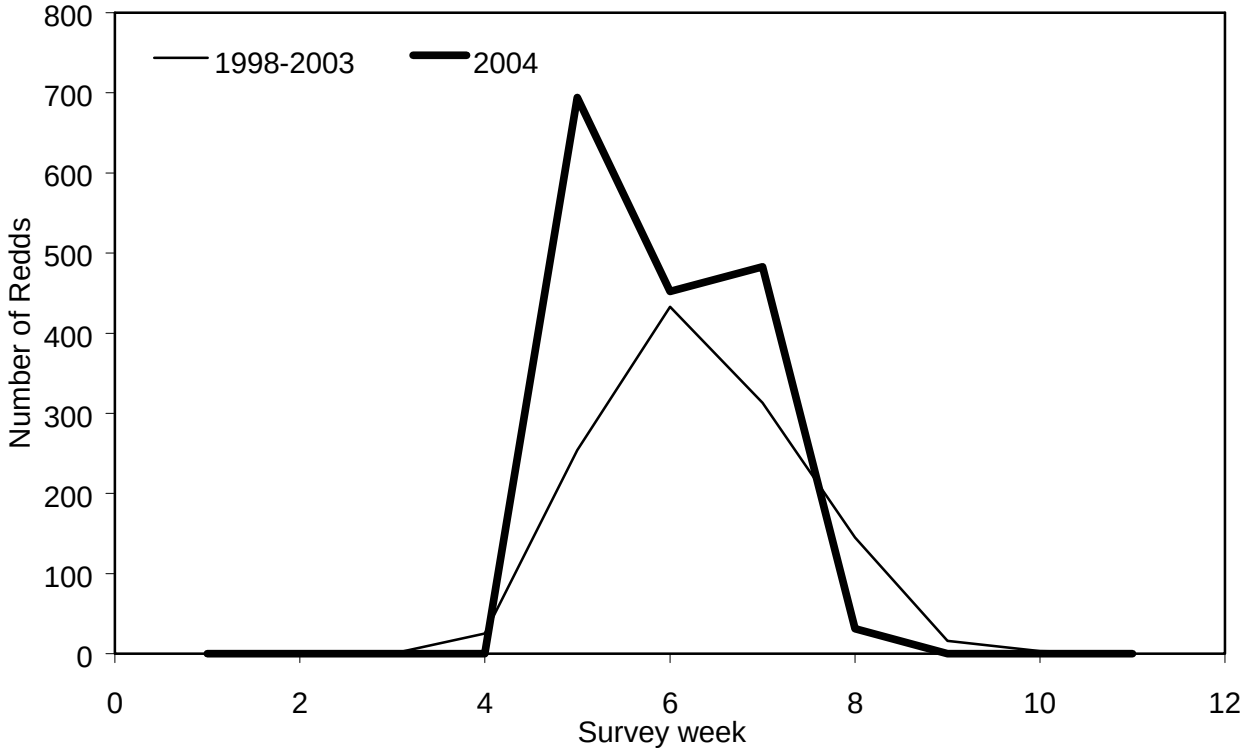

Figure 7. The number of summer Chinook redds found in the Similkameen River in 2004 and the 1998-2003 average.

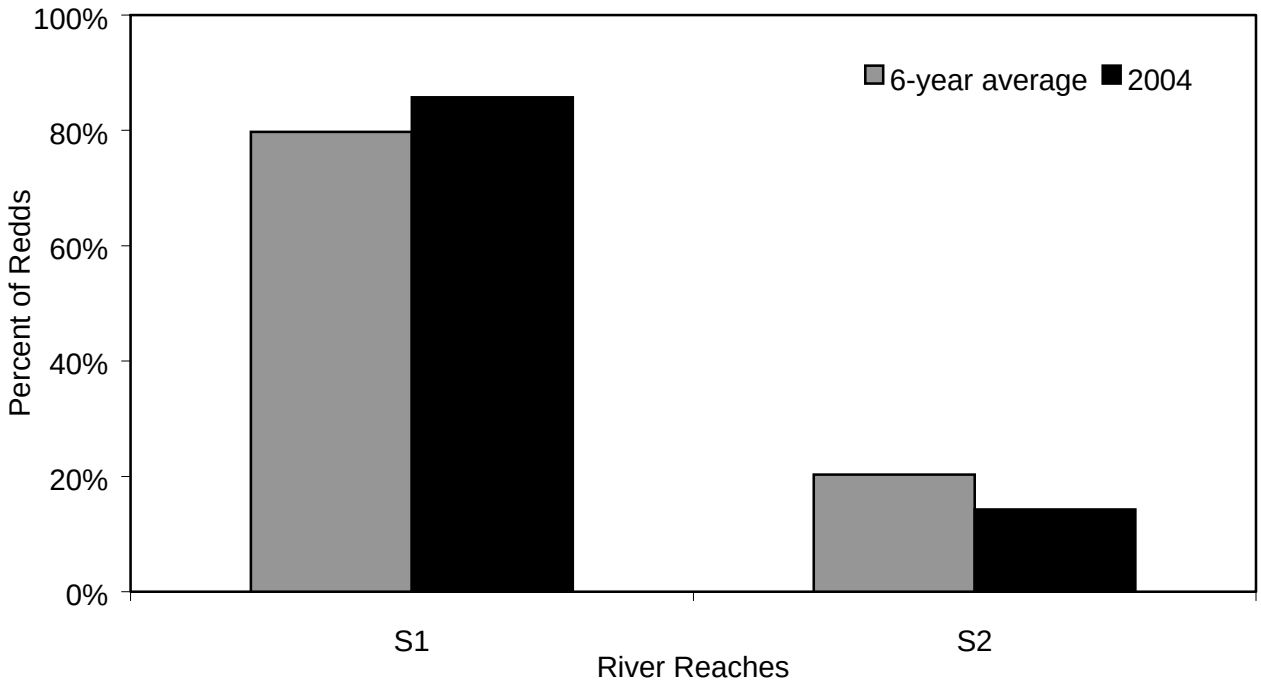

Figure 8. Similkameen River summer Chinook redd distribution in 2004 redds and the six year average (1998-2004).

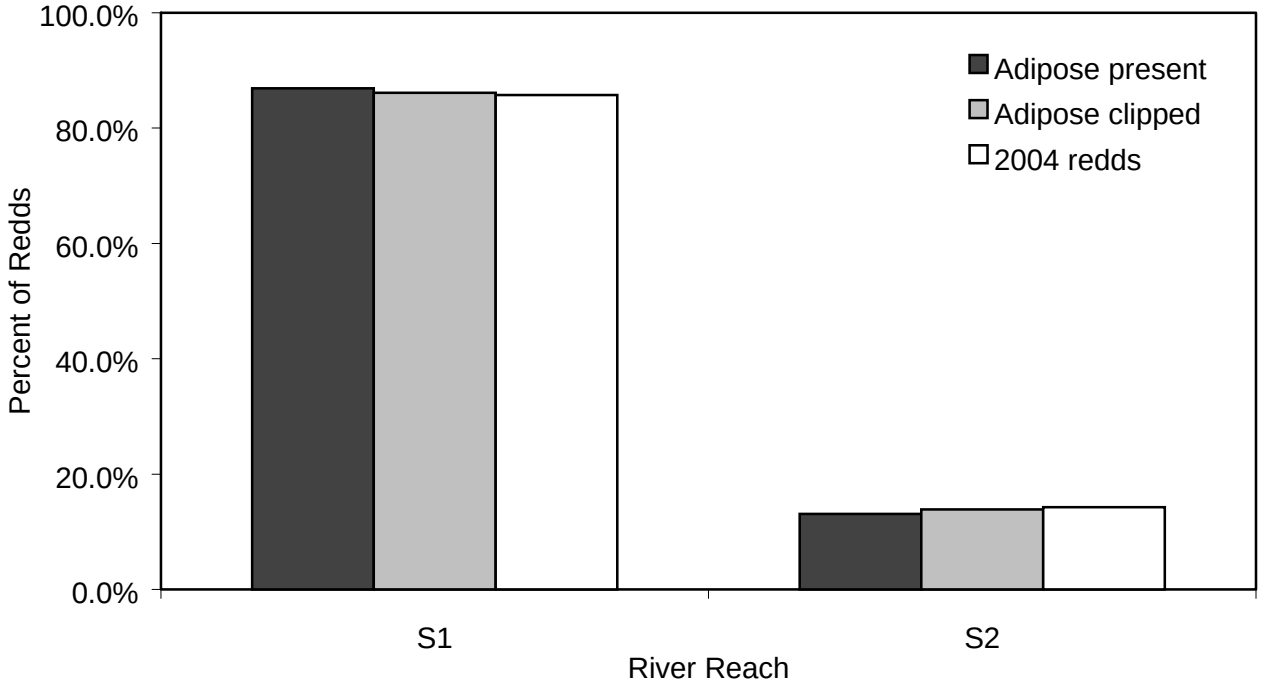

Figure 9. Similkameen River summer Chinook carcass and redd distribution in 2004.

Columbia River

No redds were counted during aerial surveys conducted above Wells Dam to the mouth of the Okanogan. No aerial surveys were conducted upstream of the Okanogan River to Chief Joseph Dam in 2004. A peak aerial count of 200+ redds were observed on the west bank immediately below Wells Dam during the second week of November. Many redds were constructed in deep water and difficult to enumerate. The actual number of redds is unknown and thought to be higher. No attempt was made to recover carcasses.

A total of 185 redds were found during spawning ground surveys in the lower 0.5 km of the Chelan River and the Columbia River in the vicinity of confluence of the Chelan River. The peak aerial count was 95.7% (177 redds) of the total ground count.

During spawning ground surveys 159 salmon carcasses were sampled in the Chelan River. Of the carcasses sampled, adipose fin-clipped fish comprised 38.4% (*N = 61*). Based on historical coded wire tag recoveries most adipose fin-clipped fish are from Wells and Turtle Rock Fish Hatchery releases**.** A total of 66 female carcasses with intact body cavities were examined for egg voidance. Mean (SD) egg voidance was 94.9 (10.1)%. An additional 37 females (24.5%) were recovered that had died prior to spawning. Male carcass recoveries comprised 21.4% (*N* = 34) of the total carcasses sampled.

The estimated summer Chinook spawning escapement for the Chelan River and vicinity was 420 fish (185 redds x 2.27 fish/redd). The 2004 estimated spawning escapement was virtually the same as 2003.

REFERENCES

Murdoch, A., and T. Miller. 1999. Summer Chinook Spawning Ground Survey in the Methow and Okanogan River Basins in 1998. Washington Department of Fish and Wildlife, Olympia, Washington. Report No. SS99-03.

Attachment A. Peak number of summer Chinook salmon redds counted during spawning ground surveys on the Methow, Okanogan, and Similkameen rivers. Total ground counts are in italics when available

Year	Methow		Okanogan		Similkameen	
	Aerial	Ground	Aerial	Ground	Aerial	Ground
1956	109	--	37	--	30	--
1957	451	--	53	--	30	--
1958	335	--	94	--	31	--
1959	130	--	50	--	23	--
1960	194	--	29	--	--	--
1961	120	--	--	--	--	--
1962	678	--	--	--	17	--
1963	298	--	9	--	51	--
1964	795	--	112	--	67	--
1965	562	--	109	--	154	--
1966	1,275	--	389	--	77	--
1967	733	--	149	--	107	--
1968	659	--	232	--	83	--
1969	329	--	103	--	357	--
1970	705	--	656	--	210	--
1971	562	--	310	--	55	--
1972	325	--	182	--	64	--
1973	366	--	138	--	130	--
1974	223	--	112	--	201	--
1975	432	--	273	--	184	--
1976	191	--	107	--	139	--
1977	365	--	276	--	268	--
1978	507	--	195	--	268	--
1979	622	--	173	--	138	--

Year	Methow		Okanogan		Similkameen	
	Aerial	Ground	Aerial	Ground	Aerial	Ground
1980	345	--	118	--	172	--
1981	195	--	55	--	121	--
1982	142	--	23	--	56	--
1983	65	--	36	--	57	--
1984	162	--	235	--	301	--
1985	164	--	138	--	309	--
1986	169	--	197	--	300	--
1987	211	--	201	--	164	--
1988	123	--	113	--	191	--
1989	126	--	134	--	221	*370*
1990	229	--	88	*47*	94	*147*
1991	--	*153*	55	*64*	68	*91*
1992	--	*107*	35	*53*	48	*57*
1993	--	*154*	144	*162*	152	*288*
1994	--	*310*	372	*375*	463	*777*
1995	--	*357*	260	*267*	337	*616*
1996	--	*181*	100	*116*	252	*419*
1997	--	*205*	149	*158*	297	*486*
1998	--	*225*	75	*88*	238	*276*
1999	--	*448*	222	*369*	903	*1,275*
2000	--	*500*	384	*549*	549	*993*
2001	--	*675*	883	*1,108*	865	*1,540*
2002	--	*2,013*	1,958	*2,667*	2,000[a]	*3,358*
2003	--	*1,624*	1,099	*1,035*	103	*378*
2004	--	*973*	1,310	*1,327*	2,127	*1,660*

[a] Unable to accurately count due to superimposition of redds.