

U.S. Fish & Wildlife Service  
**SPRING AND SUMMER CHINOOK  
SALMON SPAWNING GROUND  
SURVEYS ON THE ENTIAT RIVER, 2006**

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May 2007

SPRING AND SUMMER CHINOOK SALMON SPAWNING  
GROUND SURVEYS ON THE ENTIAT RIVER, 2006.

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The correct citation for this report is:

Hamstreet, C.O. 2007. Spring and Summer Chinook Salmon Spawning Ground Surveys on the Entiat River, 2006. 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 2006 mark the thirteenth 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 basin's 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 between Entiat NFH to the Columbia River influence (rm 6.8 to 0.3) (Figure 1).

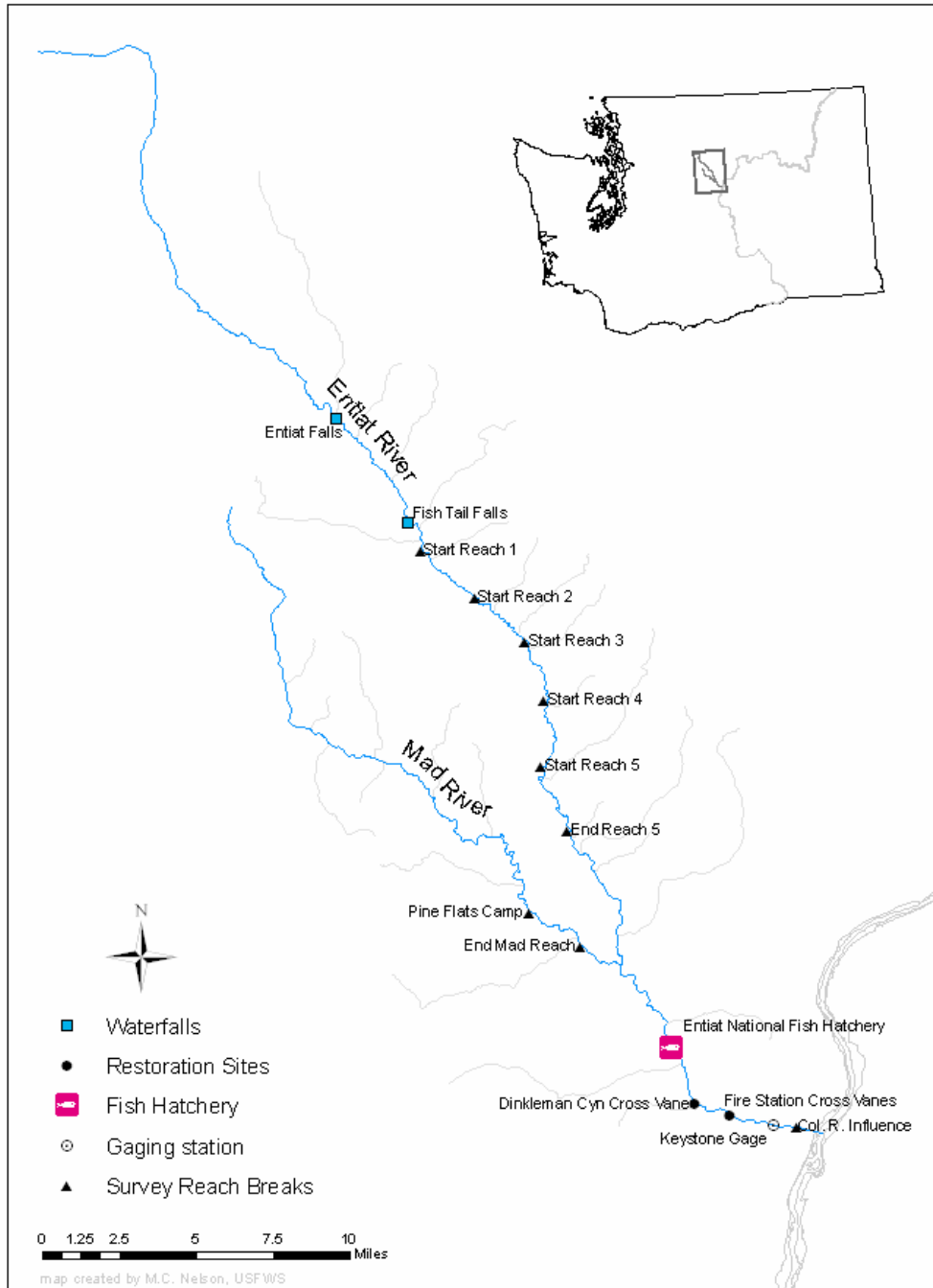


Figure 1. Overview of the Entiat River spawning ground survey areas.

## 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-yearling 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 underestimate 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 mainstem and Mad River (Brown 1993). In 2006, USFS personnel counted 7 bull trout redds in the Mad River index reach, Young Creek to Jimmy Creek (Archibald P., and E. Johnson, 2007). Incidental sightings of bull trout (1993 to 2005) have also been recorded by USFS personnel from Entiat Falls to the gauging station pool (rm 33.8 to 33.5). In 2006, 3 bull trout redds were counted in this section. Since 1994, MCRFRO has searched for bull trout and/or redds during the spring and summer Chinook salmon spawning ground surveys. In 2006, 3 bull trout and 8 redds were identified. 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). In 2006, 18 redds were counted in this section (Nelson, M.C. and R.D. Nelle. 2007).

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 2006 spawning ground surveys, nine sockeye salmon redds, ten live adults and four 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 sample 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 river 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 prespawning 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 (73) divided by the estimated number of returning spring Chinook salmon (257), yields a sample rate of 28.4%. 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 (28.4%) and divide that figure by the release group coded-wire tag percent.

Using the number of examined recovered carcasses (175) divided by the estimated number of returning summer Chinook salmon (547), yields a sample rate of 32%. 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 (32%) and divide that figure by the release group coded-wire tag percent.

## **RESULTS**

### **Spring Chinook Salmon Redd Counts**

A total of **107** redds were identified during the 2006 spawning ground surveys (Table 1). Sixty-five (61%) of the spring Chinook salmon redds were counted in the old *index* area, an additional 42 (39%) redds were found in the expanded survey area including three redds in the Mad River. Annual redd counts from the old *index* area are found in Appendix 1. The peak spawning occurred around the first week in September.

### **Spring Chinook Salmon Escapement**

The total spring Chinook salmon redd count was 107, and using the 2.4 fish per redd ratio, an estimated **257** spring Chinook salmon returned to spawn in the Entiat River.

### **Spring Chinook Salmon Sex Ratio and Spawning Success**

Seventy-three spring Chinook salmon carcasses were recovered in the 2006 spawning ground surveys. Of the 73 recovered carcasses, 48 (66%) were females and 25 (34%) were males. All female carcasses were examined for spawning success, where 41 (93%) were completely spent, three (7%) were partially spawned and four could not be determined because of carcass decomposition. Twenty-seven DNA samples were also collected from the 73 recovered carcasses.

Table 1. Spring Chinook salmon spawning ground surveys on the Entiat and Mad Rivers in 2006.

Section	River Mile	Date	Redds	Live Fish	Carcasses
Reach 1	28.1-25.8	09/01/06	18	18	2
Old <i>Index</i> Area		09/11/06	2	10	5
		09/18/06	<u>2</u>	<u>3</u>	<u>9</u>
Cumulative Total Count			22	31	16
Reach 2	25.8-23.4	08/24/06	3	10	0
Old <i>Index</i> Area		09/01/06	13	20	1
		09/11/06	5	3	9
		09/18/06	<u>0</u>	<u>1</u>	<u>1</u>
Cumulative Total Count			21	34	11
Reach 3	23.4-21.3	08/24/06	2	4	1
Old <i>Index</i> Area		09/07/06	13	11	8
		09/12/06	5	7	5
		09/19/06	<u>2</u>	<u>1</u>	<u>3</u>
Cumulative Total Count			22	23	17
<b>Index Total</b>			<b>65</b>	<b>88</b>	<b>44</b>
Reach 4	21.3-18.7	08/25/06	3	3	1
<i>Expanded</i> Area		09/07/06	10	8	4
		09/12/06	6	4	5
		09/19/06	<u>1</u>	<u>0</u>	<u>3</u>
Cumulative Total Count			20	15	13
Reach 5	18.7—16.2	08/25/06	2	5	0
<i>Expanded</i> Area		09/08/06	15	12	6
		09/13/06	1	1	8
		09/20/06	<u>1</u>	<u>1</u>	<u>4</u>
Cumulative Total Count			19	19	18
Mad River	3.5-1.5	09/08/06	3	2	0
<i>Expanded</i> Area		09/20/06	<u>0</u>	<u>0</u>	<u>0</u>
Cumulative Total Count			3	2	0
Box Cyn. – Fox Cr. C.G.	29.2-28.1	09/21/06	0	0	0
<b>Expanded Total</b>			<b>42</b>	<b>36</b>	<b>31</b>
<b>Index Total</b>			<b>65</b>	<b>88</b>	<b>44</b>
<b>Total</b>			<b>107</b>	<b>124</b>	<b>75</b>

### Spring Chinook Salmon Age Composition and Origin

Of the 73 spring Chinook salmon carcasses recovered, age and origin were successfully determined for 67. Summary of age composition for hatchery and wild fish are found in Table 2. Hatchery fish comprised 58% of the run compared to wild origin of 42%.

Table 2. Age composition and origin for spring Chinook salmon sampled from the Entiat River in 2006.

Origin	Age	Male		Female		Total (N)	Total %
		(N)	%	(N)	%		
Hatchery	2/2	2	3	0	0	2	3
	3/2	1	1	0	0	1	1
	4/2	8	12	26	39	34	51
	5/2	<u>1</u>	<u>1</u>	<u>1</u>	<u>1</u>	<u>2</u>	<u>3</u>
		12	17	27	40	39	58
Wild	3/2	2	3	0	0	2	3
	4/2	6	9	15	22	21	31
	5/2	<u>2</u>	<u>3</u>	<u>3</u>	<u>5</u>	<u>5</u>	<u>8</u>
		10	15	18	27	28	42
<b>Total</b>		<b>22</b>		<b>45</b>			<b>100</b>

### Coded-Wire Tag Recoveries from Spring Chinook Salmon Carcasses

All 73 recovered carcasses from the Entiat River were checked for missing adipose fins and scanned with a portable handheld wand detector for coded-wire tags. Thirty-three (45%) were identified as having a missing adipose fin, of which 12 had a coded-wire tag, 36 (49%) had an adipose fin present, of which eight had CWT's and four (6%) could not be determined due to carcass decomposition (Table 3).

Table 3. Coded-wire tag recoveries collected from spring Chinook salmon on the Entiat River in 2006.

Tag Code	Brood Year	Release Agency	Hatchery	Recovered	Sample Rate %	CWT %	Expanded Recoveries
051184	02	USFWS	Dworshak NFH	1	28.4	12.7	28
051185	02	USFWS	Dworshak NFH	1	28.4	12.3	29
051197	02	USFWS	Entiat NFH	2	28.4	43.5	16
051269	02	USFWS	Winthrop NFH	1	28.4	86.6	4
051493	02	USFWS	Leav. NFH	1	28.4	64.2	5
051588	04	USFWS	Winthrop NFH	1	28.4	90.8	4
054945	02	USFWS	Leav. NFH	1	28.4	59.1	6
109673	01	IDFG	Sawtooth SFH	1	28.4	97.0	4
631389	02	WDFW	Chiwawa R.P.	6	28.4	96.9	22
631448	01	WDFW	Chiwawa R.P.	1	28.4	98.6	4
631976	02	WDFW	Methow SFH	1	28.4	98.2	4
632373	04	WDFW	Chiwawa R.P.	1	28.4	100	4
<b>Total</b>				<b>18</b>			<b>130</b>

### Summer Chinook Salmon Redd Counts

A total of **228** redds were counted in reaches 1 thru 5, Mad/Entiat River confluence and Entiat NFH to the Columbia River influence in 2006 (Table 4).

Table 4. Summer Chinook spawning ground surveys on the Entiat and Mad River in 2006.

Section	River Mile	Date	Redds	Live Fish	Carcasses
Reach 1	28.1-25.8	10/03/06	7	7	0
		10/27/06	<u>1</u>	<u>0</u>	<u>1</u>
Cumulative Total Count			8	7	1
Reach 2	25.8-23.4	10/04/06	9	11	0
		10/17/06	<u>10</u>	<u>4</u>	<u>4</u>
Cumulative Total Count			19	15	4
Reach 3	23.4-21.3	10/04/06	16	10	1
		10/17/06	<u>9</u>	<u>27</u>	<u>9</u>
Cumulative Total Count			25	37	10
Reach 4	21.3-18.7	<sup>1</sup> 09/07/06	0	0	1
		10/05/06	2	19	2
		10/18/06	<u>3</u>	<u>5</u>	<u>5</u>
Cumulative Total Count			5	24	8
Reach 5	18.7—16.2	<sup>2</sup> 09/13/06	0	0	1
		10/05/06	47	123	2
		10/18/06	48	75	21
		<sup>3</sup> 10/26/06	<u>NA</u>	<u>NA</u>	<u>34</u>
Cumulative Total Count			95	198	58
Road Mile Marker 13		10/06/06	1	2	0
Mad River	0.2-0.0	10/25/06	2	1	0
Entiat River at Mad River Confluence	10.1	10/25/06	1	3	0
Entiat NFH to Dinkleman Cyn. Rd. Br	6.8-4.1	10/19/06	25	32	3
Dinkleman Cyn. Rd. Br. to Fire Station	4.1-3.1	10/19/06	26	30	2
		11/02/06	<u>1</u>	<u>16</u>	<u>76</u>
Cumulative Total Count			27	46	78
Fire Station to Keystone USGS Station	3.1-1.5	10/19/06	4	6	2
Keystone USGS Station to Columbia R. Influence	1.5-0.3	10/24/06	16	32	11
<b>Total</b>			<b>228</b>	<b>403</b>	<b>175</b>

<sup>1</sup> Recovered summer Chinook carcass during spring Chinook salmon redd survey on 09/07/06. <sup>2</sup> Recovered summer Chinook carcass during spring Chinook redd survey on 09/13/06. <sup>3</sup> Conducted carcasses recovery survey on 10/26/06.

### Summer Chinook Salmon Escapement

The total summer Chinook salmon redd count was 228, and using the 2.4 fish per redd ratio, an estimated **547** summer Chinook salmon returned to spawn in the Entiat River.

This estimated number should be considered a minimum since not all portions of the Entiat River were surveyed and a flood event occurred on November 3, compromising additional lower river redd surveys and carcass recoveries.

### Summer Chinook Salmon Sex Ratio and Spawning Success

One hundred seventy-five summer Chinook salmon carcasses were recovered in 2006, of which 100 (57%) were females and 75 (43%) males. All 100 female carcasses were examined for spawning success, 69 (73%) successfully spawned, 25 (27%) were partially spawned and six were not sampled due to carcass decomposition. There was a notable difference in spawning success between hatchery and wild females, only 44% of the hatchery females spawned successfully compared to 88% for the wild females.

### Summer Chinook Salmon Age Composition and Origin

Of the 175 summer Chinook salmon carcasses recovered, age and origin were successfully determined for 160. Summary of age composition for hatchery and wild fish are found in Table 5. Hatchery origin fish comprised 24.5% of the run compared to wild origin of 75.5%.

Table 5. Age composition and origin for summer Chinook salmon sampled from Entiat River in 2006.

Origin	Age	(N)	Male			Female			Total (N)	Total %	
			%	Reservoir Reared	River Yearling	%	Reservoir Reared	River Yearling			
Hatchery	3/2	0	0			0	0		0	0	
	4/2	7	4			2	1		9	5	
	5/1	0	0			1	0.5		1	0.5	
	5/2	3	2			17	10		20	12	
	6/2	4	3			6	4		10	7	
		14	9			26	15.5		40	24.5	
Wild	2/1	6	4			0	0		6	4	
	3/1	3	2			0	0		3	2	
	3/2	0	0			0	0		0	0	
	4/1	6	4			9	6		15	10	
	4/2	5	3	4	1	3	2	3	8	5	
	5/1	31	19			33	20		64	39	
	5/2	5	3	5		14	9	11	19	12	
	6/1	1	0.5			0	0		1	0.5	
6/2	0	0			4	3	4	4	3		
		57	35.5	9	1	63	40	18	4	120	75.5
<b>Total</b>		<b>71</b>				<b>89</b>				<b>160</b>	<b>100</b>

### Coded-Wire Tag Recoveries from Summer Chinook Salmon Carcasses

All 175 recovered carcasses from the Entiat River were checked for missing adipose fins and scanned with a portable handheld wand detector for coded-wire tags. Seventy (35%) were identified as having a missing adipose fin with 66 containing a coded-wire tag (Table 6).

Table 6. Coded-wire tag recoveries collected from summer Chinook salmon on the Entiat River in 2006.

Tag Code	Brood Year	Release Agency	Hatchery	Recovered	Sample Rate %	CWT %	Expanded Recoveries
630889	01	WDFW	Turtle Rock SFH	5	32	97	16
630891	01	WDFW	Turtle Rock SFH	7	32	98	22
630894	01	WDFW	Turtle Rock SFH	1	32	41	8
630996	00	WDFW	Similkameen SFH	2	32	99	6
631007	02	WDFW	Turtle Rock SFH	2	32	98	6
631271	00	WDFW	East Bank SFH	5	32	99	16
631272	00	WDFW	East Bank SFH	3	32	95	10
631548	01	WDFW	Wells SFH	3	32	96	10
631587	01	WDFW	Dryden Pond	4	32	99	13
631980	02	WDFW	Dryden Pond	6	32	96	20
Lost Tag				2			2
<b>Total</b>				<b>40</b>			<b>129</b>

### **Bull Trout, Sockeye and Coho Salmon**

Surveyors identified, counted and/or recovered three live bull trout, eight redds; nine sockeye salmon redds, ten live and four carcasses, one coho salmon redd and five live adults.

### **Coded-Wire Tag Recovery from Sockeye Salmon**

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

Table 7. Coded-wire tag recovery collected from a sockeye salmon on the Entiat River in 2006.

Species	Tag code	Brood Yr.	Release Agency	Hatchery	Recovered
Sockeye	631866	02	WDFW	Lk. Wenatchee Net Pens	1

## **SUMMARY**

The total number of spring Chinook redds counted during the 2006 spawning ground surveys was 107, which included 65 redds in the old index area and 42 redds found in the expanded section. Using the 2.4 fish per redd ratio and the total redd count of 107, an estimated 257 spring Chinook salmon returned to spawn in the Entiat River. Seventy-three carcasses were recovered and examined, of these, 66% were female and 34% male with female spawning success at 93%. Hatchery origin comprised 58%, compared to wild origin of 42%. A total of 18 coded-wire tags were recovered; eight from Chiwawa Rearing Ponds, two from Dworshak NFH, two from Entiat NFH, two from Leavenworth NFH, one from Methow SFH, one from Sawtooth SFH and two from Winthrop NFH (Table 3).

The total number of summer Chinook redds counted during the 2006 spawning ground surveys was 228, which included 152 (67%) in Reaches 1-5 and 76 (33%) located below river mile 10.1. Using the 2.4 fish per redd ratio and the total redd count of 228, an estimated 547 summer Chinook salmon returned to spawn in the Entiat River. One hundred seventy-five carcasses were recovered and examined, of which 57% were females and 43% males. All female carcasses recovered were examined for spawning success; 69 (69%) successfully spawned, 25 (25%) were

pre-spawn mortalities and six were not sampled due to carcass decomposition. There was a notable difference in spawning success between hatchery and wild females, only 44% of the hatchery females spawned successfully compared to 88% of the wild females. Hatchery origin fish comprised 24% compared to wild origin of 76%. Scale analysis revealed wild summer Chinook had three distinctive freshwater life histories; 4% were resident yearling migrants, 23% were reservoir reared yearling migrants and 73% were sub-yearlings migrants. Forty coded-wire tags were recovered from 175 carcasses; ten from Dryden Pond, eight from East Bank SFH, two from Similkameen SFH, 15 from Turtle Rock SFH, three from Wells SFH and two were lost before de-coding.

During the spring and summer Chinook spawning ground surveys, surveyors identified, counted and/or recovered three live bull trout, eight redds; nine sockeye salmon redds, ten live and four carcasses, one coho salmon redd and five live adults. Of the four recovered sockeye carcasses, two were adipose clipped and one was coded-wire tagged from Lake Wenatchee Net Pens.

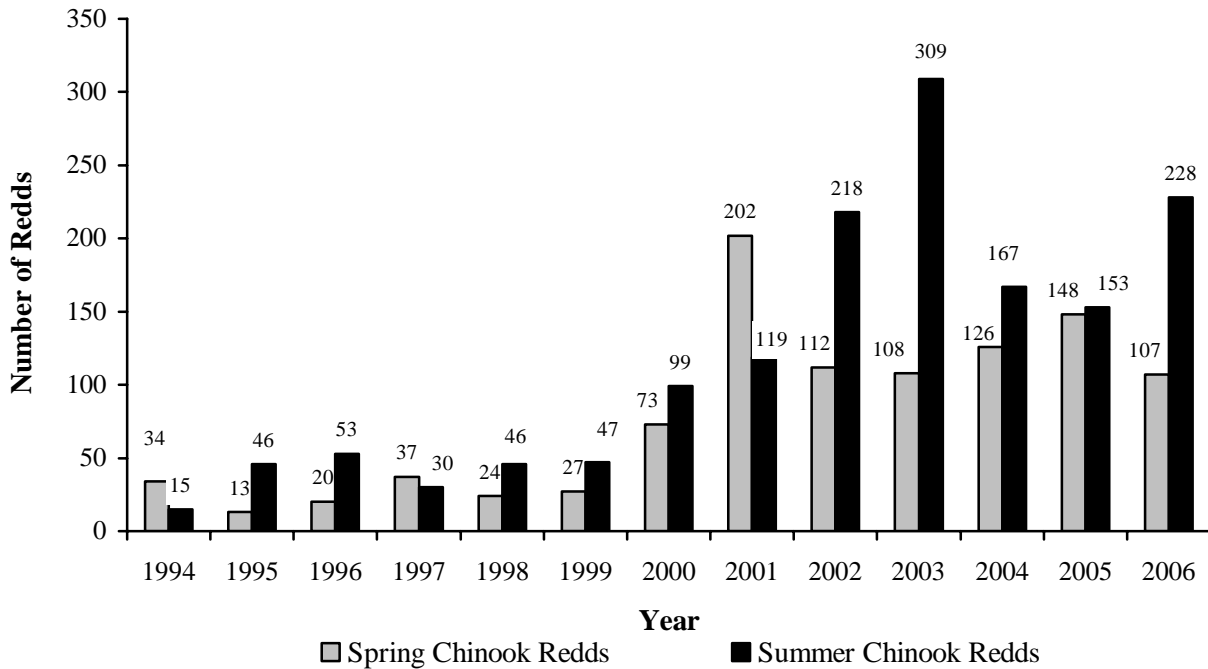


Figure 2. Spring and summer Chinook salmon redd counts for the Entiat River, 1994 to 2006.



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## **ACKNOWLEDGMENTS**

Thanks to the following individuals for their assistance with the spawning ground surveys: Becky Christopherson, Terry Dellapenna, David Conlin, Amy Markeson, Bruce Hunner, RD Nelle, Jamie Hallman, Meagan Lemons and Jim Craig. I would also like to thank John Sneva of the Washington State Department of Fish & Wildlife who reviewed my summer Chinook age determinations, Matt Cooper for all his data analysis and Dave Carie for reviewing the draft report.

## 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 1994-2006 (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		
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 <u>Entiat River</u> 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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**April 2007**