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Fall Chinook Redd Monitoring Report Calendar Year 2011



Prepared for the U.S. Department of Energy
Assistant Secretary for Environmental Management

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P.O. Box 650
Richland, Washington 99352

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Prepared by
P Wagner, C Lindsey, and J Nugent

Prepared for the U.S. Department of Energy
Assistant Secretary for Environmental Management



P.O. Box 650
Richland, Washington 99352

APPROVED
By J. D. Aardal at 8:58 am, Apr 19, 2012

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Date

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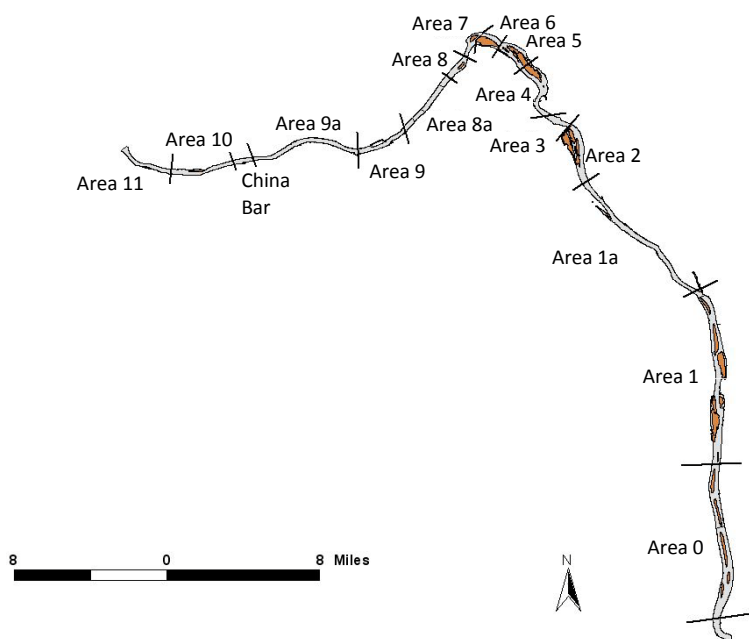
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1.0 INTRODUCTION

Chinook salmon (*Oncorhynchus tshawytscha*), also commonly referred to as king salmon, are the largest of the Pacific salmon (NMFS 1998, Netboy 1958). The Columbia River supports three major runs (spring, summer, and fall) of Chinook salmon generally based upon the season during which the adults re-enter the estuary to begin their upstream migration to spawn. Chinook salmon that spawn in the Hanford Reach of the Columbia River are fall-run fish. Fall-run Chinook salmon enter freshwater at an advanced stage of maturity, move rapidly to their spawning areas on the main stem or lower tributaries of the rivers, and spawn within a few days or weeks of freshwater entry (NMFS 1998, USFWS 1968, Healey 1991). Adult fall Chinook salmon destined for the Hanford Reach are upriver brights (URB), which enter the Columbia River in late summer and spawn in the fall. Spawning in the Hanford Reach typically begins in mid-October and lasts through November. From 1948 through 1988, the first-observation of spawning ranged from September 28 to October 26 with a median date of October 16 (PNL-7289). Females fan out nests or 'redds' in suitable gravel substrate and deposit eggs in an egg pocket while males simultaneously extrude milt to fertilize the eggs. Redds are readily identifiable at this time and appear as clean swept gravel patches amidst darker undisturbed substrate that is covered by algae (periphyton). 'Redd life' is a term applied to mean the period of time during which periphyton growth has not rendered the redd substrate indiscernible from the surroundings. Redd life is typically about six weeks on the Hanford Reach (PNL-7289).

Aerial counts of Chinook salmon redds have been conducted since 1948 at Hanford to provide an index of relative abundance among spawning areas and years. In addition, the counts are used to document the onset of spawning, to locate spawning areas, and to determine intervals of peak spawning activity. The survey area has historically been divided into 11 sections (Figure 1), with the number of redds being totaled by section.

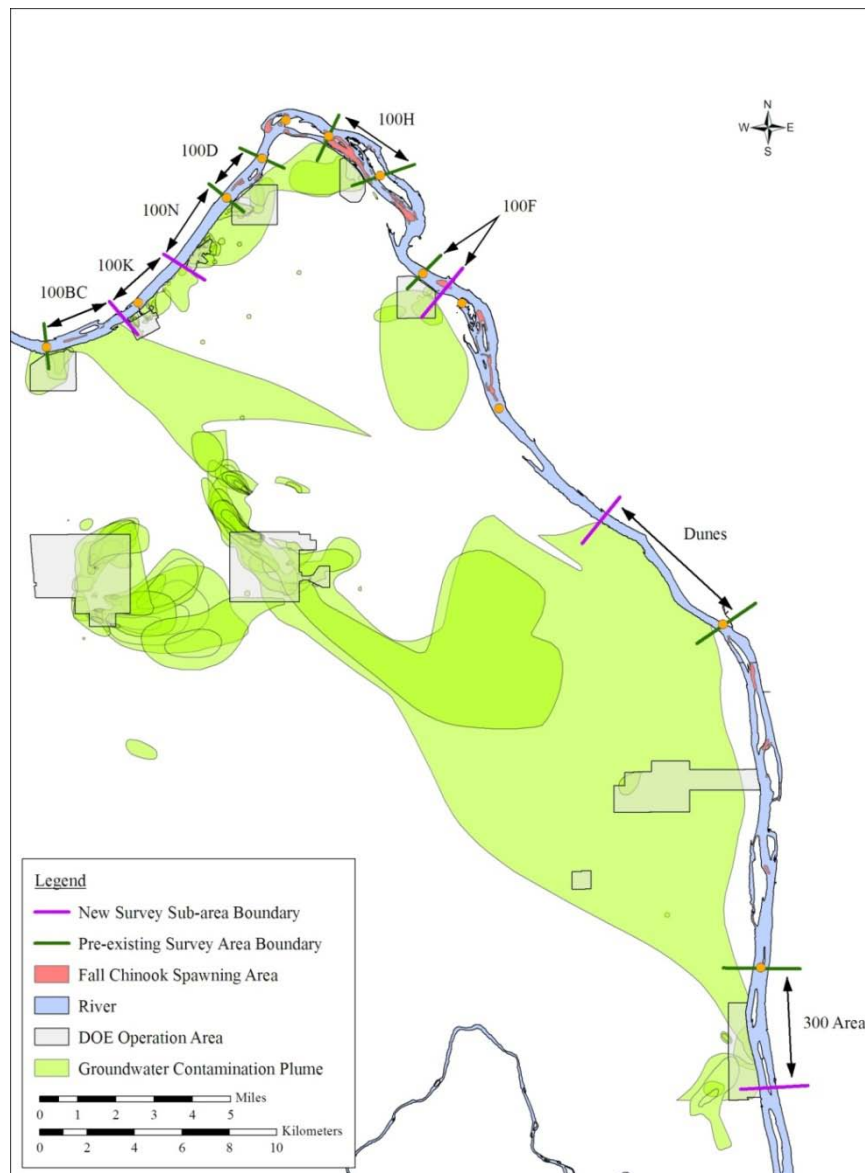
Figure 1. Aerial Survey Areas for Fall Chinook Redds (Historically and in 2011)



2.0 METHODS

Aerial surveys of fall Chinook redds were conducted in eleven areas of the Hanford Reach (Figure 1) consistent with past survey efforts and the historical database. Eight additional sub-sections (100B/C, 100K, 100N, 100D, 100H, 100F, Dunes, and 300 Areas) were added to monitor better the abundance and distribution of fall Chinook redds in areas of potential upwelling of contaminated groundwater (Figure 2). These eight new sub-sections were added to the Department of Energy (DOE) Public Safety and Resource Protection Program’s (PSRP) Aquatic Community database. This change to the historical monitoring technique provides additional spatial resolution to the survey information, but the sum of redd counts in the original areas and the sub-areas they contain allows collected data to be directly comparable to historical records.

Figure 2. Survey Sub-Areas Where Groundwater Upwelling’s may Contain Contamination from the Hanford Site (2011)



The primary physical factors influencing the accuracy of aerial counts include the clarity and depth of water over the redds. Wind action, available light, orientation of the river, and direction of the current can also affect redd counts. Field measurements suggest that the upper depth limit for detecting redds during aerial surveys conducted in 1988 was 3-4 m (PNL-7289). Other studies indicate that fall Chinook salmon spawn in water up to 8 meters deep. Therefore, a proportion of redds located in deeper water may not be detected during aerial surveys (PNL-7289). Because it is seldom possible to view all redds from the air, these counts provide an annual index of relative abundance and distribution of fall Chinook spawning in the Hanford Reach of the Columbia River.

Beginning in mid-October, under the terms of the Hanford Reach Fall Chinook Protection Program Agreement, river flows are reduced every Sunday morning (day of lowest power demand) to the Priest Rapids Dam minimum operating discharge of 36,000 cubic feet per second (cfs). This allows the Agency and Utility Party Monitoring Team to manually survey for redd distribution. These drawdowns occur every Sunday morning until the initiation of fall Chinook spawning has been set both above and below the 50,000 cfs flow elevations. A final drawdown is conducted on the Sunday prior to Thanksgiving to establish the minimum critical flow needed to protect pre-emergent fall Chinook. Given the previously described limitations, this weekly reduction in river flow affords the best viewing conditions for aerial flights. Therefore, aerial flights are scheduled to be conducted concurrent with the Sunday morning drawdowns.

Flights are scheduled from mid-October (initiation of spawning) through the third week of November (end of spawning) to encompass the entire fall Chinook spawning period. As indicated above, flights are scheduled on Sundays to maximize low flow viewing conditions. Four to six flights are typically conducted during this period. Early flights (October) are conducted to establish the initiation of spawning. Later flights (November) are conducted during and just after the peak spawning period to establish the maximum redd count for the season by area and for the entire Reach. Multiple flights are necessary to minimize the effect of poor visibility or other sources of count variability, which may occur during a single flight. Multiple flights also ensure comparability within the long-term database through consistency with past efforts. As a courtesy, consistent with past practices, aerial flight redd count information is shared with the Hanford Reach Fall Chinook Protection Program parties to assist in the implementation of protective measures.

Survey flight altitudes range from approximately 244 to 366 meters (800 to 1200 feet) with air speeds of 120 to 161 kilometers (75 to 100 miles per hour). Widely spaced fall Chinook redds are individually counted while tightly grouped clusters of redds are estimated in groups of 10 or 50. Areas of heavy spawning require multiple aerial passes in order to collect complete counts. Flights are cancelled if weather conditions are adverse (i.e., wind, fog, or low clouds). Observations begin near Richland at Nelson Island and end at Priest Rapids Dam. Flights are conducted near noon with the intent to bracket the highest angle of the sun for optimum viewing conditions. Observers wear polarized glasses as necessary to reduce glare. All redds observed are documented by survey area on large format printed maps.

3.0 RESULTS

Four aerial surveys were completed along the length of the Hanford Reach during the 2011 survey, which is consistent with historical levels of effort. The first survey was performed on October 16, the second on October 23, the third on November 5 and the final survey was completed on November 20. Two additional surveys were attempted on October 30 and November 13 but were

suspended due to poor weather conditions. Table 1 describes the counts performed by survey area for each flight. The maximum count describes the highest number of redds documented in a survey area within a single flight. The total number of redds is comprised of the maximum count from each survey area and totaled 8,915 for the 2011 survey. Table 2 shows the number of redds occurring within the newly defined sub-areas, coinciding with areas of potential upwelling of contaminated groundwater.

**Table 1. Summary of Fall Chinook Salmon Redd Counts for Aerial Surveys
Hanford Reach, Columbia River (2011)**

Area	Description	10/16/2011	10/23/2011	11/5/2011	11/20/2011	Maximum Count
0	Islands 17-21 (Richland)	0	3	2	2	3
1	Islands 11-16	0	2	568	673	673
2	Islands 8-10	0	6	796	814	814
3	Island 7	0	0	670	630	670
4	Island 6 (lower half)	4	7	1,105	1,181	1,181
5	Islands 4, 5 and upper 6	0	7	1,524	1,221	1,524
6	Island 3	0	3	520	525	525
7	Island 2	0	13	653	576	653
8	Island 1	0	2	202	295	295
9	Coyote Rapids	0	1	44	22	44
	Midway (China Bar)	0	0	40	67	67
10	Vernita Bar	5	23	2,410	2,463	2,463
11	Near Priest Rapids Dam	0	0	0	3	3
	TOTAL	9	67	8,534	8,472	8,915

**Table 2. Summary of Fall Chinook Aerial Redd Counts by Potential
Contaminated Groundwater Upwelling Sub-Sections (2011)**

Sub-Area	10/16/2011	10/23/2011	11/5/2011	11/20/2011	Maximum Count
300 Area	0	0	0	0	0
Dunes	0	0	0	0	0
100F	0	0	670	630	670
100H	0	7	1,524	1,221	1,524
100D	0	2	202	295	295
100N	0	0	0	0	0
100K	0	0	0	0	0
100BC	0	1	44	22	44
TOTAL	0	10	2,440	2,168	2,533

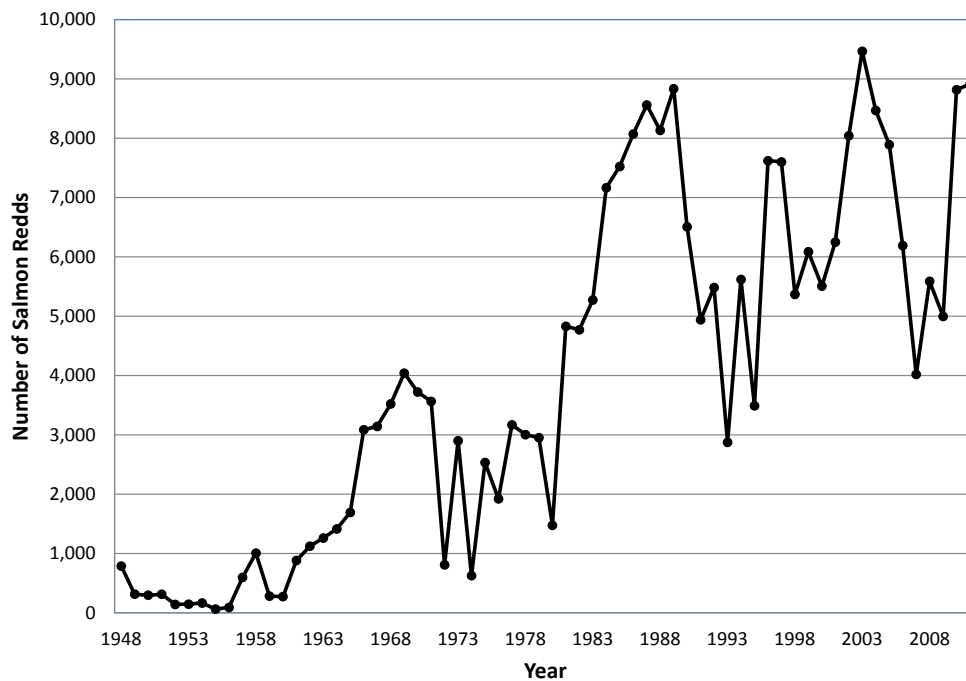
4.0 DISCUSSION

Aerial counts of fall Chinook redds have been conducted in the Hanford Reach since 1948 to generate annual indices of abundance and distribution. However, this was the first year that these counts have been conducted under the MSA contract. Because long term trends in both redd abundance and distribution are important monitoring components, several steps were taken to ensure compatibility and consistency with past efforts, including:

- Thoroughly reviewing and adopting past monitoring protocols
- Coordination/training with former redd count personnel to ensure consistency with past efforts
- Coordination and exchange of information with the Washington Department of Fish and Wildlife and with the Grant County Public Utility District to ensure consistency with the ongoing Hanford Reach Fall Chinook Protection Program
- Using maps detailing the entire survey reach as well as all historical sub-areas and spawning sites as both in-flight guidance documents as well as field data recording forms.
- Using the same air service, airplane, and pilots in 2011 that were used in previous years.

In summary, the peak annual redd count for this season (8,915) slightly surpassed that of 2010 (8,817), was less than the all-time highest count of 9,465 (year 2003), and was well in excess of the average for the past ten years (6,972). Viewing conditions were excellent during the first three surveys and fair on the last which undoubtedly contributed to the relatively high number of redds counted in 2011. The historical trend in red counts since 1948 is shown in Figure 3.

Figure 3. Fall Chinook Salmon Red Counts (1948 through 2011)



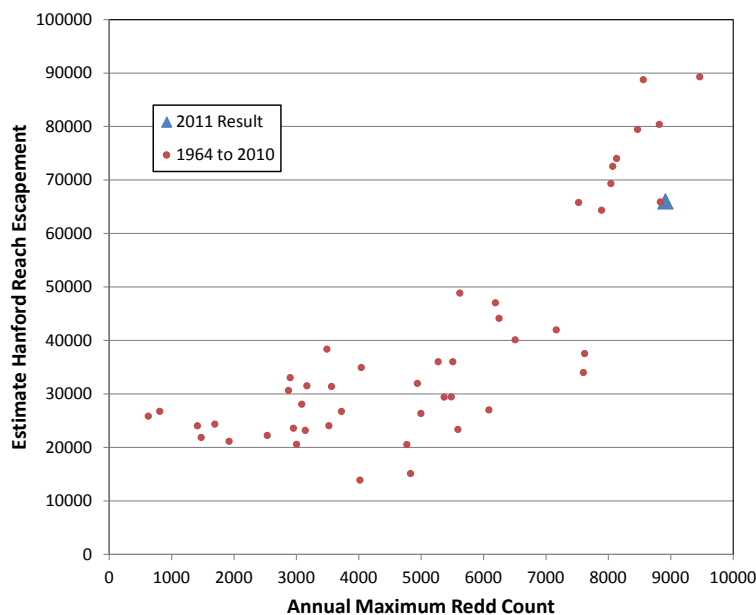
Because redd life in the Hanford Reach is approximately 6 weeks , which encompasses the entire survey time period, the total number of redds counted per survey area should remain the same or

continue to increase through the final survey. Reductions in redd counts during the survey season are due to count variability. Redd superimposition is a factor that is virtually impossible to quantify but can certainly affect the accuracy of redd counts. During the third survey (November 5), redd superimposition was documented to be minimal, however superimposition was more prevalent during the final survey (November 20). This, along with reduced visibility on the final survey likely contributed to count variability in year 2011. In addition, redds are counted individually, and in groups of 10 and 50. In areas of extensive spawning (i.e., 2,463 redds counted on Vernita Bar on November, 20, 2011) counting redds in groups of 50 is necessary but this procedure does introduce a high potential for count variability as it requires a higher level of count estimation on the part of the surveyor.

Sources of potential count variability notwithstanding, as in past years, the 2011 redd count showed fair correlation with the 2011 adult fall Chinook escapement estimate for the Hanford Reach generated annually by the Washington Department of Fish and Wildlife. This indicates overall consistency of the dataset (Figure 4). For example, the escapement estimates for years 1989 and 2011 were virtually identical and the redd counts, although collected independently by two different surveyors, were also virtually identical in spite of all potential sources of count variation. In addition, redds observed in year 2011 were located almost entirely in previously identified 'historical spawning areas' indicating that the long term preference of spawning Chinook for these areas was again captured in the 2011 surveys.

The historical areas where fall Chinook redds were observed in 2011 included locations of where contaminated groundwater upwelling's may exist. However, more work would be necessary to confirm the actual presence of contaminated groundwater upwelling within spawning areas.

Figure 4. Relationship between Annual Fall Chinook Maximum Redd Count and Estimated Hanford Reach Escapement (1964 through 2011)



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