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Spring Chinook Spawning Ground Surveys in the Methow River Basin in 2003

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ABSTRACT

This report summarizes the spring chinook spawning ground surveys conducted in the Methow Basin during the 2003 spawning season. Comprehensive ground surveys were conducted by foot, canoe, and raft within historical spawning ground survey reaches, encompassing all known spring chinook spawning habitat in the Methow Basin.

Spawning began in early to mid-August within the main survey reaches. Peak spawning occurred during the last week of August in the Methow River, and the first week of September in the Twisp and Chewuch Rivers. A total of 251 redds were found on the Methow River, hatchery outfalls, and several smaller tributaries. Only one redd was found in the Lost River. Surveyors found 204 redds in the Chewuch River and 18 redds in the Twisp River.

The Wells Dam spring chinook count ($N = 4{,}485$) was adjusted by subtracting summer chinook ($N = 2{,}124$), hatchery broodstocks ($N = 687$), and the estimated escapement to the Okanogan Basin ($N = 50$). The estimated number of spring chinook escaping to spawning grounds in the Methow Basin was 1,624 fish. We calculated tributary spawning escapement estimates by expanding the redd counts for each stream by the estimated fish per redd value of 2.4. Estimated spawning escapement for the Methow and its smaller tributaries was 604 fish. Estimated escapements for the Chewuch and Twisp rivers were 490 and 43 fish, respectively. Total estimated spawning escapement extrapolated from redd counts ($N = 1{,}137$) represents 70.0% of the adjusted Wells Dam count.

During spawning ground surveys we recovered a total of 318 (52.6%), 203 (41.4%), and 10 (23.3%) salmon carcasses on the Methow River and its tributaries, Chewuch, and Twisp rivers, respectively. Of the carcasses sampled, hatchery fish comprised 98.1% on the Methow River, 94.0% on the Chewuch River, and 40.0% on the Twisp River of all carcasses. Proportions of wild spring chinook were 1.7% ($N = 5$) on the Methow River and its tributaries, 5.9% ($N = 12$) on the Chewuch River and 60.0% ($N = 6$) on the Twisp River. Of hatchery carcasses recovered in the Methow River, 64.9% ($N = 137$) were Methow Composite stock from Methow State Fish Hatchery (MSFH). Of hatchery carcasses recovered on the Chewuch River, 94.4% ($N = 152$) were Methow Composite stock from Chewuch River releases (MSFH). Of the hatchery carcasses recovered on the Twisp River, three were MSFH Twisp stock and one was a non-tagged hatchery origin fish.

A total of 223 spring chinook female carcasses (85.7% of females recovered) were examined during surveys to determine egg voidance. Pre-spawn mortalities comprised 14.3% ($N = 32$) of the females recovered. Mean egg voidance of all sampled post-spawn females was 99.4% (SD = 1.7%). An additional 37 females were not examined for egg voidance due to excessive decomposition of the body cavity.

We estimate that 12 redds (4.7%) in the Methow River became dewatered after the completion of surveys. No dewatered redds were observed elsewhere in the basin.

We snorkeled a total of 19 active redds between 28 August and 3 September to monitor for the presence of precocial males. None were encountered during snorkel surveys. However, one precocial hatchery male was recovered during spawning ground surveys.

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INTRODUCTION

As part of the mitigation requirements outlined in the Wells Settlement Agreement to compensate for unavoidable loss of juvenile anadromous fishes at Wells Dam, the Methow Basin Spring Chinook Supplementation Plan (i.e., the Plan) was initiated. Phase I of the Plan is to operate and monitor a hatchery supplementation operation with the goal of increasing natural propagation of salmon in the Methow, Chewuch and Twisp rivers in a manner that minimizes or eliminates ecological and genetic risks to the natural population. Objective 2 of the Plan states that managers must determine that actions taken under the Plan conserve the genetic integrity and long-term fitness of naturally spawning populations of salmon in the Methow Basin (Wells Project Coordinating Committee 1995). Spawning ground surveys are an integral component of the Plan that provides data to assess the efficacy of the hatchery supplementation program and the natural population abundance.

Spring chinook salmon *Oncorhynchus tshawytscha* spawning ground surveys in the Methow River basin have been conducted since 1960 (SASI 1993). Historic data is limited to index area redd counts for the Methow, Chewuch and Twisp rivers, and does not include information regarding spawning population demographics. From 1987 to 2002, the Yakama Nation (YN) conducted more comprehensive spawning ground surveys that included biological sampling of salmon carcasses. Beginning in 2003, spawning ground surveys were conducted by the Washington Department of Fish and Wildlife (WDFW) Supplementation Research Team. Our objectives in conducting this work included:

1). Conduct comprehensive spawning ground surveys and enumerate the total number and distribution (spatial and temporal) of spring chinook redds in the Methow River Basin.

2). Collect biological data (sex, length, age, egg retention, and origin) and summarize length-at-age information from carcasses recovered during surveys.

3). Collect DNA samples from 100% of wild fish sampled for subsequent analysis.

4). Compare the number of redds, spatial, and temporal distribution to historical information.

5). Calculate tributary spawning escapement estimates and determine the proportion of wild and hatchery origin salmon that spawned in each tributary.

6). Quantify the loss of production due to dewatering of redds in the Methow and Twisp rivers.

STUDY AREA

The Methow River watershed is located in north-central Washington on the east slope of the Cascades. The confluence of the Methow River with the Columbia River (rkm 843) is located above Wells Dam (rkm 831). The Methow River flows 134 km through a U-shaped moderately confined alluvial valley with a drainage area of approximately 4,662 km^2 (Hillman and Ross 1992). Major tributaries to the Methow include the Lost River, Chewuch River, Twisp River, and Early Winters Creek. Spring chinook spawning in the Methow Basin is generally concentrated above the town of Twisp (rkm 64.7; Hubble et al. 2003).

During the sampling period discharge gradually decreased throughout the basin. Gradual decreases in discharge are normal in the Methow Basin during summer and fall months. However, flows decreased below average levels in 2003. Mean discharge of the Methow River near the town of Pateros, Washington (site 12449950) during the survey period (27 July – 31 October) was 8.7 m^3sec^{-1} (range 6.6 - 15.9). The mean flow at the same site for the month of September 2003 was the lowest value on record (7.08 m^3sec^{-1}) for 43 years of data. Stream flow data for all sites obtained from USGS gauge is considered preliminary.

Methow River

The Methow River spring chinook survey area is primarily upstream of the Hwy 20 bridge located in the town of Winthrop, Washington (rkm 80.0). Additional surveys were performed from the Winthrop Bridge downstream to the confluence of the Twisp River (rkm 64.7). This section is seldom used for spawning by spring chinook but can be an important area for carcass recoveries.

Small tributaries to the Methow River utilized by spring chinook salmon other than the Chewuch and Twisp rivers include the Lost River (rkm 118.0), Early Winters Creek (rkm 108.4), Suspension Creek (rkm 101) and Wolf Creek (rkm 85). Suspension Creek is a small, spring-fed side-channel often heavily utilized by spawning spring chinook. The Methow State Fish Hatchery (MSFH) and Winthrop National Fish Hatchery (WNFH) outfall channels are used for the collection of hatchery broodstock, and are also included in spawning ground surveys. Mean water temperatures for the hatchery channels during the survey period were 11.1°C (range 8-15) for the MSFH channel, and 16.1°C for the WNFH outfall channel (range 14.4-17.8).

Spring chinook spawning in the Methow basin extends upstream to Ballard Campground (rkm 120) on the Methow River, to approximately Eureka Creek (rkm 6.6) on the Lost River, and to Klipchuck Campground (rkm 7.9) on Early Winters Creek (Hubble et al. 2003). Suspension Creek and Wolf Creek are important spawning areas when water conditions permit. Mean water discharge for the Methow River above Goat Creek near the town of Mazama, Washington (site 12447383) during the survey period was

approximately 1.0 m^3sec^{-1} (range 0.0 – 3.8). Mean water temperature during the survey period was 12.7°C (range 8-20).

Chewuch River

The Chewuch River drains a watershed of approximately 1,360 km^2 originating in the Pasayten Wilderness area just south of the Canadian border. It flows in a southerly direction approximately 72 km before joining the Methow River at rkm 80.5 (Mullen et al. 1992). Historic distribution of spring chinook in the Chewuch River extends upstream approximately to the 30-Mile Campground (rkm 50.8; Hubble et al. 2003). Chewuch River tributaries utilized by spring chinook salmon have included Eightmile Creek (rkm 18.2) and Lake Creek (rkm 37.5). Mean discharge of the Chewuch River near the town of Winthrop, Washington (site 12448000) during the survey period was 1.5 m^3sec^{-1} (range 1.0-2.9). Mean water temperature during the survey period was 12°C (range 5.6-17.8).

Twisp River

The Twisp River is located east of the Chelan-Sawtooth Divide and drains an area of approximately 635 km^2 (Mullen et al. 1992). The river flows approximately 52 km east-southeast, joining the Methow River at the town of Twisp, Washington (rkm 64.7). The upper limit of spring chinook spawning in the Twisp River is approximately at the Road's End Campground (rkm 52.3; Hubble et al. 2003). Mean discharge of the Twisp River at the town of Twisp, Washington (site 12448998) during the survey period was 0.9 m^3sec^{-1} (range 0.6-2.2). Mean water temperature during the survey period was 12.8°C (range 6.7-22.2).

METHODS

Redd Surveys

Direct monitoring of spawning activities and collection of biological data from these spawning populations is integral to meeting the objectives of the Plan. Water conditions in the Methow Basin during spring chinook spawning (August-September) are typically low and clear, and stream reaches are easily accessible. In this environment, foot surveys provide the most accurate and precise estimate of redd abundance and distribution (Murdoch et al. 2001), and provide the best opportunity to collect samples from carcasses encountered throughout the stream reaches.

We conducted weekly surveys by foot of spring chinook spawning habitat in the Methow Basin to determine the temporal and spatial distribution of spawning chinook. Lower reaches of the Methow River were occasionally surveyed by canoe or raft as flows permitted, but foot surveys were required for most of the survey period. To maintain consistency with historical redd surveys, we incorporated the survey reach designations used by the YN and WDFW whenever possible when delineating survey sections (Tables 1-3). Reach codes for the Methow River were adjusted to incorporate the survey code designations used by WDFW during summer chinook surveys downstream of spring chinook survey sections and steelhead spawning ground surveys.

All redds were marked with flagging and numbered individually. The date, redd number, and exact location of each redd was recorded on flagging and in field notes. Locations of redds were also marked using Geographic Positioning System (GPS) units for subsequent graphical display.

Table 1. Methow River and tributary spring chinook survey reaches and index areas (Bold).

Reach code	Reach description	Upper reach location (rkm)	Length (km)
	Methow River		
M15	Ballard CG - Lost R.	74.8	1.8
M14	Lost R. - Gate Cr.	73.0	3.0
M13	Gate Cr. - Early Winters Cr.	70.0	2.6
M12	Early Winters Cr. - Mazama Br.	67.4	2.0
M11	**Mazama Br. - Susp. Br.**	**65.4**	**2.4**
M10	**Susp. Br. - Weeman Br.**	**63.0**	**3.4**
M9	Weeman Br. - Along Highway 20	59.6	5.6
M8	Along Highway 20 - Wolf Cr.	54.0	1.4
M7	Wolf Cr. - Foghorn Dam	52.6	1.1
M6	Foghorn Dam - Winthrop Br.	51.5	1.7
M5	Winthrop Br. - Twisp Confluence	49.8	9.7
	Lost River		
L3	Sunset Cr. - Eureka Cr.	7.0	2.9
L2	**Eureka Cr. - Lost River Br.**	**4.1**	**3.6**
L1	Lost River Br. - Confluence	0.5	0.5
	Early Winters Creek		
E5	Klipchuck CG. - Early Winters Br.	4.7	1.1
E4	Early Winters Br. - Highway 20 Br.	3.6	1.3
E3	Highway 20 Br. - Diversion Dam	2.3	1.8
E2	**Diversion Dam - Highway 20 Br.**	**0.5**	**0.2**
E1	**Highway 20 Br. - Confluence**	**0.3**	**0.3**
	Miscellaneous Creeks/Outfalls		
SC1	Suspension Creek	0.25	0.25
WLF1	Wolf Creek	1.4	1.4
MH1	Methow Hatchery Outfall	0.2	0.2
WN1	WNFH Outfall	0.4	0.4

Table 2. Chewuch River spring chinook survey reaches and index areas (Bold).

Reach code	Reach description	Upper reach location (rkm)	Length (km)
C12	30 Mi. Br. - Road Side Camp	31.7	3.2
C11	Road Side Camp - Andrews Cr.	28.5	2.7
C10	Andrews Cr. - Lake Cr.	25.8	2.5
C9	Lake Cr. - Buck Cr.	23.3	1.4
C8	Buck Cr. - Camp 4	21.9	1.5
C7	**Camp 4 - Chewuch CG.**	**20.4**	**3.2**
C6	**Chewuch CG. - Falls Cr. CG.**	**17.2**	**3.6**
C5	Falls Cr. CG. - 8 Mile Cr.	13.6	2.3
C4	8 Mile Cr. - Boulder Cr.	11.3	2.3
C3	Boulder Cr - Chewuch Br.	9.0	1.3
C2	Chewuch Br. - WDFW Land Access	7.7	4.4
C1	WDFW Land Access - Methow Confluence	3.3	3.3
LK1	Lake Creek	0.25	0.25
EM1	Eightmile Creek	0.25	0.25

Table 3. Twisp River spring chinook survey reaches and index areas (Bold).

Reach code	Reach description	Upper reach location (rkm)	Length (km)
T10	Road End CG. - South Cr. Br.	28.5	2.9
T9	South Cr. Br. - Poplar Flats CG.	25.6	2.0
T8	Poplar Flats CG. - Mystery Br.	23.6	2.3
T7	**Mystery Br. - War Cr. Br.**	**21.3**	**4.3**
T6	**War Cr. Br. - Buttermilk Br.**	**17.0**	**3.0**
T5	Buttermilk Br. - Little Br. Cr.	14.0	3.9
T4	Little Br. Cr. - Twisp Weir	10.1	2.6
T3	Twisp Weir - Upper Poorman Br.	7.5	2.3
T2	Upper Poorman Br. - Lower Poorman Br.	5.2	3.2
T1	Lower Poorman Br. - Confluence	2.0	2.0

Spawning Population Characteristics

Spawning population characteristics were derived from biological data collected from carcasses recovered during surveys. Location, origin, sex, fork length, post orbital-to-hypural plate (POH) length, number of eggs retained (females) and scale samples were collected from every fish encountered. Snouts were collected from all adipose fin-clipped adults and sent to the WDFW Coded Wire Tag (CWT) lab for extraction and decoding. Snouts from all jack chinook, regardless of external mark were collected and sent to the CWT Lab because the 2000 brood of spring chinook released from Methow Basin hatcheries were not adipose fin-clipped to designate the presence of a CWT. Surveyors removed tails from all sampled carcasses to prevent repetitive sampling of fish.

Tissue samples for DNA analysis were collected from all wild fish encountered, regardless of location. Tissue samples for DNA analysis were also collected from all hatchery fish encountered on the Twisp River due to the expected small number of fish on the spawning grounds and hatchery broodstock collections. Representative tissue samples of other hatchery stocks were collected at Methow Hatchery during broodstock spawning activities. The tissue collected consisted of four or five pieces of opercle tissue collected with a single-hole paper punch and stored in DNA preservative solution. Each sample was individually labeled and recorded to correspond with biological information.

Redd Distribution and Abundance

Redd distribution was determined from the total number of redds recorded within each historical reach. Individual redds were identified by a distinct depression within the streambed directly upstream from a mounded, cleaned and sorted pile of loose gravel. Test digs and completed redds were differentiated by the determination of whether the size, shape and substrate composition of the excavation were sufficient to conceal and protect deposited eggs.

Tributary Escapement

A review of videotape records from the Wells Dam spring chinook trapping period was conducted to exclude summer chinook that were included in the spring chinook count. The total number of spring chinook adults and jacks above Wells Dam minus the fish collected for broodstock at the various Methow Basin spring chinook collection facilities was used in calculating a redd expansion value. Meekin (1967) conducted a tagging study and estimated the number of adult spring chinook per redd in the Methow River was 2.2 adults. The total number of fish (including jacks) per redd value was calculated by expanding the 2.2 adults per redd by the proportion of spring chinook jacks in the run. Tributary escapement estimates were calculated by expanding the redd counts for each tributary by a fish per redd expansion value. We assumed that each female created one redd and that males only spawned with one female.

Hatchery Contribution

The hatchery contribution to the spawning ground escapements were calculated by dividing the number of hatchery fish recovered on the spawning grounds, based on scale analysis, by the total estimated tributary escapement. Proportions of hatchery and wild fish were compared within each reach. In addition, the distributions of hatchery fish were compared to wild fish and proximity to release sites.

Age Structure

Hatchery fish were aged based on decoded CWTs and/or scales. Ages of wild and non-tagged hatchery fish were derived from WDFW scale analysis. Post-orbital to hypural plate (POH) length-at-age information was calculated for each age, sex, and origin (wild and hatchery).

Egg Voidance

Egg voidance was determined by the number of eggs present in the body cavity of the female carcasses compared to the mean fecundity by age of broodstock at MSFH. Eggs were counted from each female carcass with intact abdomen encountered during spawning ground surveys. Greatly decomposed or scavenged carcasses were not examined for egg voidance.

Redd Dewatering

The Methow River Basin is a dynamic hydrologic system. In many years, stream flow goes subsurface on reaches of the upper Methow and Twisp Rivers from mid-September through early spring. Surveys late in the spawning season were conducted to identify stream reaches without surface flow. The GPS locations of redds within each dry section were used to quantify the amount of production that was lost due to the dewatering of redds. Reaches with severely reduced flow were also noted during surveys for further examination after the survey period. Documentation of redds located within channel margins and side channels that were considered at risk of dewatering were also maintained.

Precocial Snorkeling

To monitor for the presence of precocial male spring chinook within the spawning population, active redds were assessed visually with snorkeling equipment. Redds were considered active if at least one male and one female spring chinook were present. Surveyors worked in pairs, one snorkeling and one on shore observing and recording data. Data recorded from each surveyed redd included the date, river, reach, number, sex, and mark information from each fish observed.

RESULTS AND DISCUSSION

Redd Surveys

Methow River

We found 202 redds during ground surveys on the Methow River in 2003 (Table 4). Spawning activity began in the second week of August and progressed from high to low elevations. Peak spawning occurred during the last week of August. Redd counts in the Methow River index area ($N = 41$) in 2003 represented 51.8% of the average index area redd counts for 41 years of available data (Appendix A1). Wildfires prevented our survey crews from accessing areas above M13 after the week of 8 September.

Table 4. Spatial and temporal distribution of spring chinook redds during 2003 upper Methow River spawning ground surveys by reach and date.

Reach code	Week ending								Total
	04-Aug	11-Aug	18-Aug	25-Aug	01-Sep	08-Sep	15-Sep	22-Sep	
M5		0	0			1	4		5
M6		0		4	4	11	0	0	19
M7		0		11	3	6	0	0	20
M8		0		0	0	2	0	0	2
M9		3		42	28	21	9	2	105
M10	0	1	5	17	6	4	1	0	34
M11	0	0	5	0	0	1	1	0	7
M12	0		3	2	1		0		6
M13		0		0	0	fire	fire	fire	0
M14	0			4	dry	fire	fire	fire	4
M15	0		70% dry	0	dry	fire	fire	fire	0
Total	0	4	13	80	42	46	15	2	202

Chewuch River

We found 204 redds during ground surveys on the Chewuch River in 2003 (Table 5). Spawning activity began in the second week of August and progressed from high to low elevations. Peak spawning occurred during the last week of August and first week of September in the middle and upper reaches (C4 – C12). In the lower reaches (C1 – C3), peak spawning activity occurred during the first two weeks of September. Redd counts in the Chewuch River index area ($N = 41$) in 2003 represented 72.9% of the average index area redd counts for 30 years of available data (Appendix A2). Wildfires delayed survey crews access to sections above C10 during the middle of the spawning season. But access for all sections was granted by the USFS the week of 15 September.

Table 5. Spatial and temporal distribution of spring chinook redds during 2003 Chewuch River spawning ground surveys by reach and date.

Reach code	Week ending								Total
	04-Aug	11-Aug	18-Aug	25-Aug	01-Sep	08-Sep	15-Sep	22-Sep	
C1			4	10		9	3		26
C2						48	2	1	51
C3		0		0	0	3	0	0	3
C4		0	5	2	40	2			49
C5		1	1	4	8	4	0		18
C6	0	0	0	4	7	5	0	0	16
C7	0		3	1	13	8	0	0	25
C8			1	3	10	0	0		14
C9		0	0	1	1	0	0		2
C10		0	0	fire	fire	fire	0		0
C11		0	0	fire	0	fire	0		0
C12		0	0	fire	0	fire	0		0
Total	0	1	14	25	79	79	5	1	204

Twisp River

We found a total of 18 redds during ground surveys on the Twisp River in 2003 (Table 6). Spawning activity began in the last week of August and peaked the first week of September. Redd counts in the Twisp River index area ($N = 9$) in 2003 represented 8.6% of the average index area redd counts for 41 years of available data (Appendix A3).

Table 6. Spatial and temporal distribution of spring chinook redds during 2003 Twisp River spawning ground surveys by reach and date.

Reach code	Week ending								Total
	04-Aug	11-Aug	18-Aug	25-Aug	01-Sep	08-Sep	15-Sep	22-Sep	
T1		0		0	0	0	0	0	0
T2		0	0	0	0	0	0		0
T3		0	0	0	1	0	0	0	1
T4	0	0	0	0	1	0	0		1
T5	0	0	0	1	5	1	0		7
T6	0	0		2	4	2	0		8
T7	0	0	0	1	0	0	0		1
T8	0		0	0	0	0			0
T9	0		0	0					0
T10	0		0	0	dry	dry	dry	dry	0
Total	0	0	0	4	11	3	0	0	18

Methow River Tributaries

Survey crews found a total 26 redds in Methow River tributaries and an additional 24 in hatchery outfall channels (Table 7). Spawning activity began in the third week of August in Early Winters and Suspension Creeks, the only tributaries with significant numbers of spawners. Peak spawning activity in these creeks and hatchery outfalls occurred during the last two weeks of August. Wildfires delayed or prevented access to survey sections on the Lost River and Early Winters Creek after the week of 8 September.

Table 7. Spatial and temporal distribution of spring chinook redds during 2003 upper Methow River tributary spawning ground surveys by reach and date.

Reach code	Week ending							Total
	04-Aug	11-Aug	18-Aug	25-Aug	01-Sep	08-Sep	15-Sep	22-Sep	
Lost River									
L1			0	0		fire	fire	fire	0
L2	0		0	1	0	fire	fire	fire	1
L3				0		fire	fire	fire	0
Early Winters Creek									
E1	0	0	0	0		fire	fire	0	0
E2		0	0	0	1	fire	fire	0	1
E3	0		1	1	1	fire	fire	0	3
E4	0		0	0		fire	fire	0	0
E5	0			0		fire	fire	0	0
Wolf Creek									
WLF1		0			0	2			2
Suspension Creek									
SC1			6	7	4		2	0	19
Hatchery Outfall Channels									
MH1	0	0	0	3	4	3	3		13
WN1	0	0	0	6	4	1			11
Total	0		7	18	14	6	5	0	50

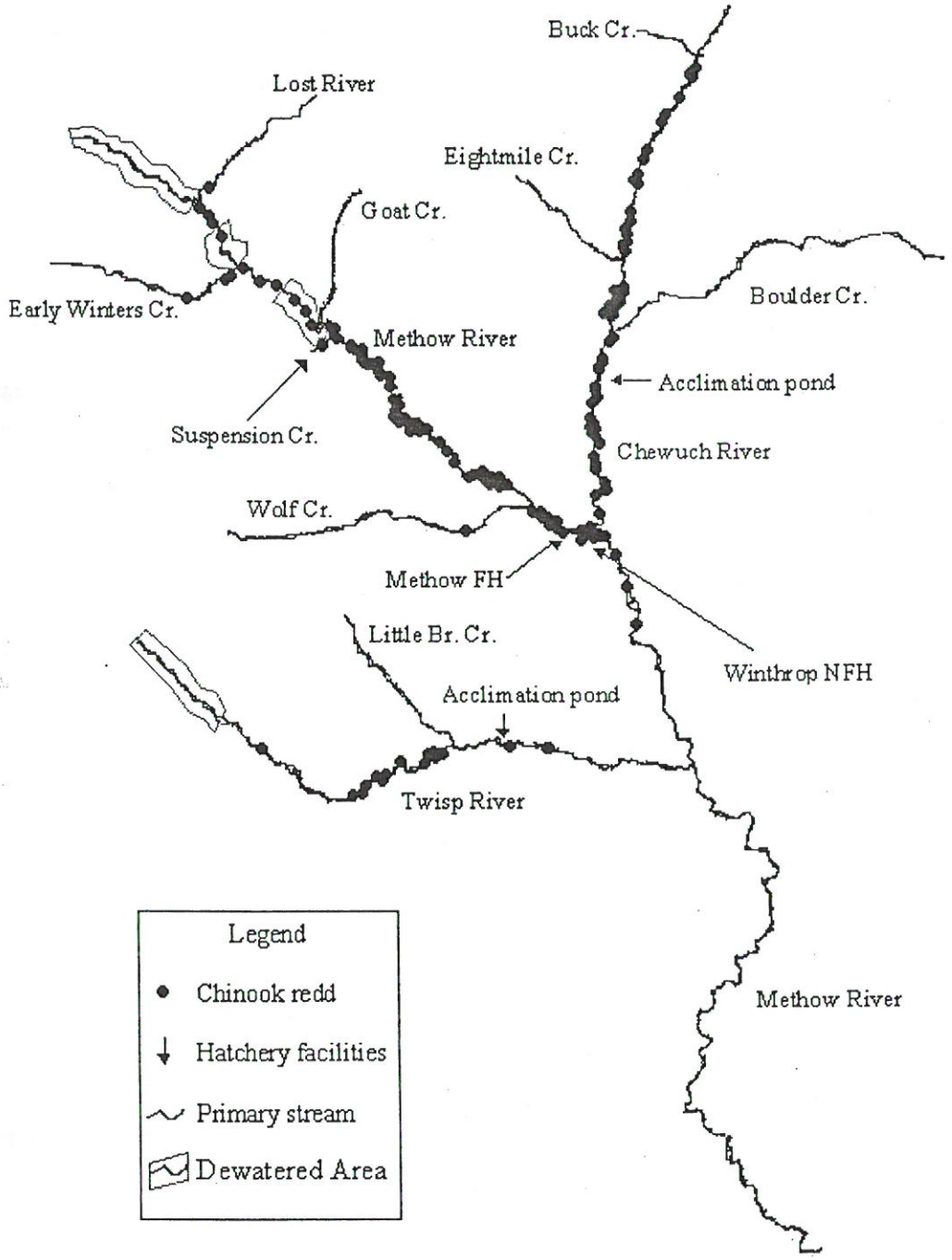

Figure 1. Spring chinook spawning distribution within the Methow River basin in 2003.

Spawning Population Characteristics

Methow Basin

Redd abundance was lower in Methow Basin when compared to 2002, 5-year, and 10-year averages. Surveys identified 474 redds in the Methow Basin, representing 39.8% of the 2002 redd count ($N = 1,192$). The five and ten year average redd counts for the Methow Basin were 1,229 and 790, respectively. Basin wide redd abundance in 2003 was affected by the lack of tributary escapement in 1998, and the low tributary escapement in 1999. In 1998, the entire spring chinook run returning past Wells Dam was collected for broodstock. In 1999, surveyors counted a total of 33 redds within the Methow Basin (Hubble et al. 2003). Poor natural escapement from the 1998 and 1999 broods resulted in tributary redd abundance based primarily on hatchery releases from those brood years.

The average redd distribution within the Methow Basin since the implementation of comprehensive redd counts in 1987 was 47.8% in the Methow River, 26.5% in the Chewuch River, and 25.6% in the Twisp River. Basin-wide redd distribution in 2003 (Figure 1) was divided between the Methow River and tributaries (53.1%) and the Chewuch River (43.0%). The Twisp river contained 3.8% of the Methow Basin redds ($N = 18$). Since 1987, the Lost River has contributed from 0.0% (1995) to 11% (1989) of the total production in the basin. In 2003 the Lost River contained 0.2% of the redds in the Methow basin ($N = 1$). This was likely due to the lack of tributary escapement in 1998 ($N = 0$ redds) and 1999 ($N = 3$ redds), and restricted access due to dry streambed upstream of Goat Creek from August through October 2003.

Methow River

The Methow River had 46.6% of the redds identified in the Methow Basin in 2003. Redds were found as far upstream as the Lost River confluence (M14) and downstream between the towns of Winthrop and Twisp (M5). Redds in the Methow River were concentrated within reaches M9 and M10, where 68.8% of all redds were located. A significant number of redds (19.3%) were also located from the town of Winthrop upstream to Wolf Creek (reaches M6 and M7).

As in the previous three seasons, proportions of redds in the highest and lowest reaches were 5% or less. Use of the Methow River above Mazama (M12-M15) is affected by intermittent access due to naturally occurring low flows and subsequent decreased egg survival in many years. The lowest reaches (M5-M6) were probably not historically significant spawning reaches, but have become more important spawning areas due to the proximity and direct release of fish from two hatchery locations (Figure 1). Proportional distributions of redds by reach in 2003 were similar when compared to the 2000-2002 average (Figure 2; Table 8).

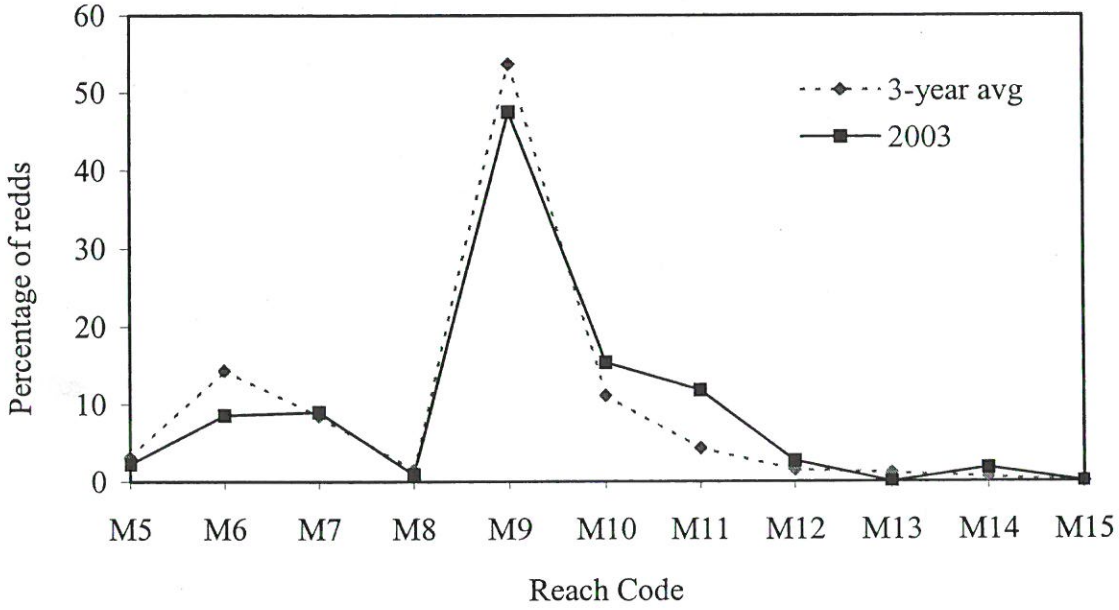

Figure 2. Proportional redd distribution of 2003 Methow River redds compared to 3-year (2000-2002) average.

Table 8. Density of spring chinook redds in the Methow River during 2003.

Reach	Length (km)	Redds	
		N	Density (redds/km)
M15	1.8	0	0
M14	3.0	4	1.3
M13	2.6	0	0
M12	2.0	6	3.0
M11	2.4	7	2.9
M10	3.4	34	10.0
M9	5.6	105	18.8
M8	1.4	2	1.4
M7	1.1	20	18.2
M6	1.7	19	11.2
M5	9.7	5	0.5
		Mean	6.1

Chewuch River

The Chewuch River contained 43.0% of all redds found in the basin in 2003. Redd distribution extended from the mouth upstream to the confluence of Lake Creek. No redds were found between Lake Creek and Thirty Mile Campground, although a single fish was observed in section C12 during surveys. The majority (99.0%) of the redds were located below Buck Creek (upper limit of C8). Highest redd densities were recorded in

reaches C4 and C2, with densities of 21.3 and 11.6 redds/km, respectively. High redd density in reach C4 is likely due to an abundance of quality spawning habitat and the close proximity of WDFW Chewuch Acclimation Pond. Relatively low spawner density in section C3 is due to lack of suitable spawning habitat between Boulder Creek and the Chewuch Bridge.

Reaches C10 through C12 contained significant production during the late 1980's but spawning activity above Lake Creek has been minimal since that time, averaging only 4.6 redds since 1991 (excluding years with 100% collection at Wells Dam). The amount of ash, soot, and other debris associated with the Farewell Peak Fire had a noticeable effect on water clarity and substrate composition, and may have affected spawner distribution in 2003.

The middle reaches of the Chewuch River (C3 through C9) had decreased redd abundance when compared to the 2000-2002 escapement. The proportion of redds within reaches C3 through C9 was 75.0%, 73.3%, and 70.1% in 2000, 2001, and 2002, respectively. In 2003, only 62.3% of the redds in the Chewuch River occurred within these reaches. Conversely, there was an increase in redd abundance in reach C2 in 2003. The proportion of redds in reaches C1 and C2 consisted of 25.0%, 25.3%, and 28.9% in 2000, 2001, and 2002, respectively. We estimated that 37.7% of all the redds in the Chewuch River occurred in reaches C1 and C2 in 2003 (Figure 3; Table 9).

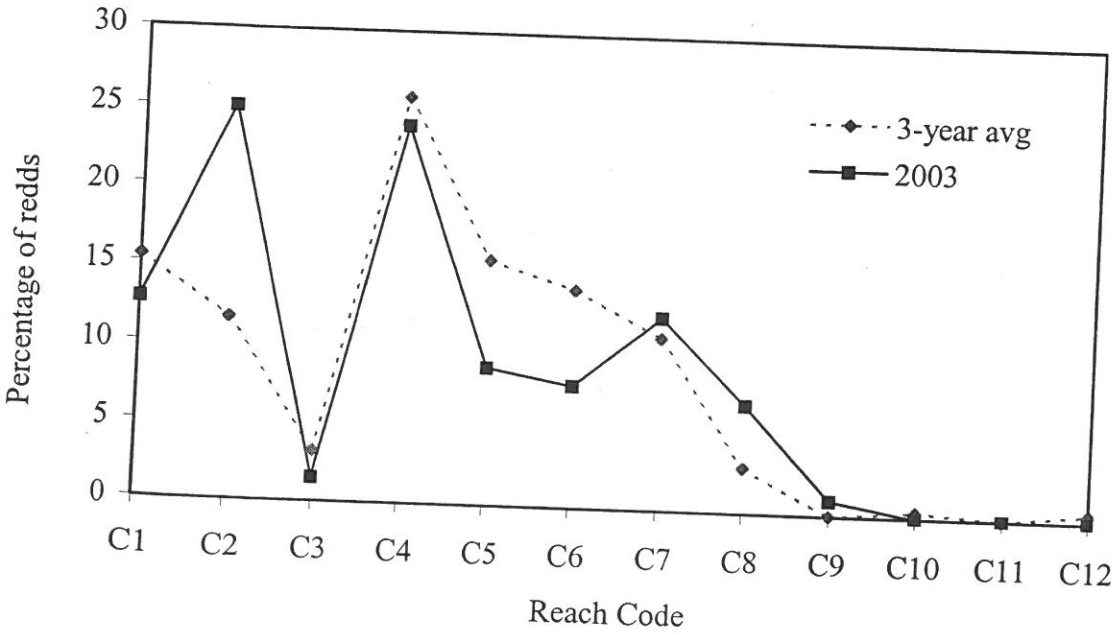

Figure 3. Proportional redd distribution of 2003 Chewuch River redds compared to 3-year (2000-2002) average.

Table 9. Density of spring chinook redds in the Chewuch River in 2003.

Reach	Length (km)	Redds	
		N	Density (redds/km)
C12	3.2	0	0
C11	2.7	0	0
C10	2.5	0	0
C9	1.4	2	1.4
C8	1.5	14	9.3
C7	3.2	25	7.8
C6	3.6	16	4.4
C5	2.3	18	7.8
C4	2.3	49	21.3
C3	1.1	3	2.7
C2	4.4	51	11.6
C1	3.3	26	7.9
		Mean	6.18

Twisp River

The Twisp River contained 3.8% of the total redds counted in the Methow Basin. The 2003 redd count represents 16.5% of the 2002 total and 14.7% of the overall average since 1987, excluding when 100% of the run was collected at Wells Dam.

Redd distribution throughout the middle reaches (T3-T7) was similar to the previous three year average, except in reach T5. No redds were found in the river above Mystery Bridge (reaches T8-T10). Lack of escapement to these reaches may have been due in part to the low water conditions in sections T9 and T10 that prevented fish passage. There were no redds found in the lowest sections of the Twisp River (T1 and T2) in 2003 (Figure 4; Table 10). Poor escapement in 1998 and 1999 coupled with limited spawning habitat and high water temperatures likely precluded spawning activity in these reaches in 2003. Mean water temperature during the survey period was 12.8°C, a maximum water temperature of 22.2°C was recorded near the confluence with the Methow River in mid-August.

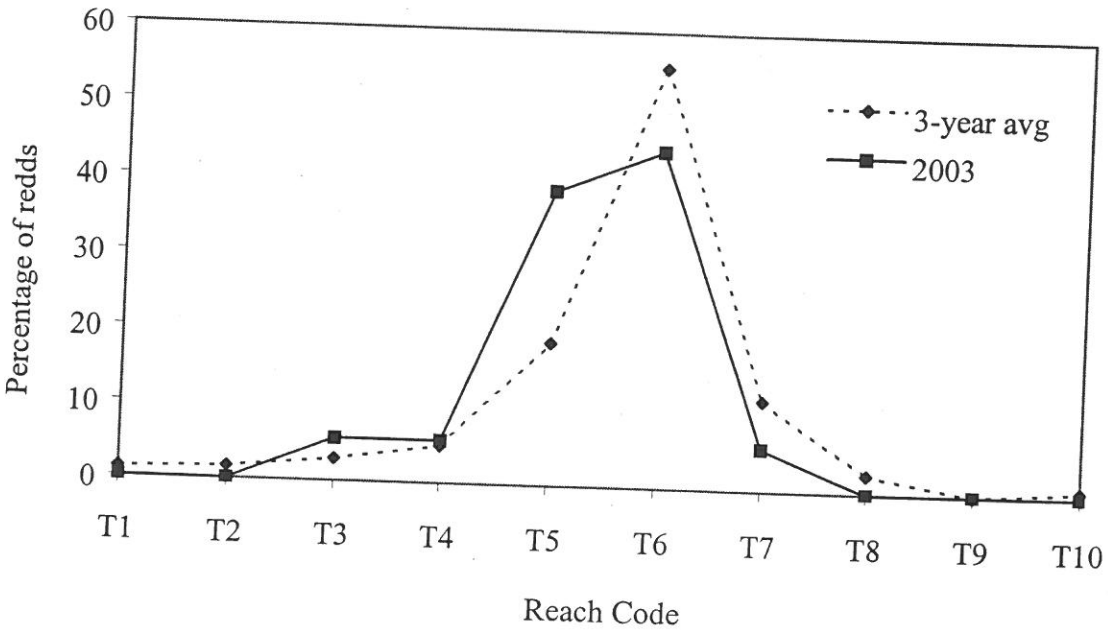

Figure 4. Proportional redd distribution of 2003 Twisp River redds compared to 3-year (2000-2002) average.

Table 10. Density of spring chinook redds in the Twisp River in 2003.

Reach	Length (km)	Redds	
		N	Density (redds/km)
T10	2.9	0	0
T9	2.0	0	0
T8	2.3	0	0
T7	4.3	1	0.2
T6	3.0	8	2.7
T5	3.9	7	1.8
T4	2.6	1	0.4
T3	2.3	1	0.4
T2	3.2	0	0
T1	2.0	0	0
		Mean	0.55

Methow River Tributaries

Our surveys identified a single redd in the Lost River in 2003. The average number of redds found in the Lost River from 1987-2002 was 35. The average number of redds over the last five years on the Lost River was 28. Limited numbers of redds in 2003 was due to the low water conditions which limited access to the Lost River and upper Methow River above the confluence of Early Winters Creek (M13-M15). Although few adult fish were expected to return due to low spawning escapements in 1998 and 1999.

Surveyors identified four redds in Early Winters Creek in 2003. The number of redds found in 2003 is similar to the average number of redds found in the creek from 1987-2002 (N = 5). Surveyors found 19 redds in Suspension Creek in 2003. Suspension Creek was previously considered part of the main stem Methow River and was consequently included within reach M11. We have elected to account for it separately due to flow and water temperature differences as compared to the Methow River, and to facilitate dewatering estimations that may affect the two spawning reaches differently. Suspension Creek supported the highest redd density within the Methow Basin (76.0 redds/km). A total of two redds were found in Wolf Creek in 2003. The 2000-2002 average was one redd. The utilization of Wolf Creek by spring chinook in 2003 was likely the result of the transplanting of 471 surplus adult spring chinook from the Winthrop National Fish Hatchery. Limited surveys were also conducted on Lake, Eightmile and Gold creeks but no spring chinook adults or redds were encountered. Surveyors identified 13 redds in the MSFH outfall channel and 11 in the WNFH outfall channel. These values are 30.2% and 42.3% of 2002 counts, respectively (Table 11).

Table 11. Density of spring chinook redds in Methow River tributaries during 2003.

Reach	Length (km)	Redds	
		N	Density (redds/km)
	Lost River		
L3	2.9	0	0
L2	3.6	1	0.3
L1	0.5	0	0
	Early Winters Creek		
E5	1.1	0	0
E4	1.3	0	0
E3	1.8	3	1.7
E2	0.2	1	5.0
E1	0.3	0	0
	Other Tributaries		
Suspension	0.25	19	76.0
Wolf	1.4	2	1.4
MSFH Outfall	0.2	13	65.0
WNFH Outfall	0.4	11	27.5

Tributary Escapement

The total 2003 escapement of spring chinook above Wells Dam was reported as 4,485 fish (FPC; www.fpc.org). Review of the daily passage numbers available from the FPC indicated that many of the fish passing in the final week of spring chinook counting were likely summer chinook (Figure 5). We reviewed 38 hours of video records for the period between 23 and 28 June 2003, and estimated that 2,124 of the fish counted as spring chinook were actually summer chinook. Determination of race was based on body size and coloration. Spring chinook passing Wells Dam during the review period were typically smaller in size and darker in color with a thin body shape. Summer chinook were typically larger fish that were lighter in color (e.g., chrome-bright) with a heavier body shape.

Based on releases of spring chinook above Wells Dam, an estimated 2.1% ($N = 50$) of the spring chinook passing Wells Dam in 2003 originated from Colville Confederated Tribe hatchery releases in the Okanogan Basin. Discounting summer chinook that were classified as spring chinook, the number of fish collected for hatchery broodstock at MSFH and WNFH ($N = 687$), and estimated escapement to the Okanogan River an estimated 1,624 spring chinook salmon returned to the Methow Basin and were available for spawning.

We incorporated age-3 spring chinook into tributary escapement estimates by applying the proportion of age-3 spring chinook present in Wells Dam counts (7.3%) to the Meekin value (2.2), yielding 2.4 fish per redd. Tributary escapement values were calculated separately by expanding the total redd counts of each stream by the redd expansion value (Table 12). Our total estimated tributary escapement ($N = 1,137$) accounts for 70.0% of the adjusted Wells Dam count. The redd based tributary escapement estimate does not account for prespawn mortality, dam fall back, illegal harvest, predation, straying, or undetected spawning in other tributaries.

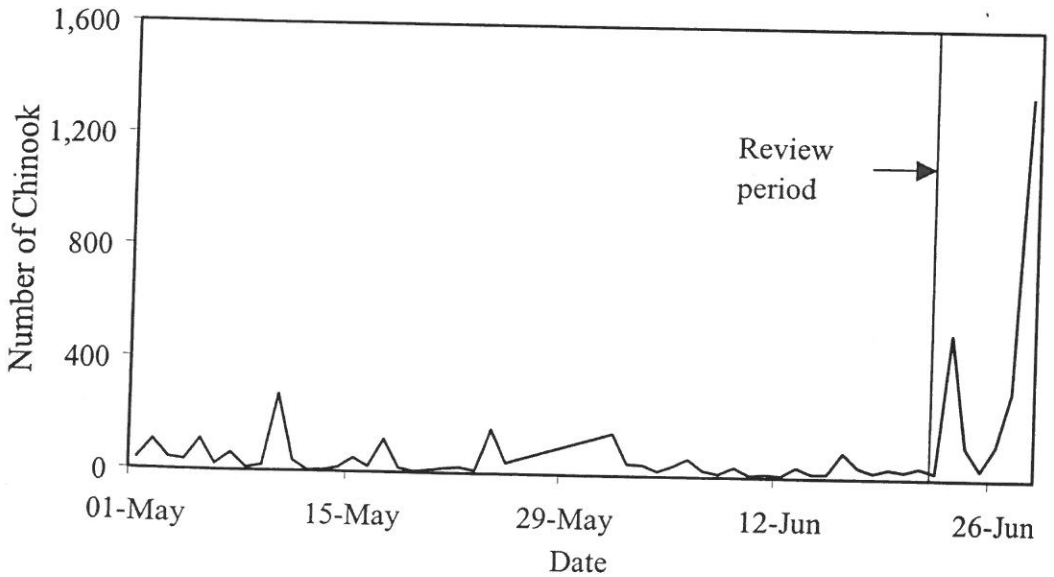

Figure 5. 2003 spring chinook passage at Wells Dam and period of review.

Table 12. Estimate of 2003 Methow basin spring chinook escapement and fish passage at Wells Dam.

Population	Redds (*N*)	Tributary escapement (2.4 fish per redd)
Methow River	251	602
Chewuch River	204	490
Twisp River	18	43
Lost River	1	2
Total escapement above Wells Dam (Percent of Wells Dam count)[a]	474	1,137 (70.0)

[a] Wells Dam count (4,485) minus summer chinook (2,124) minus hatchery broodstocks (687) minus Okanogan spring chinook (50) = 1,624 spring chinook.

Hatchery Contribution

We assumed the location of carcasses recovered to be the same as the spawning location. Unknown origin carcasses were those where neither CWT, scale analysis, or mark information could positively identify origin or hatchery release location. Comparisons of hatchery and wild distribution were not made due to the small number of wild fish recovered.

Methow River

We recovered a total of 264 carcasses on the Methow River in 2003 (43.8%). Of those carcasses, 79% were recovered downstream of Weeman Bridge (M9-M5). The majority of all carcasses recovered in the Methow River were hatchery origin fish (98.1%; N = 252). Wild origin carcasses were limited to 1.9% (N=5) of the total recovery on the Methow River. The origin of remaining fish was undeterminable. High proportions of hatchery fish ($\geq$ 88%) were recovered in all reaches where carcasses were found. No carcasses were recovered in reaches M14 or M15. Coded wire tag recoveries in the Methow River consisted primarily of Methow Composite stock spring chinook released from MSFH (64.9%; N = 137). Recoveries of spring chinook released from WNFH and from MSFH Twisp Acclimation Pond were 29.4% (N = 62) and 5.2% (N = 11), respectively. One summer chinook carcass was also recovered (Table 13; Appendix B1).

Table 13. Summary of spring chinook carcasses by origin and reach on the Methow River during 2003

Reach	Hatchery origin		Wild origin		Total
	N	%	*N*	%	
M13	1	100	0	0	1
M12	9	90	1	10	10
M11	12	100	0	0	12
M10	33	100	0	0	33
M9	80	98	2	2	82
M8	15	88	2	12	17
M7	27	96	0	0	27
M6	45	88	0	0	45
M5	30	100	0	0	30
Total	252	98.1%	5	1.9%	257

Chewuch River

We recovered a total of 203 carcasses from the Chewuch River (41.4%). All recoveries were made downstream of the confluence of Buck Creek (C1 – C8). No carcasses were recovered from Buck Creek to Thirty Mile Campground (C9-C12). Of the carcasses recovered, 94.0% were of hatchery origin ($N = 189$), 6.0% were of wild origin ($N = 12$). The origin could not be determined on the remaining carcasses ($N = 2$). The highest proportions of hatchery origin carcass recoveries were in sections C1, C3, and C8 (i.e., 100%). Of 161 coded wire tag recoveries in the Chewuch River, the majority were MSFH Methow Composite stock spring chinook (94.4%, N=152). Recoveries of WNFH spring chinook releases comprised 2.9% of the spring chinook CWT recoveries. One additional spring chinook CWT (0.5%) from a Nez Perce Tribe Lolo Creek release was also recovered (Table 14; Appendix B2).

Table 14. Summary of spring chinook carcasses by origin and reach on the Chewuch River during 2003.

Reach	Hatchery origin		Wild origin		Total
	N	%	*N*	%	
C8	17	100	0	0	17
C7	26	93	2	7	28
C6	24	86	4	14	28
C5	18	95	0	0	18
C4	32	97	1	3	33
C3	9	100	0	0	9
C2	51	89	5	9	56
C1	12	100	0	0	12
Total	189	94%	12	6%	201

Twisp River

We recovered a total of ten carcasses in the Twisp River (23.2%). No carcasses were recovered above War Creek Bridge (T7-T10). A single carcass was recovered from the lowest three reaches (T1-T3). The proportion of wild fish recovered was greater on the Twisp River (60%) than any other survey reach in the Methow Basin, although the total number of recoveries was low. The greatest proportions of hatchery origin carcasses recovered were in the two reaches immediately above the Twisp Acclimation Pond (T4 and T5). The three CWTs recovered from the Twisp River were from MSFH Twisp River releases (75%). No CWT was recovered from the fourth hatchery fish, but scale analysis indicated the fish was of hatchery origin (Table 15; Appendix B3).

Table 15. Summary of spring chinook carcasses by origin and reach on the Twisp River during 2003

Reach	Hatchery origin		Wild origin		Total
	N	%	*N*	%	
T6	1	33	2	67	3
T5	2	50	2	50	4
T4	1	50	1	50	2
T3	0	0	0	0	0
T2	0	0	1	100	1
T1	0	0	0	0	0
Total	4	40%	6	60%	10

Methow River Tributaries

Carcasses found in miscellaneous Methow River tributaries and hatchery outfalls comprise 9.5% of all carcasses found in the Methow Basin in 2003 ($N = 45$). All carcasses recovered in tributaries were of hatchery origin (Table 16).

A total of seven carcasses were recovered from Early Winters Creek in 2003. Coded wire tag recoveries indicate that 42.8% of the fish were from WNFH releases ($N = 3$), and 42.8% were from MSFH releases ($N = 3$). One additional fish did not have a CWT, but scale analysis indicated that the fish was of hatchery origin.

No carcasses were recovered in the Lost River during 2003 surveys. This was due to limited escapement to the Lost River.

We recovered a total of three carcasses from Wolf Creek in 2003. Escapement to Wolf Creek may have been supplemented by the transfer of 471 non-ESA adult spring chinook from WNFH to Wolf Creek. Coded wire tags recovered in Wolf Creek were from WNFH releases (66.6%; $N = 2$) and MSFH releases (33.3%; $N = 1$). Transfers did not appear to affect the number of WNFH-origin carcasses recovered on the Methow River near the mouth of Wolf Creek (M7 and M8). In these sections, two (9.5%; M7) and one (11.1%; M8) WNFH-origin carcasses were recovered. Transplanted spring chinook

adults likely moved farther upstream into reach M9 and M10 of the Methow River where 55.3% ($N = 21$) and 34.6% ($N = 9$) of all decoded CWTs were of WNFH-origin.

We recovered a total of 12 carcasses from Suspension Creek in 2003. Of those fish, eight CWTs were successfully decoded. Coded wire tag recoveries consisted of WNFH releases (37.5%; $N = 3$), MSFH Methow Composite releases (37.5%; $N = 3$), one MSFH Twisp River fish (12.5%), and one post-spawn Lyons Ferry Fall Chinook (12.5%).

A total of 13 and 17 carcasses were recovered from the MSFH and WNFH outfalls, respectively. All carcasses recovered at both sites were of hatchery origin. Of those 11 and 16 CWTs successfully decoded from the MSFH and WNFH outfalls, respectively. Coded wire tag information indicates that MSFH releases were the primary component of the MSFH Outfall recoveries (63.6%; $N = 7$). While spring chinook released from WNFH were the primary component of the carcasses recovered in the WNFH Outfall (62.5%; $N = 10$).

Table 16. Summary of spring chinook carcass origin by reach in Methow River tributaries during 2003.

Reach	Hatchery origin		Wild origin		Total
	N	%	*N*	%	
E3	4	100	0	0	4
E2	2	100	0	0	2
E1	1	100	0	0	1
Total	7	100	0	0	7
WLF1	3	100	0	0	3
SC1	12	100	0	0	12
MH1	13	100	0	0	13
WN1	17	100	0	0	17
Total	45	100%	0	0%	45

Age Structure

Methow River and Tributaries

All carcasses recovered from Early Winters, Suspension and Wolf Creeks as well as both hatchery outfalls were combined with Methow River carcasses for the purpose of age structure analysis. Age structure and length at age information did not differ between the main stem and tributaries. All length at age data for the Methow River and its tributaries are presented in Table 17 and Figure 6.

The modal age of hatchery male and female spring chinook salmon was age-5, representing 42.0% and 43.8% of the total recoveries, respectively. The remaining hatchery male recoveries were primarily age-4 fish (1.7%), and age-3 fish (2.8%). The overall contribution of age-4 hatchery females was 7.6% of the total recoveries. A single age-2 hatchery precocial male from the 2001 brood MSFH Methow Composite release was also recovered (0.3%). The length frequency distribution reflects the high incidence of age-5 fish and low incidence of age-4 fish.

Table 17. Post Orbital-hypural length (cm) at age information for spring chinook carcasses recovered from the Methow River and tributaries in 2003.

Total age	Male				Female			
	Mean	SD	*N*	%	Mean	SD	*N*	%
				Hatchery				
5	75.8	4.7	121	42.0	71.4	3.9	126	43.8
4	62.0	5.1	5	1.7	60.6	5.2	22	7.6
3	38.0	5.2	8	2.8				
2	14.0		1	0.3				
				Wild				
5	79.0		1	0.3				
4				0.0	63.0		1	0.3
3	38.0	1.0	3	1.0				

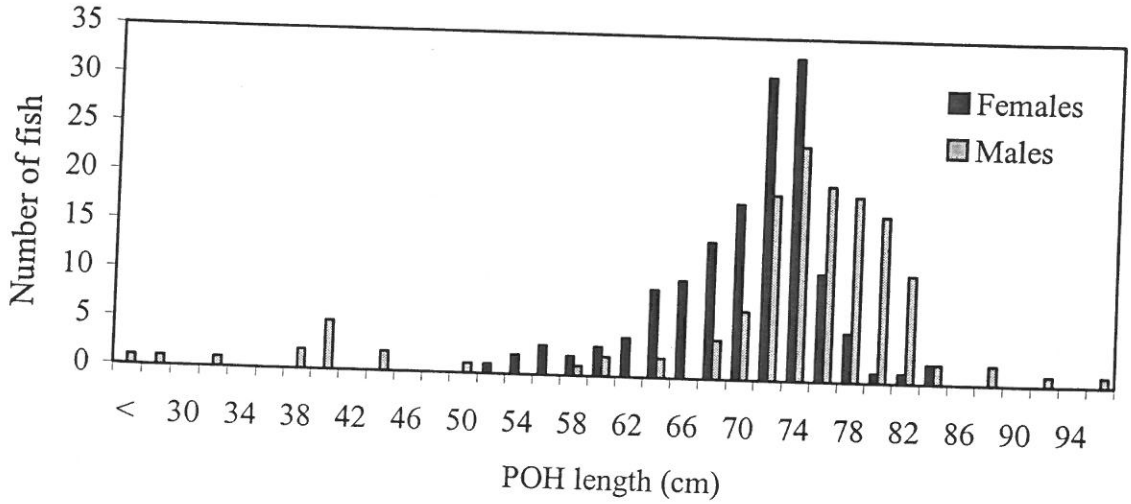

Figure 6. Length frequency of Methow River and tributaries spring chinook carcasses recovered in 2003.

Chewuch River

The modal age of both hatchery male and female carcasses recovered in the Chewuch River was age-5, representing 39.4% and 40.9% of the total recoveries, respectively. Hatchery male age-4 fish contributed 1.0% of the total recovery and hatchery male age-3 fish contributed 9.8%. Hatchery female age-4 fish only contributed 2.6% of the total recoveries. Modal age of wild males and female carcasses recovered in the Chewuch was age-5, with overall contributions of 2.1% and 2.6%, respectively. Wild age-3 males contributed 1.0% of the total recoveries and wild age-4 females contributed 0.5% of the total recoveries ($N = 1$). Surveyors did not recover any age-4 wild male carcasses in the Chewuch River. The length frequency distribution reflects the high incidence of age-5 fish and low incidence of age-4 fish (Table 18; Figure 7).

Table 18. Post orbital-hypural length (cm) at age information for spring chinook carcasses recovered from the Chewuch River in 2003.

Total age	Male				Female			
	Mean	SD	*N*	%	Mean	SD	*N*	%
				Hatchery				
5	75.2	4.6	76	39.4	70.8	3.8	79	40.9
4	54.5	6.3	2	1.0	59.0	4.4	5	2.6
3	38.1	4.2	19	9.8				
				Wild				
5	77.2	2.8	4	2.1	72.8	3.3	5	2.6
4					61.0		1	0.5
3	35.0	1.4	2	1.0				

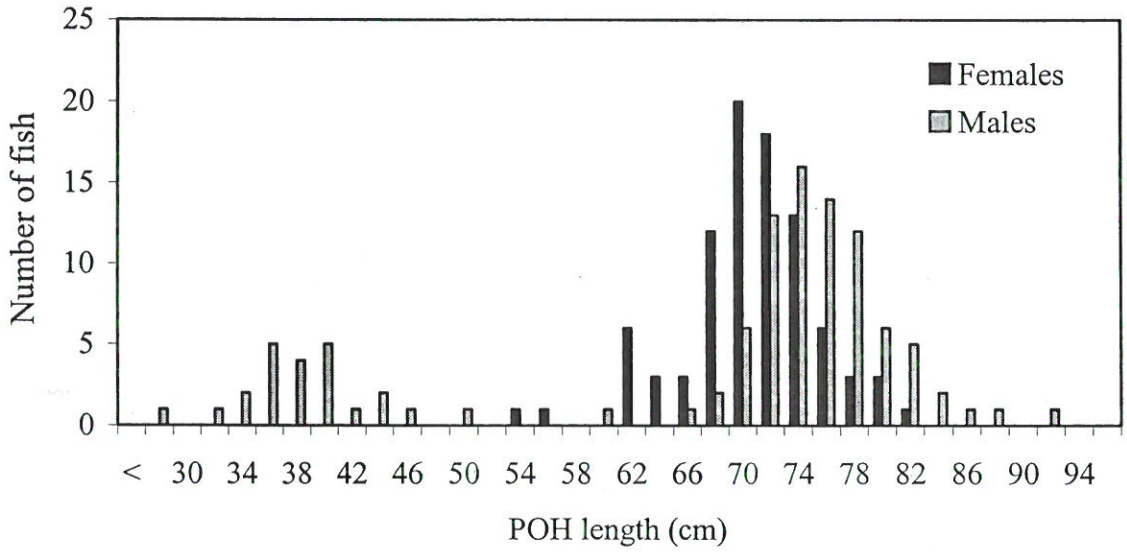

Figure 7. Length frequency of Chewuch River spring chinook carcasses recovered in 2003.

Twisp River

Only ten carcasses were recovered on the Twisp River in 2003, representing 23.3% of the estimated escapement to the spawning grounds. Hatchery fish represented 40% of the total recoveries and were divided between age-3 males ($N = 2$), and age-4 females ($N = 2$). Modal age of wild males and females was age-3 (20%) and age-5 (30%), respectively. A single wild age-4 female represented 10% of the total recoveries. The Twisp River carcass recoveries exhibited the highest proportion of wild fish (60%) of all tributaries sampled in the Methow Basin. The length frequency distribution reflects the low number of total recoveries in the Twisp River in 2003 (Table 19; Figure 8).

Table 19. Post orbital-hypural length (cm) at age information for spring chinook carcasses recovered from the Twisp River in 2003.

	Male				Female			
Total age	Mean	SD	*N*	%	Mean	SD	*N*	%
				Hatchery				
5								
4					59.5	3.5	2	20.0
3	40.0	1.4	2	20.0				
				Wild				
5					74.0	4.0	3	30.0
4					63.0		1	10.0
3	37.0	2.8	2	20.0				

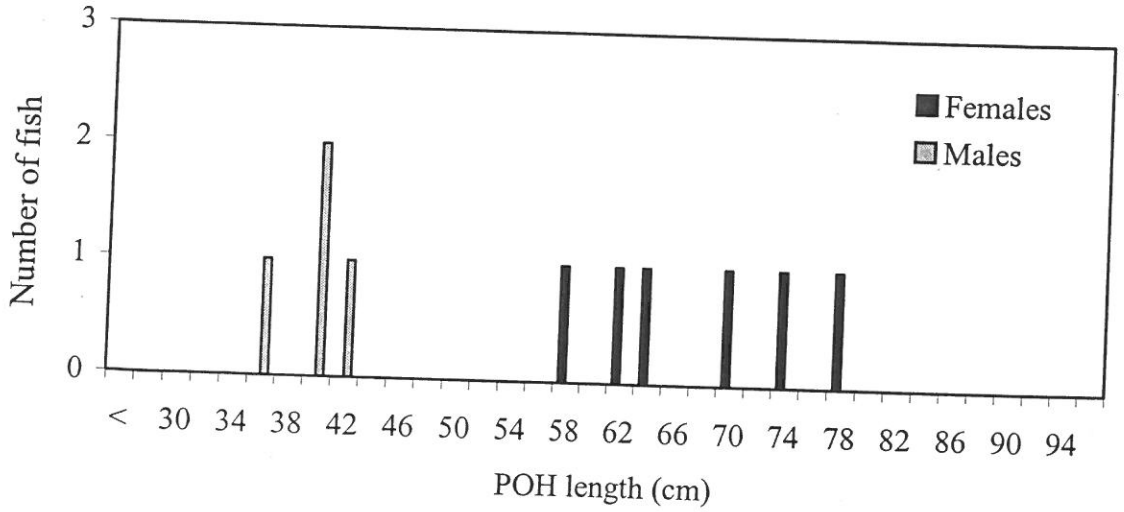

Figure 8. Length frequency of Twisp River spring chinook carcasses recovered in 2003.

Egg Voidance

Surveyors examined all females for egg voidance (Table 20). Of the 260 female spring chinook encountered, 223 (85.8%) were in suitable condition to determine egg voidance. Prespawn females totaled 32 of the female carcasses found within the Methow Basin (12.3%), only one of which was a wild origin fish from the Twisp River. Of the 223 females that successfully spawned, the average voidance was 99.4% (SD 1.7%, range 87.3-100%). Average fecundity values (*N*, SD) of Methow Composite stock age-4 and age-5 were 3,795 (17, 759) and 4,839 (31, 1,403), respectively. Average values for Twisp stock age-4 and age-5 fish were 3,452 (12, 1,018) and 5,765 (35, 1,360), respectively.

Table 20. Summary of 2003 Methow Basin spring chinook egg voidance examinations.

River	Females recovered (*N*)	Females examined (*N*)	Mean egg voidance (%)	Range[a] (%)
Methow River	158	140	99.6	95.4-100
Chewuch River	96	79	99.0	87.3-100
Twisp River	6	4	99.7	88.1-100
Total	260	223	99.4	87.3-100

[a] Values do not include pre-spawn mortality.

Redd Dewatering

GPS analyses and field notes revealed a total of 12 redds dewatered on the Methow River. These consisted of four redds dewatered in reach M11, seven in reach M12 and one in reach M13. No redds were recorded as dewatered in the Chewuch or Twisp rivers or in any of the smaller tributaries. In years of much higher spawning densities (e.g.,

2001 and 2002) the numbers of redds dewatered on the upper Methow were as high as 183 (Hubble et al. 2003). Two dewatered redds were also reported on the Twisp River in 2001 and 2002. Dewatering in 2003 was less dramatic than past years due largely to the extremely low water levels that occurred early in the spawning season, limiting access to spawning grounds that would typically dewater.

Precocial Snorkeling

A total of 19 redds were snorkeled between 28 August and 3 September. Of those redds eight, five, and six active redds were sampled on the Methow River, Suspension Creek and Chewuch River, respectively. No actively spawning fish were observed on the Twisp River, thus no redds were snorkeled. No precocial male spring chinook were associated with any snorkeled redds in 2003. However, one precocial hatchery male (2001 Methow Composite) was recovered during spawning ground surveys on the Methow River. This fish was noted as sexually mature and expressing milt.

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APPENDICES

APPENDIX A1

Historical Methow River spring chinook redd counts by section and year.

Year	Section											Index total	Total ground surveys
	M5	M6	M7	M8	M9	M10	M11	M12	M13	M14	M15		
1960												97	--
1961												23	--
1962												187	--
1963												110	--
1964												127	--
1965												111	--
1966												233	--
1967												140	--
1968												92	--
1969												57	--
1970												150	--
1971												113	--
1972												65	--
1973												95	--
1974												49	--
1975												39	--
1976												34	--
1977												65	--
1978												67	--
1979												12	--
1980												25	--
1981												39	--
1982												56	--
1983												63	--
1984												43	--
1985												23	--
1986												63	--
1987						58	17					75	256
1988						59	23					82	262
1989	2					48	12			6		60	110
1990	7					56	24			11		80	194
1991	3	3	2	0	16			3	0	15	0	31	74
1992	21	22	25	17	109	78	12	2	19	24	0	90	336
1993	15	11	13					11	15	32	1	92	190
1994	2	0	3	2	34			8	2	5	0	8	64
1995	0	0	2	0	0	5	2	0	0	0	0	7	9
1996[b]	--	--	--	--	--	--	--	--	--	--	--	--	--
1997												4	56

Appendix A1, continued.

Year	Section											Index total	Total ground surveys
	M5	M6	M7	M8	M9	M10	M11	M12	M13	M14	M15		
1998[a]	--	--	--	--	--	--	--	--	--	--	--	--	--
1999												2	17
2000	3	47	14	3	120	18	5	2	0	0	0	23	212
2001	38	272	188	100	1893	445	8	15	2	1	0	453	2,962
2002	51	116	78	1	306	36	19	12	29	4	0	55	652
2003	5	19	20	2	105	34	7	6	0	4	0	41	247

[a] Surveys not preformed due to100% collection of run at Wells Dam.

APPENDIX A2

Historical Chewuch River spring chinook redd counts by section and year.

Year	Section												Index totals	Total ground surveys
	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12		
1960													155	--
1961						56								--
1962						58								--
1963						78								--
1964						176								--
1965						34								--
1966						91								--
1967														--
1968							30						--	--
1969														--
1970													49	--
1971													46	--
1972													33	--
1973													97	--
1974													89	--
1975													52	--
1976						98								--
1977						22								--
1978						107								--
1979													146	--
1980													31	--
1981													22	--
1982													7	--
1983													10	--
1984													35	--
1985													39	--
1986													127	--
1987					24	54	23			0			34	--
1988						15	40			0			77	191
1989	12	30				32	12			0			55	202
1990	19	2				36	25			0			44	160
1991	13	15	0	11	5	16	14	11	0	0	0	6	61	158
1992	0	9	1	24	36	55	22	26	0	0	0	12	30	91
1993	3	2	0	8	12	22	13	14	1	0	0	8	77	185
1994	4	6	0	0	1	3	8	3	0	0	0	2	35	83
1995	0	0	0	0	0	0	0	2	0	0	0	0	11	27
1996[a]	--	--	--	--	--	--	--	--	--	--	--	--	0	2
1997										0			--	--
1998[a]	--	--	--	--	--	--	--	--	--	--	--	--	27	55
1999										0			--	--
													0	6

Appendix A2, continued.

Year	Section												Index total	Total Ground surveys
	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12		
2000	5	3	1	7	4	6	5	1	0	0	0	0	11	32
2001	179	101	59	185	246	146	86	23	1	11	fire	fire	232	1,037
2002	40	47	2	113	32	27	27	10	0	0	0	3	54	301
2003	26	51	3	49	18	16	25	14	2	0	0	0	41	204

[a] Surveys not preformed due to100% collection of run at Wells Dam.

APPENDIX A3

Historical Twisp River spring chinook redd counts by section and year.

Year	Section										Index total	Total ground surveys
	T1	T2	T3	T4	T5	T6	T7	T8	T9	T10		
1960											199	--
1961											45	--
1962											203	--
1963											132	--
1964											211	--
1965											138	--
1966											257	--
1967											135	--
1968											190	--
1969											123	--
1970											75	--
1971											97	--
1972											97	--
1973											247	--
1974											129	--
1975											177	--
1976											53	--
1977											174	--
1978											265	--
1979											40	--
1980											27	--
1981											24	--
1982											17	--
1983											58	--
1984											48	--
1985											95	--
1986											38	--
1987						48	31				79	164
1988						49	62				111	199
1989					41	57	43			0	100	179
1990					19	46	31			1	77	112
1991	0	0	0	0	17	17	23	8	4	0	40	69
1992	0	15	25	0	16	42	31	6	6	0	73	141
1993	0	8	21	0	15	70	38	22	18	0	108	192
1994	0	0	0	0	6	12	1	13	0	0	13	32
1995	0	0	2	0	0	1	1	0	0	0	2	4
1996[a]	--	--	--	--	--	--	--	--	--	--	--	--
1997				1	12					1	12	32
1998[a]	--	--	--	--	--	--	--	--	--	--	--	--
1999											1	7

Appendix A3, continued.

Year	Section										Index total	Total ground surveys
	T1	T2	T3	T4	T5	T6	T7	T8	T9	T10		
2000	0	0	3	8	23	48	15	0	0	2		99
2001	10	8	21	25	79	190	29	7	0	1	219	370
2002	1	3	0	0	13	72	14	6	0	0	86	109
2003	0	0	1	1	7	8	1	0	0	0	9	18

[a] Surveys not preformed due to100% collection of run at Wells Dam.

APPENDIX A4

Historical Lost River and Early Winters Cr. spring chinook redd counts by section and year.

Year	Lost River		Index total	Total ground surveys	Early Winters Cr.					Index total	Total ground surveys
	L1	L2			E1	E2	E3	E4	E5		
1987	4	52	52	56			8		6	--	14
1988	0	53	53	53			9		8	--	17
1989	4	53	53	57			6		5	--	11
1990	2	31	31	33			1		0	--	1
1991	0	16	16	16			0		0	--	0
1992	2	71	71	73			1		2	--	3
1993	0	51	51	51			1		0	--	1
1994	0	6	6	6			0		4	--	4
1995	0	0	0	0			0		0	--	0
1996[a]	--	--	--	--			--		--	--	--
1997	0	7	7	7			0		0	--	0
1998[a]	--	--	--	--			--		--	--	--
1999	3	0	0	3			0		0	--	0
2000	2	0	0	2			0		1	--	1
2001	16	56	56	72			9		8	--	17
2002	14	40	40	54	0	6	0	0	0	6	6
2003	0	1	1	1	0	1	3	0	0	1	4

[a] Surveys not preformed due to100% collection of run at Wells Dam. From 1987-2001, Early Winters Cr. redd counts were combined for reaches E1-E3 and E4-E5.

APPENDIX B1

Coded wire tag recoveries from the Methow River in 2003.

Brood	Hatchery	Stock (release)	CWT code	Recoveries	Mark rate	Expanded recoveries
1998	EBFH	MEOK	631033	1	0.987	1
1998	MSFH	MetComp	631024	117	0.954	123
1998	MSFH	Twisp	631041	1	0.974	1
1998	WNFH	WNFH	053632	5	0.966	5
1998	WNFH	WNFH	054406	10	0.962	10
1998	WNFH	WNFH	054613	1	0.971	1
1998	WNFH	WNFH	054614	2	0.950	2
1998	WNFH	WNFH	054615	1	0.976	1
1998	WNFH	WNFH	054616	4	0.998	4
1998	WNFH	WNFH	054841	3	0.961	3
1998	WNFH	WNFH	054931	7	0.960	7
1998	WNFH	WNFH	054949	25	0.969	26
1999	MSFH	MetComp (Methow)	630377	11	0.992	11
1999	MSFH	Twisp	630378	4	0.996	4
1999	MSFH	Twisp	630379	4	0.995	4
1999	MSFH	Twisp	630378	1	0.996	1
1999	WNFH	WNFH	054408	1	0.993	1
1999	WNFH	WNFH	054656	1	0.992	1
2000	MSFH	MetComp (Chewuch)	630776	2	0.958	2
2000	WNFH	MetComp (WNFH)	054441	1	1.000	1
2000	MSFH	Twisp	630182	1	0.991	1
2001	MSFH	MetComp (Methow)	631477	1	0.975	1
			Total	204		212

APPENDIX B2

Coded wire tag recoveries from the Chewuch River in 2003.

Brood	Hatchery	Stock (release)	CWT code	Recoveries	Mark rate	Expanded recoveries
1998	WNFH	WNFH	053632	1	0.966	1
1998	WNFH	WNFH	054406	2	0.962	2
1998	WNFH	WNFH	054931	1	0.960	1
1998	WNFH	WNFH	054949	1	0.969	1
1999	Nez Perce	Clearwater (Lolo Cr)	610102	1	- -	1
1999	MSFH	MetComp (Methow)	630377	3	0.992	3
2000	MSFH	MetComp (Chewuch)	630776	11	0.958	11
1998	MSFH	MetComp	631024	141	0.954	148
			Total	161		162

APPENDIX B3

Coded wire tag recoveries from the Twisp River in 2003.

Brood	Hatchery	Stock	CWT code	Recoveries	Mark rate	Expanded recoveries
2000	MSFH	Twisp	630182	1	0.991	1
1999	MSFH	Twisp	630378	1	0.996	1
1999	MSFH	Twisp	630379	1	0.995	1
			Total	3		3

APPENDIX B4

Coded wire tag recoveries from Methow River tributaries in 2003.

Brood	Hatchery	Stock (release)	CWT code	Recoveries	Mark rate	Expanded recoveries
Early Winters Cr						
1998	WNFH	WNFH	054406	1	0.962	1
1999	WNFH	WNFH	054408	1	0.993	1
1998	WNFH	WNFH	054949	1	0.969	1
1998	MSFH	MetComp	631024	3	0.954	3
			Total	6		6
MSFH Outfall						
1998	WNFH	WNFH	053632	1	0.966	1
1998	WNFH	WNFH	054613	1	0.971	1
1998	WNFH	WNFH	054949	2	0.969	2
1999	MSFH	MetComp (Methow)	630377	2	0.992	2
1998	MSFH	MetComp	631024	5	0.954	5
			Total	11		11
Suspension Creek						
1999	Lyons Ferry	Lyons Ferry Fall	630478	1	0.996	1
1998	WNFH	WNFH	054406	1	0.962	1
1998	WNFH	WNFH	054949	2	0.969	2
1999	MSFH	MetComp (Methow)	630377	1	0.992	1
1999	MSFH	Twisp	630381	1	0.995	1
1998	MSFH	MetComp	631024	2	0.954	2
			Total	8		8
WNFH Outfall						
1998	WNFH	WNFH	053632	3	0.966	3
1998	WNFH	WNFH	054406	1	0.962	1
1998	WNFH	WNFH	054931	3	0.960	3
1998	WNFH	WNFH	054949	3	0.969	3
1999	Umatilla	Umatilla River	093157	1	0.409	2
1998	MSFH	MetComp	631024	5	0.954	5
			Total	16		17
Wolf Creek						
1998	WNFH	WNFH	054931	1	0.960	1
1998	WNFH	WNFH	054949	1	0.969	1
1998	MSFH	MetComp	631024	1	0.954	1
			Total	3		3
			Grand total	44		45