U.S. Fish & Wildlife Service

SPRING AND SUMMER CHINOOK SALMON SPAWNING GROUND SURVEYS ON THE ENTIAT RIVER, 2007

U. S. Fish and Wildlife Service
Mid-Columbia River Fishery Resource Office
7501 Icicle Road
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February, 2008

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The correct citation for this report is:

Hamstreet, C.O. 2008. Spring and Summer Chinook Salmon Spawning Ground Surveys on the Entiat River, 2007. U. S. Fish and Wildlife Service, Leavenworth, WA.

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INTRODUCTION

From 1962 to 1994, spring Chinook salmon, *Oncorhynchus tshawytscha*, spawning was monitored by the Washington Department of Fish and Wildlife (WDFW) in a seven-mile section of the Entiat River known as the "index area" (river mile (rm) 28.9 to 21.3). From 1957 to 1991, Chelan County Public Utility District monitored summer Chinook salmon spawning in the lower ten miles (rm 10.4 to 0) of the Entiat River. In 1994, the United States Fish and Wildlife Service (USFWS), Mid-Columbia River Fishery Resource Office (MCRFRO), began monitoring spring and summer Chinook salmon spawning more intensely on the Entiat River. Efforts in 2007 mark the 14th year that MCRFRO has conducted the expanded spawning surveys.

The objectives of the spawning surveys are to:

1. Continue to assess the distribution of spring and summer Chinook salmon spawning throughout the index and expanded areas of the Entiat & Mad rivers and provide estimates of the respective spawning populations.

2. Evaluate possible straying of hatchery spring and summer Chinook salmon.

3. Search for and note presence and/or redds of other salmonid species, which may include sockeye salmon, *O. nerka*, coho salmon, *O. kisutch*, Pacific lamprey, *Entosphenus tridentatus* and bull trout, *Salvelinus confluentus* and identify their spawning distribution in the survey sections.

STUDY AREA

The Entiat River Basin is located in Chelan County, north-central Washington State. The river heads in a glaciated basin near the crest of the Cascade Mountains and flows southeasterly. Base flow is 385 cubic feet per second (Mullan et al. 1992) and major tributaries are the North Fork (rm 34) and Mad River (rm 10.5). The upstream limit of anadromy is Entiat Falls (rm 33.8).

The Entiat system drains an area of about 416.5 square miles. The watershed is nearly 42 miles in length and varies in width from 5 to 14 miles. The basins highest elevation is the 9,249 foot summit of Mt. Fernow and its lowest is about 700 feet at the confluence with the Columbia River (USDA 1979). The Entiat River enters the Columbia River at approximately river mile 484 and eight main stem hydroelectric dams above the Pacific Ocean.

Spring Chinook salmon spawning ground surveys were conducted between Fox Creek Campground (C.G.) and McKenzie Diversion Dam (rm 28.1 to 16.2), and Mad River (rm 3.5 to 1.5) (Figure 1). Summer Chinook salmon surveys focused on Reaches 1 through 5 (rm 28.1 to 16.2) and from Entiat NFH to the Columbia River influence (rm 6.8 to 0.3) (Figure 1).

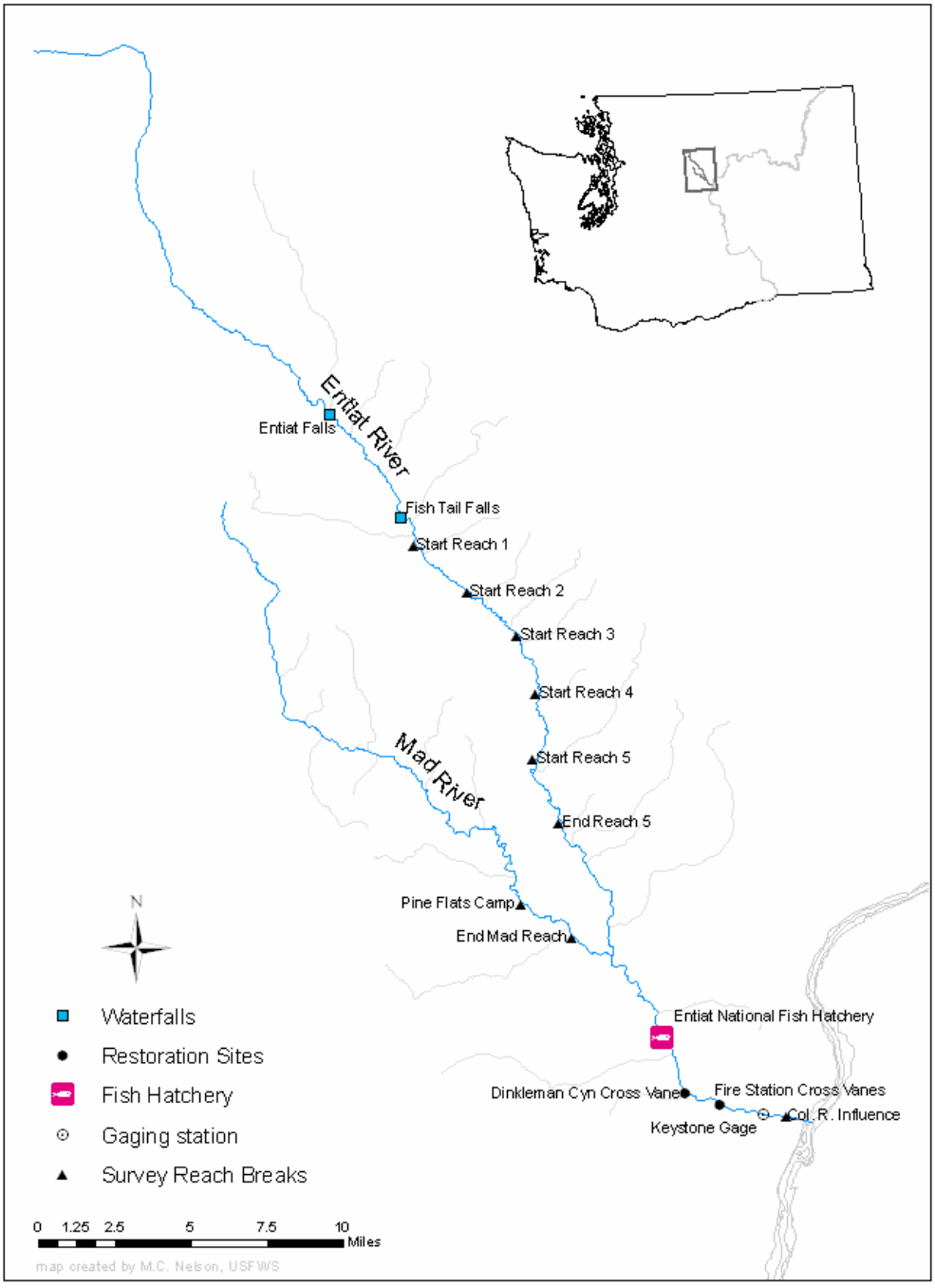

Figure 1. Overview of the Entiat River spawning ground survey areas.

SALMON AND BULL TROUT POPULATIONS

The Entiat River has historically supported excellent salmon runs consisting of Chinook (probably spring Chinook salmon) and coho salmon (Craig and Suomela 1941). Construction of dams around the turn of the century near the mouth of the Entiat River blocked salmon from their spawning grounds, and salmon runs were essentially nonexistent by 1939 when Grand Coulee Dam was built (Craig and Suomela 1941). From 1939 to 1943, as part of the Grand Coulee Fish Maintenance Project mitigation effort, all ascending adult salmon, mainly summer and fall Chinook salmon, were trapped at Rock Island Dam and relocated to upstream tributary streams below Grand Coulee Dam, including the Entiat River, and to hatcheries, including Leavenworth, Entiat, and Winthrop National Fish Hatcheries (NFH) (Fish and Hanavan 1948). The goal of these efforts was to rebuild salmon runs in the tributary streams and mitigate for lost production above Grand Coulee Dam.

Spring Chinook Salmon

In the initial years after Grand Coulee Dam was built, little effort was made to re-establish wild spring Chinook salmon runs in the Entiat River. From 1942 to 1944, Entiat NFH released a total of 1.3 million sub-yearlings and fewer than 50,000 yearling spring Chinook salmon that were offspring of the upriver stocks collected at Rock Island Dam (Mullan 1987). No spring Chinook salmon were released from Entiat NFH from 1945 to 1975. As early as 1956 and 1957, a wild spring Chinook salmon run was observed spawning in the area above Stormy Creek (rm 18.4) (French and Wahle 1960). Since 1962, spring Chinook salmon redds have been counted in an *index* area between river mile 28 and 21 where an established spring Chinook salmon run has been documented. Entiat NFH resumed spring Chinook salmon production in 1974. Egg sources have included Cowlitz River (1974), Carson NFH (1975 to 1982), Little White Salmon NFH (1976, 1978, 1979, 1981), Leavenworth NFH (1979-1981, 1994), and Winthrop NFH (1988). Adults that voluntarily returned to the hatchery were the primary brood stock in 1980 and from 1983 to 2006.

Summer Chinook Salmon

Although summer Chinook salmon are not believed to be endemic to the Entiat River (Craig and Suomela 1941), several efforts were made to establish summer Chinook salmon in the Entiat River following completion of Grand Coulee Dam. In 1939 and 1940, a total of 3,015 adult summer Chinook salmon, collected at Rock Island Dam from the commingled upriver stocks, were placed in upper Entiat River spawning areas. Only an estimated 1,308 of these survived to spawn (Fish and Hanavan 1948). Entiat NFH reared and released juvenile summer Chinook salmon into the Entiat River from 1941-1964 and in 1976 (Mullan 1987). Egg sources included the commingled upriver stocks intercepted at Rock Island Dam (1939-1943), Methow River (1944), Carson NFH (1944), Entiat River (1946-1964), Spring Creek NFH (1964), and Wells Dam (1974). Summer Chinook salmon spawning was monitored by aerial surveys in the lower 10.4 river miles from 1957 to 1991. Positive redd identification from the air is difficult at best, therefore aerial surveys likely underestimated actual redd numbers. Spawning numbers were never high, with a maximum of 55 redds in 1967. For years 1972-1991, aerial redd counts averaged about five per year.

Bull Trout, **Sockeye Salmon and Coho Salmon**
Bull trout presence/absence surveys were conducted in 1984 and 1987, with limited data obtained (WDFW 1997). In 1989, the United States Forest Service (USFS) contracted with WDFW to determine bull trout distribution and abundance within the Wenatchee National Forest, including the Entiat River main-stem and Mad River (Brown, 1993). Incidental sightings of bull trout (1993 to 2005) have also been recorded by USFS personnel (Archibald P., and E. Johnson, 2007) from Entiat Falls to the gauging station pool (rm 33.8 to 33.5). Beginning in 2004, MCRFRO initiated bull trout redd surveys from the gauging station pool to Fox Creek Camp Ground (rm 33.5 to 28.0) (Nelson, M.C. and R.D. Nelle, 2007). Since 1994, MCRFRO has searched for bull trout and/or redds during the spring and summer Chinook salmon spawning ground surveys. In 2007, one adult bull trout was identified.

Sockeye salmon are not indigenous to the Entiat River (Craig and Suomela 1941), and have only been stocked on two occasions (1943 and 1944), from Lake Quinault and Lake Whatcom stocks (Mullan 1986). A small run of sockeye salmon became established in the Entiat River and Entiat NFH collected sockeye salmon from 1944 to 1963, and their progeny were planted elsewhere (Mullan 1986). During the 2007 spawning ground surveys, one sockeye salmon redd, three live adults and one carcass were identified, counted and recovered.

Coho salmon runs had been largely destroyed in the mid Columbia River prior to 1941 (Mullan 1983). Propagation of coho salmon at the Mid-Columbia Federal hatcheries began in the 1940s and extended into the early 1970s. Chelan and Douglas County Public Utility Districts, in cooperation with WDFW, started propagation of coho salmon in the 1970's and continued until 1994. In 1996, the Yakama Nation initiated the Mid-Columbia Coho Restoration Program, which reintroduced coho into the Wenatchee and Methow sub-basins. Although no releases have occurred in the Entiat River, coho salmon have been found there during our previous surveys. During the 2007 spawning ground surveys, six coho salmon redds, twelve live adults and three carcasses were identified, counted and recovered.

METHODS

Spring and Summer Chinook Salmon Redd Surveys
Methods for surveying Chinook salmon redds consisted of dividing the survey area into several reaches. Each reach was surveyed multiple times by walking or rafting downstream, enumerating and marking only well established redds, recording numbers of live fish and sampling any recovered carcasses. Carcasses were measured by fork length and post orbital to hypural plate (POH) length, gender identified, females were dissected to visually determine spawning success and scale samples were collected when possible. Scales were viewed using a microfiche reader and age and origin (wild or hatchery) determined. Snouts were removed from carcasses with detected coded-wire tags (CWT) for later retrieval and de-coding of CWT. Tissue samples were taken for future DNA analysis and the tail was removed to prevent re-counting. All redd locations were marked with colored flagging on nearby vegetation and GPS points were recorded.

Bull Trout, **Sockeye and Coho Salmon**
During the Chinook salmon spawning ground surveys, bull trout, sockeye and coho salmon /or redds were searched for, recorded and marked when identified.

Estimating River Escapement by Fish/Redd Ratio
Estimating escapement for spring Chinook salmon returning to the Entiat River was calculated by expanding redd counts using the expansion value of 2.4 fish per redd. Mullan, 1990, used a spawner/redd ratio of 2.4 to account for pre-spawning mortality. To estimate return escapement for summer Chinook, the expansion value of 2.4 fish/redd is also applied.

Age Designation
Age designation in this report follows the Gilbert and Rich (1927) system, where total age is referenced by the first digit and age at the time of migration from freshwater is indicated by the subscript.

Estimating Coded-Wire Tag Expansions for Spring and Summer Chinook
Using the number of examined recovered carcasses (40) divided by the estimated number of returning spring Chinook salmon (245; see Spring Chinook Salmon Escapement section below), yields a sample rate of 16.3%. To calculate the expanded coded-wire tag recoveries for each tag code recovered, divide the number of coded-wire tags recovered by the sample rate (16.3%) and divide that figure by the release group coded-wire tag percent.

Using the number of examined recovered carcasses (89) divided by the estimated number of returning summer Chinook salmon (245; see Summer Chinook Salmon Escapement section from page 10), yields a sample rate of 36.3%. To calculate the expanded coded-wire tag recoveries for each tag code recovered, divide the number of coded-wire tags recovered by the sample rate (36.3%) and divide that figure by the release group coded-wire tag percent.

Female Carcass Egg Voidance Determination
Egg voidance from female carcasses was determined by visual estimation; fully voided (>90% egg loss), partial voided (89%-11%) and pre-spawn mortality (<10%).

RESULTS

Spring Chinook Salmon Redd Counts
A total of **102** spring Chinook salmon redds were identified during the 2007 spawning ground surveys (Table 1). The number of redds per reach in 2007 and the ten year running totals are found in Figure 2. Seventy redds were counted in the old *index* area, and an additional 32 redds were found in the expanded survey area. No redds were counted in the Mad River. Annual redd counts from the old *index* area are found in Appendix 1. Peak spawning occurred around the first week in September.

Spring Chinook Salmon Escapement
The total spring Chinook salmon redd count was 102. Using the 2.4 fish per redd ratio, an estimated **245** spring Chinook salmon returned to spawn in the Entiat River.

Spring Chinook Salmon Sex Ratio and Spawning Success
Forty spring Chinook salmon carcasses were recovered during the spawning ground surveys. Of the 40 recovered carcasses, 19 (48%) were females and 21 (52%) were males. All female carcasses were examined for spawning success, 17 were fully voided and two could not be determined because of carcass decomposition. Thirty-nine DNA samples were also collected from the 40 recovered carcasses.

Table 1.Spring Chinook salmon spawning ground surveys on the Entiat and Mad Rivers in 2007.

Section	River Mile	Date	Redds	Live Fish	Carcasses
Reach 1	28.1-25.8	08/31/07	9	5	2
Old *Index* Area		09/06/07	2	0	2
		09/12/07	0	0	1
Cumulative Total Count			11	5	5
Reach 2	25.8-23.4	08/31/07	12	14	2
Old *Index* Area		09/06/07	8	9	2
		09/12/07	9	0	7
		09/18/07	2	3	1
Cumulative Total Count			31	26	12
Reach 3	23.4-21.3	08/24/07	3	0	0
Old *Index* Area		09/04/07	15	22	3
		09/12/07	8	4	5
		09/18/07	2	1	3
Cumulative Total Count			28	27	11
Index Total			**70**	**58**	**28**
Reach 4	21.3-18.7	08/24/07	1	4	0
Expanded Area		09/04/07	8	14	1
		09/12/07	6	3	2
		09/18/07	3	3	0
Cumulative Total Count			18	24	3
Reach 5	18.7-16.2	08/24/07	0	2	0
Expanded Area		09/04/07	2	1	2
		09/12/07	8	5	5
		09/18/07	4	0	4
Cumulative Total Count			14	8	11
McKenzie Div.to Mad River Mouth	16.2-10.1	09/17/07	0	0	0
Expanded Area					
Cumulative Total Count			0	0	0
Mad River Mouth to Entiat NFH	10.1-6.8	09/14/07	0	0	0
Expanded Area					
Cumulative Total Count			0	0	0
Mad R./Pine Flats C.G. to Road Sign	3.5-1.5	09/11/07	0	0	0
Expanded Area		09/19/07	0	0	0
Cumulative Total Count			0	0	0
Mad R./Hornet Cr. to Pine Flats C.G.	5.0-3.5	09/13/07	0	0	0
Expanded Area					
Cumulative Total Count			0	0	0
Expanded Total			**32**	**32**	**14**
Index Total			**70**	**58**	**28**
Total			**102**	**90**	**42**

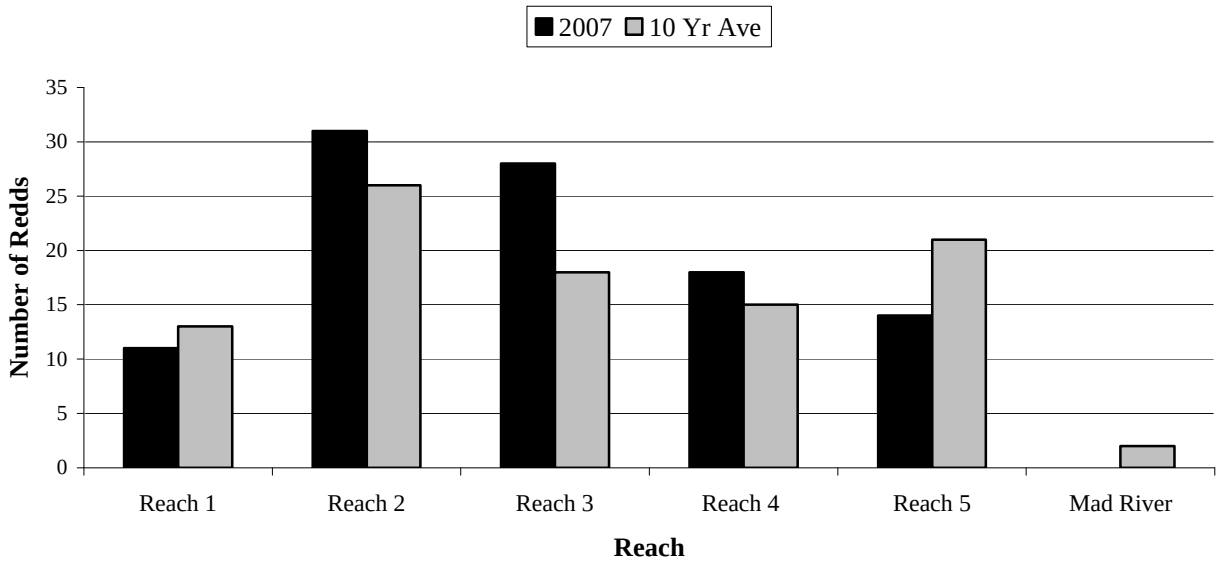

Figure 2. Entiat River spring Chinook salmon redd counts for Reaches 1-5 and Mad River for year 2007 and 10 year average.

Spring Chinook Salmon Age Composition and Origin

Of the 40 spring Chinook salmon carcasses recovered, age and origin were successfully determined for 39 (Table 2). Hatchery fish comprised 56% of the run and wild fish 44%. The percent composition of hatchery vs. wild in the Entiat River for years 2000–2007 is found in Figure 3.

Table 2. Age composition and origin for spring Chinook salmon sampled from the Entiat River in 2007.

		Male	Female		
Origin	Age	(N)	(N)	Total (N)	%
Hatchery	2/2	1	0	1	3
	3/2	6	0	6	15
	4/2	5	8	13	33
	5/2	2	0	2	5
		14	8	22	56
Wild	3/2	3	0	3	8
	4/2	1	8	9	23
	5/2	2	3	5	13
		6	11	17	44
Total		**20**	**19**	**39**	**100**

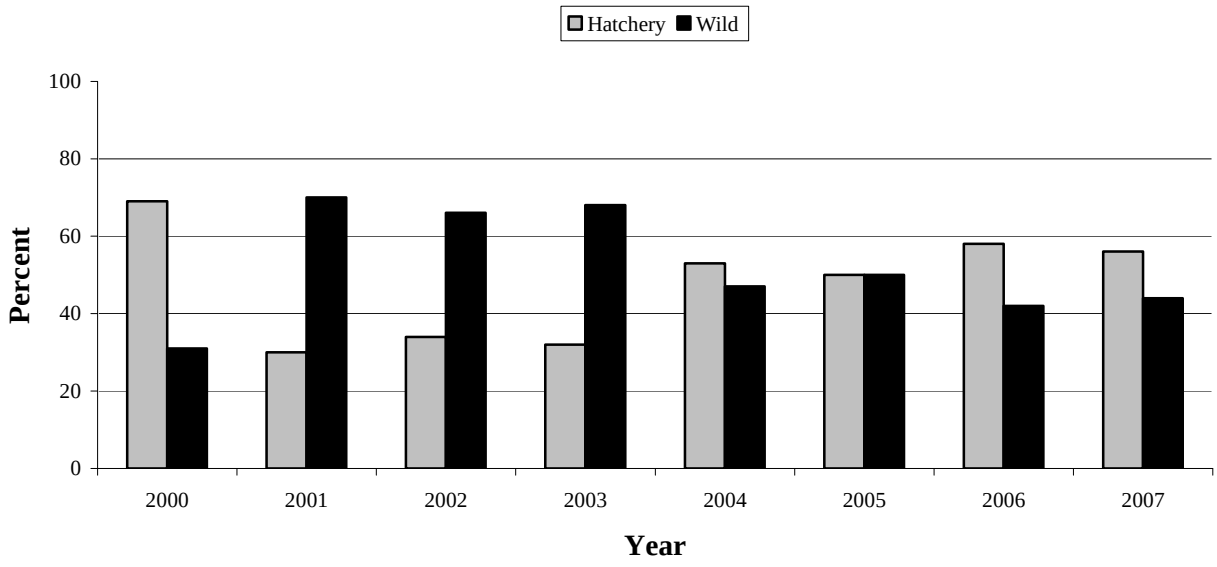

Figure 3. Estimated percent composition of hatchery vs. wild spring Chinook salmon escapement into the Entiat River, 2000-2007.

Coded-Wire Tag Recoveries from Spring Chinook Salmon Carcasses

All 40 recovered carcasses from the Entiat River were checked for missing adipose fins and scanned with a portable handheld wand detector for coded-wire tags. Twenty (50%) were identified as having a missing adipose fin, of which nine had a coded-wire tag (Table 3). Note: Four carcasses were identified with a missing adipose fin but could not be scanned because of predation to their head. Composition of hatchery origin fish are as follows: Kooskia NFH comprised 37%, Entiat NFH 34%, Chiwawa Rearing Ponds 23% and Twisp Acclamation Pond 6%.

Table 3. Coded-wire tag recoveries collected from spring Chinook salmon carcasses on the Entiat River in 2007.

Tag Code	Brood Year	Release Agency	Hatchery	Recovered	Sample Rate %	CWT %	Expanded Recoveries
051264	03	USFWS	Entiat NFH	1	16.3	49.7	12
051784	04	USFWS	Kooskia NFH	1	16.3	15.3	40
054121	03	USFWS	Entiat NFH	1	16.3	49.3	12
054135	03	USFWS	Entiat NFH	1	16.3	49.6	12
631894	03	WDFW	Chiwawa R.P.	2	16.3	97.4	13
632373	04	WDFW	Chiwawa R.P.	1	16.3	99.4	6
632564	03	WDFW	Twisp Acc. Pond.	1	16.3	95.5	6
632898	04	WDFW	Chiwawa R.P.	1	16.3	99.6	6
Total				**9**			**107**

Summer Chinook Salmon Redd Counts

A total of **102** redds were counted in reaches 1 thru 5, Mad/Entiat River confluence and Entiat NFH to the Columbia River influence in 2007 (Table 4).

Table 4. Summer Chinook spawning ground surveys on the Entiat and Mad River in 2007.

Section	River Mile	Date	Redds	Live Fish	Carcasses
Reach 1	28.1-25.8	10/05/07	0	1	0
		10/26/07	0	0	0
Cumulative Total Count			0	1	0
Reach 2	25.8-23.4	10/05/07	0	0	1
		10/25/07	0	0	0
Cumulative Total Count			0	0	1
Reach 3	23.4-21.3	10/05/07	0	0	0
		10/25/07	0	0	0
Cumulative Total Count			0	0	0
Reach 4	21.3-18.7	10/05/07	1	1	0
		10/25/07	0	1	0
Cumulative Total Count			1	2	0
Reach 5	18.7—16.2	[1]09/04/07	0	0	1
		[2]09/12/07	0	0	1
		10/05/07	16	9	0
		10/15/07	18	31	8
		10/24/07	0	5	6
Cumulative Total Count			34	45	16
Road Mile Marker 13		10/13/07	1	0	0
Entiat R.at Mad R. Confluence	10.1	10/22/07	1	0	0
Entiat NFH to	6.8-4.1	10/19/07	18	47	5
Dinkleman Cyn. Rd. Br		11/06/07	5	7	10
Cumulative Total Count			23	54	15
Dinkleman Cyn. Rd. Br.	4.1-3.1	10/19/07	6	16	1
to Fire Station		11/06/07	1	1	4
Cumulative Total Count			7	17	5
Fire Station to	3.1-1.5	10/19/07	17	37	4
Keystone USGS Station		11/06/07	3	0	24
Cumulative Total Count			20	37	28
Keystone USGS Station	1.5-0.3	[3]10/19/07	11	29	5
to Columbia R. Influence		11/06/07	4	1	19
Cumulative Total Count			15	30	24
Total			**102**	**186**	**89**

1 Recovered summer Chinook carcass during spring Chinook salmon redd survey on 09/04/07. **2** Recovered summer Chinook carcass during spring Chinook redd survey on 09/12/07. **3** Recovered summer Chinook carcass on 09/11/07 at USFWS rotary screw trap (RM 1.1).

Summer Chinook Salmon Escapement

The total summer Chinook salmon redd count was 102, and using the 2.4 fish per redd ratio, an estimated **245** summer Chinook salmon returned to spawn in the Entiat River. This estimate should be considered a minimum since not all portions of the Entiat River were surveyed.

Summer Chinook Salmon Sex Ratio and Spawning Success

Eighty-nine summer Chinook salmon carcasses were recovered in 2007, of which 63 (72%) were females and 25 (28%) males. All 63 female carcasses were examined for spawning success, 32 (55%) were fully voided, 9 (16%) were partial voided, 17 (29%) were pre-spawn mortalities and five were not sampled due to carcass decomposition. There was a notable difference in spawning success between hatchery and wild females; only 36% of the hatchery females were fully voided compared to 73% for the wild females.

Summer Chinook Salmon Age Composition and Origin

Of the 89 summer Chinook salmon carcasses recovered, age and origin were successfully determined for 84. Summary of age composition for hatchery and wild fish are found in Table 5. Hatchery origin fish comprised 59% of the run compared to wild origin of 41%.

Table 5. Age composition and origin for summer Chinook salmon sampled from Entiat River in 2007.

		Male				Female					
Origin	Age	(N)	%	Reservoir Reared	River Yearling	(N)	%	Reservoir Reared	River Yearling	Total (N)	Total %
Hatchery	3/2	0	0			0	0			0	0
	4/2	4	5			2	2			6	7
	5/2	8	10			30	36			38	46
	6/2	0	0			5	6			5	6
		12	15			37	44			49	59
Wild	3/1	5	6			1	1			6	7
	3/2	0	0			0	0			0	0
	4/1	1	1			1	1			2	2
	4/2	0	0			2	2	*2*		2	2
	5/1	3	4			11	14			14	18
	5/2	2	2	*2*		5	6	*4*	*1*	7	8
	6/1	2	2			0	0			2	2
	6/2	0	0			2	2	*2*		2	2
		13	15			22	26			35	41
Total		**25**				**59**				**84**	100

Coded-Wire Tag Recoveries from Summer Chinook Salmon Carcasses

All 89 recovered carcasses from the Entiat River were checked for missing adipose fins and scanned with a portable handheld wand detector for coded-wire tags. Forty-nine carcasses (55%) were identified as having a missing adipose fin and contained a coded-wire tag (Table 6).

Table 6. Coded-wire tag recoveries collected from summer Chinook salmon carcasses on the Entiat River in 2007.

Tag Code	Brood Year	Release Agency	Hatchery	Recovered	Sample Rate %	CWT %	Expanded Recoveries
105976	03	IDFG	McCall SFH	1	36.3	25.3	11
630889	01	WDFW	Turtle Rock SFH	2	36.3	97.3	6
630891	01	WDFW	Turtle Rock SFH	1	36.3	98.2	3
631007	02	WDFW	Turtle Rock SFH	16	36.3	98.2	45
631373	02	WDFW	Turtle Rock SFH	2	36.3	98.1	6
631394	02	WDFW	Wells SFH	2	36.3	98.6	6
631587	01	WDFW	Dryden Pond	2	36.3	98.7	6
631890	02	WDFW	Wells SFH	3	36.3	98.7	8
631979	02	WDFW	Methow SFH	1	36.3	99.1	3
631980	02	WDFW	Dryden Pond	14	36.3	96.4	40
632396	03	WDFW	Wells SFH	1	36.3	98.8	3
632577	03	WDFW	Eastbank SFH	3	36.3	92.6	9
632581	03	WDFW	Dryden Pond	1	36.3	97.8	3
Total				**49**			**149**

Bull Trout, Sockeye and Coho Salmon

Surveyors identified, counted and/or recovered one live bull trout; one sockeye salmon redd, three live and one carcass; and six coho salmon redds, twelve live adults and three carcasses.

Coded-Wire Tag Recoveries from Coho Salmon Carcasses

All sockeye and coho salmon carcasses were checked for missing adipose fins and scanned with a portable handheld wand detector for coded-wire tags. Of the one recovered sockeye carcass and the three coho salmon carcasses, all three coho carcasses were coded-wire tagged (Table 7).

Table 7. Coded-wire tag recoveries collected from coho salmon carcasses on the Entiat River in 2007.

Species	Tag Code	Brood Year	Release Agency	Hatchery	Recovered
Coho	052572	04	USFWS	Winthrop NFH	1
Coho	052664	04	WDFW	Wells SFH	1
Coho	052665	04	WDFW	Wells SFH	1

SUMMARY

The total number of spring Chinook redds counted during the 2007 spawning ground surveys was 102, which included 70 redds in the old index area and 32 redds found in the expanded section. Using the 2.4 fish per redd ratio and the total redd count of 102, an estimated 245 spring Chinook salmon returned to spawn in the Entiat River. Forty carcasses were recovered and examined, of these, 48% were female and 52% male with female spawning success at 100%. Hatchery origin comprised 56%, compared to wild origin of 44%. A total of nine coded-wire tags were recovered; four from Chiwawa Rearing Ponds, three from Entiat NFH, one from Kooskia NFH and one from Twisp Acclamation Ponds.

The total number of summer Chinook redds counted during the 2007 spawning ground surveys was 102, which included 35 (34%) in Reaches 1-5 and 67 (66%) located below river mile 10.1. Using the 2.4 fish per redd ratio and the total redd count of 102, an estimated 245 summer Chinook salmon returned to spawn in the Entiat River. Eighty-nine carcasses were recovered and examined, of which 72% were females and 28% males. All female carcasses recovered were examined for spawning success; 32 (55%) were fully voided, 9 (16%) were partial voided, 17 (29%) were pre-spawn mortalities and five were not sampled due to carcass decomposition. There was a notable difference in spawning success between hatchery and wild females, only 36% of the hatchery females were fully voided compared to 73% of the wild females. Hatchery origin fish comprised 59% compared to wild origin of 41%. Scale analysis revealed wild summer Chinook had three distinctive freshwater life histories; 3% were resident yearling migrants, 28% were reservoir reared yearling migrants and 69% were sub-yearling migrants. Forty-nine coded-wire tags were recovered from 89 carcasses; 17 from Dryden Acclamation Pond, 21 from Turtle Rock SFH, six from Wells SFH, three from Eastbank SFH, one from Methow SFH and one from McCall SFH.

During the spring and summer Chinook spawning ground surveys, surveyors identified, counted and/or recovered one live bull trout; one sockeye salmon redd, three live and one carcass; and six coho salmon redds, twelve live and three carcasses.

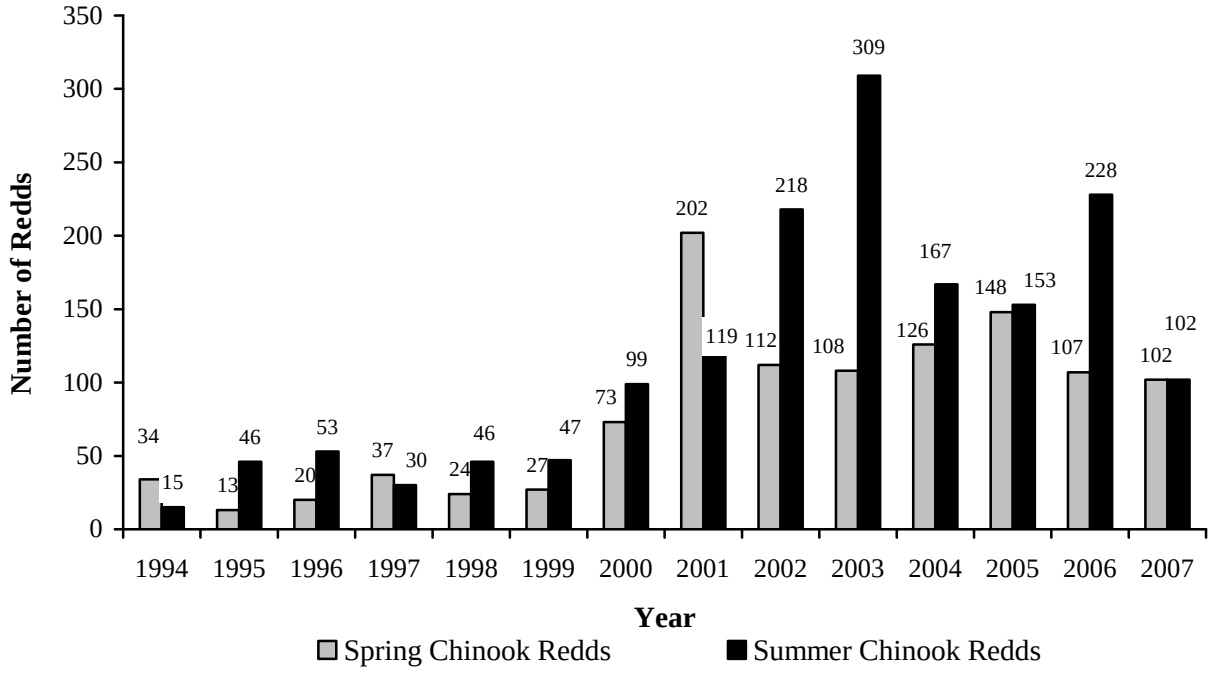

Figure 4. Spring and summer Chinook salmon redd counts for the Entiat River, 1994 to 2007.

ACKNOWLEDGMENTS

Thanks to the following individuals for their assistance with the spawning ground surveys: Drew Pearson, Andy Johnsen, Erica Saginus, Heather Trainer, Trevor Wilk, Jim Craig, LeAnne Grove and Ben Truscott. I would also like to thank RD Nelle for loaning his steelhead spawning crew, Matt Cooper for all his data analysis and Dave Carie for reviewing the draft report.

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APPENDIX 1

Entiat River spring Chinook salmon redd counts from annual surveys in old *index* area, Fox Creek C. G. to Dill Creek (RM 28 to 21), 1962-1993 (WDFW) and 1994-2007 (USFWS).

YEAR	#of REDDS	YEAR	#of REDDS	YEAR	#of REDDS	YEAR	#of REDDS
1962	115	1974	88	1986	105	1998	15
1963	145	1975	156	1987	64	1999	6
1964	384	1976	47	1988	67	2000	28
1965	104	1977	171	1989	37	2001	144
1966	307	1978	326	1990	83	2002	72
1967	252	1979	NA	1991	32	2003	70
1968	252	1980	107	1992	42	2004	65
1969	83	1981	95	1993	100	2005	81
1970	70	1982	107	1994	24	2006	65
1971	136	1983	107	1995	1	2007	70
1972	61	1984	84	1996	8		
1973	229	1985	115	1997	20		

N/A= not available

APPENDIX 2

River mile index of the Entiat River from the mouth to Entiat Falls.

River Mile	Description
0.0	Mouth of Entiat River at river-mile 483.7 on Columbia River
0.3	Columbia River influence
1.5	Keystone Bridge
3.1	Entiat River Road Bridge (Fire Station Restoration Site)
4.1	Dinkleman Canyon Road Bridge (Dinkleman Canyon Road Restoration Site)
6.8	Entiat National Fish Hatchery
10.1	Mad River
15.2	Potato Creek
16.2	McKenzie Ditch and Diversion Dam (end of Reach 5)
18.4	Stormy Creek
21.2	Dill Creek
23.1	Preston Creek
23.4	Brief Bridge
23.9	Brennegan Creek
25.0	McCrea Creek
25.5	Burns Creek
27.7	Fox Creek
28.0	Fox Creek Campground (start of Reach 1)
28.6	Tommy Creek
28.9	Lake Creek Campground
33.8	Entiat Falls

mileage may not be exact

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February 2008