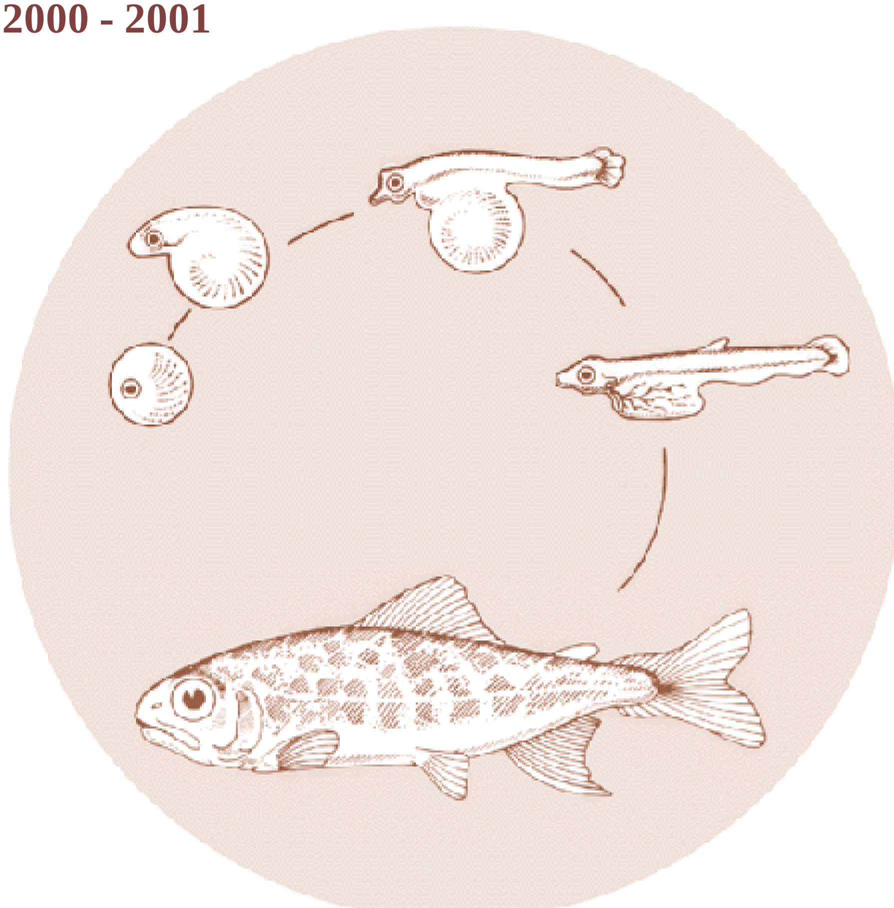
# Fish Research Project Oregon

# John Day Basin Spring Chinook Salmon Escapement and Productivity Monitoring

## Annual Report
## 2000 - 2001



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# FISH RESEARCH PROJECT
# OREGON

# JOHN DAY BASIN SPRING CHINOOK SALMON ESCAPEMENT AND PRODUCTIVITY MONITORING

## ANNUAL PROGRESS REPORT

PROJECT PERIOD: July 1, 2000 to June 30, 2001


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## EXECUTIVE SUMMARY

### Objectives

1. Estimate annual spawner escapement and number of spring chinook salmon redds in the John Day River basin.

2. Determine sex ratio, age composition, length-at-age of spawners, and proportion of natural spawners that are hatchery origin strays.

3. Determine adequacy of historic index surveys for indexing spawner abundance and for detecting changes in spawner distribution through time.

4. Estimate smolt-to-adult survival for spring chinook salmon emigrating from the John Day River basin.

### Accomplishments and Findings

We surveyed and enumerated all known spring chinook spawning habitat in the John Day River basin, PIT-tagged a representative sample, and estimated the abundance of smolts emigrating from the basin. During September 2000, spawning ground surveys were conducted in four main spawning areas (Mainstem, Middle Fork, North Fork, and Granite Creek System) and three minor spawning areas (South Fork, Camas Creek, Desolation Creek) of the John Day basin. These areas encompass 293.1 river kilometers (87.6 km in index, 91.9 km in extensive and 113.6 km in exploratory sites) of spawning habitat. A total of 1,869 redds were observed and 1,530 carcasses were sampled during the surveys. Redd and spawner estimates for the basin included 381 redds and 1,409 spawners in the Mainstem, 569 redds and 2,104 spawners in the Middle Fork, 611 redds and 2,259 spawners in the North Fork, 307 redds and 1,135 spawners in the Granite Creek System and 11 redds and 40 spawners in the minor spawning areas. Eighty percent of the redds in the John Day basin were within the index survey areas, and 96% of the spawning within the index areas was completed by the time index surveys were conducted. Age composition of the carcasses sampled for the entire basin was 0.1% age 2 (precocious males), 1.9% age 3 (jacks), 96.7% age 4, and 1.3% age 5. The sex ratio of the carcasses recovered was 50.1% female and 49.9% male. Sixteen (1.0%) of 1,530 carcasses examined were identified by fin markings as hatchery origin. Lookingglass, Rapid River, Round Butte, and McCall hatcheries were identified as the source of six hatchery carcasses by coded wire tag analysis. To examine smolt-to-adult survival rates, 3,893 chinook smolts and 435 steelhead smolts were tagged with PIT tags during the spring of 2001 in the John Day basin. From February 6 to May 25, 2001, we estimated that 92,922 (95% CLs: 79,258 and 111,228) chinook smolts migrated past our sampling area on the Mainstem John Day River between Kimberly and Spray, OR.

**Management Recommendations**

1. Continue managing John Day basin spring chinook exclusively for wild fish. The near- and long-term ecological and scientific importance of maintaining a totally wild population to compare with hatchery supplemented populations and upriver stocks cannot be overemphasized. Spring chinook salmon in the John Day River basin can serve as a long-term control for comparisons to other more manipulated populations in the Columbia River basin.

2. Surveys of index, extensive and exploratory areas in the John Day basin should be continued because together, they provide the most accurate assessment of the size, composition, and distribution of the spawning population. Surveying index areas during three time periods and extensive and exploratory areas once allows us to estimate natural spawning escapement and assess age composition and progeny to parent production values in the John Day River basin.

3. Conduct adult spring chinook summer holding area surveys in the John Day basin during the month of July to assess pre-spawner survival and adult summer holding habitat requirements. Use global positioning system (GIS) technology to evaluate and determine which historical instream habitat projects are beneficial to pre-spawner survival and determine if the availability of summer holding habitat for adult chinook is limiting population growth within the John Day basin.

4. Determine the summer, fall, and winter distribution of rearing chinook parr within the John Day basin.

5. The prevalence and distribution of *Renibacterium salmoninarum* (Rs) antigen within the spawning population should be monitored for comparison with the prevalence and distribution of Rs antigen in systems where hatcheries are used to supplement native spring chinook populations.

# INTRODUCTION

The John Day River basin (Figure 1) supports one of the healthiest populations of spring chinook salmon in the Mid-Columbia River Basin. This population, however, remains depressed relative to historic levels. The study of life history and natural escapement conducted from 1978 to 1985 (Lindsay et al. 1986) provided valuable information on production and productivity of John Day River spring chinook. Since completion of this past study in 1985 (with the exception of 1989 and 1995), spring chinook spawning surveys were conducted in index areas only. For this reason, the surveys have not provided adequate information to assess age-structure, progeny-to-parent production values, spatial distribution of spawning activity, and estimate natural spawning escapement. Columbia Basin managers have identified the John Day subbasin spring chinook population as an index population for assessing the effects of alternative future management actions on salmon stocks in the Columbia Basin (e. g. Schaller et al. 1999). We believe that John Day spring chinook salmon are the most important lower river reference stock and future biological performance standards will rely heavily on data from this population. To meet the data needs as an index stock, to assess the long-term effectiveness of habitat projects, and to differentiate freshwater and ocean survival, sufficient annual estimates of spawner escapement, age structure, smolt-to-adult survival, egg-to-smolt survival, and freshwater habitat use are essential. This need can be partially met by expanding the annual chinook spawning surveys, estimating the annual escapement, and determining age composition by scale pattern analyses.

This project provides information as directed under two measures of the Columbia Basin Fish and Wildlife Program. Measure 4.3C specifies that key indicator naturally spawning populations should be monitored to provide detailed stock status information. In addition, measure 7.1C identifies the need for collection of population status, life history, and other data on wild and naturally spawning populations. This project was developed in direct response to recommendations and needs of continuing regional modeling efforts, the Fish and Wildlife Program, and the Columbia Basin Fish and Wildlife Authority Multi-year Implementation Plan.

## STUDY AREA

The John Day River drains 20,300 $km^2$ of east central Oregon, the third largest drainage area in the state (Figure 1). From its source in the Strawberry Mountains at an elevation near 1,800 m, the John Day River flows 457 km to an elevation near 90 m to its mouth at river km 351 of the Columbia River. The basin is bounded by the Columbia River to the north, the Blue Mountains to the east, the Strawberry and Aldrich Mountains to the south, and the Ochoco Mountains to the west. Spring chinook salmon primarily spawn in the upper mainstem John Day River (hereafter called Mainstem) above the mouth of Indian Creek (Figure 2), in the Middle Fork John Day River (hereafter called Middle Fork) above Armstrong Creek (Figure 3), in the North Fork John Day River (hereafter called North Fork; Figure 4) above the mouth of Camas Creek including Camas Creek, Desolation Creek and Granite Creek and its tributaries, Clear and Bull Run creeks (hereafter called Granite Creek system), and the South Fork John Day River (hereafter called South Fork).

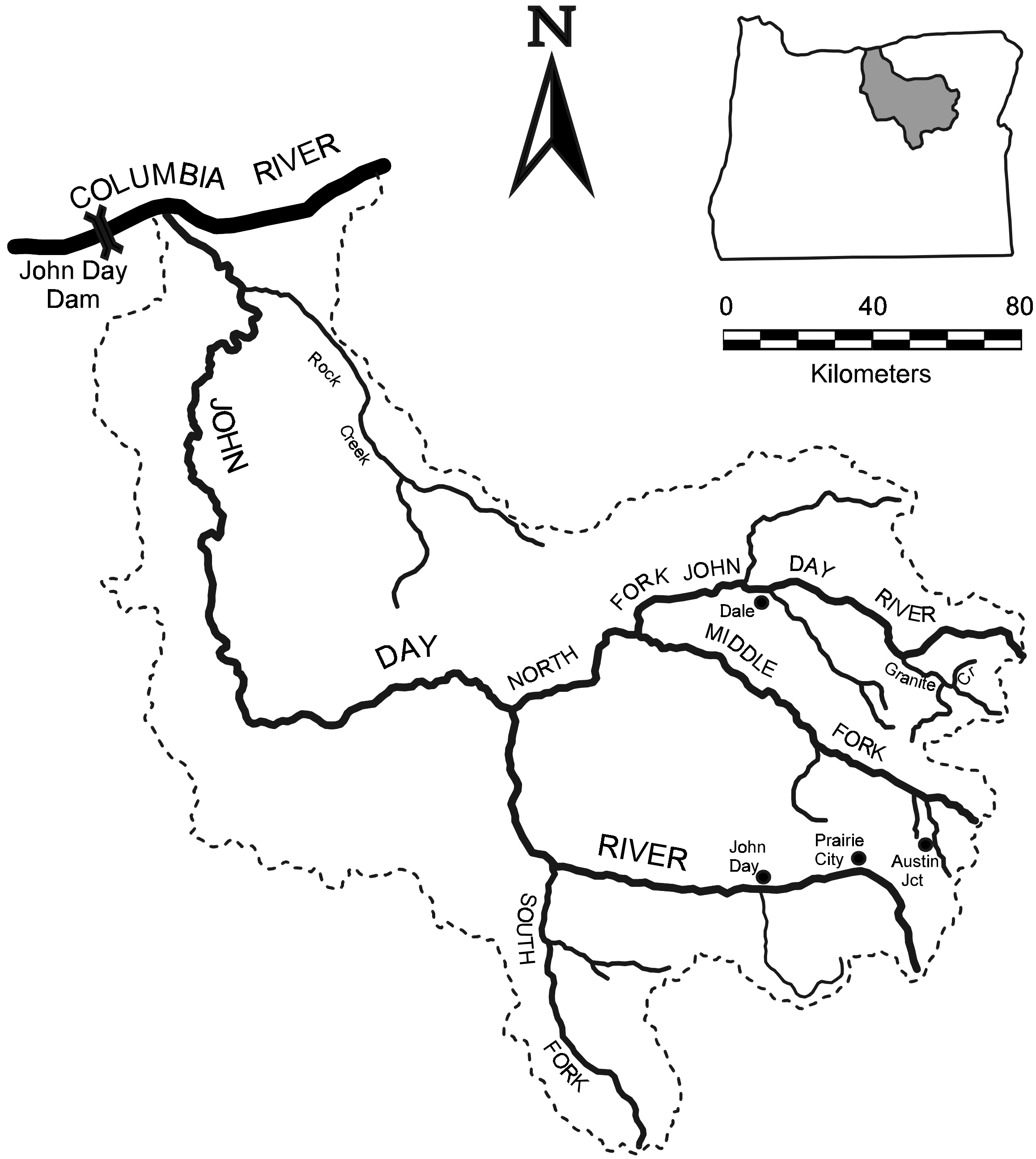


Figure 1. Map showing the entire John Day River basin. Dashed lines denote boundaries of the basin.

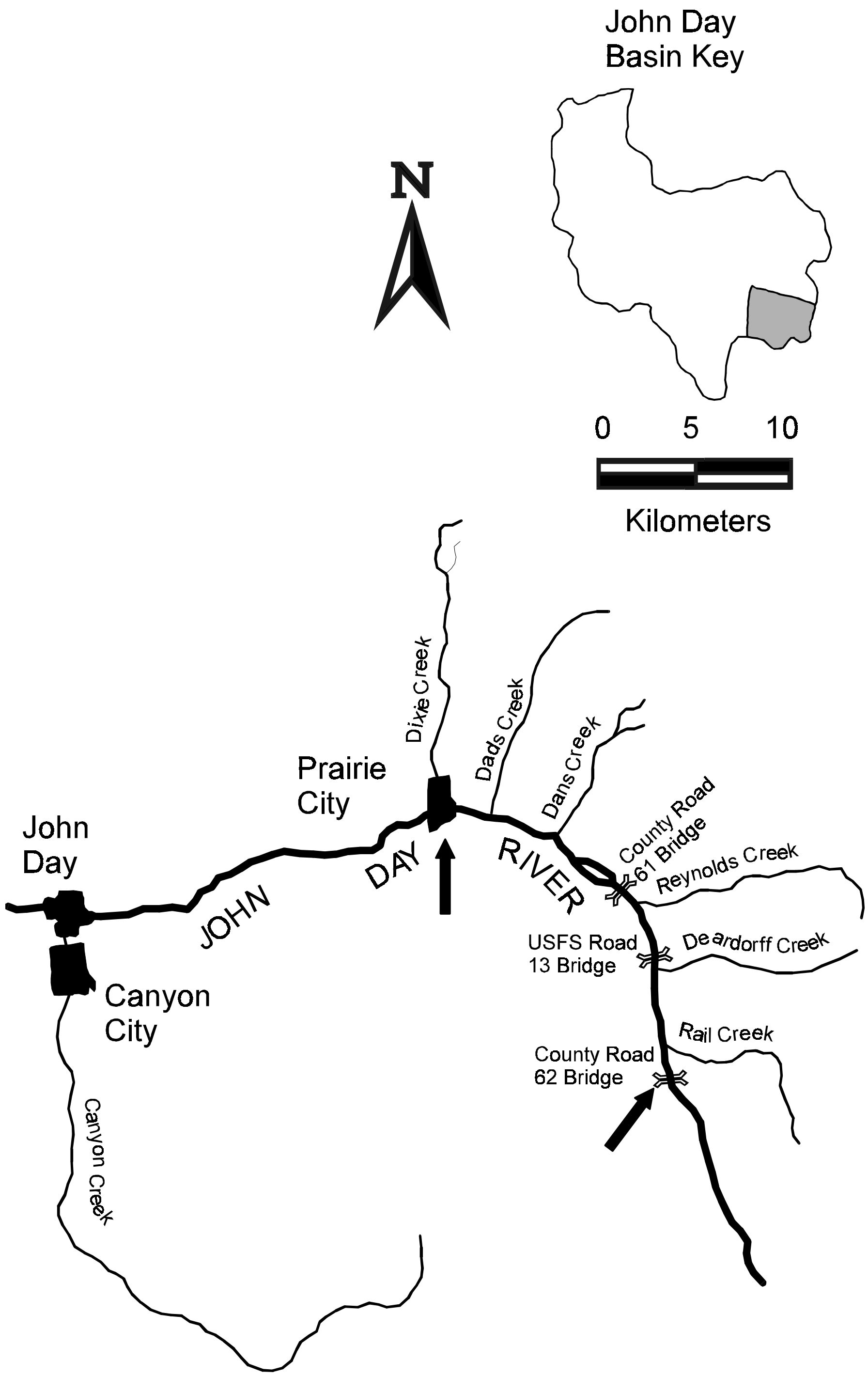


Figure 2. Map showing the upper Mainstem John Day River. Arrows indicate upstream and downstream limits of index and extensive spawning ground surveys.

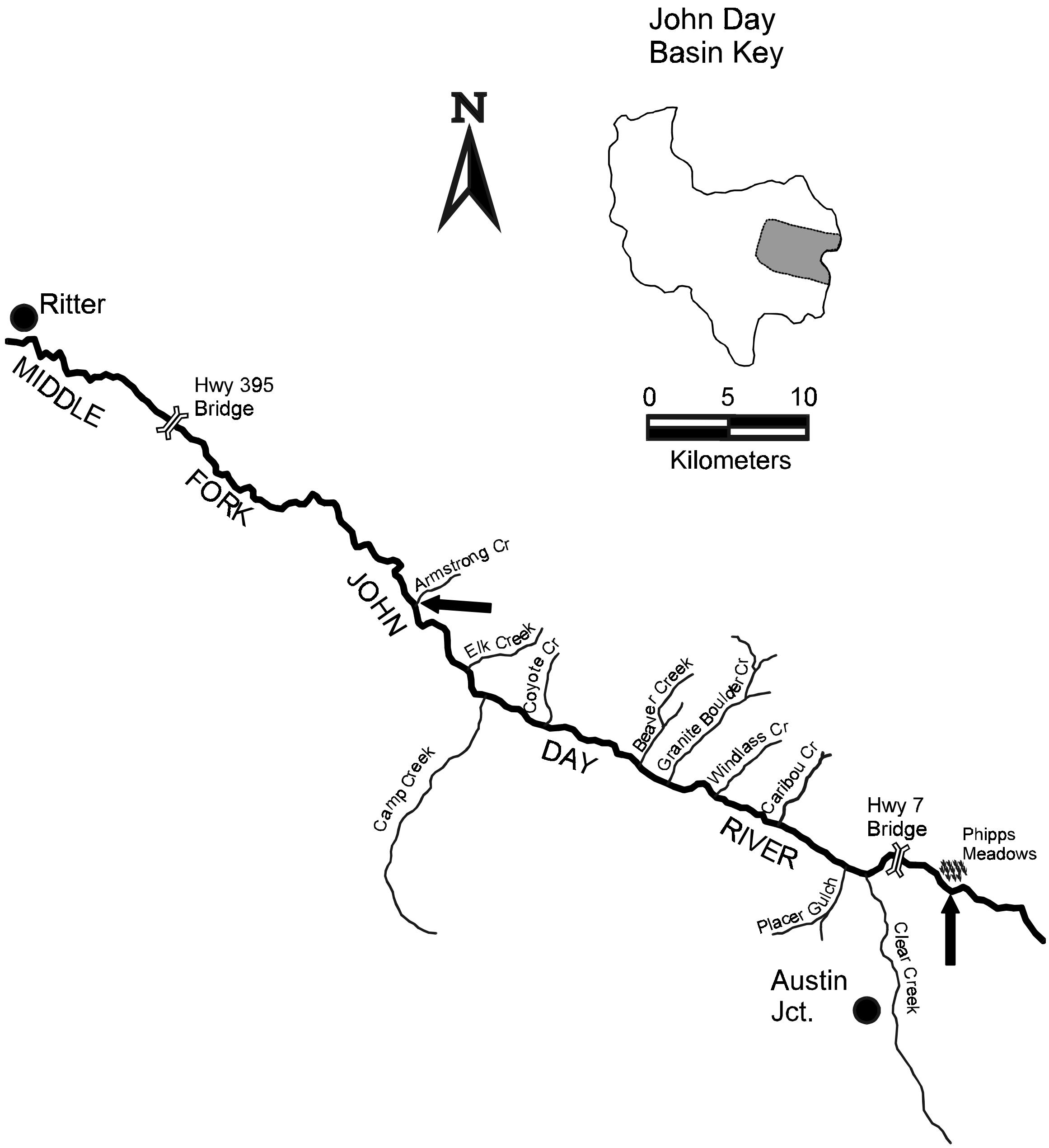


Figure 3. Map showing the Middle Fork John Day River. Arrows indicate upstream and downstream limits of index and extensive spawning ground surveys.

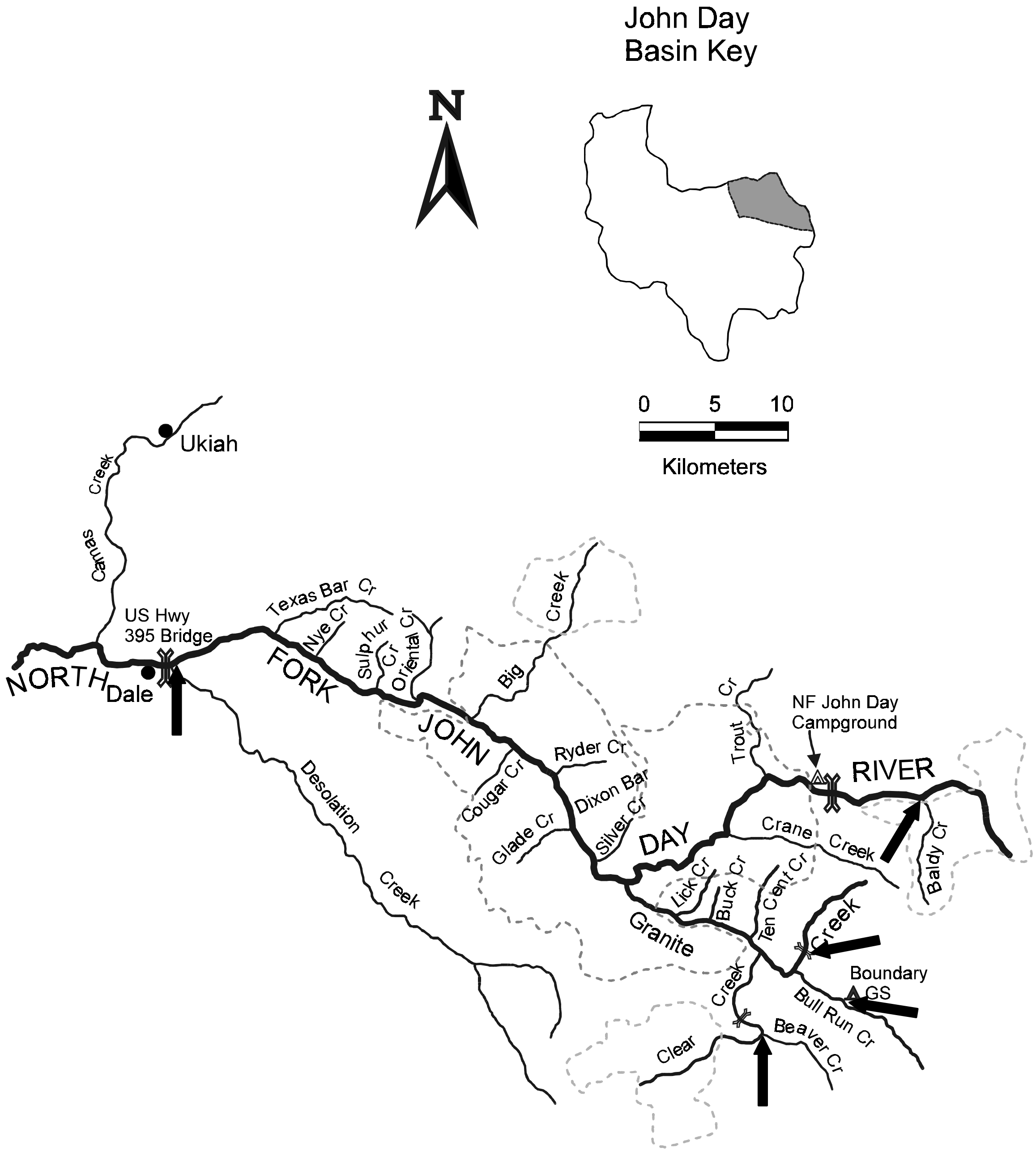


Figure 4. Map showing the North Fork John Day River. Survey areas begin at the confluence with Desolation Creek and extend upstream to the confluence with Baldy Creek. Granite Creek survey areas extend from the mouth to approximately two kilometers above the confluence with Bull Run Creek, Clear Creek to the confluence with Beaver Creek, and Bull Run Creek upstream to the USFS Boundary guard station. Arrows show limits of index and extensive spawning survey areas. Dashed lines denote boundaries of the North Fork John Day Wilderness.

## METHODS

### Spawning Surveys

Spring chinook spawning surveys were scheduled to encompass the temporal and spatial distribution of spawning activity in the John Day River basin. Surveys were conducted during the month of September and the first week of October. Index sections were surveyed to provide information about the relative abundance of redds and to make comparisons with historical index redd count data. Index surveys were scheduled to take place near the peak of spawning in each of the four primary spawning areas (Mainstem, Middle Fork, North Fork, and the Granite Creek System) and were completed within two days of the mean index survey dates of 1989-97 (Jonasson et al. 1998). Three surveys were conducted within each index section to account for temporal variation in spawning activity: pre-index (one week prior to the index survey), index, and post-index (one week after the index survey). To account for spawning outside of the index areas, extensive and exploratory surveys were conducted. Extensive surveys took place on the same day as the index surveys. Exploratory surveys were conducted in areas where reports were received of spring chinook spawning outside of the extensive survey areas. Exploratory surveys of the four primary spawning areas took place within two days of the index surveys (the only exception was in the North Fork where the survey from Desolation Creek to Camas Creek took place 11 days after the last index survey. Exploratory surveys of minor spawning areas (Camas Creek, Desolation Creek, and South Fork) were surveyed when personnel and time allowed. Survey sections and dates are shown in Table 2 and Figures 2,3,4. The lengths of survey sections were determined using computer software (Maptech Inc., 1998).

Surveys were conducted by walking in an upstream direction on the Mainstem and Middle Fork systems, and in a downstream direction on the North Fork, South Fork, Desolation Creek, Camas Creek and Granite Creek systems. Survey sections ranged from 2.7 to 6.6 kilometers in length, depending on accessibility and difficulty. Surveyors recorded number of occupied and unoccupied redds, number of live fish observed (on redds and off redds), and number of carcasses recovered in each survey section. To determine the number of new redds in each successive survey of the index area, individual redds were identified using numbered color flagging placed near each redd location. Flagging was removed during post-index surveys.

Carcasses of dead fish were examined to obtain population and life-history information. From each sampled carcass, surveyors recorded the sex, origin (hatchery or wild; based on fin marks), and middle of eye to posterior scale (MEPS) lengths (mm). Percentage of eggs spawned was estimated to the nearest 25% for females. Any identifying marks or tags were noted, and tags were removed for identification and returned to the appropriate agency. Kidney samples were collected from a target of 10 carcasses in each of the main spawning areas to test for the presence of *Renibacterium salmoninarum* (Rs) antigen (bacterial kidney disease). Surveyors randomly selected carcasses with intact organs and craft sticks were used to scrape a sample of kidney from carcasses. Samples were placed in sterile whirl-pack bags and stored in a cooler with ice until transported to a freezer. The enzyme-linked immunosorbent assay (ELISA) was used to obtain optical density values according to methodology adopted from Pascho and Mulcahy (1987). The direct fluorescent antibody (DFAT) staining method was also utilized as a back-up assay for each sample to visualize by microscopy elevated levels of Rs cells (Banner et al. 1982). The Rs antigen level is an indication of the bacterial infection level with *Renibacterium salmoninarum*, the causative agent of bacterial kidney disease. The following table summarizes the optical density value ranges and the designated Rs antigen level category (Table 1).

Table 1. Summary of ELISA optical density value ranges and designated Rs antigen category.

| Optical density value ($OD_{405}$) range | Rs Antigen level category |
|---|---|
| 0 – 0.114 | Negative or Very Low |
| 0.115 – 0.299 | Low Positive |
| 0.300 – 0.699 | Moderate Positive |
| 0.700 – 0.999 | High Positive |
| ≥ 1.000 | Clinical[a] |

[a] By the ELISA, an optical density (OD) equal-to or greater-than 1.000 is considered to be clinical BKD.

Scale samples were removed from the key scale area (Nicholas and Van Dyke 1982) for age determination. After the pre-index survey, and because of the large number of returning spawners, carcasses with MEPS lengths less than 450 mm (likely age 3 or jack adults) and over 650 mm (likely age 5 adults) were subsampled for scales. This sub-sampling criteria was based on the size distribution of carcasses aged during 1999 (Figure 5). When fin marks were observed, the snout of the fish was removed for subsequent analyses to determine the presence of a coded-wire tag. Tails were removed from sampled carcasses to prevent repeated sampling. All carcasses were returned to their original position in the stream. Scales were mounted on gummed cards and impressions were made in acetate. Scale impressions were viewed using a microfiche reader. Freshwater and ocean annuli were counted to determine the age of the sampled carcasses. For carcasses with unreadable scales, age was assigned using a length/age relationship developed from aged carcasses. We estimated age-structure for spawning populations separately for the Mainstem, Middle Fork, North Fork, and Granite Creek systems.

Timing of the index surveys relative to the timing of spawning in each primary spawning area was assessed (i.e. Mainstem, Middle Fork, North Fork, and Granite Creek system) using the equation:

$$P_t = \frac{R_1 + R_2}{R_1 + R_2 + R_3}, \tag{1}$$

where $P_t$ is the proportion of redds in the index area that were completed at the time of the index survey, $R_1$ is the number of redds counted during the pre-index survey, $R_2$ is the number of new redds counted during the index survey, and $R_3$ is the number of new redds counted during the post-index survey. Spawning in index survey areas relative to the extensive spawning areas was also assessed using the equation:

$$P_a = \frac{R_1 + R_2}{R_1 + R_2 + R_4}, \tag{2}$$

where $P_a$ is the proportion of redds in the spawning area that were within the index survey area and $R_4$ is the number of redds counted in the extensive survey area.

Spawning in the index survey area relative to the extensive and exploratory spawning areas was assessed using the equation:

$$P_{ae} = \frac{R_1 + R_2}{R_1 + R_2 + R_4 + R_5} \ , \tag{3}$$

where $P_{ae}$ is the proportion of redds in the spawning area that were within the index survey area and $R_5$ is the number of redds counted in the exploratory survey area. Because extensive and exploratory survey areas were surveyed only once, during or within a day of the index survey, the total number of redds in each primary spawning area were estimated using the equation:

$$\hat{R}_{total} = \frac{R_1 + R_2 + R_3}{P_{ae}} \ , \tag{4}$$

where $\hat{R}_{total}$ is the estimated number of redds in the entire primary spawning area.
In addition, the number of redds in the North Fork was calculated using equation 4 and adding the number of redds counted in the exploratory survey to the numerator.

The estimated number of spawners in each of the four main spawning areas was determined by multiplying the number of redds by 3.7. The ratio 3.7 was determined by estimating the mean of fish per redd estimates above the Warm Springs River weir, Oregon (Department of Natural Resources, Confederated Tribes of the Warm Springs Reservation, Unpublished Data) and the Imnaha River weir, Oregon (Oregon Department of Fish and Wildlife, Unpublished Data) during the period of 1996-2000.

Table 2. Description, length, and date of index, extensive, and exploratory spawning survey sections in the John Day River basin for 2000.

| Stream, survey type | Survey boundaries | Distance | | Survey dates |
|---|---|---|---|---|
| | | Km | Mile | |
| Mainstem: | | | | |
| Exploratory | Indian Creek to Prairie City | 9.0 | 5.3 | 11 Sep |
| Extensive | Prairie City to Dad's Creek | 3.5 | 2.2 | 11 Sep |
| Index | Dad's Creek to 62 Road Culvert | 18.9 | 11.8 | 11 Sep |
| Exploratory | 62 Road Culvert to Trout Farm | 5.1 | 3.2 | 11 Sep |
| Exploratory | Reynolds Creek - (Axe Gulch to Trailhead) | 3.2 | 2.0 | 11 Sep |
| | Deardorff Creek - (0.5 mile above mouth) | 0.8 | 0.5 | 11 Sep |
| | Canyon Creek - (J-L Ranch to Wickiup Campground) | 13.8 | 8.6 | 8 Sep |
| Middle Fork: | | | | |
| Extensive | Armstrong Creek to Beaver Creek | 23.5 | 14.6 | 20 Sep |
| Index | Beaver Creek to Hwy 7 | 20.9 | 13.0 | 21 Sep |
| Extensive | Hwy 7 to Phipps Meadow | 7.1 | 4.4 | 20 Sep |
| | Lower mile of Clear Creek | 2.1 | 1.3 | |
| Exploratory | Clear Creek - (three miles above Hwy 26) | 9.2 | 5.7 | 6, 19 Sep |
| North Fork: | | | | |
| Exploratory | Cunningham Creek to Baldy Creek | 5.0 | 3.1 | 22 Sep |
| Extensive | Baldy Creek to Granite Creek | 30.6 | 19.0 | 18-20, 22 Sep |
| Index | Granite Creek to Cougar Creek | 13.4 | 8.3 | 20-21 Sep |
| Extensive | Cougar Creek to Big Creek | 3.9 | 2.4 | 21 Sep |
| Index | Big Creek to Nye Creek | 15.1 | 9.4 | 20 Sep |
| Extensive | Nye Creek to Desolation Creek | 10.9 | 6.8 | 20 Sep |
| Exploratory | Desolation Creek to Camas Creek | 5.6 | 3.5 | 3 Oct |
| Granite Creek: | | | | |
| Index | 73 Road to Buck Creek | 9.5 | 5.9 | 12 Sep |
| Extensive | Buck Creek to Mouth | 7.9 | 4.9 | 12 Sep |
| Clear Creek[a]: | | | | |
| Extensive | Beaver Creek to 13 Road Crossing | 1.6 | 1.0 | 12 Sep |
| Index | 13 Road Crossing to Mouth | 4.8 | 3.0 | 12 Sep |
| Bull Run Creek[a]: | | | | |
| Index | Boundary Guard Station to Mouth | 5.0 | 3.1 | 12 Sep |
| Extensive | 0.5 mile above Boundary Guard Station | 0.8 | 0.5 | 12 Sep |

[a] *Tributary of Granite Creek.*

Table 2. Continued.

| Stream, survey type | Survey boundaries | Distance | | Survey dates |
|---|---|---|---|---|
| | | Km | Mile | |
| South Fork: | | | | |
| Exploratory | South Fork Falls to Black Canyon Ranch | 18.2 | 11.3 | 25 Sep |
| | Izee Road Turnoff to Road 45 Bridge | 6.1 | 3.8 | 4 Oct |
| | Murderer's Creek - (1.5 miles above Chickenhouse Gulch) | 2.4 | 1.5 | 25 Sep |
| Desolation Creek[b]: | | | | |
| Exploratory | South Fork Desolation Creek - (2.5 miles above confluence with North Fork Desolation Creek) | 3.7 | 2.3 | 2 Oct |
| | North Fork Desolation Creek - (0.8 miles above confluence with South Fork Desolation Creek) | 1.0 | 0.6 | 2 Oct |
| | Confluence of North and South Forks of Desolation Creek to Peep Creek | 18.3 | 11.4 | 2 Oct |
| Camas Creek[b]: | | | | |
| Exploratory | Lehman Springs Road to Forest Boundary below Lane Creek Campground | 9.0 | 5.6 | 1 Sep, 3 Oct |
| | Ukiah-Dale Park to Bridge Creek | 11.3 | 7.0 | 1 Sep, 3 Oct |
| | Cable Creek - (Cable Creek Forks to Bridge) | 9.7 | 6.0 | 1,7 Sep |

[b]*Tributary of North Fork John Day River*

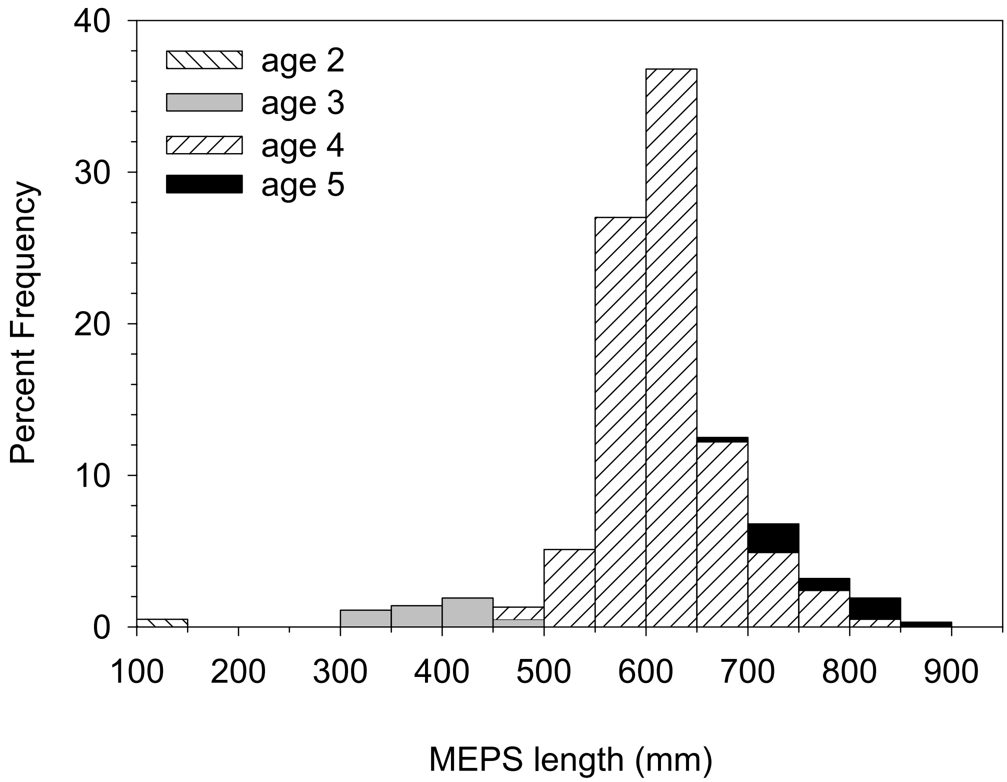


Figure 5. Middle of eye to posterior scale (MEPS) length frequency distribution of four age classes of 370 adult spring chinook salmon carcasses sampled in the John Day River basin during 1999.

**Smolt Capture and Tagging**

Using primarily beach seining techniques while wading and with the aid of a jet boat, we collected chinook and steelhead smolts from February 6, to June 15, 2001 on the Mainstem John Day River between river kilometers (Rkm) 278 and 298. Eddies, riffles and river margins were sampled with one of three different seines. The most frequently used seine was constructed of 12.7 mm delta mesh netting and measured 30.5 m long by 2.4 m deep with a 1.2 m x 1.2 m bag in the middle. In order to increase catch of smaller smolts, we modified the net by lining the bag section with 10 mm mesh netting. In large deep pools, we used a larger seine constructed of 12.7 mm delta mesh netting that measured 61 m long by 2.4 m deep with a 1.2 x 1.2 m bag in the middle. An additional seine constructed of 12.5 mm mesh netting that measured 61m long by 2.4 m deep was also used infrequently.

In order to maximize catches of fish, a sampling plan using standard sites for seining was not followed. Instead, the location for sampling within our river kilometer reaches varied on a daily basis depending on daily discharge and success during previous sampling days. Captured smolts were anesthetized with tricaine methane sulfonate (MS-222) and passive integrated transponder (PIT) tags were implanted into the peritoneal cavity following standard PIT-tag marking procedures (PTAGIS 1999). Smolts were measured for fork length (FL) to the nearest millimeter and weighed to the nearest 0.1 gram. Mean weekly catch per seine set was determined to assess smolt migration timing through the lower Mainstem (Rkm 274 - 298) during the months of February, March, April and May. We also recorded the presence of black spot disease (trematode cysts) on captured smolts. PIT-tag information was submitted to the PIT tag Information System (PTAGIS).

To determine short-term handling mortality and retention of PIT tags, we performed PIT-tag retention and tagging mortality trials during the month of April. Each of five taggers tagged a minimum of 40 smolts. Smolts were placed in a net pen along the river margin, held overnight, checked for mortality, and interrogated for the presence of PIT tags the following morning.

We estimated capture efficiency (CE) of our seining efforts using mark-recapture techniques. We determined capture efficiency for the entire sampling period (6 February to 25 May, 2001) by releasing known numbers of PIT-tagged smolts at Kimberly, OR (2.5 km above the actual capture area). CE was estimated using the equation:

$$CE = R / M, \tag{5}$$

where M is the number of marked fish released upstream and R is the number of marked fish recaptured.

In addition to seining, two methods of capturing smolts were explored to increase the number of PIT-tagged fish. A ditch diversion trap in the Mainstem near river Rkm 391 was operated from April 3 to June 15. We also dip netted fish while snorkeling at night in the upper Middle Fork (Rkm 90 - 91), Mainstem (Rkm 387), and North Fork (Rkm 88 - 104) from February 12 to 28, 2001. Our plan was to catch 500 chinook smolts with a catch ratio of 15.7% from the Mainstem, 28.4% from the Middle Fork and 55.9% from the North Fork subbasins. This catch ratio is the same as the ratio of redds distributed among index spawning areas of the John Day basin in 1999 (Jonasson et al. 1999).

To calculate smolt-to-adult survival, we will rely on detections of PIT-tagged fish as they return as adults to the Bonneville and John Day Dams and within the spawning areas of the John Day basin. Smolt-to-adult survival rates will be reported in future annual reports.

To evaluate the efficacy of the February, upper-basin dip net method we used Z-tests of 2 x 2 contingency tables (SPSS Inc., 1997). We determined the ratio of tagging in February in the upper Middle Fork and upper North Fork and compared it to the ratio of tag detection between these sites at the John Day Dam detection facilities. We also determined the ratio of tagging during February in the upper basin and smolts tagged and released at Kimberly and compared it to the ratio of tag detection between these sites at the John Day Dam.

We recorded daily incidental fish species catch from seining efforts as the total catch by species in the areas sampled. Incidental fish species catch information will be used to assess the need to obtain threatened and endangered species take permits and promote interagency and intra-agency cooperation in collecting fish data from the John Day basin. When steelhead carcasses were observed, sex, percentage of eggs spawned by females, fork length, and scale samples were taken. We also observed fin clips of captured steelhead to determine if they were of hatchery origin. Steelhead carcass data was given to the ODFW, John Day District Fish Biologist.

## RESULTS

### Redds and Escapement

During 2000, we observed 1,869 spring chinook redds while surveying 293.1 Rkms of the John Day River basin (87.6 km within index areas, 91.9 km within extensive areas and, 113.6 km within exploratory areas; Table 3). Of the four main subbasins, 32.6% of the redds were observed in the North Fork (609 redds), 30.1% were observed in the Middle Fork (563 redds), 20.3% were observed in the Mainstem (380 redds), and 16.4% were observed in the Granite Creek System (306 redds; Table 3). Exploratory surveys of the South Fork, Camas Creek, and Desolation Creek accounted for only 0.6% of all redds observed (Table 3).

After post-index surveys were concluded, spawning density in the index area of the John Day basin was 16.7 redds/km (Table 3). Spawning densities within the four main spawning areas were 19.3 redds/km in the Mainstem, 17.6 redds/km in the Middle Fork, 17.0 redds/km in the North Fork, and 12.7 redds/km in the Granite Creek System by the time of the post-index surveys (Table 3).

Using our estimate of the total number of redds (1,879) and a ratio of 3.7 spawners/redd, we estimated that 6,947 spawners escaped to the John Day River basin in 2000 (Table 4). See Appendix A for redd and fish count data collected during each survey, percentage of redds counted in individual survey sections, and spawning density expressed as redds per mile or kilometers per mile in individual survey sections. Appendix B summarizes historic index redd count data for the John Day basin.

### Characteristics of Spawners

To determine population sex ratio, age and length structure, presence of strays and retention of eggs by post-spawn females, we sampled 1,533 carcasses representing 22% of the estimated escapement (6,947 spawners) in the John Day basin (Table 5). Of the carcasses sampled, we were able to determine the age and sex of 1,499 carcasses (Table 6). The sex ratio of all carcasses sampled in the John Day basin was 50.1% female and 49.9% male (Table 7). Age 4 fish dominated the age structure accounting for 96.8% of all fish aged (Table 6). Age 3 adults (jacks), accounted for 1.8%, age 5 for 1.3%, and age 2 (precocious males) for 0.1% (Table 6). Compared to the three other main spawning areas, Mainstem age-4 females composed a significantly larger percentage (61.06%) of the spawners than age 4 males (35.4%; Table 6). Within the exploratory spawning areas of Camas Creek and Desolation Creek, we were able to sample seven carcasses, all of which were age 4 adults (Table 6).

Of the carcasses sampled, we were able to determine the age, sex, and MEPS length of 1,490 carcasses (Table 8). MEPS length of all female carcasses sampled in the John Day basin was 763 ± 15.1 mm (standard error; SE) for age five females and 601.9 mm ± 1.5 mm SE for age four females. Age 5 males had a mean MEPS length of 763 ± 13.9 mm SE, age 4 males were 605.9 ± 1.7 mm SE, age 3 males were 456.9 ± 13.6 mm SE, and age 2 males (precocious males) were 106.5 ± 16.5 mm SE (Table 8). The mean MEPS length of North Fork carcasses tended to be longer than carcasses sampled in the other spawning areas (Table 8). We were able to estimate the percentage of eggs spawned for 751 individual female carcasses sampled during spawning surveys in the John Day Basin (Table 9).

Of all female carcasses sampled, 94.4% had spawned 100% of their eggs (Table 9). All Mainstem female carcasses were 100% spawned while 5.3% of Middle Fork, 5.9% of North Fork and 9.7% of Granite Creek system female carcasses were incompletely spawned (Table 9). We also collected five female pre-spawning moralities during spawning surveys in the John Day River basin (Table 9). Sixteen of 1,530 (1.0%) carcasses examined were of hatchery origin as identified by fin clips. Hatchery carcasses were identified in all major spawning areas of the John Day River basin (Table 10). Six of the hatchery carcasses had coded wire tags, which allowed the identification of the hatchery sources. All hatchery fish originated from Idaho or Oregon hatcheries (Table 10).

Table 3. Kilometers surveyed, total number of redds observed, and number of new redds observed during five types of spring chinook salmon spawning surveys in the John Day River basin, 2000.

| Stream | Kilometers surveyed | | | Total | New redds observed | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Index | Extensive | Exploratory | Redds | Pre-index | Index | Post-index | Extensive | Exploratory |
| Mainstem | 18.9 | 3.5 | 14.1 | 380 | 154 | 183 | 28 | 3 | 12 |
| Middle Fork | 20.9 | 32.7 | 9.2 | 563 | 345 | 11 | 11 | 183 | 13 |
| North Fork | 28.5 | 45.4 | 10.6 | 609 | 468 | 9 | 8 | 115 | 9 |
| Granite Creek System | 19.3 | 10.3 | 0 | 306 | 197 | 44 | 5 | 60 | 0 |
| Camas Creek | | | 30.0 | 3 | | | | | 3 |
| Desolation Creek | | | 23.0 | 5 | | | | | 5 |
| South Fork John Day | | | 26.7 | 3 | | | | | 3 |
| Basin Total | 87.6 | 91.9 | 113.6 | 1,869 | 1,164 | 247 | 52 | 361 | 45 |

Table 4. Estimated number of spring chinook salmon redds and spawners, and percentage of basin-wide spawning in the John Day River basin, 2000.

| Stream | Number | | Percent of total basin |
|---|---|---|---|
| | Redds | Spawners | |
| Mainstem | 381 | 1,409 | 20.3 |
| Middle Fork | 569 | 2,104 | 30.3 |
| North Fork | 611 | 2,259 | 32.5 |
| Granite Creek System | 307 | 1,135 | 16.3 |
| Camas Creek | 3 | 11 | 0.2 |
| Desolation Creek | 5 | 18 | 0.2 |
| South Fork | 3 | 11 | 0.2 |
| Entire Basin | 1,879 | 6,947 | |

Table 5. Number of carcasses sampled during each type of spring chinook salmon spawning survey in the John Day River basin, 2000.

| Stream | Number of carcasses sampled | | | | | |
|---|---|---|---|---|---|---|
| | Total | Pre-index | Index | Post-Index | Extensive | Exploratory |
| Mainstem | 113 | 26 | 38 | 48 | 1 | 0 |
| Middle Fork | 678 | 95 | 330 | 24 | 229 | 0 |
| North Fork | 502 | 216 | 163 | 33 | 89 | 1 |
| Granite Creek System | 233 | 12 | 102 | 87 | 32 | --- |
| Desolation Creek | 5 | --- | --- | --- | --- | 5 |
| Camas Creek | 2 | --- | --- | --- | --- | 2 |
| Basin Total | 1533 | 349 | 633 | 192 | 351 | 7 |

Table 6. Percent age and sex composition of male (M) and female (F) spring chinook salmon carcasses sampled in the spawning areas of the John Day River basin, 2000. Number of carcasses sampled (n) is also shown.

| | | Age | | | | | |
|---|---|---|---|---|---|---|---|
| | | 2 | 3 | 4 | | 5 | |
| Stream / year | n | M | M | M | F | M | F |
| Mainstem | 113 | 0 | 1.77 | 35.40 | 61.06 | 0.88 | 0.88 |
| Middle Fork | 657 | 0 | 1.67 | 49.62 | 47.64 | 0.15 | 0.91 |
| North Fork | 489 | 0 | 1.43 | 47.14 | 50.20 | 0.41 | 0.82 |
| Granite Creek System | 232 | 0.86 | 3.02 | 48.71 | 45.69 | 0.43 | 1.29 |
| Camas Creek | 2 | 0 | 0 | 100 | 0 | 0 | 0 |
| Desolation Creek | 5 | 0 | 0 | 0 | 100 | 0 | 0 |
| Basin Total | 1499 | 0.13 | 1.80 | 47.50 | 49.30 | 0.33 | 0.93 |

Table 7. Sex ratio of carcasses sampled during each survey type in the John Day River basin, 2000.

| Survey Type | n | Female | Male |
|---|---|---|---|
| Pre – index | 347 | 49.3 | 50.7 |
| Index | 621 | 53.1 | 46.9 |
| Post – index | 190 | 60.0 | 40.0 |
| Extensive | 340 | 39.7 | 60.3 |
| Exploratory | 5 | 40.0 | 60.0 |
| All Surveys | 1503 | 50.1 | 49.9 |

Table 8. Number of spring chinook salmon carcasses examined, and mean and standard error (SE) of middle of eye to posterior scale (MEPS) length (mm) by age and sex of sampled carcasses during spawning ground surveys of the John Day basin, 2000.

| | Age | | | | | |
|---|---|---|---|---|---|---|
| | 2 | 3 | 4 | | 5 | |
| Stream, item | male | male | male | female | male | female |
| Mainstem | | | | | | |
| number | 0 | 2 | 40 | 68 | 1 | 1 |
| mean | -- | 402.5 | 595.7 | 601.1 | 740 | 755 |
| SE | -- | 27.5 | 8.9 | 3.8 | -- | -- |
| range | -- | 375 - 430 | 450 - 710 | 535 - 670 | -- | -- |
| Middle Fork | | | | | | |
| number | 0 | 11 | 326 | 312 | 1 | 6 |
| mean | -- | 447.3 | 591.9 | 588.2 | 790 | 690 |
| SE | -- | 27.5 | 2.1 | 1.9 | -- | 25.1 |
| range | -- | 360 - 635 | 395 - 830 | 470 - 750 | -- | 580 - 740 |
| North Fork | | | | | | |
| number | 0 | 7 | 225 | 246 | 2 | 4 |
| mean | -- | 473.7 | 627.3 | 615.8 | 752.5 | 762.5 |
| SE | -- | 19.5 | 2.9 | 2.3 | 45.9 | 17.8 |
| range | -- | 370 - 530 | 440 - 765 | 505 - 720 | 720 - 785 | 715 - 790 |
| Granite Creek | | | | | | |
| System | 2 | 7 | 113 | 105 | 1 | 3 |
| number | 106.5 | 470.7 | 607.2 | 608.2 | 780 | 688.3 |
| mean | 16.5 | 20.9 | 4.9 | 4.8 | -- | 18.3 |
| SE | 90 - 123 | 375 - 540 | 510 - 790 | 460 - 731 | -- | 652 - 710 |
| range | | | | | | |
| Desolation Creek | | | | | | |
| number | 0 | 0 | 0 | 5 | 0 | 0 |
| mean | -- | -- | -- | 652.2 | -- | -- |
| SE | -- | -- | -- | 29.0 | -- | -- |
| range | -- | -- | -- | 570 - 710 | -- | -- |
| Camas Creek | | | | | | |
| number | 0 | 0 | 2 | 0 | 0 | 0 |
| mean | -- | -- | 630 | -- | -- | -- |
| SE | -- | -- | 10.0 | -- | -- | -- |
| range | -- | -- | 630 - 640 | -- | -- | -- |
| Basin wide | | | | | | |
| number | 2 | 27 | 706 | 736 | 5 | 14 |
| mean | 106.5 | 456.9 | 605.9 | 601.9 | 763 | 715 |
| SE | 16.5 | 13.6 | 1.7 | 1.5 | 13.9 | 15.1 |
| range | 90 - 123 | 360 - 540 | 395 - 830 | 460 - 750 | 720 - 790 | 580 - 790 |

Table 9. Distribution of estimated percentage of eggs spawned by individual female carcasses sampled from four subbasins during spring chinook spawning surveys of the John Day River basin, 2000. Each female was examined separately and placed into one of the five categories shown. Sample sizes (n) from each subbasin are also shown.

| | | Percentage Spawned | | | | |
|---|---|---|---|---|---|---|
| Stream | n | 0% | 25% | 50% | 75% | 100% |
| Mainstem | 69 | 0 | 0 | 0 | 0 | 100 |
| Middle Fork | 319 | 0.31 | 0.63 | 1.25 | 3.14 | 94.67 |
| North Fork | 252 | 0.79 | 0.79 | 0.40 | 3.97 | 94.05 |
| Granite Creek | 111 | 0.90 | 2.70 | 0.90 | 4.51 | 90.99 |
| Total | 751 | 0.53 | 0.93 | 0.80 | 3.33 | 94.41 |

Table 10. Sample date, sample identification, stream location, fin clip, sex, medial eye to posterior scale length (MEPS; mm), and hatchery origin and release location as determined by coded wire tag (CWT) information for all fin-clipped spring chinook salmon sampled during spawning ground surveys of the John Day River basin, 2000. Fin clips were either adipose (Ad), left ventral (LV), or right ventral (RV).

| Date | Sample Tag # | Stream | Fin clip | Sex[a] | Length (MEPS) | Coded wire tag record of hatchery origin |
|---|---|---|---|---|---|---|
| 9/16/97 | 9z2709 [b] | Mainstem John Day | Ad | F | 600 | No CWT |
| 9/11/00 | 00H 6050 | Mainstem John Day | Ad | F | 600 | No CWT |
| 9/12/00 | 00H 6065 | Clear Cr. - GCS | Ad | J | 460 | No CWT |
| 9/12/00 | 00H 6035 | Granite Creek | Ad | M | 560 | No CWT |
| 9/12/00 | 00H 6060 | Granite Creek | Ad | F | 460 | No CWT |
| 9/12/00 | 00H 6090 | Granite Creek | Ad | F | 570 | No CWT |
| 7/2000 | 00H 6082 | Desolation Creek | Ad | --- | --- | Looking Glass Hatchery, Grande Ronde River, OR. |
| 9/20/00 | 00H 6067 | North Fork John Day | Ad | F | 620 | Rapid River Hatchery, ID. |
| 9/20/00 | 00H 6071 | North Fork John Day | Ad | F | 720 | McCall Hatchery, ID. Released in the South Fork Salmon River at Knox Bridge. |
| 9/20/00 | 00H 6057 | North Fork John Day | Ad | M | 590 | Rapid River Hatchery, ID. |
| 9/20/00 | 00H 6066 | North Fork John Day | Ad | M | 650 | No CWT |
| 9/20/00 | 00H 6056 | North Fork John Day | Ad RV | M | 610 | Looking Glass Hatchery, Grande Ronde River, OR. |
| 9/20/00 | 00H 7922 | Middle Fork John Day | Ad | F | 570 | No CWT |
| 9/20/00 | 00H 6016 | Middle Fork John Day | Ad | F | 560 | No CWT |
| 9/20/00 | 00H 6476 | Middle Fork John Day | LV | F | 590 | No CWT |
| 9/21/00 | 00H 6041 | Middle Fork John Day | Ad | M | 623 | No CWT |
| 9/21/00 | 00H 6081 | Middle Fork John Day | Ad | J | 395 | Round Butte Hatchery, OR. Acclimated and released in the West Fork Hood River, OR. |

[a] Sex categories include: male (M), female (F), and age 3 males or jacks (J).
[b] This sample was from 1997 and previously lost.

## Occurrence of Bacterial Kidney Disease

Thirty-eight kidney samples from fish in the John Day basin were analyzed for Rs antigen by the ELISA and DFAT methods. Of these 38 samples, one from Granite Creek (2.6%) had a very high ELISA value of 0.909 OD units and four (10.5%) from the Mainstem John Day had low level positive ELISA values in the 0.200-0.299 range. All other values were ≤ 0.195 OD units (Table 11). The high level ELISA value for the Granite Creek sample had a corresponding high level of Rs by the DFAT. All other DFAT stains were negative. The presence of BKD in the John Day basin was confirmed from one kidney sample taken in the Granite Creek system. This sample had an ELISA value just below the clinical level defined as ≥ 1.000 OD units and the DFAT confirmed that a significant infection had been occurring in this fish.

Table 11. ELISA readings ($OD_{405}$) for *Renibacterium salmoninarum* from kidney samples taken from carcasses in the four main spring chinook salmon spawning areas of the John Day basin.

| Granite Creek System | | North Fork | |
|---|---|---|---|
| Sample | $OD_{405}$ | Sample | $OD_{405}$ |
| 1 | 0.909 | 1 | 0.170 |
| 2 | 0.135 | 2 | 0.126 |
| 3 | 0.148 | 3 | 0.161 |
| 4 | 0.127 | 4 | 0.160 |
| 5 | 0.145 | 5 | 0.195 |
| 6 | ---- | 6 | 0.188 |
| 7 | 0.160 | 7 | 0.189 |
| 8 | 0.153 | 8 | 0.189 |
| 9 | 0.174 | 9 | 0.121 |
| 10 | 0.137 | 10 | 0.128 |
| **Middle Fork** | | **Mainstem** | |
| Sample | $OD_{405}$ | Sample | $OD_{405}$ |
| 1 | 0.144 | 1 | 0.219 |
| 2 | 0.160 | 2 | 0.167 |
| 3 | ---- | 3 | 0.184 |
| 4 | 0.165 | 4 | 0.167 |
| 5 | 0.151 | 5 | 0.166 |
| 6 | 0.140 | 6 | 0.263 |
| 7 | 0.187 | 7 | 0.200 |
| 8 | 0.172 | 8 | 0.149 |
| 9 | 0.189 | 9 | 0.152 |
| 10 | 0.176 | 10 | 0.210 |

### Adequacy of Historic Index Surveys

Index surveys adequately represented a majority of both the spatial and temporal distribution of spring chinook spawning in the John Day River basin. We determined that 96.4% of spawning occurred by the time of the index surveys (Table 12). Relative to the extensive survey area, the index survey accounted for 79.6% of spawning. Index surveys also accounted for 77.7% of all spawning observed in the basin (i.e. relative to the combined index, extensive, and exploratory spawning survey areas; Table 12). The percentage distribution of redds determined by index surveys in the four main spawning areas of the John Day basin were 33.8% in the North Fork, 25.2% in the Middle Fork, 23.9% in the Mainstem, and 17.1% in the Granite Creek System.

We were able to sample 982 (64%) of the 1,533 carcasses by the time of the index survey. The post-index, extensive, and exploratory surveys all contributed to increasing the total number of carcasses observed. During these surveys, we counted 192 carcasses (12.5%) in the post-index surveys, 351 (22.9%) carcasses in the extensive surveys, and 5 carcasses (0.3%) in the exploratory surveys (Table 5). We were able to determine the age of 1,511 carcasses sampled during spawning surveys in the John Day basin (Table 13). A majority of carcasses of each age class were sampled by the time of the index survey. Of the carcasses examined, 100% of age 2, 57.2% of age 3, 64% of age 4, and 84.2% of age 5 carcasses were sampled by the index survey time (Table 13). No age 2 or age 5 carcasses were observed outside of the index survey areas (Table 13). We were able to determine the sex of 1,503 carcasses (Table 7). The sex ratio of carcasses sampled during the pre-index (50.7% male to 49.3% female) and index surveys (49.6% male to 53.1% female) more closely resembled the sex ratio of carcasses sampled from all surveys (50% male to 50% female, Table 7). In addition, 66.6% of all male carcasses and 62.1% of all female carcasses were observed by the time of the index survey (Table 14). During the extensive surveys, nine percent more males than females were recovered while five percent more females than males were recovered during the post-index surveys (Table 14).

Table 12. Percentage of redds observed by the time of the index survey relative to those observed by the time of the post-index survey and percentage of redds observed within the spatial extent of the index survey relative to those observed within the spatial extent of the extensive survey, and the combined extensive and exploratory surveys in the John Day basin, 2000.

| | Percentage of redds counted during the index survey | | |
|---|---|---|---|
| Stream | Relative to the post-index survey | Relative to the extensive survey | Relative to extensive and exploratory survey |
| Mainstem | 92.3 | 99.1 | 95.7 |
| Middle Fork | 97.0 | 66.0 | 64.5 |
| North Fork | 98.4 | 80.6 | 79.4 |
| Granite Creek System | 98.0 | 80.1 | 80.1 |
| All Basins | 96.4 | 79.6 | 77.7 |

Table 13. Percentage of carcasses sampled according to age and type of survey in the John Day basin, 2000.

| | | Age | | | | |
|---|---|---|---|---|---|---|
| Age | N | Pre-index | Index | Post-index | Extensive | Exploratory |
| 2 | 2 | 100 | 0 | 0 | 0 | 0 |
| 3 | 28 | 14.3 | 42.9 | 10.7 | 32.1 | 0 |
| 4 | 1,462 | 22.8 | 41.2 | 12.4 | 23.1 | 0.3 |
| 5 | 19 | 31.6 | 52.6 | 15.8 | 0 | 0 |
| All ages | 1,511 | 22.9 | 41.4 | 12.4 | 23.0 | 0.3 |

Table 14. Number of carcasses sampled, and percent recovery of male and female carcasses during each survey type conducted in the John Day River basin, 2000.

| Survey | Female | Male |
|---|---|---|
| N | 752 | 751 |
| Pre-index | 22.7 | 23.4 |
| Index | 43.9 | 38.7 |
| Post-index | 15.2 | 10.1 |
| Extensive | 18.0 | 27.3 |
| Exploratory | 0.3 | 0.4 |

**Smolt Capture and Tagging**

We captured and PIT tagged a total of 3,893 chinook and 435 steelhead smolts in the John Day basin between February 6 and June 15, 2001. Most of the chinook (88.5%) and steelhead (70.8%) smolts were captured in the Mainstem between Kimberly and Spray, OR (Rkm 274 - 298, Tables 15 and 16). Three chinook smolts and 126 (28.9%) steelhead smolts were captured using a ditch diversion trap located at Rkm 391 in the Mainstem. Snorkeling was also used to capture 444 (11.4%) chinook smolts in the upper North Fork (Rkm 88 - 104), Middle Fork (Rkm 90 - 91), and Mainstem (Rkm 387) between February 12 and 28, 2001. One steelhead smolt was PIT tagged in the upper North Fork. We estimated that 92,922 (95% CLs: 79,258 and 111,228) chinook smolts migrated past the sampling area between Kimberly and Spray from 2/6/01 to 5/25/01. We were unable to calculate an abundance estimate for steelhead smolts due to limited recaptures.

There was a large variation in the size of chinook smolts captured as they migrated out of the John Day River basin. The mean fork length of chinook smolts captured while seining in the Mainstem between Kimberly and Spray, OR was 104 mm FL (± 0.1 SE; range = 79-192 mm FL; Table 15, Figure 6). Mean weight of chinook smolts captured while seining in the Mainstem between Kimberly and Spray, OR was 13.2 g (± 0.06 SE; range = 5.6–78.2g) (Table 16).

Steelhead smolts captured by seining in the Mainstem between Kimberly and Spray, OR had a mean fork length of 166 mm (± 1.5 SE; range = 98 - 312 mm FL) and mean weight of 50.6 g (± 1.8 SE; range = 11.0 - 374.0g,Table 16, Figure 7).

Table 15. Location (with river kilometer; Rkm), capture method, time of capture, number captured, mean, standard error (SE) and range of fork length (FL) and mass of chinook smolts captured in the John Day River basin during the Spring of 2001.

| Catch Site | Method (dates) | Number | FL and mass | SE | Range |
|---|---|---|---|---|---|
| Mainstem | Seining | 3,446 | 104 mm | 0.1 | 79 – 192 |
| Rkm (274 - 298) | (2/6/01 - 5/25/01) | | 13.2 g | 0.06 | 5.6 – 78.2 |
| Mainstem | Ditch Diversion Trap | 3 | 120 mm | 13.1 | 105 – 146 |
| Rkm (391) | (4/17/01 - 6/12/01) | | 25.2 g | 10.5 | 13.4 - 46.5 |
| Mainstem | Snorkeling | 2 | 99 mm | 5.0 | 94 – 104 |
| Rkm (387) | (2/21/01) | | 11.3 g | 1.1 | 10.2 – 12.4 |
| North Fork | Snorkeling | 287 | 91 mm | 0.6 | 68 – 117 |
| Rkm (88 - 104) | (2/12/01 - 2/28/01) | | 8.4 g | 0.13 | 3.5 - 16.1 |
| Middle Fork | Snorkeling | 155 | 88 mm | 0.5 | 70 – 105 |
| Rkm (90 - 91) | (2/20/01 - 2/23/01) | | 7.5 g | 0.14 | 3.1 - 12.4 |
| All sites | | 3,893 | 102 mm | 0.1 | 68 – 192 |
| | | | 12.6 g | 0.06 | 3.1 - 78.2 |

Table 16. Location (with river kilometer; Rkm), capture method, time of capture, number captured, mean, SE and range of FL and mass of steelhead smolts captured in the John Day River basin during the Spring of 2001.

| Catch Site | Method | Number | FL and mass | SE | Range |
|---|---|---|---|---|---|
| Mainstem | Seining | 308 | 166 mm | 1.5 | 98 - 312 |
| Rkm (274 - 298) | (2/6/01 - 5/25/01) | | 50.6 g | 1.8 | 11.0 - 374.0 |
| Mainstem | Ditch Diversion Trap | 126 | 174 mm | 1.5 | 116 - 218 |
| Rkm (391) | (4/17/01 - 6/12/01) | | 57.8 g | 1.5 | 15.7 - 110.2 |
| North Fork | Snorkeling | 1 | 106 mm | | |
| Rkm (88 - 104) | (2/12/01 - 2/28/01) | | 12.5 g | | |
| All sites | | 435 | 168 mm | 1.1 | 98 - 312 |
| | | | 52.6 g | 1.4 | 11.0 - 374.0 |

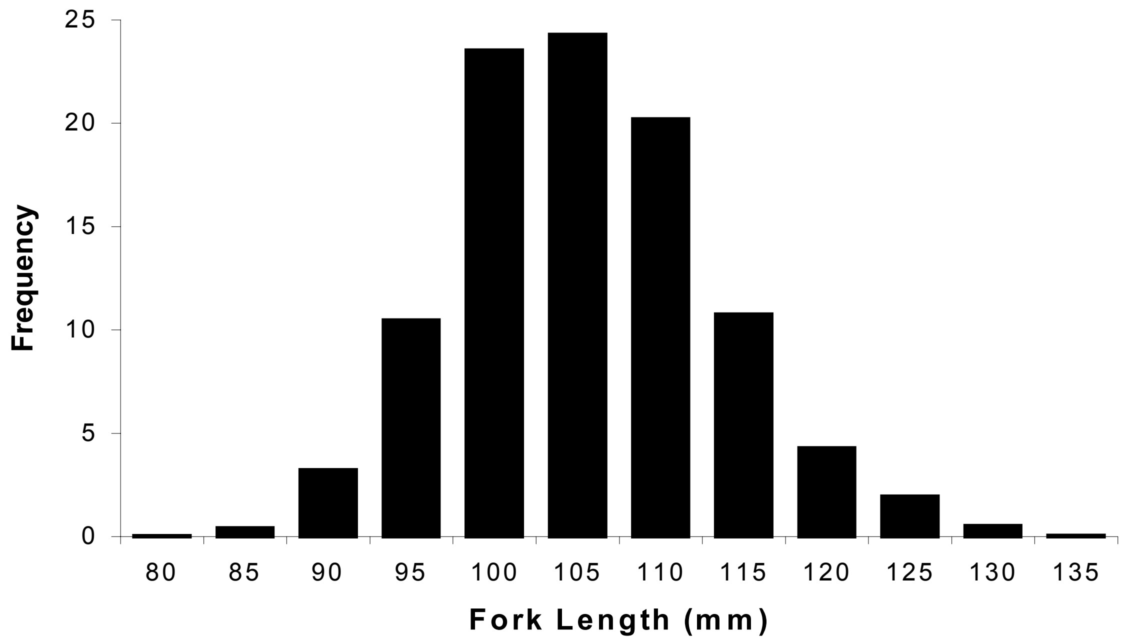


Figure 6. Length frequency histogram of chinook smolts captured using seines in the Mainstem between Kimberly and Spray, OR.

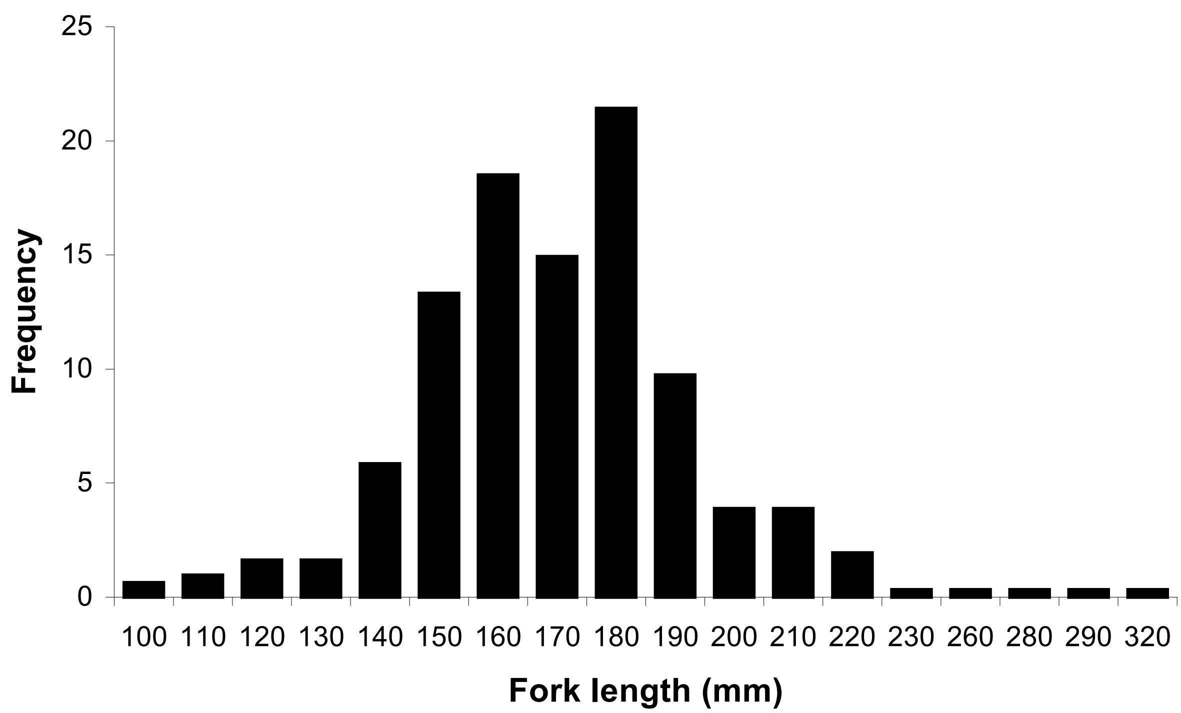


Figure 7. Length frequency histogram of steelhead smolts captured using seines in the Mainstem John Day River between Kimberly and Spray, OR.

Short-term mortality of PIT-tagged smolts was low. Of the 309 smolts that were PIT tagged and held overnight in a net pen, two (0.64%) died during the trial and all fish had PIT tags when they were interrogated the following morning. Thirteen chinook smolts died during the seining operation when they became wedged in the mesh openings of the seine net. Wedging typically occurred near the end of the seine haul as smolts tried to escape when the net bag was pursed to pull it into shallow water. To correct the problem, 10-mm ace mesh netting was sewn into the bag of the seine net to prevent small smolts from becoming wedged in the larger mesh. One steelhead smolt died when it jumped out of a transport container. Corrections were subsequently made to the transportation procedures in an effort to prevent the loss of PIT tagged smolts during transportation.

We recaptured 129 chinook smolts during our mark-recapture efforts to estimate the efficiency of our seining operation. The average time to recapture for chinook smolts PIT tagged and released at Kimberly was 9.8 days (± 0.96 SE) and ranged from one to 27 days. Seining catch efficiency between Kimberly and Spray from February 6 to May 25, 2001 was 3.7%. Because of our inability to recapture any tagged steelhead smolts, we were unable to calculate the catch efficiency of our seines for these fish. Catch per seine haul for chinook smolts peaked during April and peaked during the middle of May for steelhead smolts (Figure 8).

Although we captured only three chinook smolts in the ditch diversion trap, we were successful in capturing 126 steelhead smolts in this trap. This significantly increased our total number of PIT-tagged steelhead smolts. Fish captures in the diversion trap increased after April 1 when irrigators diverted more flow to the diversion ditch.

We had differential success capturing chinook smolts in upper North Fork and Middle Fork areas while snorkeling in February. Adequate water clarity and accessible over-wintering habitat in these two areas allowed us to capture nearly 550 parr (Table 16). However, we were unable to locate a significant population of over-wintering smolts in the upper Mainstem area. Accordingly, we only captured and tagged two parr in the upper Mainstem.

Both chinook and steelhead smolts were observed for signs of *Neascus* or blackspot infestation prior to being PIT tagged. Of the 3,893 chinook smolts captured in the John Day basin, 58 (1.5%) showed visible signs of *Neascus*. Of the 435 steelhead smolts captured in the John Day basin, 13 (2.9%) showed visible signs of *Neascus*.

**Detection of PIT Tagged Smolts at Columbia River Dam Facilities**

PIT tagged chinook smolts were detected at the John Day and Bonneville Dams during April, May and June 2001 (Figure 9, Tables 17 and 18). Of the 3,891 chinook smolts PIT tagged and released in the John Day River basin, 2,010 (51.6%) were detected by either the John Day or Bonneville Dam detection facilities. PIT-tag detection facilities at the John Day Dam detected 1,743 (45%) smolts and facilities at the Bonneville Dam detected 749 (19%) chinook smolts. Of the chinook smolts detected at John Day Dam, 27.6% were also detected at Bonneville Dam.

The detection rate at John Day Dam of chinook smolts released at Kimberly (47.6%) was significantly higher than the detection rate of smolts tagged during February in the upper basin (23%, $z = 20.9$, $P < 0.001$). The detection rate at John Day Dam of chinook smolts tagged during February in the upper North Fork (25.4%) also differed significantly from the detection rate of chinook smolts tagged during February in the upper Middle Fork (18.1%; $z = 2.5$, $P = 0.012$).

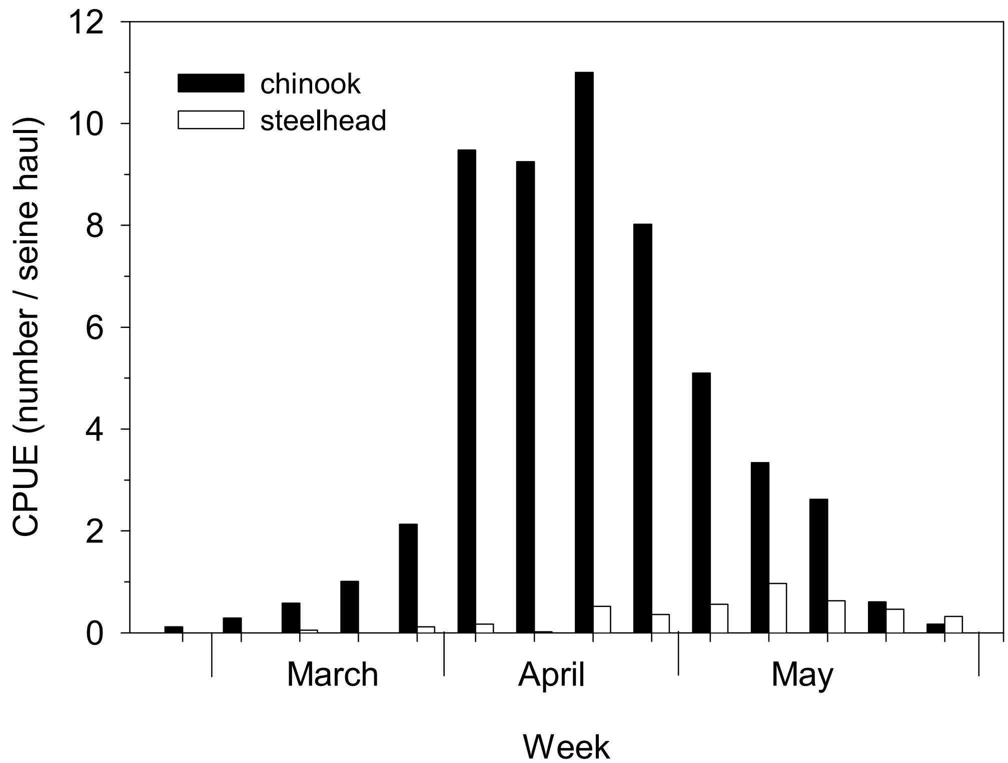


Figure 8. Weekly average catch-per–unit-effort (CPUE) of chinook and steelhead smolts captured using seines in the Mainstem John Day River between Kimberly and Spray, OR.

PIT-tagged steelhead smolts were detected at the John Day and Bonneville Dam facilities during April, May and June 2001 (Figure 9, Tables 17 and 18). Of the 434 steelhead smolts PIT tagged in the John Day River basin, 112 (25.8%) were detected at both the John Day and Bonneville Dam facilities. PIT-tag detection facilities at the John Day Dam detected 97 (22.3%) steelhead smolts while 60 (13.8%) were detected at Bonneville Dam. Of the steelhead smolts detected at John Day Dam, 40% were also detected at Bonneville Dam. In general, the detection rate of steelhead smolts detected at the John Day and Bonneville Dam facilities was lower than the detection rate of chinook smolts. However, repeat detection between dams was higher for steelhead compared to chinook smolts.

Steelhead smolts captured by seining in the Mainstem between Kimberly and Spray, OR took less time to migrate to John Day and Bonneville Dam facilities than chinook smolts (Table 17). Detection of our PIT-tagged chinook smolts at the John Day Dam peaked during the final week of April (Figure 9). Steelhead smolt detection peaked between 30 April and 1 May with a secondary minor peak from 14-18 May (Figure 9). Chinook smolts tagged in the upper Middle Fork also tended to take more time to migrate to John Day Dam than smolts tagged in the upper North Fork and Mainstem (Table 18). Twenty (0.6%) chinook smolts and one steelhead smolt (0.3%) released at Kimberly were detected in the Columbia River Estuary during May and June. Three chinook smolts released in the upper Middle Fork and one chinook smolt released in the upper North Fork during February were also detected in the Columbia River Estuary 75-93 days after release.

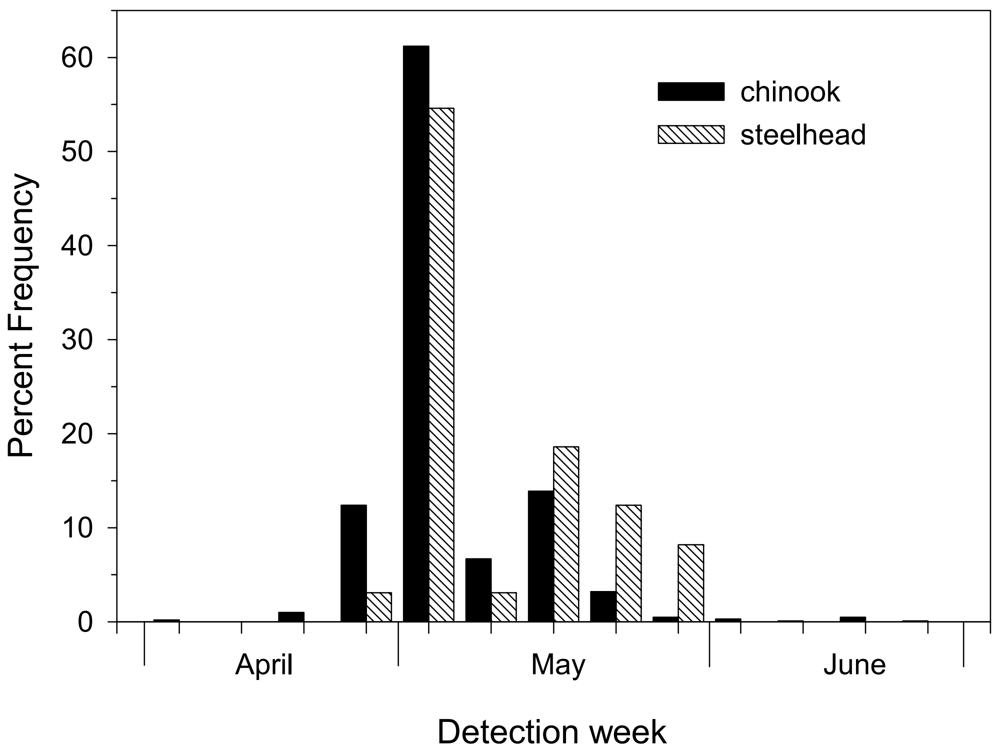


Figure 9. Percent detection of chinook and steelhead smolts at John Day Dam facilities during 2001 that were PIT tagged and released in the Mainstem John Day River near Kimberly (Rkm 298), OR.

Table 17. Number detected and mean, standard error (SE), and range of travel time to John Day and Bonneville Dam facilities for chinook and steelhead smolts captured in the Mainstem (Rkm 274 - 298) by seining from 10 March to 24 May, 2000 and 6 February to 25 May, 2001.

| Dam | Year | Species | Number Detected | Mean Travel Time (Days) | SE | Range (Days) |
|---|---|---|---|---|---|---|
| John Day | 2000 | Chinook | 559 | 17 | 0.41 | 3 - 52 |
| John Day | 2001 | Chinook | 1,640 | 23 | 0.31 | 3 - 90 |
| Bonneville | 2000 | Chinook | 311 | 22 | 0.61 | 6 - 64 |
| Bonneville | 2001 | Chinook | 700 | 31 | 0.47 | 8 - 92 |
| John Day | 2001 | Steelhead | 97 | 17 | 1.07 | 4 - 45 |
| Bonneville | 2001 | Steelhead | 60 | 20 | 1.39 | 7 - 56 |

Table 18. Number detected and mean, standard error (SE), and range of travel time to John Day Dam for chinook smolts captured by snorkeling in the upper North Fork, Middle Fork, and Mainstem during February, and captured using the Mainstem diversion trap from 3 April to 2 June, 2001.

| Catch Site | Method | Number Detected | Mean Travel Time (Days) | SE | Range |
|---|---|---|---|---|---|
| Mainstem Rkm (391) | Diversion Trap | 1 | 13 | --- | --- |
| Mainstem Rkm (387) | Snorkeling | 1 | 64 | --- | --- |
| North Fork Rkm (88 - 104) | Snorkeling | 73 | 68 | 1.35 | 52 - 113 |
| Middle Fork Rkm (90 - 91) | Snorkeling | 28 | 75 | 2.40 | 61 - 125 |

**Incidental Catch and Observation**

In addition to chinook salmon and steelhead smolts, we captured numerous other species. We captured approximately 756 fish representing 14 species during our seining effort on the Mainstem John Day River. Most of this incidental catch was comprised of smallmouth bass *Micropterus dolomieui* and adult large scale *Catostomus macrocheilus* and bridge lip *C. columbianus* suckers (Table 19). In addition to the six adult steelhead captured while seining, two steelhead carcasses were also observed. One carcass was of hatchery origin (as identified by an adipose fin clip). The diversion trap located on the Mainstem at Rkm 391 captured 741 incidental fish representing nine species (Table 20). Most of this incidental catch was comprised of unidentified lamprey species (58%). The majority of lamprey were captured on two separate days (300 on 4/27/01 and 100 on 6/13/01) during the sampling period of 4/3/01 to 6/15/01. Also of note were two adult steelhead kelts captured on 6/2/01 and 6/7/01. While snorkeling to capture chinook smolts in the upper North Fork, Middle Fork and Mainstem, we observed 3 salmonid and 9 non-salmonid species (Table 28). Of note were 6 pacific lamprey ammocoetes, one in the North Fork and 5 in the Middle Fork (Table 20).

Table 19. Number of each fish species captured incidentally while seining (Rkm 274 – 298) and using a diversion trap (Rkm 391) in the Mainstem John Day River from 6 February to 25 May 2001.

| Species | Seining | Diversion Trap |
|---|---|---|
| Steelhead adult (*Oncorhynchus mykiss*) | 6 | 2 |
| Redband trout (*O. mykiss*) | 1 | 5 |
| Mountain whitefish (*Prosopium williamsoni*) | 1 | ---- |
| Sculpin (*Cottus sp.*) | 2 | 29 |
| Sucker sp. (*Catostomus macrocheilus)* or (*C. columbianus*) | 462 | 122 |
| Northern pike minnow *(Ptychocheilus oregonensis)* | 73 | 13 |
| Chiselmouth *(Acrocheilus alutaceus)* | 23 | 12 |
| Redside shiner *(Richardsonius balteatus)* | 6 | 48 |
| Brown bullhead *(Ameiurus nebulosus)* | 6 | ---- |
| Smallmouth bass *(Micropterus dolomieui)* | 158 | ---- |
| Dace *(Rhinichthys sp.)* | 2 | 71 |
| Common carp *(Cyprinus carpio)* | 15 | ---- |
| Pacific lamprey *(Lampetra tridentata*), adult carcass | 1 | --- |
| Brook lamprey sp. *(Lampetra sp.)* | --- | 410 |
| Total | 756 | 712 |

Table 20. Number of each fish species PIT tagged, observed or incidentally captured while snorkeling in the John Day River basin during February, 2001.

| Species | Mainstem Rkm (387) | Middle Fork Rkm (90 - 91) | North Fork Rkm (88-104) |
|---|---|---|---|
| Chinook smolt (*Oncorhynchus tshawytscha*) | 2 tagged<br>1 observed | 155 tagged<br>50 observed | 287 tagged<br>25 observed |
| Steelhead (*Oncorhynchus mykiss*) | ---- | 110 | 1 tagged<br>105 observed |
| *Mountain whitefish* (*Prosopium williamsoni*) | ---- | 4 | 51 |
| Sculpin (*Cottus sp.*) | 20 | 17 | 25 |
| Sucker sp. (*Catostomus macrocheilus*) or (*C. columbianus*) | 10 | 10 | 8 |
| Chiselmouth (*Acrocheilus alutaceus*) | | | 1 |
| Redside shiner (*Richardsonius balteatus*) | 300 | 89 | 1,241 |
| Dace (*Rhinichthys sp.*) | ---- | 22 | ---- |
| Common carp (*Cyprinus carpio*) | ---- | ---- | 1 |
| Brook lamprey sp. ammocoetes (*lampetra sp.*) | ---- | 40 | 26 |
| Pacific lamprey ammocoetes (*Lampetra tridentata*) | ---- | 5 | 1 |
| Total | 332 | 502 | 1,771 |

## DISCUSSON

Based on historic index-area data recorded since 1959, we observed a record number of redds in index areas (1,411) of the John Day River basin during 2000 (Table B-1). The index counts for the Mainstem, Middle Fork and North Fork were also the highest recorded since 1959 (Appendix Table B-1). The Granite Creek System index redd count (241) was above the previous 10-year average (120 redds) and above the average redd count from 1978-1985 (104 redds; Lindsay et al. 1986). Redd density was also the highest ever recorded since 1959 (Appendix Table B-2).

During 2000, index survey times were representative of spring chinook spawn timing. Over the past three years, index survey timing has been adequate for observing most redds within the survey areas. During these years, index surveys accounted for > 90% of the redds observed within the index survey areas (pre-index, index, post-index) and > 75% of spawning in all spawning areas surveyed (index, extensive, and exploratory; Jonasson et al. 1998, Wilson et al. 1999).

As in previous years, the majority of redds observed in the John Day River basin occurred in index survey areas. The distribution of redds among the four primary spawning locations during 2000 was within the range reported from 1986 - 1999 (Jonasson et al. 1998, Wilson et al. 1999). A direct comparison between data collected after 1986 and historical data collected prior to 1986 cannot be made in the Middle Fork because the index area of the Middle Fork was increased in 1986 (Jonasson et al. 1998). The percentage of redds observed in both the index and extensive surveys that were within the index survey areas of the Mainstem, North Fork, and Granite Creek System were within the historically recorded range. This percentage, however, has decreased in the Middle Fork over the last three years. During 2000, 33% of the total redds were observed in the extensive section of the Middle Fork (Table 21). This increase in spawners outside of index areas in the Middle Fork may suggest that the quantity of habitat within the index area is inadequate for the high spawner numbers recently observed there. Spawning below the Middle Fork index area in the extensive survey section (Armstrong Creek to Beaver Creek) increased from 0% in 1998 to 23.8% in 2000 (Appendix Table A-2). Spawning in exploratory reaches upstream of index areas has also increased. (Appendix Table A-2). Index, extensive, and exploratory surveys are necessary to adequately describe the spatial distribution of spawning in the John Day basin. Without extensive surveys, we would not have been able to detect the changes observed in spawning distribution of the Middle Fork. Without exploratory surveys, we also would not have demonstrated the occurrence of spawning downstream of the extensive survey section of both the Mainstem and North Fork spawning areas nor the presence of spawning in the South Fork, Camas Creek, or Desolation Creek (Appendix Table A-1).

Currently, a limited ceremonial tribal fishery is the only within-basin fishery for spring chinook salmon. John Day basin Umatilla tribal members harvested 49 of their allotted 50 adult spring chinook from the Granite Creek System in the North Fork subbasin (Dave Wolf, Umatilla Tribal harvest monitor, personal communication). Due to the depressed population status, the sport fishery for spring chinook in the John Day basin has been closed since 1978 (ODFW et al., 1990). While the estimated spring chinook escapement in 2000 was the highest ever recorded in the John Day basin, it was still below the threshold of 7,000 returning adults necessary to allow a sport fishery (ODFW et al., 1990). Spring chinook fishery guidelines developed by comanagers in 1990 state that when average annual escapement of spring chinook in the John Day basin reaches 7,000 adults, 1,050 fish will be available for sport and tribal harvest leaving 5,950 fish for natural reproduction (ODFW et al., 1990). The dramatic increase in redd counts in the John Day basin during 2000 is encouraging and unprecedented. Much of this increase is likely due to elevated ocean survival rates. However, this does not diminish the importance of continued conservation efforts of private landowners, government and tribal agencies, and other interested parties in the John Day basin. Continued conservation efforts coupled with quality out-of-basin environments may eventually allow spring chinook production goals to be realized.

During July of 2000, pre-spawning mortalities of spring chinook were observed in the Granite Creek System (Jeff Neal and Tim Unterwegner, ODFW, personal communication), Desolation Creek (Dave Crabtree, USFS, personal communication) and upper North Fork (Todd Bennett, NMFS, personal communication). The mortalities had no apparent physical damage suggesting the potential for bacterial, fungal or viral infection as the cause of mortality. Bacterial kidney disease (BKD) is a potential cause of pre-spawning mortality (Bullock and Herman, 1988). We recommend that pre-spawn mortalities be tested for BKD and the spawning population should be monitored to better explain pre-spawning mortality and trends in infection levels. Monitoring for bacterial kidney disease in spawners within the John Day basin would provide valuable data for comparisons with BKD levels in systems where hatcheries are used for supplementation. Percent of eggs spawned by females during spawning surveys should also continue to be monitored to determine annual variation. The detection of BKD in one carcass from Granite Creek emphasizes that continued monitoring of the retention of eggs by females and pre-spawning mortality may help explain the declining trend in the spawning population of spring chinook in the Granite Creek System (Appendix Table B-1).

During the spring of 2001, we were able to capture significantly more chinook smolts by seining between Kimberly and Spray than in the previous year when we only captured 1,622 smolts. Contrarily, we captured fewer steelhead smolts than during 2000 (308 vs. 665; Wilson et al. 1999). Increased sampling effort and a decrease in spring flow contributed to our success in capturing chinook smolts. The reduction in overall catch of steelhead smolts was not expected since spawning survey counts were slightly higher in 1999 than in 1998 (Jeff Neal, ODFW. personal communication). The reduction in overall catch of steelhead smolts is likely due to differences in the sampling locations and inter-annual differences in flow conditions. Many of the sampling sites that were used during the spring of 2000 were not available due to the lower than usual spring flow. Due to our limited success in seining steelhead smolts, we recommend that an alternative capture technique be employed in the future. Rotary screw traps have been used successfully in other basins to capture emigrating steelhead smolts and we recommend their use in the John Day River. Rotary screw traps will also provide an efficient means of capturing chinook smolts as well. The diversion trap near Rkm 391 could also be used to increase the number of PIT tagged steelhead smolts. From 17 April to 12 June, we captured 126 actively migrating steelhead smolts. However, a design fault with this trap caused chronic problems with debris plugging the trap screen and allowing fish to escape. Modification of the diversion trap to include a powered debris drum should reduce this debris problem.

Our abundance estimate for chinook smolts emigrating from the John Day River basin was within the range of expected production (70,359 - 168,810 smolts; Lindsay et al. 1986). Mean fork length of chinook smolts caught between Kimberly and Spray in 2001 was also within the range reported by Lindsay et al. (1986). The percentage of chinook smolts detected during the spring of 2001 was slightly higher than during 2000 when 30% were detected at the John Day Dam and 17% were detected at Bonneville Dam facilities (Wilson et al. 2000). In general, mean travel time for chinook smolts captured and released was also longer in 2001 than 2000 (Wilson et al. 2000). The increase in mean travel time may be partially due to low flow in the John Day River during 2001. Increased smolt travel time may also be due to the change in release location among years. The release site for 2000 chinook smolts was approximately two km below Spray, OR (Rkm 273) while the release site for chinook smolts in 2001 was at Kimberly (Rkm 298). We changed release locations to provide a means of measuring our capture efficiency and to provide an abundance estimate of emigrating smolts.

Although tagging in the upper basin during February increased the total number of tagged chinook smolts, there was a significant difference in detection rates of PIT-tagged fish at the John Day Dam among the two capture locations. The difference in detection rates between upper basin and lower basin tagged chinook smolts suggests a difference in survival rate. In the future we will therefore only use smolts that were actively migrating out of the system to determine our smolt-to-adult survival rate estimate.

As part of the John Day spring chinook-monitoring program, we will continue to conduct pre-index, index, post-index, extensive and exploratory spawning surveys in the four main spawning areas of the John Day basin. We will also continue to monitor spring chinook spawning in the South Fork John Day River and Desolation, and Camas Creeks (tributaries of the North Fork John Day River). After the 2001 spawning season (fourth year of the project), we will use spawning data to evaluate the adequacy of historical index surveys from a multi-year perspective. We also recommend that the monitoring program be expanded to confirm the presence of fall chinook in the lower Mainstem John Day River. During November 2000, redds were observed and fishermen reported catching fall chinook salmon below Cottonwood Bridge (Todd R. Hoodenpyl, Oregon State Police, personnel communication). Fall chinook redd counts could be conducted using aerial surveys but composition of the spawner population necessitates the observing of live fish and sampling of carcasses.

## REFERENCES


Banner, C.R., J.S. Rohovec, and J.L. Fryer. 1982. A rapid method for labeling rabbit immunoglobulin with fluorescein for use in detection of fish pathogens. Bulletin of the European Association of Fish Pathologists 2:35-37.

Bullock, G. L. and R. L. Herman. 1988. Bacterial kidney disease of salmonid fishes caused by Renibacterium salmoninarum. U.S. Fish and Wildlife Service, Research and Development (http://www.aquatext.com/imges/diseases/bkd.htm).

Columbia Basin Fish and Wildlife Authority PIT Tag Steering Committee. 1999. PIT tag marking procedures manual, Version 2.0. PIT Tag Operations Center. Portland, OR.

Jonasson, C. B., V. D. Albaladejo and R. C. Carmichael. 1998. Fish research project Oregon. John Day basin spring chinook salmon escapement and productivity monitoring annual progress report (Contract BI11646, Project 98-016-00). Portland. OR.

Lindsay, R. B., W. J. Knox, M.W. Flesher, B. J. Smith, E. A. Olsen, and L. S. Lutz. 1986. Study of wild spring chinook salmon in the John Day River system. Final Report of Oregon Department of Fish and Wildlife to Bonneville Power Administration (Contract DE-A179-83BP39796), Portland, OR.

Maptech Inc. 1998. Maptech Terrain Navigator. Maptech Inc., Greenland, NH, 03840.

Marmorek, D. R., and C. Peters (ed.) and 24 co-authors. 1996. PATH - Plan for Analyzing and Testing Hypotheses; conclusions of the FY96 retrospective analyses. Compiled and edited by ESSA Technologies, Ltd., Vancouver, B.C.

Nicholas, J. W., and L. Van Dyke. 1982. Straying of adult coho salmon to and from a private hatchery at Yaquina Bay, Oregon. Oregon Department of Fish and Wildlife, Information Report (Fish) 82-10, Portland, OR.

NPPC (Northwest Power Planning Council). 1994. 1994 Columbia River Basin fish and wildlife program. Portland, OR.

Oregon Department of Fish and Wildlife, Confederated Tribes of the Umatilla Indian Reservation, and Confederated Tribes of the Warm Springs Reservation of Oregon. 1990. John Day River Subbasin, salmon and steelhead production plan.

Pascho, R. J. and D. Mulcahy. 1987. Enzyme linked imunosorbant assay for a soluble antigen of *Renibacterium salmoninarum*, the causative agent of salmonid bacterial kidney disease. Canadian Journal of Fisheries and Aquatic Sciences 44:183-191.

PTAGIS, 1999. The Columbia Basin PIT Tag Information System. PIT Tag Operations Center. Pacific States Marine Fisheries Commission.

Schaller, H. A., C. E. Petrosky, and O.P. Langess. 1999. Contrasting patterns of productivity and survival rates for stream-type chinook salmon (*Oncorhynchus tshawytscha*) populations of the Snake and Columbia rivers. Canadian Journal of Fisheries and Aquatic Sciences 56:1031-1045.

SPSS Inc. 1997. SigmaStat 2.0 for Windows. SPSS Inc., Chicago, IL.

Stoskopf, M.K. 1993. Fish Medicine. W.B. Saunders Company, Philadelphia.

Wilson, W. H., J. R. Ruzycki, B. C. Jonasson, R. C. Carmichael. 1999. Fish research project Oregon. John Day River basin spring chinook salmon escapement and productivity monitoring annual progress report (Contract 98BI11646, Project 98-016-00). Portland, OR.

# APPENDIX A

## Survey Data

Appendix Table A-1. Spring Chinook salmon spawning ground survey data from the John Day River basin, 2000.

| Stream, section | Survey type | Date | Miles | New redds |  | On dig |  | Off dig |  | Dead fish, unmarked |  |  |  | Dead fish, marked |  |  |  | Dead Fish | Live Fish | Unmarked Dead | Marked Dead |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
|  |  |  |  | Occupied | Unoccupied | A | J | A | J | M | F | J | U | M | F | J | U |  |  |  |  |
| **Mainstem John Day River Sub-basin** |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| **John Day River, Mainstem** |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Dad's Creek to 1 mile above Dan's Creek | Pre-index | 6-Sep | 1 | 7 | 0 | 7 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 9 | 0 | 0 |
| Top of braid to French Lane | Pre-index | 6-Sep | 0.2 | 8 | 2 | 11 | 1 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 1 | 13 | 1 | 0 |
| French Lane to Deardorff Creek | Pre-index | 6-Sep | 2.3 | 33 | 24 | 50 | 1 | 7 | 2 | 2 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 4 | 60 | 4 | 0 |
| Deardorff Creek to 62 Road culvert | Pre-index | 6-Sep | 4.1 | 49 | 31 | 78 | 3 | 4 | 0 | 7 | 14 | 1 | 0 | 0 | 0 | 0 | 0 | 22 | 85 | 22 | 0 |
| Indian Creek to Prairie City | Exploratory | 11-Sep | 5.3 | 2 | 6 | 4 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 5 | 1 | 0 |
| Prairie City to Dad's Creek | Extensive | 11-Sep | 2.2 | 3 | 0 | 2 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 4 | 0 | 0 |
| Dad's Creek to Dan's Creek | Index | 11-Sep | 2.3 | 13 | 5 | 15 | 0 | 4 | 0 | 3 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 5 | 19 | 5 | 0 |
| Dan's Creek to French Lane | Index | 11-Sep | 3.1 | 72 | 75 | 90 | 3 | 13 | 1 | 13 | 11 | 4 | 0 | 0 | 0 | 0 | 0 | 28 | 107 | 28 | 0 |
| French Lane to Deardorff Creek | Index | 11-Sep | 2.3 | 4 | 3 | 31 | 1 | 9 | 2 | 2 | 4 | 0 | 0 | 0 | 0 | 0 | 0 | 6 | 43 | 6 | 0 |
| Deardorff Creek to 62 Road culvert | Index | 11-Sep | 4.1 | 6 | 5 | 29 | 0 | 2 | 0 | 0 | 14 | 0 | 0 | 0 | 1 | 0 | 0 | 15 | 31 | 14 | 1 |
| 62 Road culvert to Trout Farm | Exploratory | 11-Sep | 3.2 | 0 | 4 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 |
| Prairie City to Dad's Creek | Extensive 2 | 18-Sep | 2.2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 0 |
| Dad's Creek to 1 mile above Dan's Creek | Post-index | 18-Sep | 1 | 0 | 0 | 4 | 0 | 1 | 0 | 3 | 4 | 0 | 0 | 0 | 0 | 0 | 0 | 7 | 5 | 7 | 0 |
| Dan's Creek to French Lane | Post-index | 18-Sep | 3.1 | 0 | 20 | 6 | 0 | 1 | 1 | 15 | 17 | 3 | 6 | 0 | 0 | 0 | 0 | 41 | 8 | 41 | 0 |
| French Lane to Deardorff Creek | Post-index | 18-Sep | 2.3 | 0 | 0 | 4 | 0 | 1 | 0 | 1 | 2 | 0 | 3 | 0 | 0 | 0 | 0 | 6 | 5 | 6 | 0 |
| Deardorff Creek to 62 Road culvert | Post-index | 18-Sep | 4.1 | 0 | 8 | 3 | 0 | 0 | 0 | 0 | 3 | 0 | 1 | 0 | 0 | 0 | 0 | 4 | 3 | 4 | 0 |
| **Mainstem Total** |  |  |  | 197 | 183 | 334 | 9 | 49 | 6 | 47 | 73 | 8 | 12 | 0 | 1 | 0 | 0 | 141 | 398 | 140 | 1 |
| **Reynolds Creek** |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Reynolds Creek Trailhead to Axe Gulch | Exploratory | 11-Sep | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **Deardorff Creek** |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Mouth and upstream one half mile | Exploratory | 11-Sep | 0.5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **Canyon Creek** |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| J-Bar L Ranch to Wickiup Campground | Extensive | 8-Sep | 8.6 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **Mainstem Sub-basin Total** |  |  |  | 197 | 183 | 334 | 9 | 49 | 6 | 47 | 73 | 8 | 12 | 0 | 1 | 0 | 0 | 141 | 398 | 140 | 1 |

Appendix Table A-1. Continued

| Stream, section | Survey type | Date | Miles | New redds | | On dig | | Off dig | | Dead fish, unmarked | | | | Dead fish, marked | | | | Dead Fish | Live Fish | Unmarked Dead | Marked Dead |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Occupied | Unoccupied | A | J | A | J | M | F | J | U | M | F | J | U | | | | |
| **South Fork John Day River Sub-basin** | | | | | | | | | | | | | | | | | | | | | |
| **South Fork John Day River** | | | | | | | | | | | | | | | | | | | | | |
| South Fork Falls to Cougar Gulch | Exploratory | 25-Sep | 3.2 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Cougar Gulch to Rock Pile Ranch Bridge | Exploratory | 25-Sep | 2.8 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Rock Pile Ranch Bridge to Murder's Creek | Exploratory | 25-Sep | 3.4 | 0 | 2 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 |
| Murder's Creek to Black Canyon Ranch | Exploratory | 4-Oct | 1.9 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Izee Road Turnoff to Road 45 Bridge | Exploratory | 4-Oct | 3.8 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **South Fork Total** | | | | 0 | 3 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 |
| **Murderer's Creek** | | | | | | | | | | | | | | | | | | | | | |
| Chickenhouse Gulch and upstream 1.5 miles | Exploratory | 25-Sep | 1.5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **South Fork Sub-basin Total** | | | | 0 | 3 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 |
| **Middle Fork John Day River Sub-basin** | | | | | | | | | | | | | | | | | | | | | |
| **Middle Fork John Day River** | | | | | | | | | | | | | | | | | | | | | |
| Beaver Creek to Windlass Creek | Pre-index | 14-Sep | 3.2 | 73 | 9 | 146 | 0 | 10 | 0 | 13 | 10 | 0 | 0 | 0 | 0 | 0 | 0 | 23 | 156 | 23 | 0 |
| Windlass Creek to Caribou Creek | Pre-index | 14-Sep | 3.7 | 44 | 12 | 51 | 0 | 12 | 0 | 12 | 8 | 0 | 0 | 0 | 0 | 0 | 0 | 20 | 63 | 20 | 0 |
| Caribou Creek to Placer Gulch | Pre-index | 14-Sep | 3.5 | 121 | 32 | 179 | 0 | 34 | 0 | 24 | 23 | 1 | 0 | 0 | 0 | 0 | 0 | 48 | 213 | 48 | 0 |
| Placer Gulch to Hwy 7 | Pre-index | 14-Sep | 2.6 | 42 | 12 | 87 | 0 | 0 | 0 | 1 | 4 | 0 | 0 | 0 | 0 | 0 | 0 | 5 | 87 | 5 | 0 |
| Armstrong Creek to Beaver Creek | Extensive | 20-Sep | 14.6 | 34 | 100 | 31 | 1 | 8 | 0 | 76 | 68 | 3 | 4 | 0 | 2 | 0 | 0 | 153 | 40 | 151 | 2 |
| Beaver Creek to Windlass Creek | Index | 21-Sep | 3.2 | 0 | 10 | 0 | 0 | 1 | 0 | 29 | 29 | 3 | 6 | 0 | 0 | 0 | 0 | 67 | 1 | 67 | 0 |
| Windlass Creek to Caribou Creek | Index | 21-Sep | 3.7 | 0 | 1 | 0 | 0 | 0 | 0 | 10 | 19 | 0 | 1 | 0 | 1 | 0 | 0 | 31 | 0 | 30 | 1 |
| Caribou Creek to Placer Gulch | Index | 21-Sep | 3.5 | 0 | 0 | 5 | 0 | 1 | 0 | 79 | 90 | 0 | 9 | 1 | 0 | 0 | 0 | 179 | 6 | 178 | 1 |
| Placer Gulch to Hwy 7 | Index | 21-Sep | 2.6 | 0 | 0 | 9 | 0 | 0 | 0 | 27 | 16 | 0 | 0 | 1 | 0 | 0 | 0 | 17 | 9 | 16 | 1 |
| Hwy 7 to Phipps Meadows | Extensive | 20-Sep | 4.4 | 8 | 31 | 8 | 0 | 3 | 0 | 43 | 25 | 0 | 2 | 0 | 1 | 0 | 0 | 71 | 11 | 70 | 1 |
| Beaver Creek to Windlass Creek | Post-index | 28-Sep | 3.2 | 0 | 0 | 0 | 0 | 0 | 0 | 4 | 4 | 0 | 1 | 0 | 0 | 0 | 0 | 9 | 0 | 9 | 0 |
| Windlass Creek to Caribou Creek | Post-index | 28-Sep | 3.7 | 0 | 2 | 0 | 0 | 0 | 0 | 4 | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 9 | 0 | 9 | 0 |
| Caribou Creek to Placer Gulch | Post-index | 28-Sep | 3.5 | 0 | 9 | 0 | 0 | 0 | 0 | 2 | 7 | 0 | 1 | 0 | 0 | 0 | 0 | 10 | 0 | 10 | 0 |
| Placer Gulch to Hwy 7 | Post-index | 28-Sep | 2.6 | 0 | 0 | 2 | 0 | 1 | 0 | 1 | 6 | 0 | 0 | 0 | 0 | 0 | 0 | 7 | 3 | 7 | 0 |
| **Middle Fork Total** | | | | 322 | 218 | 518 | 1 | 70 | 0 | 325 | 314 | 7 | 24 | 2 | 4 | 0 | 0 | 649 | 589 | 643 | 6 |
| **Clear Creek, Tributary of the Middle Fork John Day River** | | | | | | | | | | | | | | | | | | | | | |
| Mouth to Hwy 26 Bridge | Extensive | 20-Sep | 1.3 | 1 | 9 | 1 | 0 | 0 | 0 | 3 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 5 | 1 | 5 | 0 |
| Highway 26 upstream 5.7 miles | Exploratory | 6-Sep | 5.7 | 3 | 9 | 4 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 4 | 0 | 0 |
| Highway 26 upstream 1.7 miles | Exploratory | 19-Sep | 1.7 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 0 |
| **Clear Creek Total** | | | 5.7 | 5.0 | 18 | 6 | 0 | 0 | 0 | 3 | 1 | 0 | 2 | 0 | 0 | 0 | | 6 | 6 | 6 | 0 |
| **Middle Fork Sub-basin Total** | | | 58.7 | 327.0 | 236 | 524 | 1 | 70 | 0 | 328 | 315 | 7 | 26 | 2 | 4 | 0 | 0 | 655 | 595 | 649 | 6 |

Appendix A-1. Continued

| Stream, section | Survey type | Date | Miles | New redds Occupied | New redds Unoccupied | On dig A | On dig J | Off dig A | Off dig J | Dead fish, unmarked M | Dead fish, unmarked F | Dead fish, unmarked J | Dead fish, unmarked U | Dead fish, marked M | Dead fish, marked F | Dead fish, marked J | Dead fish, marked U | Dead Fish | Live Fish | Unmarked Dead | Marked Dead |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **North Fork John Day River** | | | | | | | | | | | | | | | | | | | | | |
| Granite Creek to Silver Creek | Pre-index | 13-Sep | 2.0 | 18 | 18 | 19 | 0 | 3 | 0 | 2 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 4 | 22 | 4 | 0 |
| Silver Creek to Dixon Bar | Pre-index | 13-Sep | 1.7 | 28 | 26 | 35 | 0 | 11 | 1 | 2 | 7 | 0 | 0 | 0 | 0 | 0 | 0 | 9 | 47 | 9 | 0 |
| Dixon Bar to Ryder Creek | Pre-index | 14-Sep | 2.5 | 37 | 54 | 47 | 0 | 4 | 0 | 4 | 6 | 0 | 2 | 0 | 0 | 0 | 0 | 12 | 51 | 12 | 0 |
| Ryder Creek to Cougar Creek | Pre-index | 14-Sep | 2.1 | 20 | 15 | 27 | 0 | 1 | 0 | 11 | 7 | 1 | 2 | 0 | 0 | 0 | 0 | 21 | 28 | 21 | 0 |
| Big Creek to Oriental Creek | Pre-index | 15-Sep | 3.4 | 31 | 65 | 36 | 0 | 9 | 0 | 22 | 31 | 1 | 8 | 0 | 0 | 0 | 0 | 62 | 45 | 62 | 0 |
| Oriental Creek to Sulphur Creek | Pre-index | 15-Sep | 2.0 | 24 | 37 | 24 | 0 | 4 | 1 | 33 | 37 | 2 | 2 | 0 | 0 | 0 | 0 | 74 | 29 | 74 | 0 |
| Sulphur Creek to Nye Creek | Pre-index | 15-Sep | 4.0 | 48 | 47 | 61 | 1 | 7 | 0 | 60 | 45 | 4 | 0 | 0 | 0 | 0 | 0 | 109 | 69 | 109 | 0 |
| Cunningham Creek to Baldy Creek | Exploratory | 22-Sep | 3.1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Baldy Creek to North Fork Campground | Extensive | 22-Sep | 5.2 | 0 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| North Fork Campground to Granite Creek | Extensive | 18-19 Sep | 13.8 | 1 | 45 | 1 | 0 | 0 | 0 | 6 | 11 | 1 | 2 | 0 | 0 | 0 | 0 | 20 | 1 | 20 | 0 |
| Granite Creek to Silver Creek | Index | 20-Sep | 2.0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 2 | 0 | 2 | 0 | 0 | 0 | 0 | 5 | 0 | 5 | 0 |
| Silver Creek to Dixon Bar | Index | 20-Sep | 1.7 | 0 | 4 | 0 | 0 | 0 | 0 | 3 | 6 | 0 | 0 | 0 | 0 | 0 | 0 | 9 | 0 | 9 | 0 |
| Dixon Bar to Ryder Creek | Index | 20-Sep | 2.5 | 0 | 0 | 0 | 0 | 2 | 0 | 5 | 5 | 0 | 3 | 0 | 0 | 0 | 0 | 13 | 2 | 13 | 0 |
| Ryder Creek to Cougar Creek | Index | 21-Sep | 2.1 | 0 | 4 | 0 | 0 | 0 | 0 | 3 | 10 | 0 | 1 | 0 | 0 | 0 | 0 | 14 | 0 | 14 | 0 |
| Cougar Creek to Big Creek | Extensive | 21-Sep | 2.4 | 0 | 15 | 0 | 0 | 0 | 0 | 4 | 2 | 0 | 1 | 0 | 0 | 0 | 0 | 7 | 0 | 7 | 0 |
| Big Creek to Oriental Creek | Index | 20-Sep | 3.4 | 0 | 0 | 2 | 0 | 0 | 0 | 14 | 30 | 0 | 2 | 0 | 0 | 0 | 0 | 46 | 2 | 46 | 0 |
| Oriental Creek to Sulphur Creek | Index | 20-Sep | 2.0 | 0 | 0 | 2 | 0 | 0 | 0 | 10 | 16 | 0 | 0 | 0 | 0 | 0 | 0 | 26 | 2 | 26 | 0 |
| Sulphur Creek to Nye Creek | Index | 20-Sep | 4.0 | 0 | 1 | 5 | 0 | 0 | 0 | 22 | 26 | 0 | 3 | 2 | 0 | 0 | 0 | 53 | 5 | 51 | 2 |
| Nye Creek to Desolation Creek | Extensive | 20-Sep | 6.8 | 18 | 33 | 5 | 0 | 3 | 0 | 57 | 17 | 2 | 9 | 1 | 1 | 0 | 0 | 87 | 8 | 85 | 2 |
| Desolation Creek to Camas Creek | Exploratory | 3-Oct | 3.5 | 0 | 8 | 0 | 0 | 0 | 0 | 3 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 5 | 0 | 5 | 0 |
| Granite Creek to Silver Creek | Post-index | 26-Sep | 2.0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 2 | 0 | 2 | 0 |
| Silver Creek to Dixon Bar | Post-index | 26-Sep | 1.7 | 0 | 6 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Dixon Bar to Ryder Creek | Post-index | 27-Sep | 2.5 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 4 | 0 | 4 | 0 |
| Ryder Creek to Cougar Creek | Post-index | 28-Sep | 2.1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 0 |
| Big Creek to Oriental Creek | Post-index | 28-Sep | 3.4 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 3 | 0 | 1 | 0 | 0 | 0 | 0 | 6 | 0 | 6 | 0 |
| Oriental Creek to Sulphur Creek | Post-index | 28-Sep | 2.0 | 0 | 0 | 1 | 1 | 0 | 0 | 4 | 6 | 0 | 0 | 0 | 0 | 0 | 0 | 10 | 2 | 10 | 0 |
| Sulphur Creek to Nye Creek | Post-index | 29-Sep | 4.0 | 0 | 1 | 0 | 0 | 0 | 0 | 7 | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 12 | 0 | 12 | 0 |
| **North Fork Total** | | | | 225 | 384 | 265 | 2 | 44 | 2 | 276 | 279 | 11 | 41 | 3 | 1 | 0 | 0 | 611 | 313 | 607 | 4 |

Appendix Table A-1. Continued

| Stream, section | Survey type | Date | Miles | New redds | | On dig | | Off dig | | Dead fish, unmarked | | | | Dead fish, marked | | | | Dead Fish | Live Fish | Unmarked Dead | Marked Dead |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Occupied | Unoccupied | A | J | A | J | M | F | J | U | M | F | J | U | | | | |
| **Granite Creek System** | | | | | | | | | | | | | | | | | | | | | |
| **Granite Creek** | | | | | | | | | | | | | | | | | | | | | |
| 73 Rd. Crossing to 1 mile above Clear Creek | Pre-index | 5-Sep | 1.5 | 16 | 6 | 21 | 0 | 8 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 29 | 0 | 0 |
| 1 mile above Clear Creek to Tencent Creek | Pre-index | 5-Sep | 1.9 | 42 | 6 | 79 | 1 | 31 | 2 | 2 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 4 | 113 | 4 | 0 |
| Tencent Creek to Buck Creek | Pre-index | 5-Sep | 2.5 | 33 | 21 | 48 | 2 | 44 | 3 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 97 | 2 | 0 |
| 73 Rd. Crossing to 1 mile above Clear Creek | Index | 12-Sep | 1.5 | 0 | 0 | 0 | 0 | 0 | 0 | 6 | 4 | 0 | 0 | 0 | 0 | 0 | 0 | 10 | 0 | 10 | 0 |
| 1 mile above Clear Creek to Tencent Creek | Index | 12-Sep | 1.9 | 8 | 7 | 28 | 0 | 5 | 1 | 12 | 17 | 0 | 0 | 0 | 0 | 0 | 0 | 29 | 34 | 29 | 0 |
| Tencent Creek to Buck Creek | Index | 12-Sep | 2.5 | 7 | 4 | 39 | 34 | 0 | 0 | 18 | 10 | 1 | 0 | 1 | 1 | 0 | 0 | 31 | 73 | 29 | 2 |
| Buck Creek to Indian Creek | Extensive | 12-Sep | 2.8 | 26 | 5 | 29 | 0 | 10 | 0 | 17 | 1 | 1 | 0 | 0 | 1 | 0 | 0 | 20 | 39 | 19 | 1 |
| Indian Creek to Mouth | Extensive | 12-Sep | 2.1 | 7 | 6 | 9 | 0 | 8 | 1 | 9 | 4 | 0 | 1 | 0 | 0 | 0 | 0 | 14 | 18 | 14 | 0 |
| 73 Rd. Crossing to 1 mile above Clear Creek | Post-index | 19-Sep | 1.5 | 0 | 2 | 0 | 0 | 1 | 0 | 3 | 11 | 0 | 0 | 0 | 0 | 0 | 0 | 14 | 1 | 14 | 0 |
| 1 mile above Clear Creek to Tencent Creek | Post-index | 19-Sep | 1.9 | 0 | 0 | 0 | 0 | 0 | 0 | 6 | 19 | 1 | 0 | 0 | 0 | 0 | 0 | 26 | 0 | 26 | 0 |
| Tencent Creek to Buck Creek | Post-index | 19-Sep | 2.5 | 0 | 2 | 1 | 0 | 0 | 0 | 21 | 15 | 2 | 1 | 0 | 0 | 0 | 0 | 39 | 1 | 39 | 0 |
| **Granite Creek Total** | | | | 139 | 59 | 254 | 37 | 107 | 7 | 95 | 84 | 5 | 2 | 1 | 2 | 0 | 0 | 189 | 405 | 186 | 3 |
| **Clear Creek** | | | | | | | | | | | | | | | | | | | | | |
| Mouth to road crossing | Pre-index | 5-Sep | 3.0 | 42 | 21 | 72 | 2 | 13 | 2 | 1 | 2 | 1 | 1 | 0 | 0 | 0 | 0 | 5 | 89 | 5 | 0 |
| Mouth to road crossing | Index | 12-Sep | 3.0 | 7 | 10 | 25 | 0 | 8 | 0 | 13 | 12 | 1 | 0 | 0 | 0 | 1 | 0 | 27 | 33 | 26 | 1 |
| Road Crossing to Beaver Creek | Extensive | 12-Sep | 1.0 | 6 | 10 | 9 | 0 | 1 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 10 | 2 | 0 |
| Mouth to road crossing | Post-index | 19-Sep | 3.0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 10 | 0 | 0 | 0 | 0 | 0 | 0 | 12 | 0 | 12 | 0 |
| **Clear Creek Total** | | | | 55 | 41 | 106 | 2 | 22 | 2 | 16 | 26 | 2 | 1 | 0 | 0 | 1 | 0 | 46 | 132 | 45 | 1 |
| **Bull Run Creek** | | | | | | | | | | | | | | | | | | | | | |
| Mouth to Guard Station | Pre-index | 5-Sep | 3.1 | 3 | 7 | 4 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 5 | 0 | 0 |
| Mouth to Guard Station | Index | 12-Sep | 3.1 | 1 | 0 | 5 | 0 | 0 | 0 | 1 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 5 | 3 | 0 |
| 1/2 mile above GS to Guard Station | Extensive | 12-Sep | 0.5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Mouth to Guard Station | Post-index | 19-Sep | 3.1 | 1 | 0 | 2 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 2 | 2 | 2 | 0 |
| **Bull Run Total** | | | | 5 | 7 | 11 | 0 | 1 | 0 | 1 | 3 | 0 | 1 | 0 | 0 | 0 | 0 | 5 | 12 | 5 | 0 |
| **Granite Creek System Total** | | | | 199 | 107 | 371 | 39 | 130 | 9 | 112 | 113 | 7 | 4 | 1 | 2 | 1 | 0 | 240 | 549 | 236 | 4 |

Appendix Table A-1. Continued.

| Stream, section | Survey type | Date | Miles | New redds | | On dig | | Off dig | | Dead fish, unmarked | | | | Dead fish, marked | | | | Dead Fish | Live Fish | Unmarked Dead | Marked Dead |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Occupied | Unoccupied | A | J | A | J | M | F | J | U | M | F | J | U | | | | |
| **Desolation Creek** | | | | | | | | | | | | | | | | | | | | | |
| South Fork Desolation (Trailhead up 1.5 miles) | Exploratory | 2-Oct | 1.5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| South Fork Desolation (Trailhead to confluence with North Fork Desolation) | Exploratory | 2-Oct | 0.8 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| North Fork Desolation Rd. 45 to Confluence with South Fork Desolation | Exploratory | 2-Oct | 0.6 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Confluence North and South Forks to Howard Cr. | Exploratory | 2-Oct | 2.1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Howard Creek to Battle Creek | Exploratory | 2-Oct | 2.3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Battle Creek to Bruin Creek | Exploratory | 2-Oct | 3.3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Bruin Creek to Rd. 10 Bridge | Exploratory | 2-Oct | 2.3 | 0 | 4 | 0 | 0 | 0 | 0 | 0 | 4 | 0 | 0 | 0 | 0 | 0 | 0 | 4 | 0 | 4 | 0 |
| Rd. 10 Bridge to Peep Creek | Exploratory | 2-Oct | 1.4 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **Desolation Creek Total** | | | | 0 | 5 | 0 | 0 | 0 | 0 | 0 | 4 | 0 | 0 | 0 | 0 | 0 | 0 | 4 | 0 | 4 | 0 |
| **Camas Creek** | | | | | | | | | | | | | | | | | | | | | |
| Lehman Springs Rd. to Rd. 54 Bridge | Exploratory | 1-Sep | 3.3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Rd. 54 Bridge to Forest Service Boundary | Exploratory | 1-Sep | 2.3 | 0 | 0 | 0 | 0 | 4 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 4 | 0 | 0 |
| Ukiah-Dale Park down 3 miles | Exploratory | 1-Sep | 3.0 | 0 | 0 | 0 | 0 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 0 | 0 |
| Cable Creek Forks to 4-T Ranch Property | Exploratory | 1-Sep | 5.0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Cable Creek 4-T Ranch Property | Exploratory | 7-Sep | 1.0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Rd. 54 Bridge to Forest Service Boundary | Exploratory | 3-Oct | 2.3 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 0 | 3 | 0 |
| Ukiah- Dale Park down 3 miles | Exploratory | 3-Oct | 3.0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 3 miles below park to Bridge Creek | Exploratory | 3-Oct | 4.0 | 0 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **Camas Creek Total** | | | | 0 | 3 | 0 | 0 | 7 | 0 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 7 | 3 | 0 |

Appendix Table A-2. Percentage of spring chinook redds counted in individual survey sections in each of the four Main spawning areas within the John Day River basin, 1998 - 2000.

| Stream, section | Survey Type | Miles | Km | 1998 | 1999 | 2000 |
|---|---|---|---|---|---|---|
| **John Day River, Mainstem** | | | | | | |
| Indian Creek to Prairie City | Exploratory | 5.3 | 8.5 | --- | --- | 2.1 |
| Prairie City to Dad's Creek | Extensive | 2.2 | 3.5 | 2.2 | 0.0 | 0.8 |
| Dad's Creek to Dan's Creek | Index | 2.3 | 3.7 | 9.6 | 8.1 | 6.6 |
| Dan's Creek to French Lane | Index | 3.1 | 5.0 | 37.8 | 27.4 | 46.6 |
| French Lane to Deardorff Creek | Index | 2.3 | 3.7 | 25.9 | 27.4 | 16.8 |
| Deardorff Creek to 62 Road culvert | Index | 4.1 | 6.6 | 24.4 | 37.1 | 26.1 |
| 62 Road culvert to Trout Farm | Exploratory | 3.2 | 5.2 | --- | --- | 1.1 |
| ***Mainstem Subbasin Redd Count*** | | | | **135** | **62** | **380** |
| **Middle Fork John Day River** | | | | | | |
| Armstrong Creek to Beaver Creek | Extensive | 14.6 | 23.5 | 0.0 | 10.6 | 23.8 |
| Beaver Creek to Windlass Creek | Index | 3.2 | 5.2 | 19.3 | 12.9 | 16.3 |
| Windlass Creek to Caribou Creek | Index | 3.7 | 5.9 | 18.2 | 13.6 | 10.5 |
| Caribou Creek to Placer Gulch | Index | 3.5 | 5.6 | 34.1 | 36.4 | 28.8 |
| Placer Gulch to Hwy 7 | Index | 2.6 | 4.2 | 23.9 | 17.4 | 9.6 |
| Hwy 7 to Phipps Meadows | Extensive | 4.4 | 7.1 | 4.6 | 9.1 | 6.9 |
| Clear Creek (Mouth to HWY 26 Bridge) | Extensive | 1.3 | 2.1 | 0.0 | 0.0 | 1.8 |
| Clear Creek (Hwy 26 upstream 1.7 miles) | Exploratory | 1.7 | 2.7 | --- | --- | 2.3 |
| ***Middle Fork Subbasin Redd Count*** | | | | **88** | **132** | **563** |

Appendix Table A-2 (continued).

| Stream, section | Survey Type | Miles | Km | 1998 | 1999 | 2000 |
|---|---|---|---|---|---|---|
| **North Fork John Day River** | | | | | | |
| Cunningham Creek to Baldy Creek | Exploratory | 3.1 | 5.0 | --- | --- | 0.2 |
| Baldy Creek to North Fork Campground | Extensive | 5.2 | 8.4 | 0.0 | 1.9 | 0.5 |
| North Fork Campground to Granite Creek | Extensive | 13.8 | 22.2 | 13.4 | 17.3 | 7.6 |
| Granite Creek to Silver Creek | Index | 2.0 | 3.2 | 9.5 | 13.0 | 5.9 |
| Silver Creek to Dixon Bar | Index | 1.7 | 2.7 | 13.4 | 13.0 | 10.5 |
| Dixon Bar to Ryder Creek | Index | 2.5 | 4.0 | 29.1 | 16.7 | 14.9 |
| Ryder Creek to Cougar Creek | Index | 2.1 | 3.4 | 6.3 | 7.4 | 6.6 |
| Cougar Creek to Big Creek | Extensive | 2.4 | 3.9 | 0.0 | 2.5 | 2.5 |
| Big Creek to Oriental Creek | Index | 3.4 | 5.5 | 18.1 | 11.7 | 15.8 |
| Oriental Creek to Sulphur Creek | Index | 2.0 | 3.2 | 5.5 | 3.7 | 10.0 |
| Sulphur Creek to Nye Creek | Index | 4.0 | 6.4 | 3.9 | 10.5 | 15.9 |
| Nye Creek to Desolation Creek | Extensive | 6.8 | 10.9 | 0.8 | 2.5 | 8.4 |
| Desolation Creek to Camas Creek | Exploratory | 3.5 | 5.6 | --- | --- | 1.3 |
| ***North Fork Subbasin Redd Count*** | | | | **127** | **162** | **609** |
| | | | | | | |
| **Granite Creek System** | | | | | | |
| **Granite Creek** | | | | | | |
| 73 Rd. Crossing to 1 mile above Clear Creek | Index | 1.5 | 2.4 | 7.5 | 9.8 | 7.8 |
| 1 mile above Clear Creek to Tencent Creek | Index | 1.9 | 3.1 | 28.8 | 22.1 | 20.6 |
| Tencent Creek to Buck Creek | Index | 2.5 | 4.0 | 26.3 | 26.2 | 21.9 |
| Buck Creek to Indian Creek | Extensive | 2.8 | 4.5 | --- | 9.8 | 10.1 |
| Indian Creek to Mouth | Extensive | 2.1 | 3.4 | 13.8 [a] | 7.4 | 4.2 |
| | | | | | | |
| **Clear Creek** | | | | | | |
| Mouth to road crossing | Index | 3.0 | 4.8 | 20.0 | 13.1 | 26.1 |
| Road Crossing to Beaver Creek | Extensive | 1.0 | 1.6 | 2.5 | 4.9 | 5.2 |
| | | | | | | |
| **Bull Run Creek** | | | | | | |
| Mouth to Guard Station | Index | 3.1 | 5.0 | 1.3 | 6.6 | 3.9 |
| 1/2 mile above GS to Guard Station | Extensive | 0.5 | 0.8 | --- | 0.0 | 0.0 |
| ***Granite Creek System Subbasin Redd Count*** | | | | **80** | **122** | **306** |

[a] In 1998, combined section, Buck Creek to Mouth.

Appendix Table A-3. Spring chinook spawning density expressed as redds per mile or redds per kilometer (km) in individual survey sections in each of the four Main spawning areas within the John Day River basin, 1998 - 2000.

| | | | | 1998 | | 1999 | | 2000 | |
|---|---|---|---|---|---|---|---|---|---|
| Stream, section | Survey Type | Miles | km | Redds/ mile | Redds/ km | Redds/ mile | Redds/ km | Redds/ mile | Redds/ km |
| **John Day River, Mainstem** | | | | | | | | | |
| Indian Creek to Prairie City | Exploratory | 5.3 | 8.5 | --- | -- | --- | -- | 1.5 | 0.9 |
| Prairie City to Dad's Creek | Extensive | 2.2 | 3.5 | 1.4 | 0.9 | 0 | 0 | 1.4 | 0.9 |
| Dad's Creek to Dan's Creek | Index | 2.3 | 3.7 | 5.7 | 3.0 | 2.2 | 1.4 | 10.9 | 6.8 |
| Dan's Creek to French Lane | Index | 3.1 | 5.0 | 16.5 | 10.3 | 5.5 | 3.4 | 57.1 | 35.5 |
| French Lane to Deardorff Creek | Index | 2.3 | 3.7 | 15.2 | 9.4 | 7.4 | 4.6 | 27.8 | 17.3 |
| Deardorff Creek to 62 Road culvert | Index | 4.1 | 6.6 | 8.0 | 4.9 | 5.6 | 3.5 | 24.1 | 14.9 |
| 62 Road culvert to Trout Farm | Exploratory | 3.2 | 5.2 | --- | -- | --- | -- | 1.3 | 0.8 |
| ***Mainstem Subbasin Redd Count*** | | | | **135** | | **62** | | **380** | |
| **Middle Fork John Day River** | | | | | | | | | |
| Armstrong Creek to Beaver Creek | Extensive | 14.6 | 23.5 | 0 | 0 | 1.0 | 0.6 | 9.2 | 5.7 |
| Beaver Creek to Windlass Creek | Index | 3.2 | 5.2 | 5.3 | 3.3 | 5.3 | 3.3 | 28.8 | 17.9 |
| Windlass Creek to Caribou Creek | Index | 3.7 | 5.9 | 4.3 | 2.7 | 4.9 | 3.0 | 15.9 | 9.9 |
| Caribou Creek to Placer Gulch | Index | 3.5 | 5.6 | 8.6 | 5.3 | 13.7 | 8.5 | 46.3 | 28.8 |
| Placer Gulch to Hwy 7 | Index | 2.6 | 4.2 | 8.1 | 5.0 | 8.8 | 5.5 | 20.8 | 12.9 |
| Hwy 7 to Phipps Meadows | Extensive | 4.4 | 7.1 | 0.9 | 0.5 | 2.7 | 1.6 | 8.9 | 5.5 |
| Clear Creek (Mouth to HWY 26 Bridge) | Extensive | 1.3 | 2.1 | 0 | 0 | 0 | 0 | 7.7 | 4.8 |
| Clear Creek (Hwy 26 upstream 1.7 miles) | Exploratory | 1.7 | 2.7 | --- | -- | --- | -- | 7.6 | 4.7 |
| ***Middle Fork Subbasin Redd Count*** | | | | **88** | | **132** | | **563** | |

Appendix Table A-3 (continued).

| Stream, section | Survey Type | Miles | Km | 1998 Redds/ mile | 1998 Redds/ km | 1999 Redds/ mile | 1999 Redds/ km | 2000 Redds /mile | 2000 Redds/ km |
|---|---|---|---|---|---|---|---|---|---|
| **North Fork John Day River** | | | | | | | | | |
| Cunningham Creek to Baldy Creek | Exploratory | 3.1 | 5.0 | --- | --- | --- | --- | 0.3 | 0.2 |
| Baldy Creek to North Fork Campground | Extensive | 5.2 | 8.4 | 0 | 0 | 0.6 | 0.4 | 0.6 | 0.4 |
| North Fork Campground to Granite Creek | Extensive | 13.8 | 22.2 | 1.2 | 0.7 | 2.0 | 1.2 | 3.3 | 2.1 |
| Granite Creek to Silver Creek | Index | 2.0 | 3.2 | 6.0 | 3.7 | 10.5 | 6.5 | 18.0 | 11.2 |
| Silver Creek to Dixon Bar | Index | 1.7 | 2.7 | 10 | 6.2 | 12.4 | 7.7 | 37.6 | 23.4 |
| Dixon Bar to Ryder Creek | Index | 2.5 | 4.0 | 14.8 | 9.2 | 10.8 | 6.7 | 36.4 | 22.6 |
| Ryder Creek to Cougar Creek | Index | 2.1 | 3.4 | 3.8 | 2.4 | 5.7 | 3.5 | 19.0 | 11.8 |
| Cougar Creek to Big Creek | Extensive | 2.4 | 3.9 | 0 | 0 | 1.7 | 1.1 | 6.3 | 3.9 |
| Big Creek to Oriental Creek | Index | 3.4 | 5.5 | 6.8 | 4.2 | 5.6 | 3.4 | 28.2 | 17.5 |
| Oriental Creek to Sulphur Creek | Index | 2 | 3.2 | 3.5 | 2.2 | 3.0 | 1.9 | 30.5 | 18.9 |
| Sulphur Creek to Nye Creek | Index | 4 | 6.4 | 1.3 | 0.8 | 4.3 | 2.7 | 24.3 | 15.0 |
| Nye Creek to Desolation Creek | Extensive | 6.8 | 10.9 | 0.1 | 0.06 | 0.6 | 0.4 | 7.5 | 4.6 |
| Desolation Creek to Camas Creek | Exploratory | 3.5 | 5.6 | --- | --- | --- | --- | 2.3 | 1.4 |
| ***North Fork Subbasin Redd Count*** | | | | ***127*** | | ***162*** | | ***609*** | |
| | | | | | | | | | |
| **Granite Creek System** | | | | | | | | | |
| **Granite Creek** | | | | | | | | | |
| 73 Rd. Crossing to 1 mile above Clear Creek | Index | 1.5 | 2.4 | 4 | 2.5 | 8.0 | 4.9 | 16.0 | 9.9 |
| 1 mile above Clear Creek to Tencent Creek | Index | 1.9 | 3.1 | 12.1 | 7.5 | 14.2 | 8.8 | 33.2 | 20.6 |
| Tencent Creek to Buck Creek | Index | 2.5 | 4.0 | 8.4 | 5.2 | 12.8 | 7.9 | 26.8 | 16.6 |
| Buck Creek to Indian Creek | Extensive | 2.8 | 4.5 | --- | --- | 4.3 | 2.7 | 11.1 | 6.9 |
| Indian Creek to Mouth | Extensive | 2.1 | 3.4 | 5.2[a] | 3.2 | 4.3 | 2.7 | 6.2 | 3.9 |
| **Clear Creek** | | | | | | | | | |
| Mouth to road crossing | Index | 3.0 | 4.8 | 5.3 | 3.3 | 5.3 | 3.3 | 26.7 | 16.6 |
| Road Crossing to Beaver Creek | Extensive | 1.0 | 1.6 | 2.0 | 1.2 | 6.0 | 3.7 | 16.0 | 9.9 |
| **Bull Run Creek** | | | | | | | | | |
| Mouth to Guard Station | Index | 3.1 | 5.0 | 0.3 | 0.2 | 26.0 | 16.1 | 3.9 | 2.4 |
| 1/2 mile above GS to Guard Station | Extensive | 0.5 | 0.8 | --- | --- | 0 | 0 | 0 | 0 |
| ***Granite Creek System Subbasin Redd Count*** | | | | ***80*** | | ***122*** | | ***306*** | |

[a] In 1998, combined section, Buck Creek to Mouth.

# APPENDIX B

## Historic Index Redd Counts

Appendix Table B-1. Index survey area, redd counts for spring chinook salmon in the John Day River basin, for each primary spawning area, 1959-2000.

| Year | Mainstem[a] | Middle Fork[b] | North Fork[c] | Granite Creek[d] | Basin total |
|---|---|---|---|---|---|
| 1959 | 4 | 0 | -- | 50 | 54 |
| 1960 | 9 | 32 | -- | 120 | 161 |
| 1961 | 39 | 11 | -- | 42 | 92 |
| 1962 | 159 | 28 | -- | 447 | 634 |
| 1963 | 10 | 4 | -- | 280 | 294 |
| 1964 | 17 | 36 | 140 | 415 | 608 |
| 1965 | 75 | 37 | 146 | 220 | 478 |
| 1966 | 121 | 65 | 185 | 345 | 716 |
| 1967 | 96 | 17 | 99 | 276 | 488 |
| 1968 | 9 | 4 | 158 | 534 | 705 |
| 1969 | 121 | 48 | 369 | 186 | 724 |
| 1970 | 108 | 76 | 302 | 326 | 812 |
| 1971 | 91 | 41 | 212 | 276 | 620 |
| 1972 | 51 | 51 | 189 | 458 | 749 |
| 1973 | 116 | 43 | 349 | 324 | 832 |
| 1974 | 33 | 81 | 130 | 191 | 435 |
| 1975 | 92 | 89 | 211 | 229 | 621 |
| 1976 | 60 | 66 | 111 | 162 | 399 |
| 1977 | 64 | 58 | 295 | 207 | 624 |
| 1978 | 59 | 107 | 109 | 165 | 440 |
| 1979 | 68 | 118 | 200 | 130 | 516 |
| 1980 | 16 | 58 | 78 | 78 | 230 |
| 1981 | 51 | 26 | 138 | 110 | 325 |
| 1982 | 49 | 62 | 105 | 122 | 338 |
| 1983 | 133 | 51 | 76 | 46 | 306 |
| 1984 | 73 | 67 | 63 | 48 | 251 |
| 1985 | 116 | 40 | 110 | 132 | 398 |
| 1986 | 159 | 76 | 257 | 163 | 655 |
| 1987 | 247 | 340 | 375 | 141 | 1,103 |
| 1988 | 82 | 241 | 245 | 116 | 684 |
| 1989 | 165 | 113 | 196 | 149 | 623 |
| 1990 | 124 | 47 | 257 | 78 | 506 |
| 1991 | 61 | 35 | 115 | 55 | 266 |
| 1992 | 142 | 108 | 339 | 138 | 727 |
| 1993 | 135 | 155 | 379 | 268 | 937 |
| 1994 | 169 | 93 | 201 | 96 | 559 |
| 1995 | 29 | 15 | 27 | 23 | 94 |
| 1996 | 227 | 136 | 291 | 128 | 782 |
| 1997 | 125 | 163 | 197 | 102 | 587 |
| 1998 | 108 | 79 | 109 | 61 | 357 |
| 1999 | 58 | 105 | 120 | 87 | 370 |
| 2000 | 337 | 356 | 477 | 241 | 1,411 |

[a] *Index survey is 11.8 miles (Maptech, 1998).*
[b] *Index survey was 9.5 miles during 1959-85 and 13 miles during 1986-99 (Maptech, 1998).*
[c] *Index survey is 17.7 miles (Maptech, 1998).*
[d] *Index survey is 12 miles. In 1993, 12.5 miles were surveyed (Maptech, 1998).*

Appendix Table B-2. Spring chinook redd (R) densities (redds/mile and redds/kilometer) in index areas of the John Day River basin 1959 - 2000.

| Year | Mainstem [a] | | Middle Fork[b] | | North Fork[c] | | Granite Creek System[d] | | Entire basin | |
|---|---|---|---|---|---|---|---|---|---|---|
| | R/m | R/km | R/m | R/km | R/m | R/km | R/m | R/km | R/m | R/km |
| 1959 | 0.3 | 0.2 | 0 | 0 | -- | -- | 4.2 | 2.6 | 1.1 | 0.7 |
| 1960 | 0.8 | 0.5 | 3.4 | 2.1 | -- | -- | 10.0 | 6.2 | 3.2 | 2.0 |
| 1961 | 3.3 | 2.1 | 1.2 | 0.7 | -- | -- | 3.5 | 2.2 | 1.8 | 1.1 |
| 1962 | 13.5 | 8.4 | 2.9 | 1.8 | -- | -- | 37.3 | 23.2 | 12.4 | 7.7 |
| 1963 | 0.8 | 0.5 | 0.4 | 0.3 | -- | -- | 23.3 | 14.5 | 5.8 | 3.6 |
| 1964 | 1.4 | 0.9 | 3.8 | 2.4 | 7.9 | 4.9 | 34.6 | 21.5 | 11.9 | 7.4 |
| 1965 | 6.4 | 4.0 | 3.9 | 2.4 | 8.2 | 5.1 | 18.3 | 11.4 | 9.4 | 5.8 |
| 1966 | 10.3 | 6.4 | 6.8 | 4.2 | 10.5 | 6.5 | 28.8 | 17.9 | 14.0 | 8.7 |
| 1967 | 8.1 | 5.1 | 1.8 | 1.1 | 5.6 | 3.5 | 23.0 | 14.3 | 9.6 | 5.9 |
| 1968 | 0.8 | 0.5 | 0.4 | 0.3 | 8.9 | 5.5 | 44.5 | 27.7 | 13.8 | 8.6 |
| 1969 | 10.3 | 6.4 | 5.1 | 3.1 | 20.8 | 12.9 | 15.5 | 9.6 | 14.2 | 8.8 |
| 1970 | 9.2 | 5.7 | 8.0 | 5.0 | 17.1 | 10.6 | 27.2 | 16.9 | 15.9 | 9.9 |
| 1971 | 7.7 | 4.8 | 4.3 | 2.7 | 12.0 | 7.4 | 23.0 | 14.3 | 12.2 | 7.6 |
| 1972 | 4.3 | 2.7 | 5.4 | 3.3 | 10.7 | 6.6 | 38.2 | 23.7 | 14.7 | 9.1 |
| 1973 | 9.8 | 6.1 | 4.5 | 2.8 | 19.7 | 12.2 | 27.0 | 16.8 | 16.3 | 10.1 |
| 1974 | 2.8 | 1.7 | 8.5 | 5.3 | 7.3 | 4.6 | 15.9 | 9.9 | 8.5 | 5.3 |
| 1975 | 7.8 | 4.9 | 9.4 | 5.8 | 11.9 | 7.4 | 19.1 | 11.9 | 12.2 | 7.6 |
| 1976 | 5.1 | 3.2 | 6.9 | 4.3 | 6.3 | 3.9 | 13.5 | 8.4 | 7.8 | 4.9 |
| 1977 | 5.4 | 3.4 | 6.1 | 3.8 | 16.7 | 10.4 | 17.3 | 10.7 | 12.2 | 7.6 |
| 1978 | 5.0 | 3.1 | 11.3 | 7.0 | 6.2 | 3.8 | 13.8 | 8.5 | 8.6 | 5.4 |
| 1979 | 5.8 | 3.6 | 12.4 | 7.7 | 11.3 | 7.0 | 10.8 | 6.7 | 10.1 | 6.3 |
| 1980 | 1.4 | 0.8 | 6.1 | 3.8 | 4.4 | 2.7 | 6.5 | 4.0 | 4.5 | 2.8 |
| 1981 | 4.3 | 2.7 | 2.7 | 1.7 | 7.8 | 4.8 | 9.2 | 5.7 | 6.4 | 4.0 |
| 1982 | 4.2 | 2.6 | 6.5 | 4.1 | 5.9 | 3.7 | 10.2 | 6.3 | 6.6 | 4.1 |
| 1983 | 11.3 | 7.0 | 5.4 | 3.3 | 4.3 | 2.7 | 3.8 | 2.4 | 6.0 | 3.7 |
| 1984 | 6.2 | 3.9 | 7.1 | 4.4 | 3.6 | 2.2 | 4.0 | 2.5 | 4.9 | 3.1 |
| 1985 | 9.8 | 6.1 | 4.2 | 2.6 | 6.2 | 3.9 | 11.0 | 6.8 | 7.8 | 4.8 |
| 1986 | 13.5 | 8.4 | 5.8 | 3.6 | 14.5 | 9.0 | 13.6 | 8.4 | 12.0 | 7.5 |
| 1987 | 20.9 | 13.1 | 26.2 | 16.3 | 21.2 | 13.2 | 11.8 | 7.3 | 20.2 | 12.6 |
| 1988 | 6.9 | 4.3 | 18.5 | 11.5 | 13.8 | 8.6 | 9.7 | 6.0 | 12.6 | 7.8 |
| 1989 | 14.0 | 8.7 | 8.7 | 5.4 | 11.1 | 6.9 | 12.4 | 7.7 | 11.4 | 7.1 |
| 1990 | 10.5 | 6.6 | 3.6 | 2.2 | 14.5 | 9.0 | 6.5 | 4.0 | 9.3 | 5.8 |
| 1991 | 5.2 | 3.2 | 2.7 | 1.7 | 6.5 | 4.0 | 4.6 | 2.8 | 4.9 | 3.0 |
| 1992 | 12.0 | 7.5 | 8.3 | 5.2 | 19.2 | 11.9 | 11.5 | 7.2 | 13.3 | 8.3 |
| 1993 | 11.4 | 7.1 | 11.9 | 7.4 | 21.4 | 13.3 | 21.4 | 13.3 | 17.2 | 10.7 |
| 1994 | 14.3 | 8.9 | 7.2 | 4.4 | 11.4 | 7.1 | 8.0 | 5.0 | 10.3 | 6.4 |
| 1995 | 2.5 | 1.5 | 1.2 | 0.7 | 1.5 | 0.9 | 1.9 | 1.2 | 1.7 | 1.1 |
| 1996 | 19.2 | 12.0 | 10.5 | 6.5 | 16.4 | 10.2 | 10.7 | 6.6 | 14.3 | 8.9 |
| 1997 | 10.6 | 6.6 | 12.5 | 7.8 | 11.1 | 6.9 | 8.5 | 5.3 | 10.8 | 6.7 |
| 1998 | 9.2 | 5.7 | 6.1 | 3.8 | 6.2 | 3.8 | 5.1 | 3.2 | 6.6 | 4.1 |
| 1999 | 4.9 | 3.1 | 8.1 | 5.0 | 6.8 | 4.2 | 7.3 | 4.5 | 6.8 | 4.2 |
| 2000 | 28.6 | 17.8 | 27.4 | 17.0 | 26.9 | 16.7 | 20.1 | 12.5 | 25.9 | 16.1 |

[a] *Index survey is 11.8 miles.*
[b] *Index survey was 9.5 miles during 1959-85 and 13 miles during 1986-99.*
[c] *Index survey is 17.7 miles.*
[d] *Index survey is 12 miles. In 1993, 12.5 miles were surveyed.*

# APPENDIX C.

Mainstem Seining Sites

Appendix Table C-1. Sample site name, location, percent of overall smolt captures, number of seines pulled at each site, and catch-per-unit effort (CPUE; # smolts/seine haul) during our 2001 seining effort on the Mainstem John Day River between Kimberly and Spray, OR.

| Site Name | Latitude and Longitude | Percent of total catch | | Number of seines | CPUE Chinook | CPUE Steelhead |
|---|---|---|---|---|---|---|
| | | Chinook | Steelhead | | | |
| 10 Dollar Hole | N 44° 47'45.7" W 119° 41' 37.6" | 0.7 | 0.0 | 3 | 8.7 | 0 |
| Bass Hole | N 44° 49' 07.4" W 119° 45' 21.3" | 11.9 | 4.3 | 57 | 7.3 | 0.20 |
| Bologna Hole | N 44° 46' 41.1" W 119° 40' 56.3" | 5.4 | 0.4 | 26 | 7.2 | 0.04 |
| Bullhead Hole | N 44° 49' 24.3" W 119° 44' 12.9" | 0.6 | 2.2 | 20 | 1.0 | 0.30 |
| Bull Trout Hole | N 44° 50' 19.3" W 119° 48' 10.2" | 0.3 | 3.2 | 7 | 1.7 | 1.30 |
| Chukar Hole | N 44° 48' 34.3" W 119° 44' 11.4" | 6.3 | 4.7 | 75 | 2.9 | 0.17 |
| Dam Hole | N 44° 48' 21.7" W 119° 43' 57.7" | 4.6 | 0.0 | 21 | 7.6 | 0 |
| Dead Fish Hole | N 44° 48' 26.9" W 119° 43' 28.4" | 4.9 | 0.4 | 37 | 4.6 | 0.03 |
| Ditch Hole | N 44° 49' 05.6" W 119° 44' 02.7" | 4.9 | 0.7 | 10 | 17.0 | 0.20 |
| House Hole | N 44° 48' 53.1" W 119° 47' 18.0" | 3.7 | 17.3 | 72 | 1.8 | 0.70 |
| J Hole | N 44° 49' 32.1" W 119° 44' 34.5" | 1.2 | 0.4 | 9 | 4.7 | 0.11 |
| Log Hole | N 44° 49' 11.6" W 119° 46' 58.4" | 15.4 | 33.6 | 192 | 2.8 | 0.48 |
| Ordway Hole | N 44° 49' 01.9" W 119° 45' 58.5" | 21.4 | 12.6 | 63 | 11.7 | 0.56 |
| Raven Hole | N 44° 48' 59.1" W 119° 46' 23.7" | 3.7 | 1.4 | 47 | 2.7 | 0.08 |
| Spray Boat Ramp | N 44° 49' 34.9" W 119° 47' 34.9" | 14.0 | 16.6 | 128 | 3.8 | 0.36 |
| Steelhead Hole | N 44° 47' 43.2" W 119° 42' 06.5" | 0.2 | 0.7 | 9 | 0.9 | 0.22 |
| Other Sites | NA | 0.6 | 1.4 | 36 | 0.6 | 0.10 |