Evaluation of Fall Chinook and Chum Salmon Spawning Below Bonneville, The Dalles, John Day, and McNary Dams

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EVALUATION OF FALL CHINOOK AND CHUM SALMON SPAWNING BELOW BONNEVILLE, THE DALLES, JOHN DAY AND McNARY DAMS

Annual Report 2001-2002

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CONTENTS

ABSTRACT 5

INTRODUCTION 6

METHODS AND MATERIALS 8

Adult Study 8

Juvenile Study 9

RESULTS AND DISCUSSION 12

Adult Study 12

Juvenile Study 19

SUMMARY AND CONCLUSIONS 29

PLANS FOR FY 2003 31

REFERENCES 32

TABLES

Table **Page**

1. Columbia River mainstem spawning ground surveys, 2001. 13

2. Comparison of results of below Bonneville Dam spawning ground surveys, 1998-2001. 14

3. Population estimates of returning bright fall chinook and chum below Bonneville Dam, 1998-2001. 14

4. Estimated age composition, sex composition, and length of fall chinook salmon that spawned below Bonneville Dam, 2001. 18

5. Estimated age composition, sex composition, and POH length of chum salmon that spawned below Bonneville Dam, 2001. 18

6. Columbia River water temperatures (^{0}F) and temperature units (^{0}C) below Bonneville Dam, 2001-2002. 20

7. Catch rates of juvenile chinook caught with stick and beach seines below Bonneville Dam, 2002. 24

8. Below Bonneville Dam fall chinook and chum seining summary, 2002. 25

9. Fork length distribution of juvenile chinook sampled below Bonneville Dam, 2002. 26

10. Comparison of peak emergence dates to peak catch dates of fall and chum below Bonneville Dam, 1999-2002. 28

11. Wild juvenile fall chinook tagged and released below Bonneville Dam, 2002. 30

FIGURES

Figure **Page**

1. Location of dams, hatcheries, and production areas pertinent to the evaluation. 7

2. Location of juvenile sampling sections below Bonneville Dam, 2002.....10

3. Location of fall chinook redds below Bonneville Dam, 2001. 16

4. Location of chum redds below Bonneville Dam,2001.....17

5. Percent of total juvenile chinook catch by area, below Bonneville Dam, 2002. 22

6. Percent of total juvenile chum catch by area, below Bonneville Dam, 2002. 23

EVALUATION OF FALL CHINOOK AND CHUM SALMON SPAWNING BELOW BONNEVILLE, THE DALLES, JOHN DAY AND McNARY DAMS

ABSTRACT

In 2001 a total of 309 adult fall chinook and 264 chum were sampled in the Ives and Pierce islands area below Bonneville Dam. The peak redd count for fall chinook was 48. The peak redd count for chum was 181. Peak spawning time for fall chinook was set at approximately 16 November. Peak spawning time for chum occurred approximately 26 November. There were estimated to be a total of 721 fall chinook spawning below Bonneville Dam in 2001. The 2001 chum population below Bonneville Dam was estimated to be 532 spawning fish.

Temperature unit data suggests that below Bonneville Dam 2001 brood chinook emergence began on 11 March 2002 and ended 18 May 2002, with peak emergence occurring 26 April. 2001 brood juvenile chum emergence below Bonneville Dam began 29 January and continued through 31 March 2002. Peak chum emergence took place 25 February. A total of 5,487 juvenile chinook and 678 juvenile chum were sampled between the dates of 22 January and 30 July 2002 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 from mid June through early July 2002 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, GSI analysis, juvenile emergence timing, juvenile migration timing and juvenile size at the time of migration, it appears that in 2001 and 2002 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 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 2001 to 30 September 2002. 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 99-003. 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), The Dalles Dam (RM 192), John Day Dam (RM 216), and McNary Dam (RM 292) (Figure 1) and estimate the size of these populations.

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

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

1) Documentation of fall chinook and chum spawning below Bonneville, The Dalles, John Day and McNary dams 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 and genetic baseline analysis.

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.

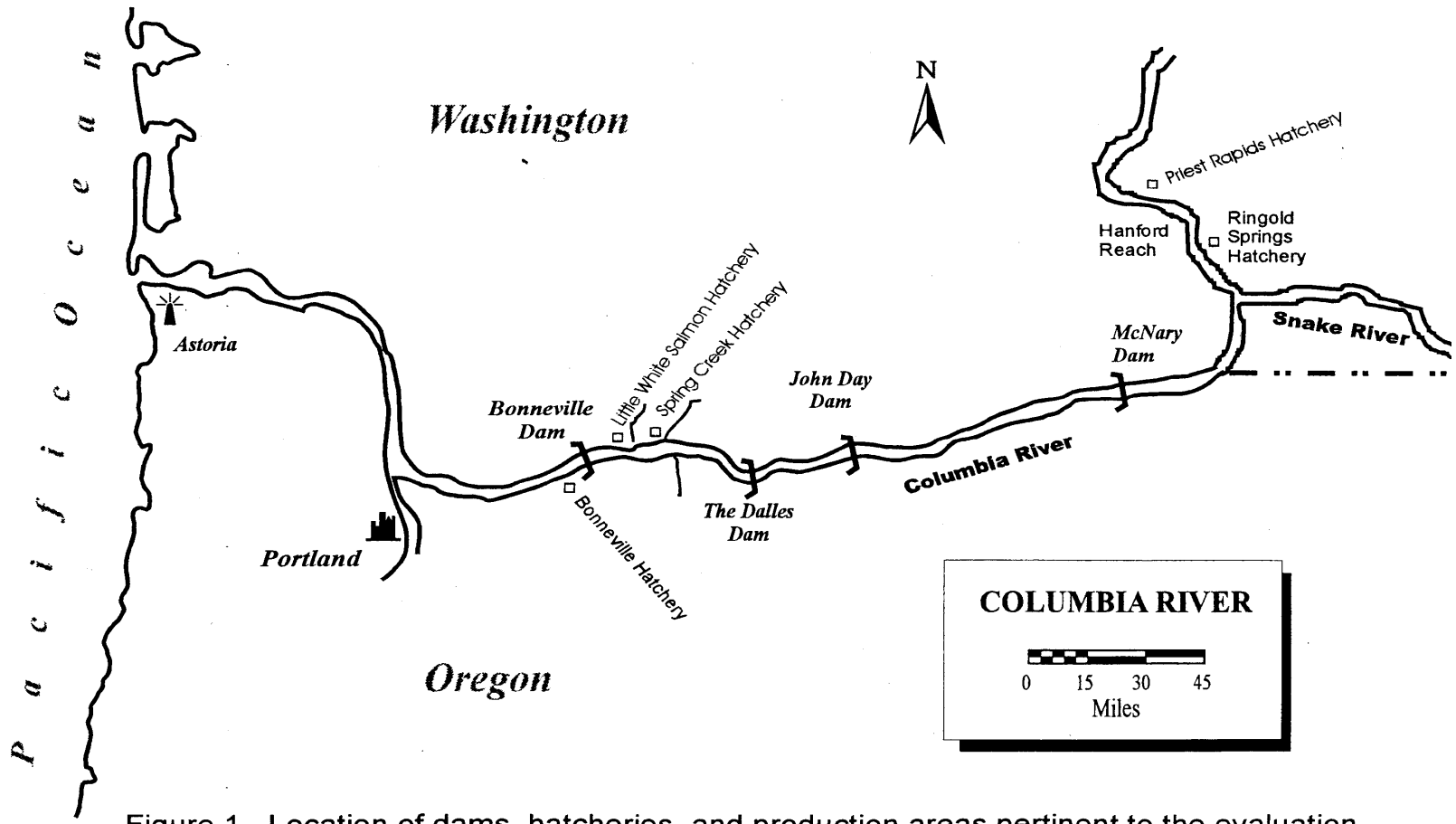


Figure 1. Location of dams, hatcheries, and production areas pertinent to the evaluation.

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, The Dalles, John Day, and McNary dams occurred from 03 October 2001 through 28 December 2001. 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. The study area below The Dalles Dam includes waters along both shorelines for two miles downstream of the dam. Approximately seven miles of both shorelines below the John Day and McNary dams were surveyed, including potential spawning habitat surrounding islands just below the John Day Dam. 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. Except for the Bonneville fall chinook group, tissue samples were collected from all populations for genetic stock identification (GSI). GSI work was not performed on the Bonneville fall chinook population since genetic baseline data for this group was completed in 1998.

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. The method used to estimate the 2001 spawner population for chum incorporated spawner curves created from survey data in conjunction with various factors which translate the area under the curve into estimates of spawner abundance. This method has successfully been used by WDFW to estimate Puget Sound chum escapement.

Juvenile Study

The juvenile portion of the study concentrated on areas where spawning occurred below Bonneville Dam in 2001. 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 800 ^{o} C. TU for chum). 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 22 January 2002. Surveys were conducted twice weekly through 30 July 2002. 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 2001, 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.

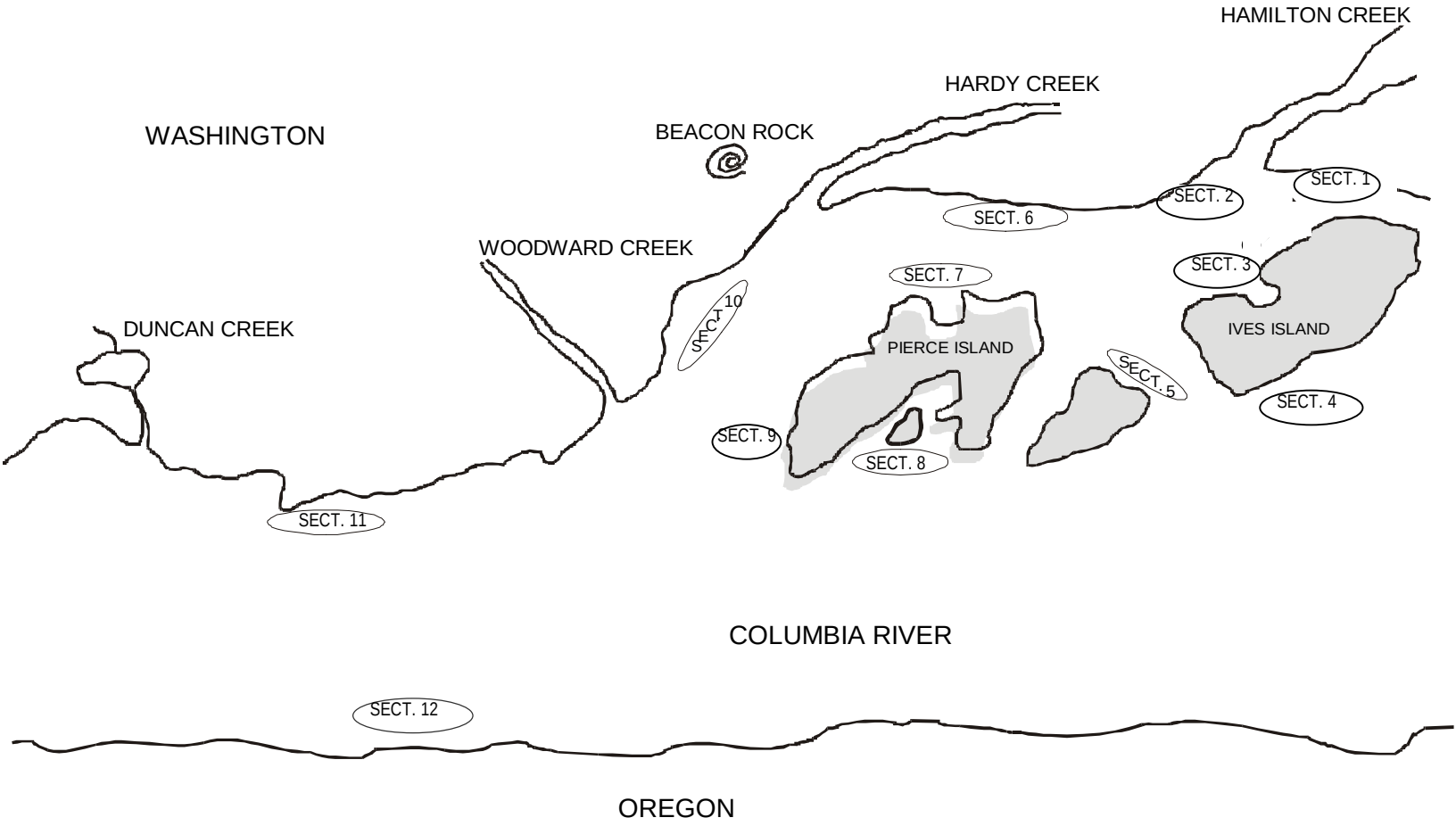


Figure 2. Locations of juvenile sampling areas below Bonneville Dam, 2002.

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.

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. Chinook less than 50 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 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 April, May and June 2002 when native fish began attaining the 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 70-100 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 2001. Initiation of spawning below Bonneville Dam for chum salmon was set at 12 November 2001.

Peak spawning for fall chinook salmon was determined to be approximately 16 November. Peak spawning for chum was set at 26 November 2001. Forty-two redds and 91 adults were observed at peak spawning for fall chinook. One hundred eighty-one r edds and 239 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 2001. The date set as the end of spawning for chum was 28 December 2001. Table 2 contains the first, peak and last counts of spawning ground information from 1998 through 2001. 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 11 November to as late as 16 November. During the previous four years, chum observed below Bonneville Dam have begun spawning the first week of November. The earliest peak spawning date for chum was set at 16 November in 1998 and the latest peak spawning date was 01 December 2000.

No fall chinook redds or carcasses were observed below McNary Dam. Three fall chinook carcasses were found below The Dalles Dam. The areas below The Dalles and McNary dams offer minimal spawning habitat. No redds and two live fall chinook were observed below the John Day Dam. A total of twelve fall chinook carcasses were found below the dam. There is evidence suggesting deeper water habitat exists below the John Day Dam where spawning could potentially occur.

In 2001, coho salmon were also observed spawning in areas used by chinook and chum. A total of 133 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 similar to that of chum spawning in nearby Hardy and Hamilton creeks.

Table 1. Columbia River mainstem spawning ground surveys, 2001.

Below Bonneville Dam

Fall Chinook

Date	Redds	Live	Dead	Sampled	CWT recoveries	Bonneville Dam tailwater (ft.)*	Bonneville Dam discharge (kcfs)*
10/03/2001	0	1	0	0	0	9.0	95.4
10/08/2001	0	0	2	2	0	6.8	72.1
10/15/2001	0	0	4	4	0	9.0	105.4
10/22/2001	1	2	0	0	0	6.7	74.4
10/26/2001	1	2	1	1	0	7.4	94.1
10/29/2001	1	2	3	3	0	9.5	111.1
11/02/2001	2	9	1	1	0	9.7	103.1
11/05/2001	33	31	9	8	0	8.2	84.8
11/09/2001	48	87	3	3	0	9.6	110.7
11/12/2001	31	107	21	21	0	9.2	106.5
11/16/2001	42	91	35	35	1	9.7	91.1
11/19/2001	8	80	34	34	0	9.6	110.4
11/26/2001	45	53	75	75	1	11.1	116.7
11/30/2001	6	10	43	43	0	11.4	91.3
12/03/2001	4	20	13	13	0	12.1	81.6
12/06/2001	2	7	16	16	0	11.5	87.0
12/10/2001	3	5	29	29	0	11.4	112.7
12/13/2001	0	0	19	19	0	11.4	96.1
12/17/2001	0	0	1	1	0	12.5	72.2
12/20/2001	0	4	1	1	0	11.9	80.0
12/28/2001	0	2	1	0	0	12.4	124.2
		513	311	309	2		

Below Bonneville Dam

Chum

Date	Redds	Live	Dead	Sampled	GSI samples	Bonneville Dam tailwater (ft.)*	Bonneville Dam discharge (kcfs)*
11/05/2001	0	10	0	0	0	8.2	84.8
11/09/2001	0	1	2	2	2	9.6	110.7
11/12/2001	8	54	1	1	0	9.2	106.5
11/16/2001	6	39	2	2	1	9.7	91.1
11/19/2001	40	92	1	1	1	9.6	110.4
11/26/2001	181	239	16	16	5	11.1	116.7
11/30/2001	162	230	26	26	6	11.4	91.3
12/03/2001	56	101	20	20	12	12.1	81.6
12/06/2001	43	107	37	37	14	11.5	87.0
12/10/2001	71	118	88	88	18	11.4	112.7
12/13/2001	35	80	41	41	3	11.4	96.1
12/17/2001	4	4	15	15	3	12.5	72.2
12/20/2001	17	18	11	11	3	11.9	80.0
12/28/2001	0	0	4	4	0	12.4	124.2
		1093	264	264	68		

Below Bonneville Dam

Coho

Date	Redds	Live	Dead	Sampled	CWT recoveries
10/26/2001	3	3	3	3	0
10/29/2001	0	0	5	5	0
11/02/2001	4	14	8	8	1
11/05/2001	15	21	19	19	0
11/09/2001	11	49	18	18	3
11/12/2001	13	18	24	24	1
11/16/2001	0	12	19	19	2
11/19/2001	2	8	10	10	1
11/26/2001	0	0	26	26	0
		125	133	133	8

* Daily readings taken at 12:00 pm.

Table 2. Comparison of results from below Bonneville Dam spawning ground surveys, 1998-2001.

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
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
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

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
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
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

* Daily readings taken at 12:00 pm.

** Tule fall chinook counts.

Table 3. Population estimates of returning bright fall chinook and chum below Bonneville Dam, 1998-2001.

Year	# chinook sampled	# chum sampled	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

The bright fall chinook population estimate was made based on results of carcass tagging (Table 3). In 2001 it was estimated that 721 fall chinook returned to spawn in the areas around Ives and Pierce islands. The population estimate of 721 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 704 adults in 2000 and 897 and 554 adults in 1999 and 1998, respectively. Population estimates below The Dalles, John Day and McNary dams were not possible in 2001 because no or too few carcasses were tagged.

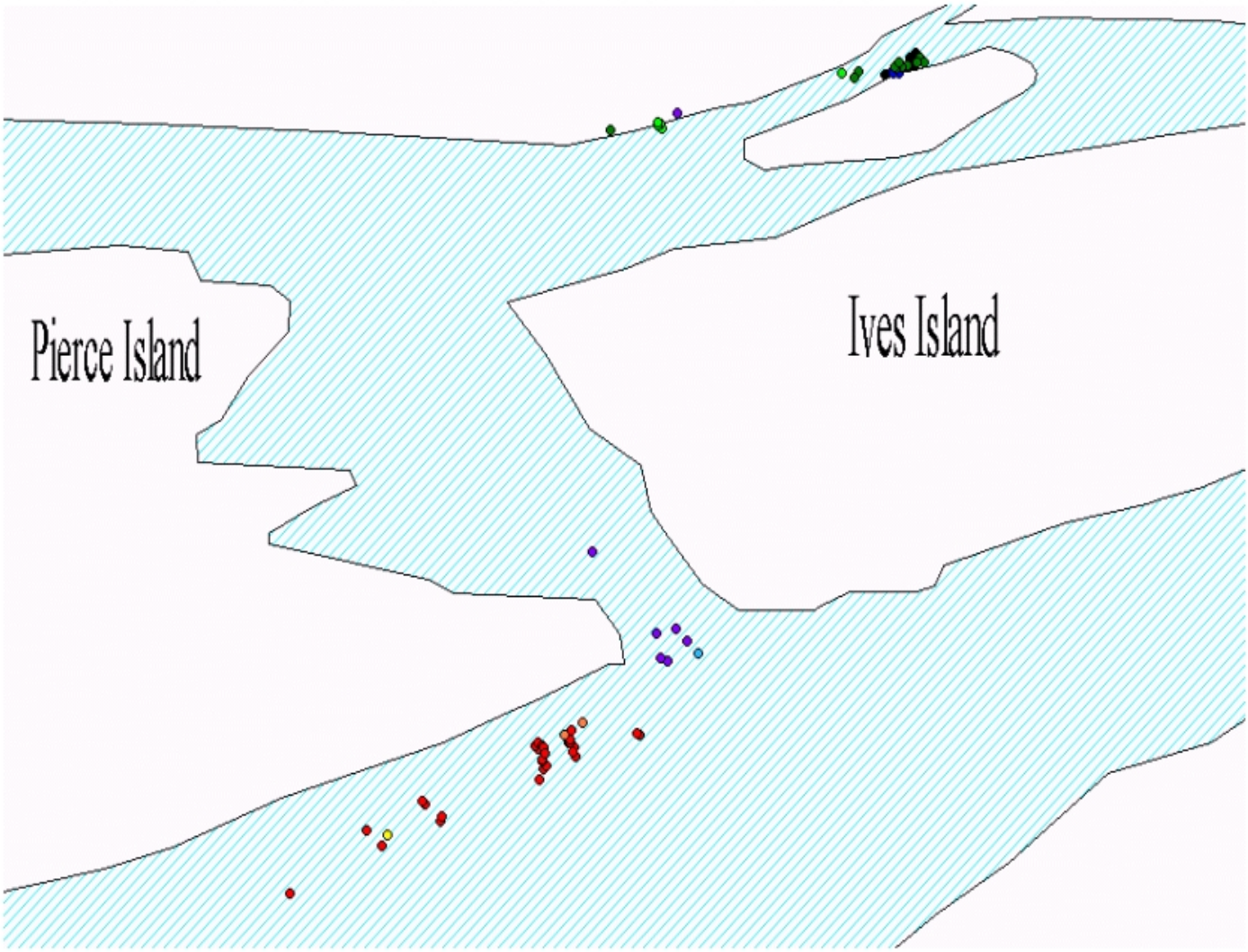
A population of 532 chum was estimated to have returned to spawn in the study area in 2001. This compares to an estimated population of 529 adults in 2000. Spawning populations of 40 and 226 adults were estimated in 1999 and 1998, respectively.

Locations of salmon redds below Bonneville Dam were recorded using GPS waypoints. Figures 3 and 4 show approximate locations of these redds. The majority of fall chinook redds were found 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. Chum redds were also found in the channel break between Ives and Pierce islands, close to the main channel of the Columbia River. In addition, chum redds were observed on the Oregon side of the river across from Hamilton Island below McCord Creek and below Woodward Creek near Beacon Rock.

Vital statistics were developed from biological samples to assist in determining stock origins of returning fish found spawning in the study areas. Vital statistics of the fall chinook population found below Bonneville Dam in 2001 include age compositions, mean fork lengths, and sex ratios (Table 4). Fall chinook sampled below the dam showed similarities in male, female, age class representation and age related mean fork lengths with other late-spawning stocks found in the Columbia River.

Table 5 contains vital statistics of chum sampled below Bonneville Dam. Three and four-year-old fish were the predominant age classes in 2001 with females being the dominant sex (57.9%). This year's age composition statistics of chum sampled in the study area were similar to other chum populations found in the lower Columbia River.

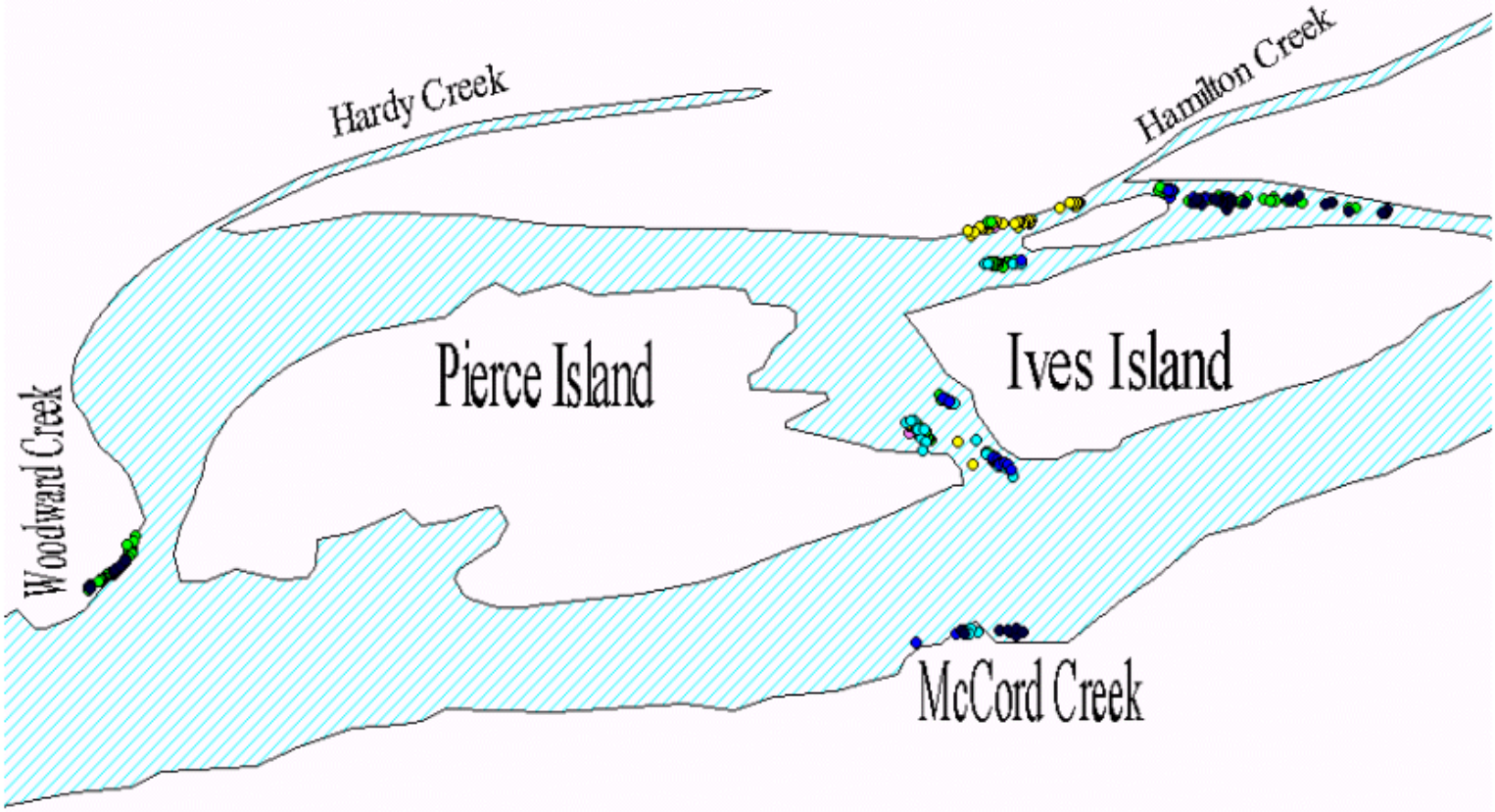
To further assist in determining the stock origin of salmon found below the dams, carcasses were sampled for fin clips and other external marks. A total of 309 fall chinook and 264 chum were sampled for marks below Bonneville Dam. Three fall chinook carcasses were found to have adipose fin clips. Two of the carcasses contained coded-wire tags. Both fish were bright fall chinook. One fish was released from Bonneville Hatchery and the other from Lyons Ferry Hatchery. There were no marked chum found.



	Date	# redds	Bonneville Flow *		Date	# redds	Bonneville Flow *
●=	26 Oct	1	89	●=	19 Nov	8	104
●=	02 Nov	2	99	●=	26 Nov	45	125
●=	05 Nov	33	89	●=	30 Nov	6	138
●=	09 Nov	48	127	●=	03 Dec	4	116
●=	12 Nov	31	97				

*Average of Hourly Kcfs, (http://www.fpc.org/ivesisland.htm).

Figure 3. Location of fall chinook redds below Bonneville Dam, 2001.



	Date	# redds	Bonneville Flow *		Date	# redds	Bonneville Flow *
●=	12 Nov	8	103	●=	30 Nov	162	138
●=	16 Nov	6	97	●=	06 Dec	43	116
●=	19 Nov	40	104	●=	10 Dec	71	116
●=	26 Nov	181	125				

*Average of Hourly Bonneville flow in Kcfs, (http://www.fpc.org/ivesisland.htm).

Figure 4. Location of chum redds below Bonneville Dam, 2001.

Table 4. Estimated age composition, sex composition, and fork length of bright fall chinook salmon that spawned below Bonneville Dam, 2001.

Age	Number in Sample		% in Sample		Mean Length (cm)		Length Range (cm)	
group	Males	Females	Males	Females	Males	Females	Males	Females
2	19	0	10.5	0.0	48	-	38-60	-
3	36	17	19.9	9.4	70	69	60-79	63-77
4	61	44	33.7	24.3	90	85	69-108	71-98
5	3	1	1.7	0.5	107	99	101-111	99
Total	119	62	65.8	34.2				

Table 5. Estimated age composition, sex composition, and POH length of chum salmon that spawned below Bonneville Dam, 2001

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	41	113	14.1	39.0	71	68	60-83	58-85
4	75	52	25.9	17.9	81	74	83-94	79-83
5	7	2	2.1	1.0	87	81	83-96	79-82
Total	123	167	42.1	57.9				

Sixty-eight GSI samples were collected from chum carcasses found below Bonneville Dam in 2001. WDFW geneticists analyzed samples collected in 1998, 1999 and 2000. 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). It should be noted that due to low flows in the year 2000, spawners from Hardy and Hamilton Creek likely mixed with fish spawning in the Columbia River below Hamilton Creek, influencing genetic collections made in the study area.

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.

Juvenile Study

Hatching and emergence times for 2001 brood salmon below Bonneville Dam are contained in Table 6. 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 2001-2002 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. 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 increased the rate of estimated hatching and emergence times of chum found in the study area. Emergence of chum was estimated to have occurred from 29 January to 31 March 2002. Estimated peak emergence of chum took place 25 February 2002.

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 fall chinook began approximately 11 March and continued through 18 May. Peak emergence of fall chinook occurred 26 April 2002.

Table 6. Columbia River water temperature (^{o} F) and temperature units (^{o} C) below Bonneville Dam, 2001-2002.

(Data sources October 2001 through Jan 25, 2002 USACE monitoring station at Warrendale, Jan 26 through June, 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	64	18	56	13	50	9	42	5	39	4	39	4	43	6	50	10	57	14
2	64	18	56	13	50	9	42	6	39	4	39	4	43	6	50	10	57	14
3	64	18	56	13	50	9	42	6	39	4	39	4	43	6	50	10	58	14
4	64	18	56	13	50	9	42	6	39	4	39	4	43	6	50	10	59	15
5	64	18	56	13	50	9	42	6	39	4	41	5	45	7	50	10	59	15
6	64	18	56	12	50	9	42	6	39	4	39	4	45	7	50	10	59	15
7	64	18	56	12	50	8	42	6	39	4	39	4	45	7	48	9	59	15
8	63	17	54	12	50	8	42	6	39	4	39	4	45	7	50	10	59	15
9	63	17	52	11	49	8	42	6	39	4	39	4	45	7	50	10	59	15
10	63	17	52	11	48	8	42	6	39	4	39	4	45	7	50	10	59	15
11	63	17	54	11	48	8	42	6	39	4	41	5	45	7	50	10	59	15
12	61	16	54	11	48	8	42	6	39	4	41	5	45	7	50	10	59	15
13	61	16	54	11	48	8	42	6	39	4	41	5	45	7	52	11	59	15
14	61	16	54	11	48	7	42	6	39	4	41	5	48	9	52	11	59	15
15	61	16	54	11	47	7	42	6	39	4	41	5	48	9	52	11	59	15
16	61	16	54	11	47	7	42	5	39	4	41	5	48	9	52	11	59	15
17	59	15	53	11	47	7	42	5	39	4	41	5	48	9	52	11	59	15
18	59	15	53	11	47	7	42	5	39	4	41	5	48	9	52	11	59	15
19	59	15	53	10	47	7	42	6	39	4	41	5	48	9	54	12	59	15
20	60	15	53	10	47	7	42	6	39	4	41	5	48	9	54	12	59	15
21	60	15	52	10	47	7	42	5	39	4	41	5	48	9	55	12	61	16
22	60	15	52	10	47	7	42	5	39	4	41	5	48	9	55	12	61	16
23	60	14	52	10	47	7	42	5	39	4	41	5	48	9	56	12	61	16
24	59	14	51	10	46	6	42	5	39	4	41	5	48	9	57	12	61	16
25	58	14	51	10	46	6	42	5	39	4	41	5	48	9	57	13	61	16
26	58	14	51	10	46	6	42	5	39	4	43	6	48	9	57	13	63	17
27	58	14	51	10	45	6	42	5	39	4	43	6	48	9	57	13	64	18
28	57	13	51	10	44	5	42	5	39	4	43	6	48	9	57	13	64	18
29	56	13	50	9	44	5	39	4	39	4	43	6	48	9	57	13	64	18
30	56	13	50	9	44	6	39	4			43	6	50	10	57	13	64	18
31	56	13			44	6	39	4			43	6			57	13		
TOTAL	--	487.3	--	330	--	225	--	166	--	116.0	--	152	--	243.2	--	348	--	466
AVE.	60.7	15.7	53.2	11.0	47.5	7.2	41.7	5.4	39.2	4.0	40.8	4.9	46.6	8.1	52.9	11.2	60.0	15.5

REQUIRED TEMPERATURE UNITS (TU'S)

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

CHUM	
EYE OUT	400
HATCHING	600
EMERGENCE	800

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	10/22	11/11	12/6	3/11	1/25	1/13
PEAK SPAWNING	11/16	12/14	1/26	4/26	3/23	3/7
END SPAWNING	12/10	1/20	3/19	5/18	4/22	4/10

CHUM

EVENT	DATE	EYED OUT	HATCHING	EMERGENCE T	EMERGENCE +2°C	EMERGENCE +3°C
BEGIN SPAWNING	11/12	12/30	2/8	3/25	2/11	1/29
PEAK SPAWNING	11/26	1/23	3/14	4/16	3/12	2/25
END SPAWNING	12/20	3/15	4/14	5/6	4/12	3/31

Sampling for post-emergent fry took place in locations identified in Figure 2. Based on emergence estimates juvenile sampling began 22 January 2002. Sampling was terminated 30 July 2002 after it appeared the majority of fish had migrated from the study area.

A total of 5,487 juvenile chinook and 678 juvenile chum were sampled in areas below Bonneville Dam. Although juvenile fish were caught in all but one 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 offered good rearing habitat seemed to yield the most catch. For chinook these areas included sections one, five, six and eight (Figure 5). Section six produced 23% of the total juvenile fall chinook catch in the area around the islands. Sections one, five and eight yielded 11%, 12% and 16% of the total fish caught around the islands, respectively. Although sections two, three, four and seven appeared to be used less frequently for rearing, those sections still accounted for 18% of the total sampled fall chinook fry. Catch rates of gear used to capture chinook fry are contained in Table 7.

Figure six shows areas that produced catch of juvenile chum in 2002. The majority (81%) of chum fry were caught in sections three, six, eight and ten. All areas where chum were found rearing likely contained progeny of adults that spawned in the Hamilton and Hardy creeks.

Results of juvenile chinook and chum sampling are found in Table 8. Juvenile chum were caught and sampled from 19 February to 31 May 2002. Peak catch of juvenile chum occurred 9 April 2002. Mean length of sampled juvenile chum for the season was 41.7 mm fork length. Once chum attained a size of approximately 44 mm fork length they began migrating from the area. It appears that by the end of April the majority of chum (86%) 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 22 January to 18 June. Peak catch of recently emerged juvenile chinook (those fish less than 50 mm in fork length), was observed to be 14 May. Peak catch of chinook fry in all size categories less than 100 mm was 07 June 2002.

Until mid to late June, juvenile chinook captured in the study area that were less than 65 mm in fork length were assumed to be products of the study area. After the month of June it was thought that relatively smaller wild upriver juvenile chinook would begin appearing in the sample. This assumption was based on information that upriver subyearling migration had begun during the middle of June. In addition, Columbia River fish hatchery data suggested that until the

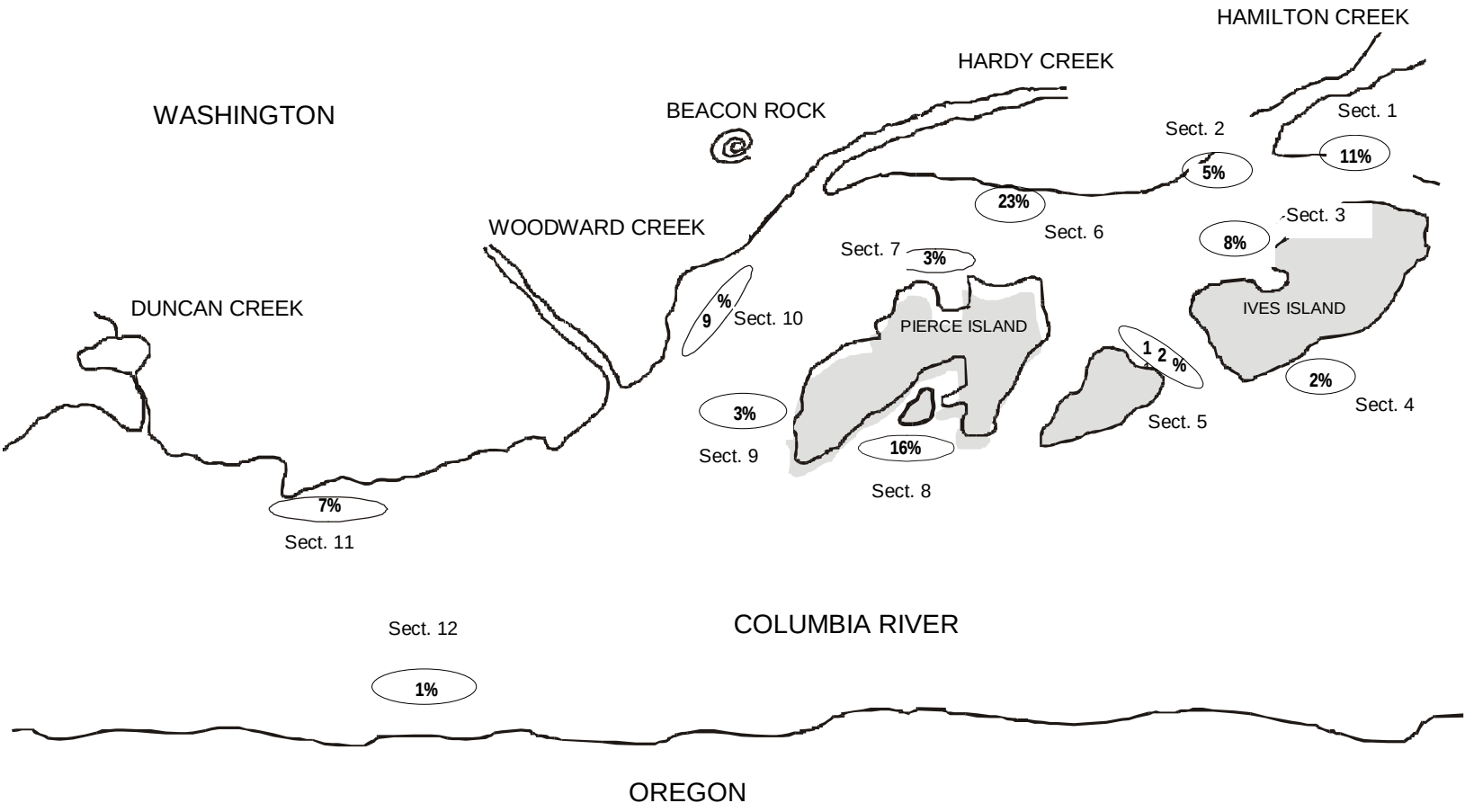


Figure 5. Percent of total juvenile chinook catch by area, below Bonneville Dam, 2002.

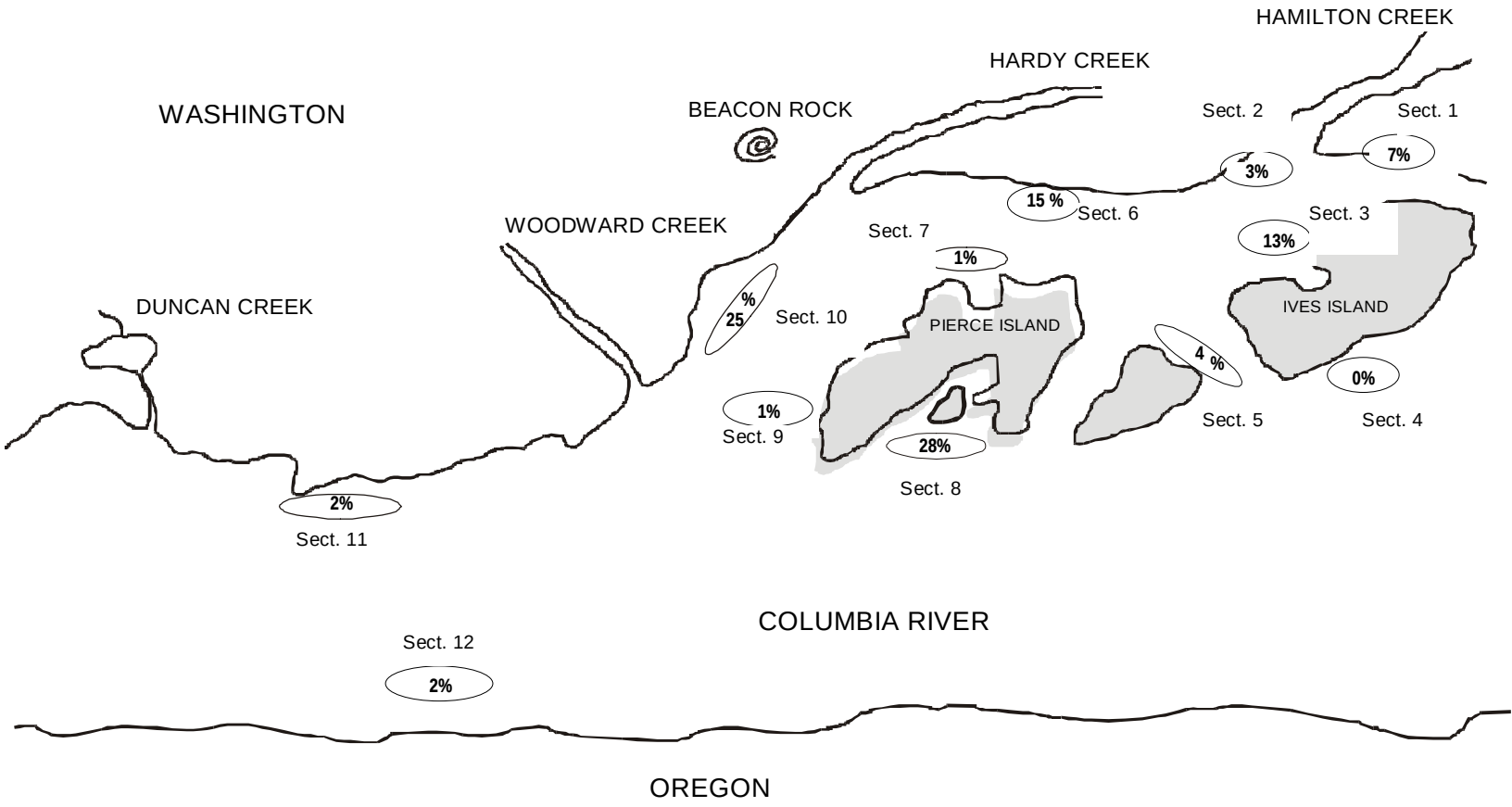


Figure 6. Percent of total juvenile chum catch by area, below Bonneville Dam, 2002.

Table 7. Catch rates of juvenile chinook (< 100 mm) caught with stick and beach seines below Bonneville Dam, 2002.

Week	Date	# chinook	# stick sets	# caught in stick	# beach sets	# caught in beach	chinook per stick	chinook per beach	Bonneville Dam tailwater (ft.)*	Bonneville Dam discharge (kcfs)*
1	1/22	16	-	-	3	16	-	5.3	14.5	160.2
1	1/24	31	-	-	5	31	-	6.2	16.7	193.3
2	1/28	25	-	-	6	25	-	4.2	15.4	156.9
2	2/1	26	1	7	6	19	7.0	3.2	16.3	175.5
3	2/8	25	-	-	6	25	-	4.2	15.6	172.6
4	2/12	38	2	2	6	36	1.0	6.0	15.5	178.6
4	2/15	53	2	2	4	51	1.0	12.8	14.7	170.7
5	2/19	43	-	-	6	42	-	7.0	13.1	138.9
5	2/22	47	-	-	6	47	-	7.8	12.2	123.7
6	2/25	17	0	2	4	17	0.0	4.3	11.8	114.0
6	3/1	168	-	-	5	168	-	33.6	14.1	147.2
7	3/4	12	-	-	8	12	-	1.5	12.0	118.3
7	3/8	27	-	-	7	27	-	3.9	11.5	116.2
8	3/12	132	-	-	5	132	-	26.4	13.7	153.6
8	3/15	104	-	-	5	104	-	20.8	15.2	158.8
10	3/19	163	-	-	6	163	-	27.2	13.2	131.9
11	3/26	97	-	-	5	97	-	19.4	11.4	114.3
11	3/29	153	-	-	6	153	-	25.5	13.8	150.7
12	4/2	112	-	-	7	112	-	16.0	15.9	179.2
12	4/5	182	-	-	7	182	-	26.0	12.4	127.2
13	4/9	162	-	-	6	162	-	27.0	13.4	136.7
13	4/11	53	-	-	6	53	-	8.8	18.7	244.3
14	4/16	105	-	-	7	105	-	15.0	25.7	362.5
14	4/19	68	1	4	7	64	4.0	9.1	23.7	306.9
15	4/23	102	-	-	6	102	-	17.0	21.9	284.1
15	4/25	89	4	4	4	85	1.0	21.3	19.4	252.2
16	4/30	92	4	26	6	66	6.5	11.0	19.5	246.8
16	5/3	278	2	52	6	226	26.0	37.7	20.0	263.4
17	5/7	208	-	-	7	208	-	29.7	20.4	266.8
17	5/10	164	-	-	7	164	-	23.4	16.1	194.8
18	5/14	187	1	2	6	185	2.0	30.8	18.0	224.5
18	5/17	116	2	29	6	87	14.5	14.5	18.0	226.6
19	5/21	72	2	9	5	63	4.5	12.6	20.1	269.3
19	5/24	115	2	27	6	88	13.5	14.7	21.6	278.6
20	5/28	155	1	66	6	89	66.0	14.8	21.7	292.8
20	5/31	103	4	67	6	36	16.8	6.0	23.3	311.9
21	6/4	102	2	19	6	83	9.5	13.8	24.8	350.6
21	6/7	319	12	225	3	94	18.8	31.3	26.4	378.5
22	6/11	105	5	37	6	68	7.4	11.3	25.5	369.4
22	6/14	61	2	1	6	60	0.5	10.0	21.6	275.9
23	6/18	228	4	27	6	201	6.8	33.5	21.3	278.2
23	6/21	146	6	23	6	123	3.8	20.5	25.9	362.8
24	6/25	214	10	71	6	143	7.1	23.8	22.3	295.2
24	6/28	116	6	17	6	99	2.8	16.5	23.8	324.0
25	7/2	67	5	8	6	59	1.6	9.8	24.1	327.1
26	7/9	234	-	-	7	233	-	33.3	17.4	212.3
26	7/12	128	-	-	6	128	-	21.3	20.0	257.6
27	7/16	95	-	-	7	95	0.0	13.6	17.1	203.6
27	7/19	118	-	-	7	118	-	16.9	17.4	216.4
28	7/23	11	-	-	7	11	0.0	1.6	16.6	183.3
29	7/30	3	-	-	7	3	-	0.4	15.6	195.7
		5,487	80	727	302	4,760	9.1	15.8		

* Daily readings taken at 12:00 pm.

Table 8. Below Bonneville Dam fall chinook and chum seining summary, 2002.

		Chinook			chf mean length	chf ad clips		Chum		Bonneville Dam	Bonneville Dam
Date	total	# ≤50mm	# 51-100mm	# 100+mm	fish < 100mm	#	mean length (mm)	#	mean length (mm)	tailwater (ft.)*	discharge (kcfs)*
22-Jan	16	14	0	2	39	0	-	0	-	14.5	160.2
24-Jan	31	30	0	1	42	0	-	0	-	16.7	193.3
28-Jan	25	23	1	1	44	0	-	0	-	15.4	156.9
01-Feb	26	26	0	0	44	0	-	0	-	16.3	175.5
08-Feb	25	20	0	5	46	0	-	0	-	15.6	172.6
12-Feb	38	33	4	1	46	0	-	0	-	15.5	178.6
15-Feb	53	53	0	0	46	0	-	0	-	14.7	170.7
19-Feb	43	23	7	13	49	0	-	1	36	13.1	138.9
22-Feb	47	30	16	1	55	0	-	0	-	12.2	123.7
25-Feb	17	6	11	0	52	0	-	0	-	11.8	114.0
01-Mar	168	38	130	0	53	0	-	1	39	14.1	147.2
04-Mar	12	5	7	0	51	0	-	3	41	12.0	118.3
08-Mar	27	13	14	0	49	0	-	0	-	11.5	116.2
12-Mar	132	23	52	57	59	0	-	114	40	13.7	153.6
15-Mar	104	16	88	0	40	0	-	12	41	15.2	158.8
19-Mar	163	80	80	3	52	0	-	41	39	13.2	131.9
26-Mar	97	19	75	3	63	0	-	63	40	11.4	114.3
29-Mar	153	18	135	0	68	1	65	94	40	13.8	150.7
02-Apr	112	52	59	1	58	1	71	30	41	15.9	179.2
05-Apr	182	67	91	24	59	1	72	44	38	12.4	127.2
09-Apr	162	64	96	2	60	3	62	141	39	13.4	136.7
11-Apr	53	22	28	3	60	0	-	15	43	18.7	244.3
16-Apr	105	24	62	19	68	2	78	13	40	25.7	362.5
19-Apr	68	56	11	1	46	1	146	1	40	23.7	306.9
23-Apr	102	74	28	0	51	0	-	0	-	21.9	284.1
25-Apr	89	35	52	2	58	1	77	7	37	19.4	252.2
30-Apr	92	59	33	0	50	0	-	6	42	19.5	246.8
03-May	278	73	184	21	76	2	93	14	40	20.0	263.4
07-May	208	99	97	12	67	3	86	0	-	20.4	266.8
10-May	164	83	73	8	57	2	92	57	41	16.1	194.8
14-May	187	139	45	3	50	0	-	2	41	18.0	224.5
17-May	116	70	45	1	48	0	-	4	51	18.0	226.6
21-May	72	31	39	2	60	2	92	6	46	20.1	269.3
24-May	115	87	27	1	46	0	-	6	41	21.6	278.6
28-May	155	123	32	0	45	0	-	2	52	21.7	292.8
31-May	103	65	38	0	52	0	-	1	55	23.3	311.9
04-Jun	102	44	57	1	55	0	-	0	-	24.8	350.6
07-Jun	319	96	223	0	60	0	-	0	-	26.4	378.5
11-Jun	105	39	66	0	61	0	-	0	-	25.5	369.4
14-Jun	61	20	41	0	61	0	-	0	-	21.6	275.9
18-Jun	228	32	194	2	68	2	86	0	-	21.3	278.2
21-Jun	146	15	128	3	68	0	-	0	-	25.9	362.8
25-Jun	214	22	190	2	68	4	77	0	-	22.3	295.2
28-Jun	116	0	116	0	75	0	-	0	-	23.8	324.0
02-Jul	67	0	67	0	76	1	80	0	-	24.1	327.1
09-Jul	234	0	231	3	76	1	74	0	-	17.4	212.3
12-Jul	128	0	128	0	78	2	90	0	-	20.0	257.6
16-Jul	95	0	94	1	76	0	-	0	-	17.1	203.6
19-Jul	118	0	116	2	80	1	103	0	-	17.4	216.4
23-Jul	11	0	11	0	77	0	-	0	-	16.6	183.3
30-Jul	3	0	3	0	82	0	-	0	-	15.6	195.7
totals:	5,487	1,961	3,325	201	58.2	30		678	41.7		
% of total:		36.0	60.6	3.7							

* Daily readings taken at 12:00 pm.

Table 9. Fork length distribution of juvenile chinook sampled below Bonneville Dam, 2002.

				Number of chinook in millimeters								Mean length (mm)	% chf		Water temp.
Week	Date	Total	Range	30-39	40-49	50-59	60-69	70-79	80-89	90-100	> 100	chf < 100	< 60 mm	60-100 mm	°F*
1	22-Jan	16	38 - 109	6	8	-	-	-	-	-	2	39	88	0	42
1	24-Jan	31	38 - 112	6	24	-	-	-	-	-	1	42	97	0	42
2	28-Jan	25	37 - 85	8	15	-	-	-	1	-	1	44	92	4	42
2	01-Feb	26	39 - 49	1	25	-	-	-	-	-	-	44	100	0	39
3	08-Feb	25	42 - 135	-	20	-	-	-	-	-	5	46	80	0	39
4	12-Feb	38	35 - 122	1	32	4	-	-	-	-	1	46	97	0	39
4	15-Feb	53	39 - 53	0	53	0	-	-	-	-	-	46	100	0	39
5	19-Feb	43	36 - 142	2	20	6	1	-	-	1	13	49	64	5	39
5	22-Feb	47	34 - 100	11	18	9	-	-	2	6	1	55	80	17	39
6	25-Feb	17	37 - 59	1	3	13	-	-	-	-	-	52	100	0	39
6	01-Mar	168	37 - 62	10	15	139	4	-	-	-	-	53	98	2	39
7	04-Mar	12	37 - 60	1	5	5	1	-	-	-	-	51	92	8	39
7	08-Mar	27	37 - 59	6	7	14	-	-	-	-	-	49	100	0	39
8	12-Mar	132	36 -145	15	8	30	8	1	3	10	57	66	40	17	41
8	15-Mar	104	34 - 77	8	8	8	33	47	-	-	-	64	23	77	41
10	19-Mar	163	34 - 118	46	34	13	53	14	-	-	3	53	57	41	41
11	26-Mar	97	36 - 129	8	11	9	30	35	1	-	3	63	29	68	43
11	29-Mar	153	39 - 81	4	9	5	49	85	1	-	-	68	12	88	43
12	02-Apr	112	38 - 118	10	42	2	12	44	1	-	1	58	48	51	43
12	05-Apr	182	34 - 181	29	38	3	21	59	6	2	24	59	38	48	45
13	09-Apr	162	34 - 125	37	27	2	25	62	7	-	2	60	41	58	45
13	11-Apr	53	39 - 113	4	16	3	4	20	3	-	3	60	43	51	45
14	16-Apr	105	37 - 137	2	22	2	1	39	17	3	19	78	25	57	45
14	19-Apr	68	35 - 146	19	37	2	2	5	2	-	1	46	85	13	48
15	23-Apr	102	38 - 92	10	64	8	5	5	9	1	-	51	80	20	48
15	25-Apr	89	38 - 135	6	29	22	3	10	16	1	2	58	64	34	48
16	30-Apr	92	35 - 82	8	51	18	5	8	2	-	-	50	84	16	50
16	03-May	278	37 - 112	5	62	23	2	2	43	120	21	76	32	60	50
17	07-May	208	37 - 106	11	88	10	4	4	23	56	12	67	52	42	48
17	10-May	164	36 - 115	4	68	56	9	1	4	14	8	57	78	17	50
18	14-May	187	37 - 105	16	116	30	4	2	7	9	3	50	87	12	52
18	17-May	116	35 - 100	19	47	45	2	1	-	1	1	48	96	3	52
19	21-May	72	37 - 101	6	22	22	3	2	1	14	2	60	69	28	55
19	24-May	115	32 - 103	38	44	21	10	1	-	-	1	46	90	10	57
20	28-May	155	34 - 92	42	80	21	9	2	-	1	-	45	92	8	57
20	31-May	103	35 - 88	12	50	11	17	12	1	-	-	52	71	29	57
21	04-Jun	102	39 - 108	12	31	25	20	10	2	1	1	55	67	32	58
21	07-Jun	319	37 - 96	13	79	63	65	78	17	4		60	49	51	59
22	11-Jun	105	38 - 106	2	33	23	15	20	9	3	0	60	54	44	59
22	14-Jun	61	39 - 88	2	14	11	16	9	9	-	-	61	44	56	59
23	18-Jun	228	35 - 102	3	26	37	68	43	35	14	2	68	29	70	59
23	21-Jun	146	43 - 105	-	13	27	28	51	22	2	3	68	27	71	61
24	25-Jun	214	40 - 115	-	15	38	62	64	29	4	2	68	25	74	61
24	28-Jun	116	51 - 91	-	-	4	17	68	25	2	-	75	3	97	64
25	02-Jul	67	67 - 76	-	-	3	8	30	23	3	-	76	4	96	65
26	09-Jul	234	55 - 105	-	-	4	36	127	54	10	3	76	2	97	65
26	12-Jul	128	57 - 117	-	-	2	19	57	44	6	0	77	2	98	65
27	16-Jul	95	56 - 102	-	-	3	14	34	36	7	1	78	3	96	68
27	19-Jul	118	53 - 103	-	-	4	16	27	57	12	2	80	3	97	68
28	23-Jul	11	69 - 82	-	-	1	7	3	-	-	-	77	9	91	69
29	30-Jul	3	69 - 92	-	-	-	1	1	1	-	-	82	0	100	69
		5,487		444	1,429	801	709	1,083	513	307	201				

* Temperature data sources through Jan 25, 2002 USACE monitoring station at Warrendale, Jan 26 through July, Ives Island Gage 1.

middle of June, upriver chinook hatchery releases consisted mainly of juvenile chinook larger than 65 mm in length. By the beginning of July, it became difficult to differentiate between sampled fish originating from the study area and upriver migrants. Based on the low rate of marked fish found in the catch, it is safe to say the majority of migrating upriver chinook remained in the main channel of the river, bypassing the islands below the dam.

Mean fork length of chinook rearing in the study area increased as water temperatures increased below Bonneville Dam. From 15 February to 25 April mean fork length of sampled juvenile chinook increased from 46.0 mm to 58.0 mm, a growth rate of 0.17 mm/day. During this time period daily water temperatures increased from 39.0 to 48.0 ^{o}F. From 21 May to 19 July, mean fork length increased from 60.0 mm to 80.0 mm, a growth rate of 0.34 mm/day. During this time period daily water temperatures increased from 55.0 to 68.0 ^{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 from mid June through early July. By 28 June, juvenile chinook less than 60 mm in length represented only three 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 1999-2002 is described in Table 10. Peak catch of 2002 chinook occurred later than the previous year but similar to peak catch dates in 1999 and 2000. The difference in the time between estimated peak emergence and peak catch of recently emerged chinook varies from 0 to 4 weeks for 1999 to 2002. In 2002 it appears that approximately 79% 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% and 64% in 1999, 2000 and 2001, respectively.

For juvenile chum in 2002 the time between peak estimated emergence and peak catch was approximately six weeks. Peak catch of 2002 chum occurred earlier than the previous year but later than peak catch dates in 1999 and 2000. In 2002 it appears that approximately 80% of the total catch of chum fry less than 50 mm in fork length was arrived at on the day of peak catch. This compares to 72%, 66% and 85% in 1999, 2000 and 2001, respectively.

All sampled juvenile chinook were examined for fin marks to assist in determining stock composition of fish using the rearing areas below Bonneville Dam. 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. Since the unmarked component of the hatchery releases were the same size as the marked component, study area wild fish could be differentiated from most hatchery-released chinook. This rule of thumb was useful until mid June when

Table 10. Comparison of peak emergence dates to peak catch dates of recently emerged fall chinook and chum below Bonneville Dam, 1999-2002.

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

* 12:00 pm reading.

migrating subyearling chinook of similar size than the earliest emergent resident bright stock chinook began appearing in the study area. Since no chum hatchery facilities exist above Bonneville Dam and nearby Hardy Creek and Hamilton Creek chum are not fin marked for assessment purposes, no marked chum were observed in the juvenile sampling. Chum from nearby creeks could not be differentiated from the population found spawning in the Columbia River since there was no size difference between the populations.

To determine a juvenile to adult survival rate for wild bright stock fall chinook found below Bonneville Dam, a part of the juvenile population were adipose fin clipped and coded-wire tagged. The tagging was conducted in the months of April, May and June 2002 when native fish began attaining the size of 47 mm fork length. To avoid tagging fish from outside the area, adipose fin clipped chinook greater than 65 mm fork length were not tagged.

Coded-wire tagging of wild juvenile fall chinook began 30 April when sampling data showed that 26 percent of fry were in the taggable range (47-60 mm fork length). The decision was made to begin tagging earlier than the previous year since the 2002 goal was to tag 25,000 fish, 15,000 fish more than the previous year's successfully met goal of 10,000 fish. Due to colder water than the previous spring, the total number of sampled fry attaining the desired minimum fork length of 47 mm did not reach the fifty percent mark until the 11 June.

The project was able to tag only 3,460 chinook due to fewer available fish relative to 2001. The lack of available fish was in part the result of high river flows, which limited seining efficiency. Tagging was terminated 28 June when it became obvious that a lack of taggable fish around the islands would not allow for the marking of a significant number of juveniles. The overall mortality rate of fish tagged and released at the end of each tagging day was 5.2%. 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

A total of 309 adult fall chinook and 264 chum were sampled below Bonneville Dam in 2001. Peak redd count below Bonneville Dam in 2001 for fall chinook was 48. The peak redd count below Bonneville Dam for chum was 181. Peak spawning time below Bonneville Dam for fall chinook was set at approximately 16 November. Peak spawning time for chum occurred approximately 26 November. There were estimated to be a total of 721 fall chinook spawning below Bonneville Dam in 2001. The 2001 chum population below Bonneville Dam was estimated to be 532 spawning fish.

Table 11. Wild juvenile fall chinook tagged and released below Bonneville Dam, 2002.

Date	Number Sampled	Number Tagged	Mortallity	Percent Mortality	Number Tagged Released	Mean Length Tagged	Untaggable Fish	Percent Untaggable
04/30/02	556	125	64	11.5	125	45.8	411	74
05/0702	888	269	11	1.2	259	48.8	619	70
05/14/02	1,244	375	43	3.5	364	44.5	831	67
05/22/02	760	452	13	1.7	449	49.9	314	41
06/05/02	1,221	480	49	4.0	476	51.5	741	61
06/11/02	1,240	583	179	14.4	566	49.1	657	53
06/14/02	689	370	25	3.6	370	53.3	318	46
06/19/02	479	267	11	2.3	258	61.9	137	29
06/21/02	392	220	11	2.8	215	60.8	161	41
06/26/02	255	164	20	7.8	151	62.3	73	29
06/28/02	424	227	0	0.0	227	67.5	197	46
Totals	8,148	3,532	426	5.2	3,460	54.1	4,459	55

Temperature unit data suggests that below Bonneville Dam 2001 brood chinook emergence began on 11 March 2002 and ended 18 May 2002, with peak emergence occurring 26 April. 2001 brood juvenile chum emergence below Bonneville Dam began 29 January and continued through 31 March 2002. Peak chum emergence below Bonneville Dam took place 25 February. A total of 5,487 juvenile chinook and 678 juvenile chum were sampled between the dates of 22 January and 30 July 2002 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 from mid June through early July 2002 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, GSI analysis, juvenile emergence timing, juvenile migration timing and juvenile size at the time of migration, it appears that in 2001 and 2002 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 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 part of the Lower Columbia River Chum ESU.

PLANS FOR FY 2003

We are planning to continue collecting data to determine the status of fall chinook and chum spawning below Bonneville Dam. In FY 2003 we will abandon adult surveys below The Dalles, John Day and McNary dams and instead begin investigating chum spawning along Oregon and Washington's Columbia River shoreline from Bonneville Dam downstream to the I-205 Bridge. We are planning to collect biological data from the fish spawning below Bonneville Dam and along both shorelines below Bonneville Dam. Biological data 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 continue to monitor entrapment of juvenile chinook and chum 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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