Evaluation of Fall Chinook and Chum Salmon Spawning below Bonneville Dam

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EVALUATION OF FALL CHINOOK AND CHUM SALMON SPAWNING BELOW BONNEVILLE DAM

Annual Report 2002-2003

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ABSTRACT

In 2002 a total of 364 adult fall chinook and 472 chum were sampled for biological data in the Ives and Pierce islands area below Bonneville Dam. Vital statistics were developed from 290 fall chinook and 403 chum samples. The peak redd count for fall chinook was 214. The peak redd count for chum was 776. Peak spawning time for fall chinook was set at approximately 15 November. Peak spawning time for chum occurred approximately 6 December. There were estimated to be a total of 1,881 fall chinook spawning below Bonneville Dam in 2002. The study area's 2002 chum population was estimated to be 4,232 spawning fish.

Temperature unit data suggests that below Bonneville Dam 2002 brood bright stock, fall chinook emergence began on February 3 2003 and ended 7 May 2003, with peak emergence occurring 20 April. 2002 brood juvenile chum emergence below Bonneville Dam began 27 January and continued through 6 April 2003. Peak chum emergence took place 1 March. A total of 10,925 juvenile chinook and 1,577 juvenile chum were sampled between the dates of 24 January and 21 July 2003 below Bonneville Dam.

Juvenile chum migrated from the study area in the 40-55 mm fork length range. Migration of chum occurred during the months of March, April and May. Sampling results suggest fall chinook migration from rearing areas took place during the month of June 2003 when juvenile fall chinook were in the 65 to 80 mm fork length size range.

Adult and juvenile sampling below Bonneville Dam provided information to assist in determining the stock of fall chinook and chum spawning and rearing below Bonneville Dam. Based on observed spawning times, adult age and sex composition, juvenile emergence timing, juvenile migration timing and juvenile size at the time of migration, it appears that in 2002 and 2003 the majority of fall chinook using the area below Bonneville Dam were of a late-spawning, bright stock of fall chinook. Observed spawning times, adult age and sex composition, GSI and DNA analysis, juvenile emergence timing, juvenile migration timing and juvenile size at the time of migration suggests chum spawning and rearing below Bonneville dam are similar to stocks of chum found in Hamilton and Hardy creek and are part of the Lower Columbia River Chum ESU.

INTRODUCTION

This report describes work conducted by the Oregon Department of Fish and Wildlife (ODFW) and the Pacific States Marine Fisheries Commission (PSMFC) from 1 October 2002 to 30 September 2003. The work is part of studies to evaluate spawning of fall chinook salmon (Oncorhynchus tshawytscha) and chum salmon (O. keta) below the four lowermost Columbia River dams under the Bonneville Power Administration's Project 1999-003-01. The purpose of this project is twofold:

1) Document the existence of fall chinook and chum populations spawning below Bonneville Dam (river mile (RM) 145), (Figure 1) and estimate the size of these populations.

2) Profile stocks for important population characteristics including: spawning time, genetic and biological make-up, emergence timing, migration size and timing, and juvenile to adult survival rates.

Specific tasks conducted by ODFW and PSMFC (WDFW) during this period were:

1) Documentation of fall chinook and chum spawning below Bonneville Dam using on-water observations.

2) Collection of biological data to profile stocks in areas described in Task 1.

3) Determination of spawning population estimates and age composition, average size at return, and sex ratios in order to profile stocks in areas described in Task 1.

4) Collection of data to determine stock origin of adult salmon found in areas described in Task 1.

5) Determination of possible stock origins of adult salmon found in areas described in Task 1 using tag rates based on coded-wire tag recoveries.

6) Determination of emergence timing and hatching rate of juvenile fall chinook and chum below Bonneville Dam.

7) Determination of migration time and size for juvenile fall chinook and chum rearing in the area described in Task 6.

8) Investigation of feasibility of determining stock composition of juvenile fall chinook and chum rearing in the area described in Task 6.

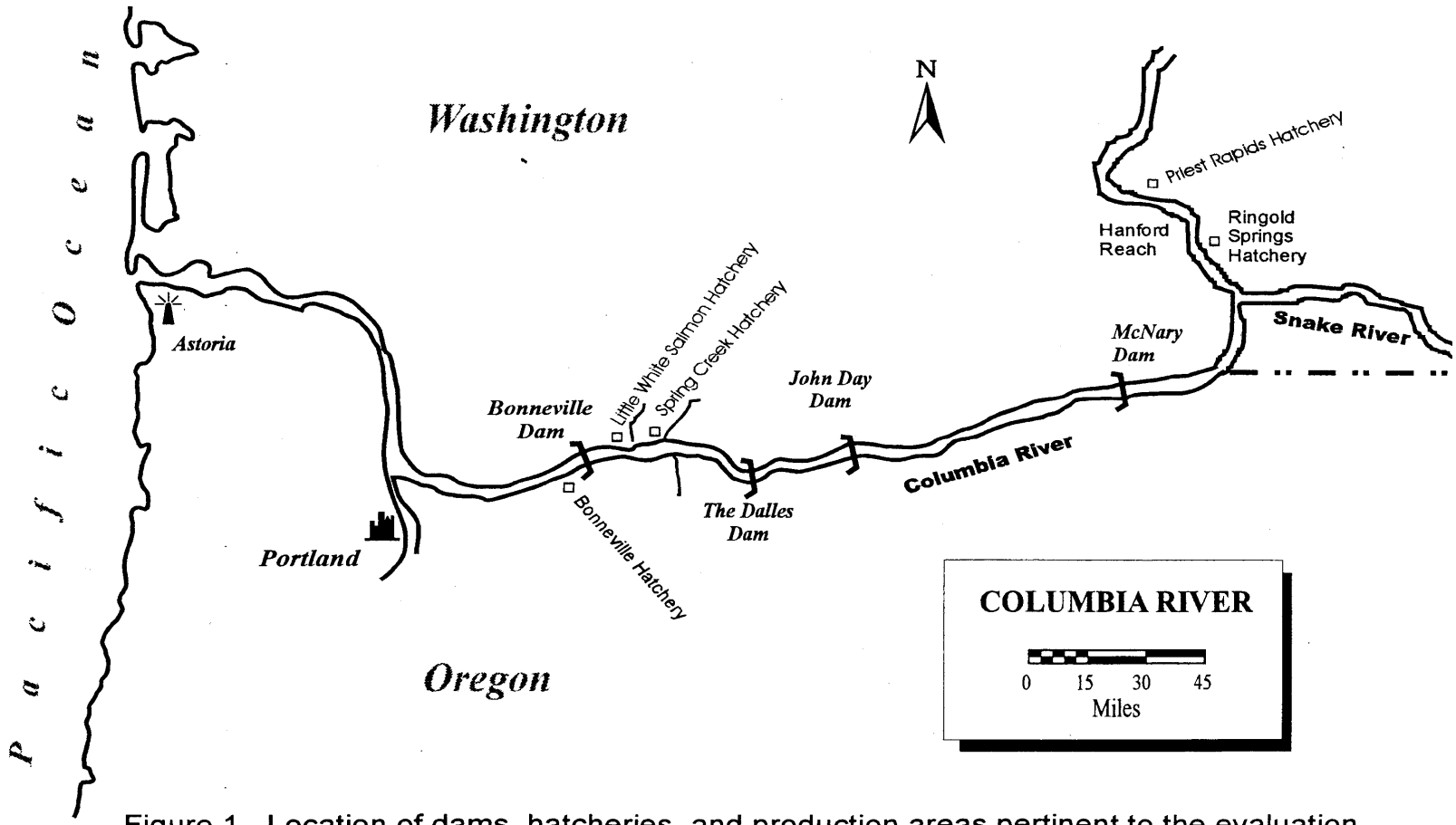

Figure 1. Location of dams, hatcheries, and production areas pertinent to the evaluation.

9) Documentation of entrapment in low-lying areas of juvenile fall chinook and chum rearing in the area described in Task 6 (separate report).

10) Investigation of feasibility of coded-wire tagging juvenile fall chinook captured in the area described in Task 6 to determine juvenile to adult survival rate.

METHODS AND MATERIALS

Adult Study

Spawning ground surveys of fall chinook and chum salmon below Bonneville Dam occurred from 08 October 2002 through 13 January 2003. The below Bonneville Dam study area is approximately two miles downstream from the dam, between river miles 141.0-143.5. The area includes Pierce and Ives Islands as well as the main channel of the Columbia River. Primary spawning areas are within the island complex and along the shorelines of the islands adjacent to the main channel of the Columbia River. Counts of spawning redds and numbers of live and dead fish were made from the bow of a jet boat and by wading in shallow water. In addition, locations of newly formed spawning redds were recorded using global positioning system (GPS) receivers.

Fish carcasses were examined and biological data was collected to profile stock for age composition, average size at return, and sex ratios. Scales from sampled fish were removed and analyzed to determine total age. To assist in determining stock origin of salmon found in the study areas, carcasses were inspected for fin clips. The snouts of fish with adipose fin clips were removed and kept for future coded-wire tag recovery and analysis. To assist in determining whether fish had successfully spawned, female carcasses were examined for the presence of eggs.

A capture-recapture carcass tagging study known as the Worlund technique was used to assist in providing spawner population estimates for fall chinook. The mathematical model used to analyze the data was developed by G. Paulik (prepared by D. Worlund) of the University of Washington and is a use of the multiple release and recapture methods of G. Seber and G. Jolly (Biometrika Vol. 49, 1962). Each week newly discovered fall chinook carcasses were marked with a different colored plastic tag and returned to their original location. The number of new tags issued and the number of tags recovered from previous week's tagging were recorded. Carcasses found with a tag were mutilated to identify them as recoveries. A population estimate was generated after tag data was analyzed by the above method.

Juvenile Study

The juvenile portion of the study concentrated on areas where spawning occurred below Bonneville Dam in 2002 and 2003. To determine emergence timing, estimated hatching and emergence dates were calculated in temperature units (TU) which are measured in Celsius degree-days. The dates were calculated in TU from the initiation of spawning to hatching of eggs (500 ^{o} C. TU for chinook and 600 ^{o} C. TU for chum) and beginning and ending of emergence (1,000 ^{o} C. TU for chinook and 825 ^{o} C. TU for chum (Keller, 2003)). Water temperatures used in TU calculations were taken from Bonneville Dam readings and from temperature gauges maintained by Battelle Pacific Northwest National Laboratories and located in the Ives Island area.

Sampling to determine the time and size juveniles that migrated from the areas used for rearing began 24 January 2003. Surveys were conducted twice weekly through 21 July 2003. Sampling was conducted in twelve designated locations below Bonneville Dam (Figure 2). The locations were selected based on their proximity to redds identified during spawning ground surveys in 2002, representative habitat and seining accessibility. Specific sampling areas within the twelve locations changed with variations in river flows.

Two types of gear were used to capture juvenile fish in the study area. Shorelines were fished with four-foot deep stick seines with one-eighth inch mesh in lengths of 18 and 28 feet. The sampling crew also employed a 100-foot long, five-foot deep beach seine with one-sixteenth inch mesh. After the seines were set, they were immediately retrieved. In-water fishing time was approximately five minutes. Seines worked best in sections of the river that were free of snags and large obstructions and with moderate flow velocities.

Captured fish were dip-netted into a five-gallon bucket containing the anesthetic MS-222. Once anesthetized, fish were identified by species, measured for fork length and examined for fin clips. Developmental stage of fry was also noted (e.g., yolk sac or button-up fry). Processing time was five to ten minutes per set. After data was collected, fish were returned to the site of capture. The number of sets fished, water temperatures and beginning and ending times for each sampling period were recorded. In addition, Bonneville Dam flows were noted and recorded for those periods when sampling occurred.

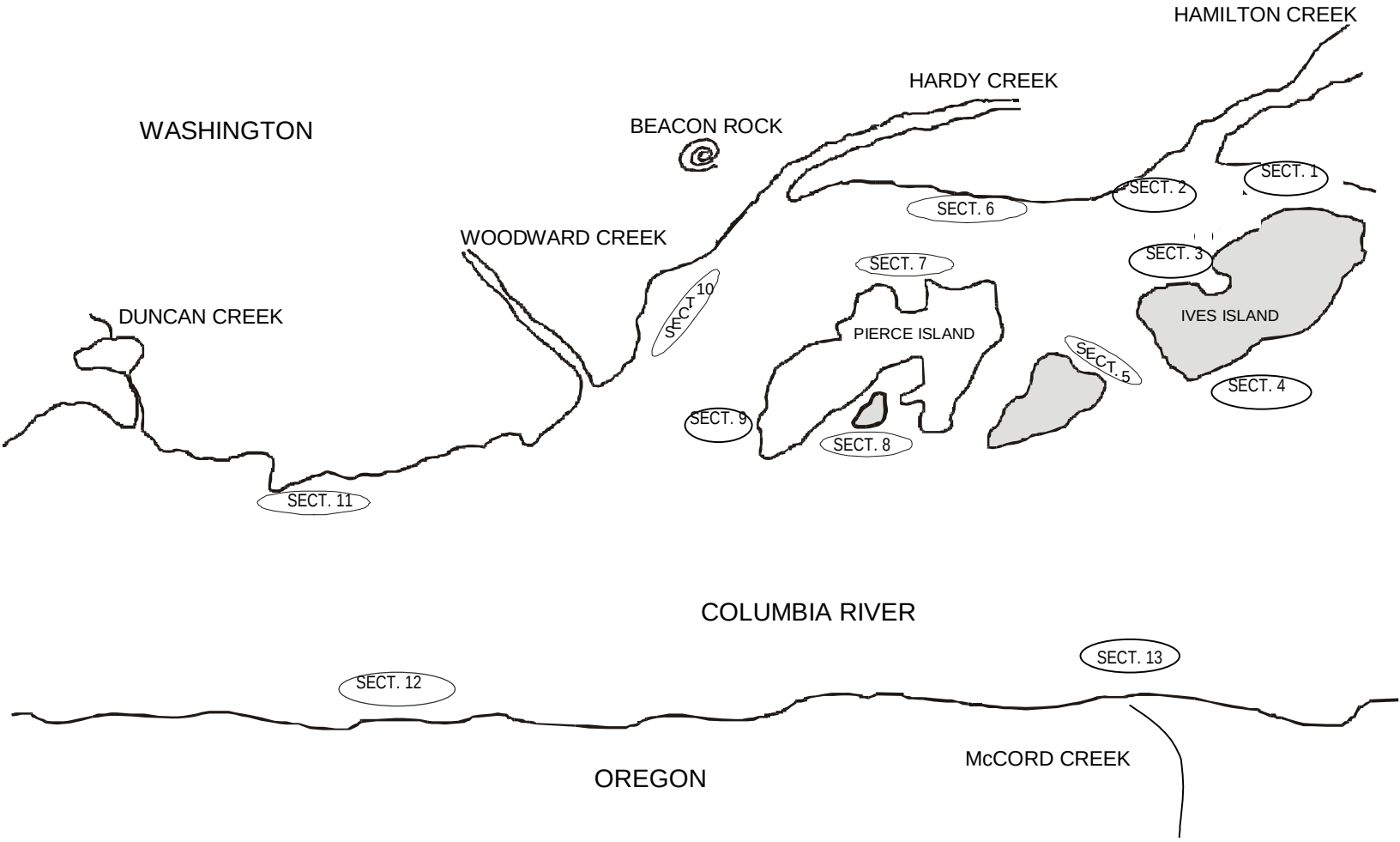

Figure 2. Locations of juvenile sampling areas below Bonneville Dam, 2003.

When unmarked juvenile chinook were caught in the study area, the criterion used for differentiating chinook juveniles that were products of the study area from upriver natural production and hatchery releases was based on the fork length of the sampled fish and presence of coded-wire tags. Chinook less than 60 mm fork length were assumed to be products of the study area. This assumption is based on the fact that chinook fry emerge at a size range of 35-40 mm fork length. In addition, hatcheries above Bonneville Dam release chinook at sizes greater than 60 mm fork length and wild upriver chinook juveniles do not begin migrating until they are larger than 60 mm fork length. As the earliest hatching, study area chinook grew in size during the mouth of June the length criterion used to differentiate them from untagged upriver hatchery was gradually increased. In the month of June, when some of the smaller sized upriver smolts of approximately the same size as study area fish were assumed to be migrating into the study area, the upper limit of the length criterion was increased to 65 mm fork length. The project is unable to determine whether chum captured in the study area, are products of main stem spawning or of nearby Hamilton and Hardy creeks, since all chum are unmarked and there are no size differences between the populations.

In order to determine a juvenile to adult survival rate for wild fall chinook found below Bonneville Dam, a part of the juvenile population was adipose fin clipped and coded-wire tagged. The tagging was conducted in the months of May and June 2003 when native fish began attaining a size of 47 mm fork length or greater. To avoid tagging fish from outside the area, tagging was terminated once fish of comparable size to the native population began migrating into the area from points above the dam. Evidence of juvenile chinook from outside the area was established when adipose fin clipped chinook in the 75-100 mm fork length range were caught in the study area.

Fish to be tagged were caught in the study area and held in a net pen for approximately 24 hours prior to tagging. They were then transported to the tagging site, anesthetized, measured, sorted, and a standard length coded-wire tag was inserted into the fish's snout. After each fish was tagged it was passed along a tag detector unit to ensure that a tag was present in the fish. The tagged fish was then placed into a recovery tank before being placed into a recovery net pen in the river. Several times a day fish were sacrificed to verify proper tag placement. At the end of each day, tagged fish were released downstream of the study area into the main channel of the Columbia River. In addition, each day approximately one percent of all tagged fish were held for 48 hours and checked for tag retention before being released.

RESULTS AND DISCUSSION

Adult Study

Spawning of fall chinook, chum and coho salmon below Bonneville Dam was documented by counts of live fish, redds and post-spawning mortality (Table 1). Based on spawning ground surveys, initiation of spawning below Bonneville Dam for bright stock fall chinook salmon was set at 22 October 2002. Based on run timing and previous years coded-wire tag recoveries, prior to 22 October, chinook observed spawning in the study area were considered to be tule stock fall chinook. Initiation of spawning below Bonneville Dam for chum salmon was set at 5 November 2002.

Peak spawning for fall chinook salmon was determined to be approximately 15 November. Peak spawning for chum was set at 6 December 2002. Two hundred fourteen redds and 515 live and 125 dead adults were observed at peak spawning for fall chinook. Seven hundred seventy-six redds and 1,015 live fish were observed at the time set for peak spawning for chum. The date determined to be the end of spawning for fall chinook was 10 December 2002. The date set as the end of spawning for chum was 30 December 2002. Table 2 contains the first, peak and last counts of spawning ground information from 1998 through 2002. For the four years the project has conducted spawning ground surveys below Bonneville Dam, estimated peak spawning time for bright chinook has been as early as 9 November to as late as 16 November. During the five years of the study, chum observed below Bonneville Dam have began spawning the first week of November. The earliest peak spawning date for chum was 16 November in 1998 and the latest peak spawning date was 6 December 2002.

In 2002, coho salmon were also observed spawning in areas used by chinook and chum. One hundred eighty-nine carcasses were sampled. Peak spawning appears to have occurred during the first two weeks of November. The coho observed in the area are of the early-spawning stock. This stock is produced at Bonneville Hatchery and is found spawning in Hardy and Hamilton creeks.

Ives Island fall chinook spawning times correspond to other late-spawning stocks of fall chinook found in the Columbia River. Timing of chum spawning below Bonneville Dam was found to be similar to that of chum spawning in nearby Hardy and Hamilton creeks.

Table 1. Columbia River mainstem spawning ground surveys, 2002-2003.

Below Bonneville Dam

Fall Chinook

Date	Redds	Live	Dead	Sampled	CWT recoveries	Bonneville Dam tailwater (ft.)*	Bonneville Dam discharge (kcfs)*
10/08/2002	7	10	11	11	1	9.0	80.3
10/11/2002	8	11	2	2	0	11.1	119.1
10/15/2002	6	4	2	2	0	10.3	116.4
10/18/2002	6	6	1	1	0	9.4	100.1
10/22/2002	10	16	2	2	0	9.3	98.8
10/25/2002	12	26	5	5	0	10.8	120.8
10/30/2002	6	0	0	0	0	10.3	122.3
11/01/2002	8	37	0	0	0	10.6	126.0
11/05/2002	31	134	16	16	0	10.8	117.6
11/08/2002	50	167	12	12	0	11.3	108.9
11/12/2002	145	365	76	74	0	11.2	125.3
11/15/2002	214	515	125	24	0	11.4	131.6
11/19/2002	170	264	222	39	8	11.5	122.2
11/22/2002	211	249	214	42	3	11.5	122.2
11/26/2002	137	201	190	38	0	11.4	132.8
12/03/2002	61	60	168	16	2	11.5	124.5
12/06/2002	37	8	70	18	0	11.5	125.4
12/10/2002	0	0	73	21	0	11.7	127.7
12/13/2002	0	0	24	12	0	11.6	126.1
12/17/2002	0	0	27	21	0	11.5	101.7
12/20/2002	0	0	10	8	0	11.7	110.1
12/23/2002	0	0	0	0	0	11.6	119.6
12/30/2002	0	0	0	0	0	11.5	115.3
01/13/2003	0	0	0	0	0	11.5	121.2
		2,073	1,250	364	14		

Below Bonneville Dam

Chum

Date	Redds	Live	Dead	Sampled	Bonneville Dam tailwater (ft.)*	Bonneville Dam discharge (kcfs)*
11/05/2002	4	5	0	0	10.8	117.6
11/08/2002	9	60	2	2	11.3	108.9
11/12/2002	36	183	4	4	11.2	125.3
11/15/2002	128	296	7	7	11.4	131.6
11/19/2002	210	449	51	48	11.5	122.2
11/22/2002	322	847	105	21	11.5	122.2
11/26/2002	540	1,157	80	16	11.4	132.8
12/03/2002	488	863	480	48	11.5	124.5
12/06/2002	776	1,015	144	32	11.6	125.4
12/10/2002	578	844	700	70	11.7	127.7
12/13/2002	288	639	555	54	11.5	126.1
12/17/2002	139	182	337	33	11.5	101.7
12/20/2002	56	113	104	9	11.7	110.1
12/23/2002	19	37	74	37	11.6	119.6
12/30/2002	0	4	104	52	11.5	115.3
01/13/2003	0	0	78	39	11.5	121.2
		6,694	2,825	472		

Below Bonneville Dam

Coho

Date	Redds	Live	Dead	Sampled
10/08/2002	0	22	0	0
10/11/2002	0	3	0	0
10/15/2002	0	0	1	1
10/18/2002	0	2	5	5
10/22/2002	0	24	4	4
10/25/2002	0	18	5	5
10/30/2002	2	3	0	0
11/01/2002	4	11	0	0
11/05/2002	7	33	3	3
11/08/2002	0	14	1	1
11/12/2002	14	40	15	15
11/15/2002	20	61	10	10
11/19/2002	6	12	54	54
11/22/2002	9	24	26	26
11/26/2002	1	3	25	25
12/03/2002	1	8	12	12
12/06/2002	3	4	9	9
12/10/2002	0	0	7	7
12/13/2002	0	0	12	12
01/13/2003	0	0	0	0
		282	189	189

* Daily readings taken at 12:00 pm (www.nwd-wc.army.mil/cgi-bin/DataQuery).

Table 2. Comparison of results from below Bonneville Dam spawning ground surveys, 1998-2002.

Fall Chinook

	Date	Redds	Live	Dead	Bonneville Dam tailwater (ft.)*	Bonneville Dam discharge (kcfs)*
First day of surveys:	10/26/1998**	16	9	3	8.8	100.4
	10/05/1999**	9	18	6	11.8	128.0
	09/19/2000	0	0	0	9.8	103.3
	10/03/2001	0	1	0	9.0	95.4
	10/08/2002**	7	10	11	9.0	80.3
Peak spawning day:	11/16/1998	198	242	82	11.5	125.3
	11/09/1999	152	268	71	13.2	143.8
	11/09/2000	225	225	23	11.7	123.1
	11/16/2001	31	107	21	9.2	106.5
	11/15/2002	214	515	125	11.4	131.6
Last day of surveys:	12/14/1998	0	0	8	14.9	158.2
	12/21/1999	0	0	0	19.1	218.7
	12/27/2000	no count	no count	1	12.9	135.7
	12/28/2001	0	2	1	12.4	124.2
	01/13/2003	0	0	0	11.5	121.2

Chum

	Date	Redds	Live	Dead	Bonneville Dam tailwater (ft.)*	Bonneville Dam discharge (kcfs)*
First day of surveys:	11/06/1998	0	13	0	11.6	125.0
	11/02/1999	0	3	0	12.6	119.7
	11/06/2000	15	18	0	11.2	126.6
	11/05/2001	0	10	0	8.2	84.8
	11/05/2002	4	5	0	10.8	117.6
Peak spawning day:	11/16/1998	47	110	2	11.5	125.3
	11/23/1999	29	40	1	15.3	172.2
	12/01/2000	95	215	34	11.6	128.4
	11/26/2001	181	239	16	11.1	116.7
	12/06/2002	776	1,015	144	11.6	125.4
Last day of surveys:	12/14/1998	0	8	23	14.9	158.2
	12/21/1999	0	0	2	19.1	218.7
	01/03/2001	no count	0	3	11.7	136.9
	12/28/2001	0	0	4	12.4	124.2
	01/13/2003	0	0	78	11.5	121.2

* Daily readings taken at 12:00 pm (www.nwd-wc.army.mil/cgi-bin/DataQuery).

** Tule fall chinook counts.

Table 3. Population estimates of returning bright fall chinook and chum below Bonneville Dam, 1998-2002.

Year	# chinook sampled for biological data	# chum sampled for biological data	population of chinook	population of chum
1998	244	118	554	226
1999	533	12	897	40
2000	451	195	704	529
2001	309	264	721	532
2002	364	472	1,881	4,232

The bright fall chinook population estimate was made based on results of carcass tagging. In 2002, it was estimated that 1,881 fall chinook returned to spawn in the areas around Ives and Pierce islands (Table 3). The population estimate of 1,881 chinook should be considered a minimum estimate since fish were observed spawning in the deeper main channel areas where carcasses could not be recovered. This compares to an estimated spawning population of 721 adults in 2001, 704 adults in 2000, also 897, and 554 adults in 1999 and 1998, respectively.

A population of 4,232 chum was estimated to have returned to spawn in the study area in 2002. This compares to an estimated population of 532 adults in 2001 and 529 adults in 2000. Spawning populations of 40 and 226 adults were estimated in 1999 and 1998, respectively.

Locations of newly observed salmon redds below Bonneville Dam were recorded using GPS waypoints. Figures 3 and 4 show approximate locations of redds that were observed for the first time. The majority of fall chinook redds in 2002 were found above and below the mouth of Hamilton Creek, between Ives and Pierce islands and in the main channel along the north side of Pierce Island. The majority of chum redds were observed near Hamilton Creek. These same areas have been frequently used by chinook in past years. The majority of chum redds were observed below Hamilton Creek and in an area on the northwest corner of Ives Island where significant upwelling occurs. Spawning chum were also found in the channel between Ives and Pierce islands, below Woodward Creek near Beacon Rock and on the Oregon side of the Columbia River below McCord Creek.

Vital statistics were developed from 290 fall chinook and 403 chum biological samples to assist in determining stock origins of returning fish found spawning in the study area. Vital statistics of tule and bright fall chinook found below Bonneville Dam in 2002 include age compositions, mean fork lengths, and sex ratios (Table 4-5). Fall chinook sampled in the study area showed similarities in male, female, age class representation and age related mean fork lengths with other late-spawning fish found in the Columbia River such as Priest Rapids and Bonneville hatcheries stocks. Table 6 contains vital statistics of chum sampled below Bonneville Dam. Four-year-old fish were the predominant age classes in 2002 with females being the dominant sex (52.3%).

To further assist in determining the stock origin of salmon found below Bonneville Dam, all carcasses were sampled for fin clips and other external marks. Fourteen fall chinook carcasses were found to have adipose fin clips. Nine of the carcasses contained coded-wire tags. All of the tagged fish were released as subyearlings from upriver bright fall chinook facilities above the study area. Three fish were released from Bonneville Hatchery and three each from Lyons Ferry and Klickitat hatcheries. There were no marked chum found.

Figure 3. Location of fall chinook redds below Bonneville Dam, 2002.

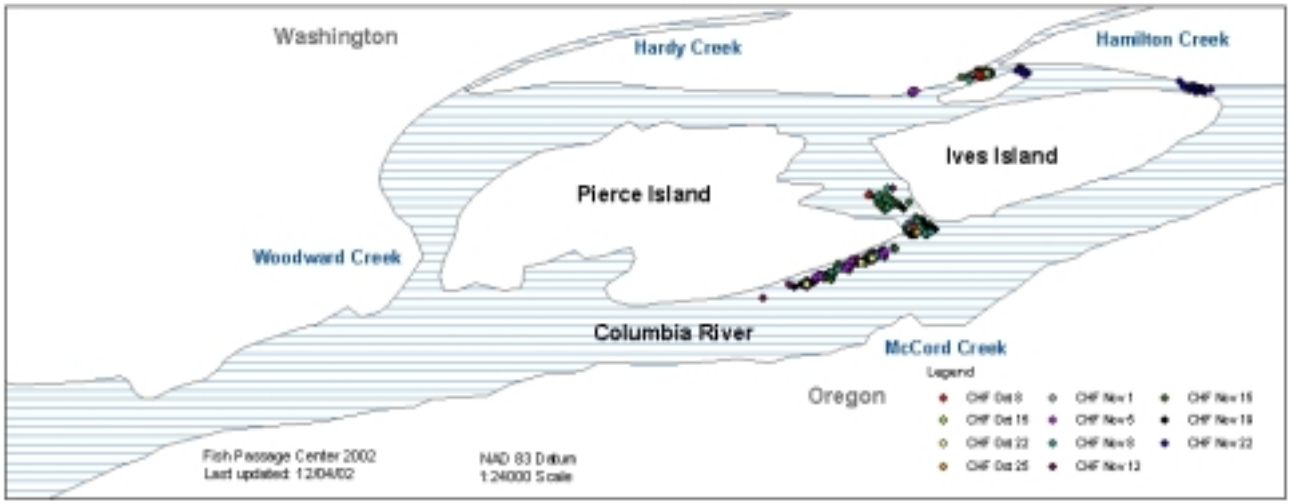

Figure 4. Location of chum redds below Bonneville Dam, 2002.

Table 4. Estimated age composition, sex composition, and fork length of tule fall chinok salmon that spawned below Bonneville Dam, 2002.

Age	Number in Sample		% in Sample		Mean Length (cm)		Length Range (cm)	
group	Males	Females	Males	Females	Males	Females	Males	Females
2	0	0	0.0	0.0	-	-	-	-
3	4	5	26.7	33.3	76	78	69-79	74-82
4	2	4	13.3	26.7	83	82	82-83	74-87
5	0	0	0.0	0.0	-	-	-	-
Total	6	9	40.0	60.0				

Table 5. Estimated age composition, sex composition, and fork length of bright fall chinok salmon that spawned below Bonneville Dam, 2002.

Age	Number in Sample		% in Sample		Mean Length (cm)		Length Range (cm)	
group	Males	Females	Males	Females	Males	Females	Males	Females
2	10	1	3.6	0.4	53	63	48-58	63
3	50	23	18.2	8.4	72	79	61-92	71-91
4	79	82	28.7	29.8	87	84	71-112	69-97
5	19	10	6.9	3.6	102	94	92-108	94
6	1	0	0.4	0.0	117	0	117	0
Total	159	116	57.8	42.2				

Table 6. Estimated age composition, sex composition, and fork length of chum salmon that spawned below Bonneville Dam, 2002.

Age	Number in Sample		% in Sample		Mean Length (cm)		Length Range (cm)	
group	Males	Females	Males	Females	Males	Females	Males	Females
2	0	0	0.0	0.0	0	0	0	0
3	48	87	11.9	21.6	76	67	72-83	63-71
4	134	116	33.3	28.8	84	75	72-91	68-81
5	10	8	2.5	1.9	82	74	68-88	72-77
Total	192	211	47.7	52.3				

There were no GSI samples collected from chum carcasses found below Bonneville Dam in 2002. WDFW geneticists analyzed samples collected in 1998, 1999, 2000 and 2001. Their findings suggest that chum found spawning in the Columbia River around Ives Island show close genetic relationships with chum from nearby Hardy and Hamilton creeks. In addition, the report suggests it is reasonable to assume that the Ives Island chum population is included in the Lower Columbia River Chum Evolutionary Significant Unit (ESU) (Marshall, 1998).

Below Bonneville Dam, bright fall chinook were sampled for GSI data by WDFW in 1996 and 1997. Analysis of 142 samples showed relatively small genetic differences between the below Bonneville Dam samples and samples taken from other Columbia River late-spawning stock, fall chinook. The analysis suggests, bright chinook spawning below Bonneville Dam are genetically similar to other bright fall chinook populations found in the Columbia River such as those found at the Hanford Reach and Bonneville Hatchery (Marshall, 1998).

To assist in determining whether adult chinook and chum successfully spawned, all female carcasses that were sampled for biological data were examined for the presence of eggs. All female chum carcasses appeared to be in a spawned-out condition. Only one of the female chinook carcasses appeared to be a pre-spawning mortality.

Juvenile Study

Hatching and emergence times for 2002 brood salmon below Bonneville Dam are contained in Table 7. Hatching and emergence times of fall chinook and chum were estimated based on required temperature units that predict chinook and chum early life history and 2002-2003 Columbia River water temperatures taken in the study area. Peizometers placed in the spawning area near the mouth of Hamilton Creek showed upwelling water to be warmer than the surrounding water (Arntzen, 2002). It is believed the warmer water increases the water temperature in chum redds on average of approximately three degrees Celsius. Consequently, an additional three degrees Celsius was factored into chum temperature unit calculations. This increase in estimated temperature the areas around Hamilton Creek. Emergence of chum was estimated to have occurred from 27 January to 6 April 2003. Estimated peak emergence of chum took place 1 March 2003.

Although some fall chinook spawned in the Hamilton Creek area the majority of areas where fall chinook spawned were not subject to the above warmer upwelling phenomenon. Except in those areas shared by chum, emergence of bright fall chinook began approximately February 3 and continued through 7 May 2003. Peak emergence of fall chinook occurred 20 April 2003.

Table 7. Columbia River water temperature (^{o} F) and temperature units (^{o} C) below Bonneville Dam, 2002-2003.

(Data source: Ives Island Gage 1)

	OCTOBER		NOVEMBER		DECEMBER		JANUARY		FEBURARY		MARCH		APRIL		MAY		JUNE	
	TEMP	TU's	TEMP	TU's	TEMP	TU's	TEMP	TU's	TEMP	TU's	TEMP	TU's	TEMP	TU's	TEMP	TU's	TEMP	TU's
DAY	(°F)	(°C)	(°F)	(°C)	(°F)	(°C)	(°F)	(°C)	(°F)	(°C)	(°F)	(°C)	(°F)	(°C)	(°F)	(°C)	(°F)	(°C)
1	57	14	54	12	50	7	43	6	41	5	41	5	46	8	52	11	57	14
2	55	13	54	12	50	8	43	6	41	5	41	5	46	8	52	11	57	14
3	55	13	54	12	50	7	43	6	41	5	41	5	46	8	52	11	58	14
4	59	15	54	12	50	7	43	6	41	5	41	5	46	8	52	11	57	14
5	59	14	54	12	50	7	43	6	41	5	41	5	46	8	52	11	59	15
6	57	15	54	12	50	7	43	6	41	5	43	6	46	8	52	11	59	15
7	59	15	48	9	50	7	43	5	41	5	41	5	46	8	52	11	59	15
8	59	15	50	10	50	7	43	6	41	5	41	5	46	8	52	11	59	15
9	59	16	50	10	49	7	43	6	41	5	41	5	46	8	52	11	59	15
10	61	16	50	10	48	7	42	6	41	5	43	6	46	8	52	11	59	15
11	59	15	51	10	48	7	40	5	41	5	43	6	48	9	52	11	59	15
12	57	14	51	10	48	7	40	5	41	5	43	6	48	9	52	11	59	15
13	55	13	50	10	48	7	41	5	41	5	43	6	48	9	52	11	61	16
14	57	14	50	10	48	7	41	5	41	5	43	6	48	9	52	11	61	16
15	57	14	50	10	47	7	41	5	41	5	43	6	48	9	54	12	61	16
16	57	14	48	9	47	7	41	5	41	5	43	6	48	9	54	12	61	16
17	59	15	48	9	47	7	41	5	41	5	45	7	48	9	52	11	61	16
18	55	13	48	9	47	7	41	5	41	5	43	6	48	9	52	11	63	17
19	57	14	51	10	47	7	41	5	41	5	45	7	50	10	52	11	61	16
20	59	15	51	10	47	6	41	5	41	5	45	7	50	10	54	12	61	16
21	59	15	51	10	47	6	41	5	41	5	45	7	50	10	55	12	61	16
22	59	15	50	10	47	6	40	5	41	5	45	7	50	10	55	12	61	16
23	58	14	50	10	47	6	40	5	41	5	45	7	50	10	56	12	61	16
24	57	14	48	9	46	6	41	5	41	5	45	7	50	10	57	13	61	16
25	57	14	48	9	46	6	41	5	41	5	45	7	50	10	57	13	61	16
26	56	14	46	8	46	6	42	6	41	5	45	7	50	10	57	13	61	16
27	56	14	46	8	45	6	42	6	41	5	45	7	50	10	57	13	61	16
28	56	13	46	8	44	6	41	5	41	5	45	7	50	10	57	13	63	17
29	55	13	45	7	44	6	41	5			45	7	50	10	57	13	63	17
30	55	13	45	7	44	6	41	5			46	8	50	10	57	14	63	17
31	55	13			44	6	41	5			46	8			57	14		
TOTAL	--	437.41	--	296.6	--	205.9	--	159.9	--	140	--	194	--	272.1	--	365	--	468
AVE.	57	14	50	10	47	7	42	5	41	5	43	6	48	9	54	12	60	16

REQUIRED TEMPERATURE UNITS (TU'S)

FALL CHINOOK	(°C)
EYE OUT	250
HATCHING	500
EMERGENCE	1000

CHUM	
EYE OUT	400
HATCHING	600
EMERGENCE	825

CUMULATIVE TU'S (°C) SINCE INITIATION AND END OF SPAWNING

FALL CHINOOK

EVENT	DATE	EYED OUT	HATCHING	EMERGENCE T	EMERGENCE +2°C	EMERGENCE +3°C
BEGIN SPAWNING	10/8	10/26	11/17	2/3	12/1	12/25
PEAK SPAWNING	11/15	12/12	1/23	4/20	3/20	3/6
END SPAWNING	12/6	1/17	3/8	5/7	4/12	3/31

CHUM

EVENT	DATE	EYED OUT	HATCHING	EMERGENCE T	EMERGENCE +2°C	EMERGENCE +3°C
BEGIN SPAWNING	11/5	12/24	1/31	3/15	2/7	1/27
PEAK SPAWNING	11/26	2/1	3/13	4/12	3/14	3/1
END SPAWNING	12/30	3/21	4/13	5/5	4/14	4/6

Sampling for post-emergent fry took place in locations identified in Figure 2. Based on emergence estimates juvenile sampling began 24 January 2003. Sampling was terminated 21 July 2003 after it appeared the majority of fish had migrated from the study area.

A total of 10,926 juvenile chinook and 1,577 juvenile chum were sampled in areas below Bonneville Dam in 2003. Although juvenile fish were caught in all of the sampling sections around Ives and Pierce islands, some areas were more productive than other areas. Those areas that were closest to redds and or good rearing habitat seemed to yield the most catch. For chinook, these areas included sections five, eight and nine (Figure 5). Section eight produced 26% of the total juvenile fall chinook catch in the area around the islands. Sections five and nine yielded 19% and 16% of the total fish caught around the islands, respectively. Although sections three, six, seven and ten appeared to be used less frequently for rearing, those sections still accounted for 27% of the total sampled fall chinook fry.

Figure six show areas that produced catch of juvenile chum in 2003. Approximately 50% of the chum were caught in areas around or below Hamilton Creek. Fourteen percent of the total catch was in the section just below Hardy Creek. This area (section ten) likely contained large numbers of fish produced in Hardy Creek.

Results of juvenile chum sampling are found in Table 8. Juvenile chum were caught and sampled from 31 January to 23 May 2003. Peak catch of juvenile chum occurred 1 April 2003. Mean length of sampled juvenile chum for the season was 41.2 mm fork length. Once chum attained a size of approximately 45 mm fork length, they began migrating from the area. It appears that by the middle of April the majority of chum (92%) had migrated from below Bonneville Dam.

Fork length distribution of sampled juvenile fall chinook is found in Table 9. The table shows changes in the length distribution of juveniles caught in the study area during the sampling season. Newly emerged fish (juveniles less than 40 mm in length) were present in the catch from 24 January to 3 June. Peak catch of recently emerged juvenile chinook (those fish less than 50 mm in fork length), was observed to be 22 April. Peak catch of chinook fry in all size categories less than 100 mm was also 22 April.

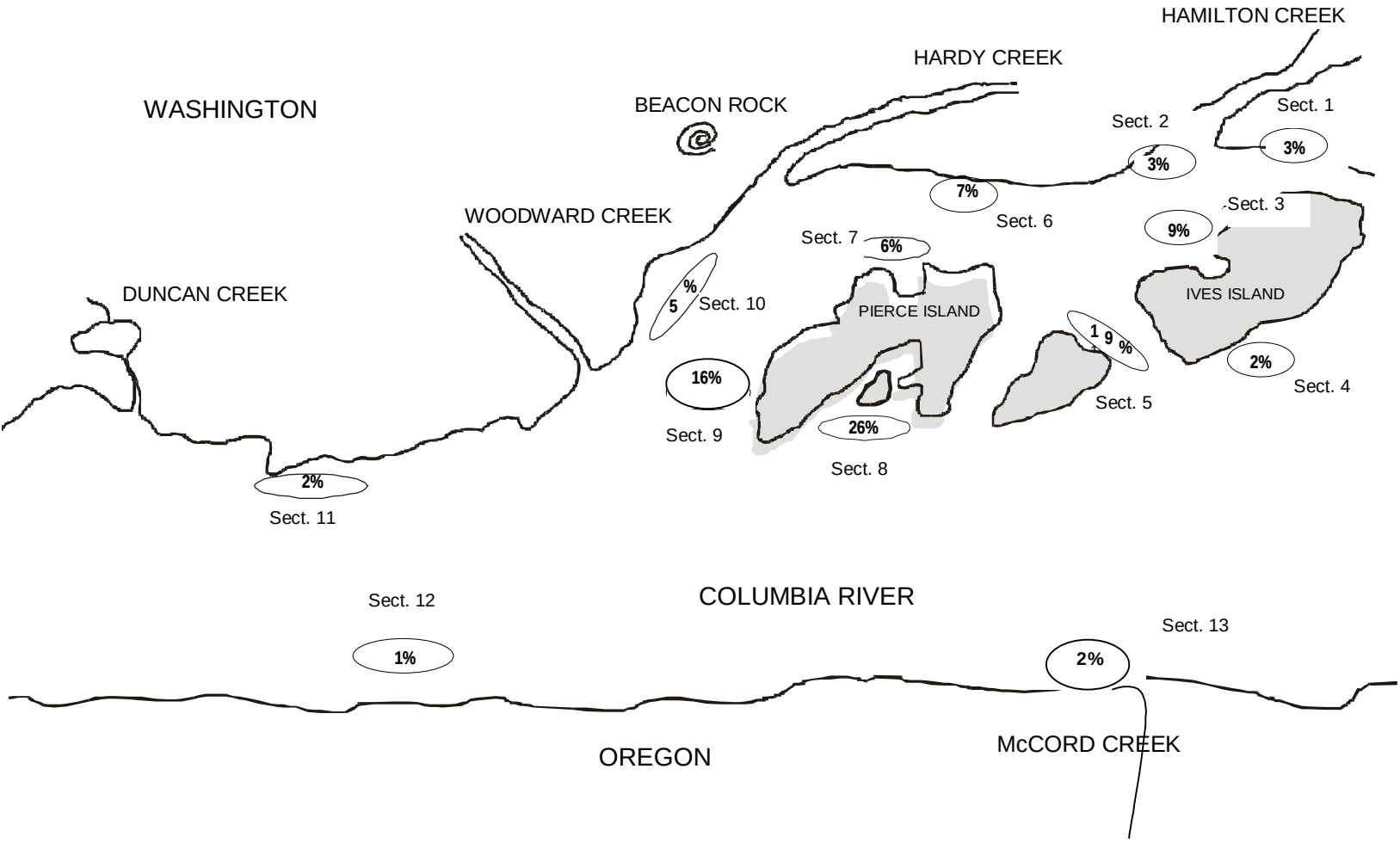

Figure 5. Percent of total juvenile chinook catch by area, below Bonneville Dam, 2003.

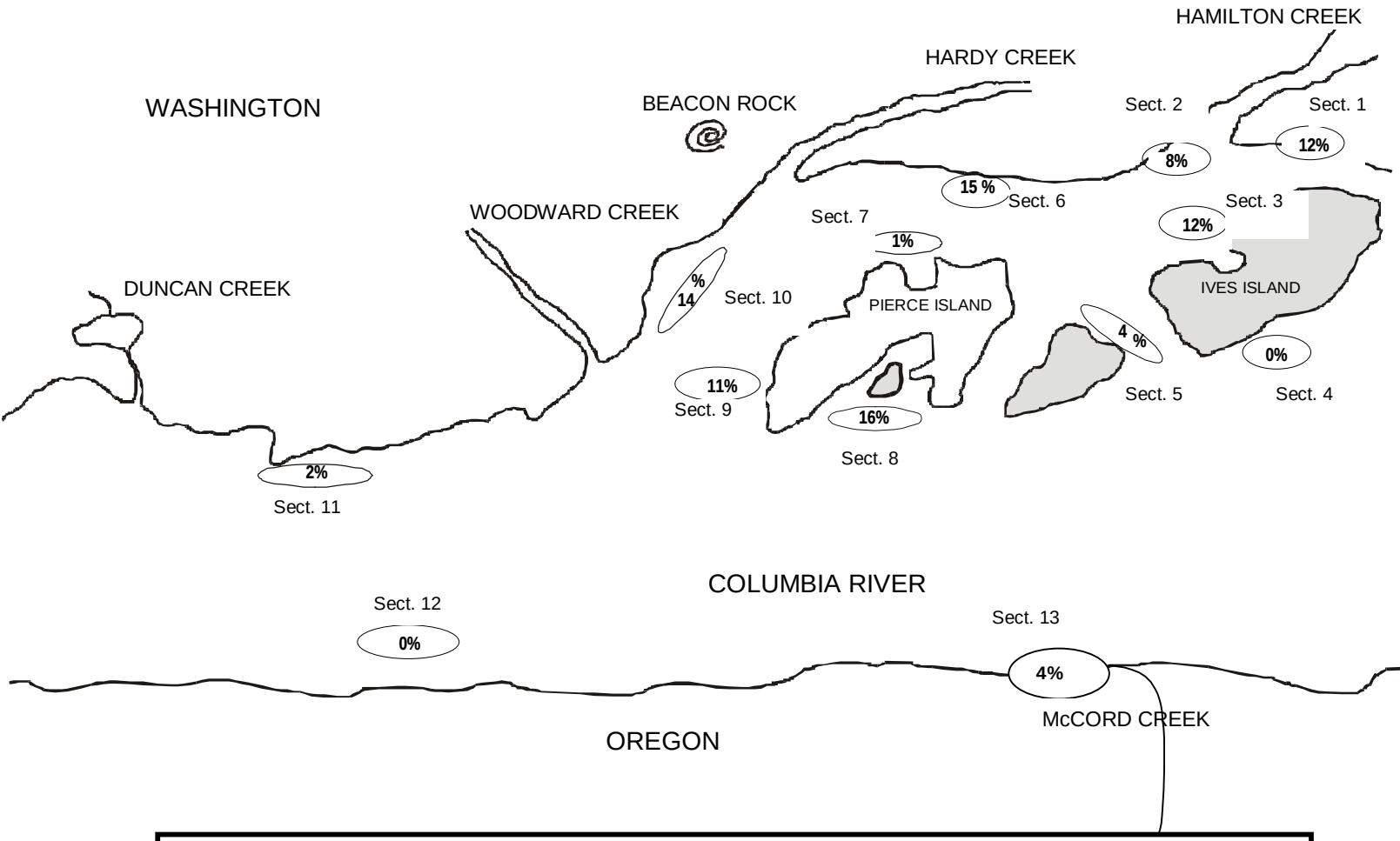

Figure 6. Percent of total juvenile chum catch by area, below Bonneville Dam, 2003.

Table 8. Fork length information of juvenile chum sampled below Bonneville Dam, 2003.

Date	Number	Fork length range (mm)	Mean Fork Length (mm)	Bonneville Dam tailwater (ft.)*	discharge (kcfs)*	water temp. (^{o}F)
31-Jan	2	33.0-37.0	35.0	16.3	150.5	41
14-Feb	1	38.0	38.0	12.2	127.2	40
18-Feb	2	39.0	39.0	11.5	107.7	41
21-Feb	1	41.0	41.0	12.9	123.2	41
25-Feb	3	40.0-42.0	41.0	11.7	129.1	42
28-Feb	22	36.0-43.0	38.2	11.5	122.7	42
03-Mar	72	33.0-48.0	41.0	13.2	139.6	41
07-Mar	24	37.0-46.0	44.0	14.6	153.0	42
11-Mar	69	34.0-55.0	41.0	15.0	177.6	42
14-Mar	51	34.0-52.0	41.0	14.9	158.1	42
18-Mar	94	34.0-51.0	40.0	17.1	194.5	44
21-Mar	175	34.0-47.0	39.5	16.1	177.8	44
25-Mar	124	36.0-49.0	40.5	15.9	174.3	44
28-Mar	76	34.0-54.0	40.0	19.8	239.7	45
01-Apr	302	37.0-51.0	40.0	18.1	189.6	46
04-Apr	49	34.0-53.0	39.8	16.8	188.0	46
08-Apr	131	35.0-49.0	40.0	17.0	195.3	46
11-Apr	202	36.0-45.0	40.0	16.6	192.8	47
14-Apr	51	34.0-49.0	40.5	16.5	196.9	48
18-Apr	39	33.0-57.0	41.0	20.7	263.4	48
22-Apr	15	37.0-41.0	40.0	19.4	245.6	49
24-Apr	58	39.0-49.0	41.5	18.1	235.2	50
28-Apr	2	37.0-40.0	39.0	19.6	264.5	50
02-May	5	40.0-49.0	42.4	17.9	219.5	50
06-May	3	40.0-53.0	46.0	20.0	276.1	50
13-May	2	44.0-52.0	48.0	16.6	211.9	52
23-May	2	54.0-55.0	54.5	19.6	278.5	54
Total	1,577	33.0-57.0	41.2			

* Daily readings taken at 12:00 pm (www.nwd-wc.army.mil/cgi-bin/DataQuery).

Table 9. Fork length distribution of juvenile chinook sampled below Bonneville Dam, 2003.

				Number of chinook in millimeters								Mean length	% chf		Bonneville Dam		
															tailwater	discharge	water
Week	Date	Total	Range	30-39	40-49	50-59	60-69	70-79	80-89	90-100	> 100	chf < 100	< 60mm	60-100mm	(ft.)*	(kcfs)*	temp. (^{o}F)
1	24-Jan	**74**	37 - 49	2	71	-	-	-	-	-	1	45.3	99%	0%	11.7	118.8	40
2	31-Jan	**17**	44 - 49	-	17	-	-	-	-	-	-	47.1	100%	0%	16.3	150.5	41
3	04-Feb	**36**	34 - 53	5	18	13	-	-	-	-	-	47.4	100%	0%	18.4	193.1	41
3	06-Feb	**63**	38 - 57	8	25	30	-	-	-	-	-	48.1	100%	0%	12.8	148.1	40
4	14-Feb	**67**	34 - 58	23	18	26	-	-	-	-	-	45.3	100%	0%	12.2	127.2	40
5	18 Feb	**38**	38 - 61	3	8	25	1	-	-	-	1	51.7	95%	3%	11.5	107.7	41
5	21-Feb	**11**	38 - 63	1	2	4	4	-	-	-	-	54.4	64%	36%	12.9	123.2	41
6	25-Feb	**61**	33 - 62	24	28	8	1	-	-	-	-	42.0	98%	2%	11.7	129.1	42
6	28-Feb	**144**	35 - 66	27	88	25	3	-	-	-	1	44.5	97%	2%	11.5	122.7	42
7	04-Mar	**73**	35 -174	9	50	6	4	-	1	-	3	45.0	89%	7%	13.2	139.6	41
7	07-Mar	**34**	34 -125	10	19	3	-	-	-	2	-	43.0	94%	6%	14.6	153.0	42
8	11-Mar	**175**	35 - 76	29	71	34	32	9	-	-	-	50.0	77%	23%	15.0	177.6	42
8	14-Mar	**183**	34 - 76	6	37	54	67	19	-	-	-	57.0	53%	47%	14.9	158.1	42
9	18-Mar	**211**	33 - 79	44	59	50	39	19	-	-	-	51.0	73%	27%	17.1	194.5	44
9	21-Mar	**127**	34 -135	47	32	10	19	18	-	-	1	49.5	70%	29%	16.1	177.8	44
10	25-Mar	**213**	36 - 73	56	128	21	4	4	-	-	-	43.0	96%	4%	15.9	174.3	44
10	28-Mar	**135**	34 - 222	50	52	9	7	15	-	-	2	47.0	82%	16%	19.8	239.7	45
11	01-Apr	**111**	34 - 82	26	69	2	3	3	2	-	6	44.0	87%	7%	18.1	189.6	46
11	04-Apr	**120**	35 - 82	23	58	16	6	14	3	-	-	49.0	81%	19%	16.8	188.0	46
12	08-Apr	**549**	35 - 91	107	403	24	8	4	2	1	-	41.0	97%	3%	17.0	195.3	46
12	11-Apr	**603**	35 - 121	164	389	23	7	11	7	-	2	43.0	96%	4%	16.6	192.8	47
13	14-Apr	**454**	34 - 82	87	334	19	5	7	2	-	-	43.0	97%	3%	16.5	196.9	48
13	18-Apr	**674**	35 - 97	46	560	39	6	11	8	4	-	45.5	96%	4%	20.7	263.4	48
14	22-Apr	**849**	37-95	74	650	63	19	22	20	1	-	46.0	93%	7%	19.4	245.6	49
14	24-Apr	**543**	35-89	45	447	25	14	8	4	-	-	45.0	95%	5%	18.1	235.2	50
15	28-Apr	**347**	36-98	30	245	48	8	3	4	9	-	47.5	93%	7%	19.6	264.5	50
15	02-May	**371**	33-95	28	265	69	3	-	2	4	-	46.4	98%	2%	17.9	219.5	50
16	06-May	**259**	32-82	20	152	81	3	1	2	-	-	47.6	98%	2%	20.0	276.1	50
16	09-May	**535**	30-99	81	317	115	12	1	4	5	-	46.5	96%	4%	20.1	285.8	51
17	13-May	**540**	35-150	48	185	144	13	13	50	68	19	59.4	69%	31%	16.6	211.9	52
17	16-May	**606**	30-107	79	283	158	38	16	12	12	8	46.3	86%	14%	20.3	274.0	52
18	20-May	**383**	34-107	36	176	103	33	8	11	11	5	51.1	84%	16%	17.6	219.8	52
18	23-May	**263**	36-105	8	88	120	23	13	3	6	2	53.7	82%	17%	19.6	278.5	54
19	27-May	**326**	34-94	9	59	142	97	11	3	5	-	57.4	64%	36%	21.5	302.5	55
19	30-May	**143**	41-93	-	44	41	45	11	1	1	-	57.1	59%	41%	24.9	360.9	55
20	03-Jun	**121**	38-88	3	33	24	42	13	6	-	-	55.8	50%	50%	23.2	330.0	57
20	06-Jun	**126**	41-108	-	20	21	42	28	1	12	2	63.5	33%	66%	21.3	291.7	57
21	10-Jun	**126**	44-101	-	5	23	40	44	10	3	1	67.4	22%	77%	21.7	308.5	59
21	13-Jun	**118**	47-101	-	2	30	37	31	11	6	1	68.0	27%	72%	21.2	302.2	59
22	17-Jun	**137**	48-109	-	1	11	30	58	27	8	2	72.5	9%	90%	21.6	310.6	60
22	20-Jun	**271**	42-101	-	4	13	65	112	59	17	1	69.5	6%	93%	17.0	202.7	61
23	23-Jun	**300**	43-95	-	2	17	54	156	62	9	-	74.4	6%	94%	15.9	201.1	60
23	26-Jun	**59**	54-97	-	-	2	9	36	9	3	-	74.0	3%	97%	18.5	242.5	61
24	30-Jun	**121**	58-101	-	-	1	10	46	44	19	1	80.0	1%	98%	14.8	179.0	62
25	03-Jul	**55**	64-96	-	-	-	3	21	25	6	-	80.8	0%	100%	11.5	128.0	63
26	08-Jul	**52**	63-92	-	-	-	2	24	23	3	-	80.0	0%	100%	10.3	123.5	64
26	11-Jul	**45**	59-95	-	-	-	-	16	25	4	-	81.7	0%	100%	14.6	176.9	64
27	14-Jul	**41**	72-104	-	-	-	-	11	23	6	1	83.5	0%	98%	15.9	209.3	66
27	17-Jul	**13**	77-113	-	-	-	-	2	10	-	1	85.2	0%	92%	14.1	171.9	67
28	21-Jul	**2**	62-86	-	-	-	1	-	1	-	-	74.0	0%	100%	12.7	162.7	68
total		**10,925**		1,258	5,514	1,692	859	839	477	225	61						

* 12:00 pm temperature reading.

Mean fork length of chinook rearing in the study area increased as water temperatures increased below Bonneville Dam. From 25 February to 28 April, mean fork length of sampled juvenile chinook increased from 42.0 mm to 47.5 mm, a growth rate of approximately 0.10 mm/day. During this time period daily water temperatures increased from 42.0 to 50.0 ^{o} F. From 28 April to 26 June, mean fork length increased from 47.5 mm to 74.0 mm, a growth rate of approximately 0.45 mm/day. During this time period, daily water temperatures increased from 50.0 to 61.0 ^{o} F. Wild juvenile chinook reared in areas below Bonneville Dam until they attained a size of approximately 65 to 80 mm in fork length. Once they attained this size they began migrating from the area. Peak migration of study area chinook occurred during the month of June. By 20 June, juvenile chinook less than 60 mm in length represented only six percent of the population below Bonneville Dam.

A comparison of estimated peak emergence dates to peak catch dates of recently emerged fry for chinook and chum caught below Bonneville Dam for the years 1999-2003 is described in Table 10. Peak catch of 2003 chinook was the earliest in the five years of the study. The difference in time between estimated peak emergence and peak catch of recently emerged chinook varies from 0 to 4 weeks for 1999 to 2003. In 2003, the date of estimated peak emergence and peak catch of recently emerged chinook were approximately the same. In 2003, it appears that 60% of the total catch of chinook fry less than 50 mm in fork length was arrived at on the day of peak catch. This compares to 56%, 72%, 64% and 79% in 1999, 2000, 2001 and 2002, respectively.

For juvenile chum in 2003, the time between peak estimated emergence and peak catch was approximately four weeks. Peak catch of 2003 chum occurred earlier than the previous years with the exception of 1999. In 2003, it appears that approximately 65% of the total catch of chum fry was arrived at on the day of peak catch. This compares to 72%, 66%, 85% and 80% in 1999, 2000, 2001 and 2002 respectively.

To assist in determining stock composition of fish using the rearing areas below Bonneville Dam, all captured juvenile chinook were examined for fin marks. Identifying hatchery released juveniles with adipose fin clips aided in determining stock composition of fish using the area below Bonneville Dam. When hatchery fish with fin clips appeared below the dam they were typically of a larger size than the wild chinook rearing below Bonneville Dam. This was especially noticeable during the months of February through April when Spring Creek National Fish Hatchery made early-spawning stock, fall chinook releases above Bonneville Dam. Since the unmarked component of the hatchery releases were approximately the same size as the marked component, study area wild fish could be differentiated from hatchery-released chinook. This rule of thumb was useful until late June when migrating subyearling chinook of similar size than the native bright stock chinook began appearing in the study area. In 2003, less than 0.4% of juvenile fall chinook sampled were fin clipped.

Table 10. Comparison of peak emergence dates to peak catch dates of recently emerged fall chinook and chum below Bonneville Dam, 1999-2003.

	Chinook					Chum				
	1999	2000	2001	2002	2003	1999	2000	2001	2002	2003
Emergence										
estimated peak emergence date:	April 28	April 14	May 06	April 26	April 20	April 04	March 13	March 26	Feb. 25	March 01
water temp. (^{o}F) (Bonneville Dam):	50	48	52	48	48	44	41	44	39	41
Catch										
peak catch date of juveniles (<50mm. chinook):	May 11	May 12	May 01	May 14	April 22	April 01	March 21	April 17	April 09	April 01
water temp. (^{o}F) (Bonneville Dam):	53	52	50	53	49	44	43	46	45	46
number caught on peak date:	248	1,077	867	132	724	13	37	1,024	141	302
% of total catch through peak (<50mm. chinook):	56	72	64	79	60	72	66	85	80	65
mean length (mm):	45	42	44	44	44	42	38	43	39	40
*Bonneville Dam discharge (KCFS) at peak catch:	266	277	180	225	246	266	187	143	137	190
weeks between peak emergence and catch:	2	4	0	3	0	0	1	3	6	4

* Daily readings taken at 12:00 pm (www.nwd-wc.army.mil/cgi-bin/DataQuery).

No marked chum were observed in the juvenile sampling, since no chum hatchery facilities exist above Bonneville Dam and nearby Hardy Creek and Hamilton Creek chum are not fin marked for assessment purposes. This being the case, chum produced from spawners in the mainstem Columbia River could not be differentiated from populations from nearby creeks.

To determine a juvenile to adult survival rate for wild bright stock fall chinook found below Bonneville Dam, a part of the juvenile population was adipose fin clipped and coded-wire tagged. The tagging was conducted in the months of May and June 2003. when mean fork length of juvenile fish met the minimum size criterion of 47 mm fork length. To avoid tagging fish from outside the area, chinook greater than 65 mm fork length were not tagged. Coded-wire tagging of wild juvenile fall chinook began 6 May when sampling data showed that approximately 25% of sampled fry were in the taggable range (47-65 mm fork length).

The project was able to tag and release 10,076 chinook in 2003. Tagging was terminated 6 June when it became obvious that only small numbers of taggable fish remained around the islands. The mortality rate of fish tagged prior to release was 4.0%. Table 11 provides results of the tagging project including total number of chinook handled, number of tagged fish, number of fish released, mortality rate and mean length of tagged fish.

SUMMARY AND CONCLUSIONS

In 2002, a total of 364 adult fall chinook and 472 chum were sampled for biological data in the study area. The peak redd count below Bonneville Dam in 2002 for bright stock, fall chinook was 214. The study area peak redd count be for chum was 776. Peak spawning time below Bonneville Dam for fall chinook was set at approximately 15 November. Peak spawning time for chum occurred approximately 6 December. There were estimated to be a total of 1,881 bright fall chinook spawning in the study area below Bonneville Dam in 2002. The 2002 study area chum population below Bonneville Dam was estimated to be 4,232 spawning fish.

Temperature unit data suggests that below Bonneville Dam 2002 brood chinook emergence began on 3 February and ended 7 May 2003, with peak emergence occurring 20 April. 2002 brood juvenile chum emergence below Bonneville Dam began 27 January and continued through 6 April 2003. Peak chum emergence below Bonneville Dam took place 1 March. A total of 10,925 juvenile chinook and 1,577 juvenile chum were sampled between the dates of 24 January and 21 July 2003 below Bonneville Dam.

Table 11. Wild juvenile fall chinook tagged and released below Bonneville Dam, 2003.

Date	Tag code	Number Sampled	Number Tagged	Tagged Mortallity	Tagged Percent Mortality	Number Tagged Released	Sampled Mean Fork length	Untaggable Fish (<47 or >65mm.)	Percent Untaggable	Water Temp. °F
05/06/03	09/35/24	1,108	799	68	8.5	731	52.0	279	25.2	54
05/07/03	"	931	573	29	5.1	544	51.0	345	37.1	50
05/08/03	"	1,267	823	29	3.5	794	49.0	428	33.8	51
05/09/03	"	905	672	3	0.4	669	55.0	212	23.4	50
05/13/03	"	1,593	1,180	73	6.2	1,107	51.1	394	24.7	52
05/14/03	"	519	410	0	0.0	410	53.4	101	19.5	54
05/15/03	"	1,231	916	38	4.1	878	52.0	309	25.1	-
05/16/03	"	821	538	10	1.9	528	49.0	279	33.9	52
05/20/03	"	1,462	903	44	4.9	890	51.0	528	36.1	54
05/21/03	"	791	552	31	5.6	531	50.1	280	35.4	57
05/22/03	"	1,435	1,423	12	1.5	830	54.8	601	41.9	59
05/23/03	"	807	530	40	7.6	490	50.4	274	34.0	58
05/29/03	"	1,291	906	72	7.9	834	59.2	385	29.8	59
05/30/03	"	590	424	25	4.2	399	56.8	166	28.1	58
06/03/03	09/35/23	705	445	4	0.9	441	60.3	260	36.9	59
06/06/03	"	947	748	17	2.3	731	58.0	199	21.0	58
Totals		15,295	11,043	427	4.0	10,076	53.4	4,761	30.4	

Juvenile chum migrated from the study area in the 40-55 mm fork length range. Migration of chum occurred during the months of March, April and May, with the majority of migration taking place in April. Sampling results suggest bright stock, fall chinook migration from took place during the month of June 2003 when juvenile fall chinook were in the 65 to 80 mm fork length size range.

Adult and juvenile sampling below Bonneville Dam provided information to assist in determining the stock of fall chinook and chum spawning and rearing just below Bonneville Dam. Based on observed spawning times, adult age and sex composition, GSI analysis, juvenile emergence timing, juvenile migration timing and juvenile size at the time of migration, it appears that in 2002 and 2003 the majority of fall chinook using the study areas below Bonneville Dam were of a late-spawning bright stock of fall chinook. Observed spawning times, adult age and sex composition, GSI analysis, juvenile emergence timing, juvenile migration timing and juvenile size at the time of migration suggests chum spawning and rearing in the study area are similar to stocks of chum found in Hamilton and Hardy creek and part of the Lower Columbia River Chum ESU.

PLANS FOR FY 2004

We are planning to continue collecting data to determine the status of fall chinook and chum spawning below Bonneville Dam from nearby creeks. We are planning to collect biological data from the fish spawning below Bonneville Dam and along both shorelines below Bonneville Dam. Biological data and coded-wire tag recoveries will be used to profile stocks and determine stock origins.

We will continue to estimate emergence timing of juvenile fall chinook and chum below Bonneville Dam. We are planning to sample juvenile populations to determine migration time and size at time of migration for juvenile fall chinook and chum rearing below Bonneville Dam. We will attempt to coded-wire tag juvenile fall chinook below Bonneville Dam to determine juvenile to adult survival rate and ocean distribution.

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