Steelhead Redd Monitoring Report for Calendar Year 2012

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

Contractor for the U.S. Department of Energy
under Contract DE-AC06-09RL14728

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1.0 Introduction

Steelhead are a prized recreational fish throughout the Pacific Northwest and within the Columbia Basin. Although a non-tribal commercial fishery for steelhead does not exist, steelhead are a primary component of tribal fisheries in the Columbia Basin. Steelhead use the Hanford Reach for rearing as juveniles, as a migratory corridor as both juveniles and adults, and for spawning as adults. Both Mid-Columbia and Upper Columbia summer-run steelhead potentially use the Hanford Reach, both of which are currently listed as threatened under the *Endangered Species Act of 1973* (ESA). Because of their high public value and ESA listing status, steelhead were selected for monitoring under this program.

On August 18, 1997 Upper Columbia Summer-Run Steelhead were listed as endangered under the ESA, with an effective date of October 17, 1997 (62 FR 43937). This status was upgraded to threatened on January 5, 2006; reinstated to endangered status per U.S. District Court decision in June 2007; status upgraded to threatened per U.S. District Court order in June 2009. NOAA Fisheries issued results of a five-year review on August 15, 2011, and concluded that this species should remain listed as threatened (76 FR 50447). Steelhead covered under this listing include all naturally spawned anadromous *Oncorhynchus mykiss* (steelhead) populations and their progeny below natural and man-made impassable barriers in streams in the Columbia River Basin upstream from the Yakima River, Washington, to the U.S.-Canada border. Also covered are six artificial propagation programs: the Wenatchee River, Wells Hatchery (in the Methow and Okanogan Rivers), Winthrop National Fish Hatchery, Omak Creek, and the Ringold steelhead hatchery programs. Critical habitat for this Evolutionarily Significant Unit (ESU) within the Hanford Site includes the entire Hanford Reach of the Columbia River (65 FR 7764, and 70 FR 52630).

Steelhead are the anadromous (sea-run) form of the rainbow trout. Steelhead migrate from their natal streams to the ocean as juveniles and return to their natal streams as mature adults to spawn. They can survive spawning (iteroparity) whereas all pacific salmon die after spawning (semelparity). Although steelhead can survive spawning to spawn a second time, the repeat spawning rate in the state of Washington is low (4 to 15 percent (Wydoski and Whitney 1979)). In addition, adults encounter four mainstem dams on their way to and from the Hanford Reach and therefore repeat spawning in the Hanford Reach by a significant number of steelhead is unlikely.

Steelhead build nests, termed “redds”, in gravel or cobble substrate and spawn in the spring; the steelhead fry emerge from the gravel later that same spring. Adult steelhead generally utilize smaller tributary habitat and substrate but will spawn in larger mainstem rivers, such as the Columbia, where suitable habitat exists. In Idaho’s Clearwater and Salmon Rivers, the preferred gravel size for nesting was 1.3 to 10.2 centimeters (cm), water depth 0.2 to 1.5 meters (m), and water velocity 0.70 to 0.76 meters per second (m/s); these habitat conditions are available within the Hanford Reach (Orcutt 1968, DOE/RL-2000-27). In 2007, steelhead spawning habitat suitability surveys were conducted at multiple sites contained within three key contaminant plumes resulting from Hanford Site operations (Stables and Tiller 2007). Habitat suitability was assessed based upon depth, velocity, substrate size, and substrate embeddedness. Eleven of the seventy-two sites surveyed were found to be entirely suitable to support steelhead spawning at the flows present during the time of the surveys.

Steelhead are present in the Hanford Reach all year; however, most adults move into the Reach from August to November, peaking in September (Watson 1973; PNL-5371, DOE/RL-2000-27). Most steelhead that enter the Hanford Reach hold in the immediate vicinity for 6 to 8 months. A limited tagging study in 1967 found adults migrated near shorelines at depths less than 3 m (Coutant 1973, DOE/RL-2000-27).

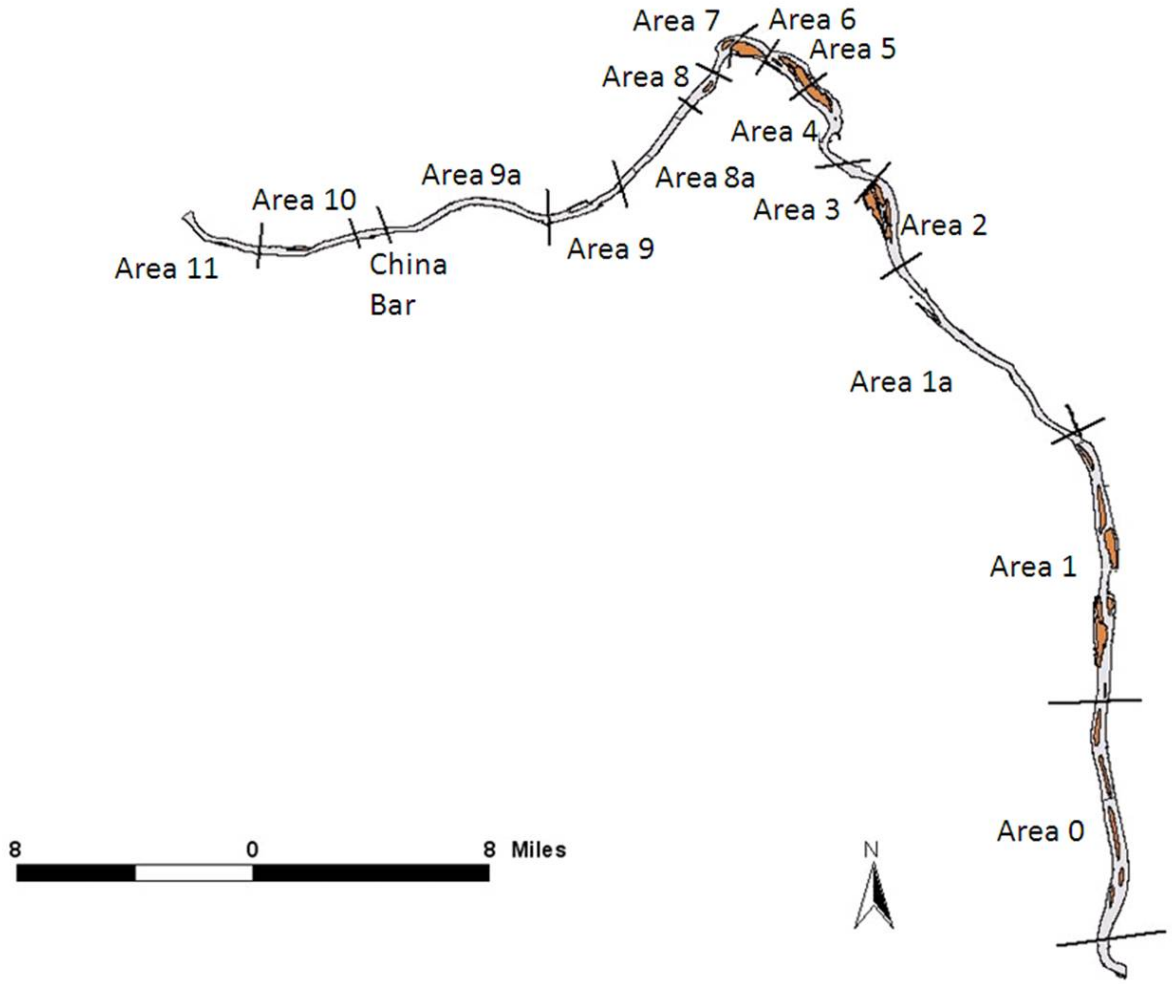
Spawning within the Reach would likely occur between February and early June, with peak spawning in mid-May (Eldred 1970; Watson 1973; PNL-5371, DOE/RL-2000-27). Little is known about the quality and quantity of steelhead spawning, rearing, and adult holding habitat in the Hanford Reach. Watson (1973) estimated that from 1962 to 1971, an average of 35,000 steelhead trout that annually passed McNary Dam did not pass Priest Rapids Dam on the Columbia River or Ice Harbor Dam on the Snake River (DOE/RL-2000-27). He estimated that 10,000 of these fish were potential spawners in the Hanford Reach, after taking into account reductions due to migration into the Yakima and Walla Walla Rivers, sport catch, and natural mortality. Counts from 1977 to 1996 indicated an average of 20,000 steelhead trout that annually passed McNary Dam did not pass Ice Harbor or Priest Rapids dams, and approximately 9,000 of these could potentially spawn in the Hanford Reach (DOE/RL-2000-27, and PNNL unpublished data).

Gray and Dauble (1976) provide other evidence of steelhead spawning (DOE/RL-2000-27). They collected gravid and ripe females in late April and early May and collected spent males in August within the Reach. Information on the quantity and location of steelhead spawning is uncertain because aerial surveys of steelhead spawning are often hampered by high turbid spring runoff that obscures visibility. Historical information on steelhead spawning was from the late 1960s and early 1970s during unusually low flow conditions (39 to 78 thousand cubic feet per second (kcfs), normal average flow is ~120 kcfs). Key spawning areas reported from aerial surveys conducted in 1968 and 1970 included Vernita Bar, Coyote Rapids, Locke Island, 100-F islands, and Ringold (Tony Eldred, personal communication with D. R. Geist PNNL 9-28-89). A total of 220 redds were counted in 1968 and 95 in 1970; total steelhead spawning was estimated by Eldred to be approximately 2,200 to 25,000 in 1968 and 950 to 7,800 in 1970. Fickeisen et al. (1980) indicated steelhead likely spawned at Vernita Bar, Coyote Rapids, Locke Island, and Ringold. An aerial survey conducted on April 30, 1998, identified up to 75 redds in the Hanford Reach, with the area from Wooded Island to Ringold having 14 redds and the 100-F islands having 61 (Dauble 1998, DOE/RL-2000-27). The area at Locke Island that had redds in the 1970s has since been silted over due to slumping of the bluffs from agricultural water seepage.

Recent documentation of steelhead spawning in the Hanford Reach is rare. A comprehensive study was conducted in spring 1999 to survey likely spawning areas near Locke Island, but no steelhead redds were found (PNNL-13055). The 100-N Area shoreline was investigated by aerial and boat surveys during spring 2005 to search for spawning areas (PNNL-SA-75348). Results of these surveys show only limited spawning near the Ringold Hatchery Creek (near river mile 355) in certain years. One verified steelhead redd was found near the 300 Area in spring 2003. Surveys in the spring of 2005 identified a single location where steelhead redds occurred downstream of Ringold at Island 15 (PNNL-SA-75348). Aerial steelhead redd counts were conducted during years 2007 through 2009 but only a single redd was observed in 2008 which was located near the upper portion of Locke Island.

Although few redds are counted, aerial counts of steelhead redds are conducted at Hanford in the spring of each year to identify spawning areas and timing as well as to provide an annual index of relative abundance among spawning areas. The counts are also useful to document that spawning by ESA listed wild upriver summer steelhead is minimal in the Hanford Reach, and would allow project activities to avoid redds, if identified. Similar to the methods used to document fall Chinook salmon spawning, the survey area is divided into 11 sections (Figure 1), with the number of redds being totaled by section.

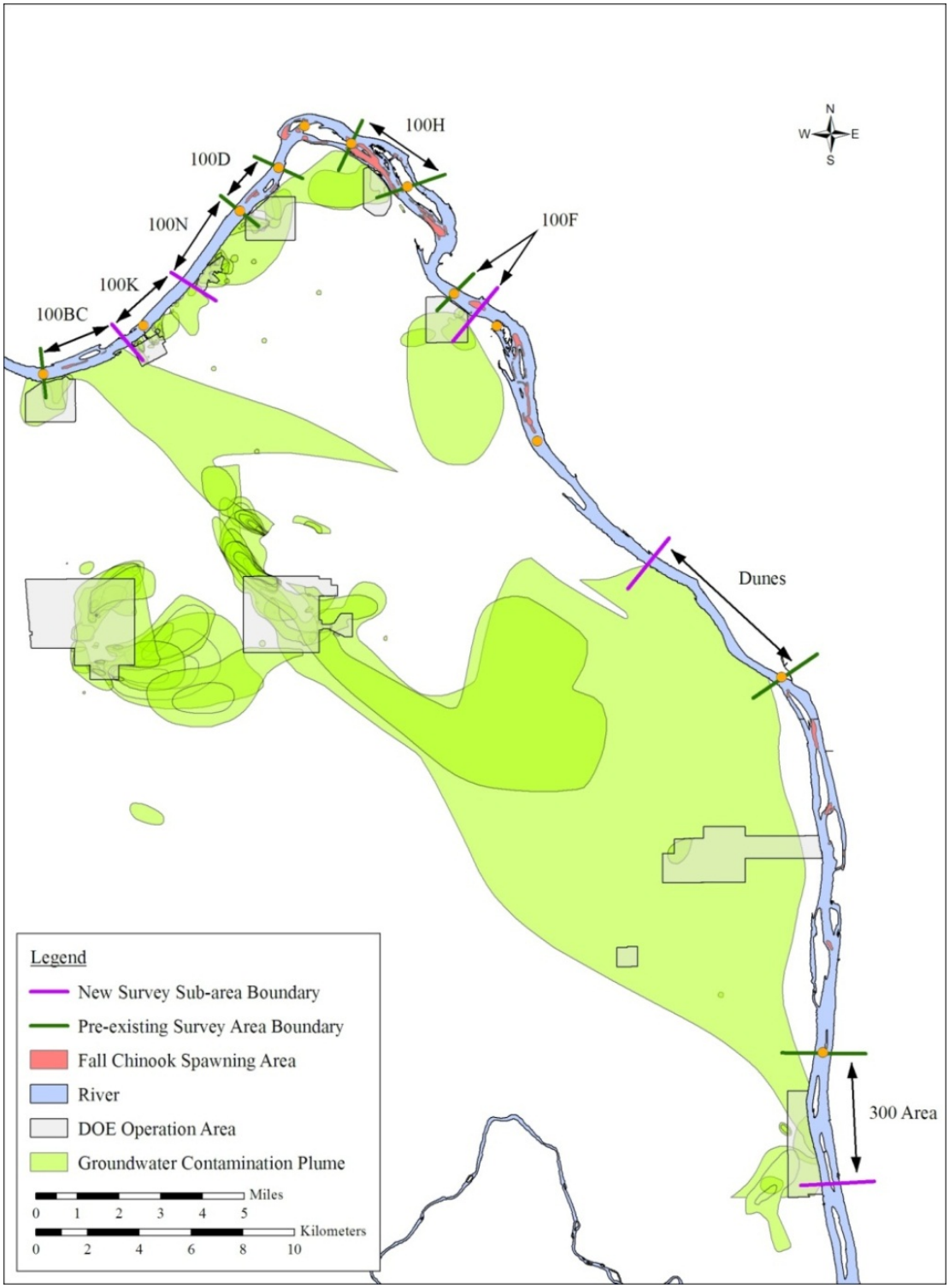
Figure 1. Aerial Survey Areas for Steelhead Redds (Historically and 2012)



2.0 Methods

Aerial surveys of steelhead 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, 300 Area) were added to better monitor the abundance and distribution of steelhead redds in areas of potential upwelling of contaminated groundwater (Figure 2). These eight new sub-sections were added to the Aquatic Community database maintained by the Mission Support Alliance (MSA) Public Safety and Resource Protection Program (PSRP). This change to the historical monitoring technique provides additional spatial resolution to the survey information, but does not impede the summing of redd counts in the original areas, still allowing collected data to be directly comparable to historical records.

Figure 2. Survey Sub-Areas, New for 2012, where Groundwater Upwelling's may contain Contamination from the Hanford Site



The primary physical factors influencing the accuracy of aerial counts include depth of water over the redds and water clarity. Wind action, available light, orientation of the river, and direction of the current can also affect visibility. Because it is seldom possible to view all redds from the air, these counts provide an annual index of relative abundance and distribution of steelhead spawning in the Hanford Reach of the Columbia River.

Power demand and associated discharge from Priest Rapids Dam are typically lower on weekends than during weekdays and, given the previously described limitations, this weekly reduction in river flow affords the best viewing conditions for aerial flights. Aerial flights are therefore conducted on weekends. Flights were scheduled from March through May to encompass the entire steelhead-spawning period. Three flights, one per month, were scheduled during this period.

Survey flight altitudes ranged from approximately 244 to 366 m (800 to 1200 ft) with air speeds of 120 to 161 km (75 to 100 miles) per hour. Redds, when observed, are counted individually. Flights were cancelled if weather conditions are adverse (i.e., wind, fog, or low clouds) or if river flows are excessively high. High flows resulting from spring run-off can justify survey cancelation because as river flows increase they eventually flood areas typically characterized by terrestrial vegetation and lacking steelhead spawning habitat, leaving previously usable habitat too swift for spawning and too deep to be observed from the air. Sustained flows in excess of 160 kcfs, were considered too high to survey.

Redd count surveys began near Richland at Nelson Island and ended at Priest Rapids Dam. Flights were normally conducted near noon with the intent to bracket the highest angle of the sun for optimum viewing conditions. Observers wore polarized glasses as necessary to reduce glare. Any redds observed were documented by survey area on large format printed maps.

3.0 Results

Two of three scheduled aerial surveys were completed along the length of the Hanford Reach during the 2012 survey season, which is consistent with historical levels of effort. The first survey was performed on March 18 and the second and final survey was completed on April 21. High river flows (Figure 3) prevailed throughout the month of May, which hampered the survey effort. The May survey was attempted on May 12, 20, and 26 but suspended due to either poor weather conditions and/or high river flows.

Figure 3. Daily Average Priest Rapids Project Discharge

(March 1, 2012 through June 15, 2012)

Source: Columbia River Dart (http://www.cbr.washington.edu/dart/dart.html).

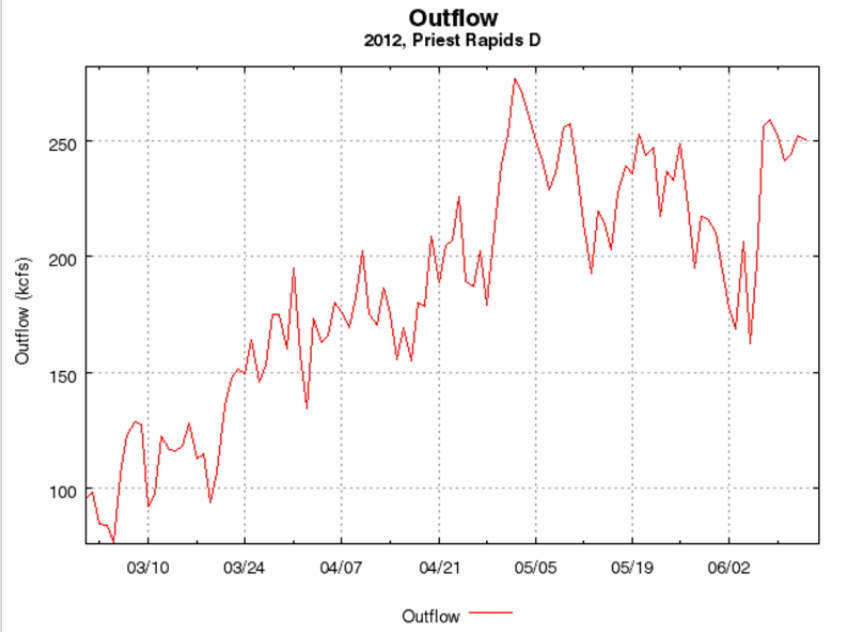


Table 1 describes the counts performed by survey area for each flight. The maximum count describes the highest number of redds documented in a survey area within a single flight. Table 2 shows the number of redds occurring within the newly defined sub-areas, coinciding with areas of potential upwelling of contaminated groundwater. No steelhead redds were observed in 2012.

Table 1. Summary of Steelhead Redd Counts for the 2012 Aerial Surveys, Hanford Reach, Columbia River

Area	Description	3/18/2012	4/21/2012	5/12/2012	Maximum Count
0	Islands 17-21 (Richland)	0	0	n/a[1]	0
1	Islands 11-16	0	0	n/a[1]	0
2	Islands 8-10	0	0	n/a[1]	0
3	Island 7	0	0	n/a[1]	0
4	Island 6 (lower half)	0	0	n/a[1]	0
5	Islands 4, 5 and upper 6	0	0	n/a[1]	0
6	Island 3	0	0	n/a[1]	0
7	Island 2	0	0	n/a[1]	0
8	Island 1	0	0	n/a[1]	0
9	Coyote Rapids	0	0	n/a[1]	0
	Midway (China Bar)	0	0	n/a[1]	0
10	Vernita Bar	0	0	n/a[1]	0
11	Near Priest Rapids Dam	0	0	n/a[1]	0
TOTAL		0	0	n/a[1]	0

Table 2. Summary of steelhead Redd Counts for the 2012 Aerial Surveys by Potential Contaminated Groundwater Upwelling Sub-Sections

Area	3/18/2012	4/21/2012	5/12/2012	Maximum Count
300 Area	0	0	n/a[1]	0
Dunes	0	0	n/a[1]	0
100-F	0	0	n/a[1]	0
100-H	0	0	n/a[1]	0
100-D	0	0	n/a[1]	0
100-N	0	0	n/a[1]	0
100-K	0	0	n/a[1]	0
100-BC	0	0	n/a[1]	0
TOTAL	0	0	n/a[1]	0

[1]Aerial survey cancelled due to excessively high river flows (sustained flows in excess of 160 kcfs).

4.0 Discussion

Aerial counts of steelhead redds have been conducted annually in the Hanford Reach since 1998. Surveys were previously performed by the Pacific Northwest National Laboratory (PNNL) under contract with the United States Department of Energy (USDOE). Beginning in 2012, Environmental Assessment Services LLC (EAS) under contract with the MSA continued this work as part of the PSRP program. 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. These included reviewing and adopting past monitoring protocols, coordination/training with former redd count personnel, using maps detailing the entire survey reach as well as all historical sub-areas and spawning sites both as in-flight guidance documents as well as field data recording forms, and using the same air service, airplane, and pilots that were used in previous years.

Although 220 redds were counted in 1968, and 95 in 1970, in the Hanford Reach by the Washington Department of Game (now Washington Department of Fish and Wildlife) during unusually low flow conditions, few spawning steelhead have been observed in the Hanford Reach in recent years. For example, aerial steelhead redd count survey data for years 2007 through 2009 resulted in the observation of only a single redd in 2008 which was located near the upper portion of Locke Island. However, high water conditions during the spring freshet such as occurred during the month of May in 2012 often limit effective surveying.

The 2012 survey effort was hampered throughout the spring due to increasing flows. Viewing conditions were excellent during the March 18 survey but river flows began to rise in April which limited effective aerial surveying for the remainder of the season. The typical morning rise in discharge at Priest Rapids Dam takes approximately 8 hours to translate to lower portions of the Hanford Reach. For this reason, the April 21, 2012, survey was conducted at 10 am (2 hours earlier than the standard noon starting time) in an attempt to complete the survey during adequate light conditions but before the daily rise in water level precluded effective viewing. This strategy proved to be largely successful in that the entire study area up to Vernita Bar could be surveyed (i.e., approximately 160 kcfs) during the flight. However, by the time surveyors arrived at Vernita Bar, flows had risen to 191 kcfs and this section could not be surveyed. Flows remained high throughout May and that flight was cancelled.

Steelhead redds were not observed in 2012 but there were some other noteworthy observations. Surprisingly, 2011 fall Chinook salmon redds were still readily visible in some locations during the first (March 18, 2012) steelhead redd survey flight. This is well past the six week redd life, the period after which redds are indiscernible from the surrounding substrate, expected for fall Chinook salmon redds. Fall Chinook redds were especially noticeable in survey area 7 (Figure 1). The large number and size of the redds, presence in historic fall Chinook salmon spawning areas, as well as the complete lack of adult fish observed in the vicinity distinguished these as fall Chinook salmon redds rather than steelhead redds. Under the conditions observed on March 18, 2012, in areas where steelhead and fall Chinook salmon spawning habitat features may overlap, steelhead spawning on top of or in close proximity to fall Chinook salmon redds would be extremely difficult to distinguish from still readily visible fall Chinook salmon redds. The presence of adult steelhead would be necessary to distinguish them. Under the conditions just described, verification of steelhead redds absent of spawning adults would require closer inspection via boat, submersible camera, or diver. Fall Chinook salmon redds were no longer visible by the second (April 21, 2012) steelhead redd count survey.

Consistent with the results of the 2012 surveys, few steelhead redds have been observed in the Hanford Reach in recent years. Dauble (1998)counted 75 redds in the spring of 1998 but the 2012 observations suggest that these could have been fall Chinook salmon redds and not steelhead redds. Rising river flows in 1998 precluded ground-truth verification of the spring redd sightings. Orcutt et al. 1968 identified preferred steelhead spawning gravel size, water depth and water velocity in Idaho's Clearwater and Salmon Rivers and habitat features with these same characteristics are available in the Hanford Reach (DOE/RL-2000-27). It should be noted that steelhead in the Hanford Reach and Upper Columbia Basin are all A-run while the Snake River Basin contains both A-run and B-run steelhead. A-run steelhead occur throughout the steelhead-bearing streams of the Snake River Basin; B-run steelhead are thought to be produced only in the Clearwater, Middle Fork Salmon, and South Fork Salmon Rivers (IDFG 1994). B-run steelhead are larger than A-run steelhead and would therefore be better suited to spawning in mainstem habitats. While the habitat features identified by Orcutt et al. 1968 may be available in the Hanford Reach, they may be less likely to be used by the smaller A-run steelhead.

Watson (1973) estimated that from 1962 to 1971, an average of 10,000 steelhead were potentially available to spawn in the Hanford Reach, this estimate was based upon dam counts uncorrected for fallback. During a two year evaluation, Wagner (1990) and Wagner and Hillson (1991) counted several thousand pre-spawn adult steelhead falling back through the juvenile collection system at McNary Dam (5,721 from September 15 through November 30, 1990 and 11,512 from March 25 through December 15, 1991) and these fallbacks were not accounted for in the upstream passage data. In addition, the fallback statistics for 1990 and 1991 only include steelhead that were intercepted by the juvenile bypass screening system and do not include steelhead that may have passed either: 1) under the screens and through the turbines; 2) over the spillways during periods of spill; 3) through the navigation locks; or 4) through the turbine intakes outside of the time period when the screening system was in place. All of these factors potentially inflate adult passage estimates. Because thousands of adult steelhead fall back at McNary Dam, it is difficult to estimate accurately how many, if any, are available to spawn in the Hanford Reach.

High spring flows and hampered steelhead redd count surveys notwithstanding, if significant steelhead spawning does occur in the Hanford Reach, we would expect to find sub-yearling and pre-smolt juveniles (i.e., young-of-the-year). Gray and Dauble (1976) reported that young-of-the-year steelhead were not collected by small mesh beach seines in areas and the time of the year when steelhead juveniles should have been present. Other studies have failed to collect young-of-the-year steelhead (Dauble et al. 1989, Wagner et al. 1997, Hoffarth et al. 1998, Nugent et al. 1999 and 2000). In

June 2001, four wild steelhead fry were collected from an entrapment pool near Wooded Island for the first time during the fifth year of an on-going fry stranding study (Nugent et al. 2002). The lack or complete absence of young-of-the-year steelhead noted in these studies, even in cases where juvenile fish of all species residing in the Hanford Reach were targeted during the summer months when steelhead fry should have been present (Wagner et al. 1997, Hoffarth et al. 1998, Nugent et al. 1999 and 2000) coincides with the very low number of redds counted in recent years.

While the data discussed above strongly suggests that very little steelhead spawning actually occurs in the Hanford Reach, the observations of small numbers of steelhead redds and fry do confirm that some steelhead spawning does in fact occur. Furthermore, because the population of natural origin steelhead inhabiting the upper Columbia River has been reduced to the point of listing under the ESA, the number of steelhead spawning in the Hanford Reach may be low at present but will likely increase as recovery actions are successfully implemented. Monitoring should continue to document this as well as to ensure that Hanford Site activities do not adversely affect the recovery of these fish.

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