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FISH RESEARCH PROJECT
OREGON

IMPLEMENTATION OF THE ENVIRONMENTAL MONITORING AND ASSESSMENT PROGRAM (EMAP) PROTOCOL IN THE JOHN DAY SUBBASIN

ANNUAL TECHNICAL REPORT

CONTRACT PERIOD: September 1, 2008 to August 31, 2009

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Objectives

1. Monitor status and trends in steelhead redd abundance and spawners in the John Day River basin.
2. Estimate the distribution of summer steelhead redds and spawners in the John Day River Basin.
3. Provide background data that can be used for:
   a. Stock assessment.
   b. Comparison data for long-term effectiveness monitoring of habitat projects.
   c. Annual estimates of spawner escapement, age structure, SAR, egg-to-smolt survival, smolt-per-redd ratio, and freshwater habitat use.

Accomplishments and Findings

We sampled 49 random, spatially-balanced sites throughout the John Day River basin during the spring (11 March–23 June) of 2009 to determine summer steelhead *Oncorhynchus mykiss* redd abundance. Survey sites encompassed 98.6 km of an estimated 4,335 km of steelhead spawning and rearing habitat within the basin. During these surveys, 44 redds and 37 live steelhead were observed. Redds were observed at 15 of the 49 sites (31%). Redd and adult steelhead escapement estimates for the basin were 1,934 and 7,368, respectively. We observed an additional 50 redds in the South Fork subsample, while surveying 25.9 km of the 249 km of habitat available for spawning above the rotary screw trap. We estimate 481 redds were constructed in the South Fork subbasin by 1,833 spawners. We also observed an additional 45 live steelhead in the South Fork. Hatchery steelhead composed 7% (3 of 44) of observed live fish where the presence or absence of an adipose fin clip could be determined. We estimate that of the 7,368 steelhead in the John Day River basin in 2009, 516 were of hatchery origin and 6,852 were wild steelhead. High flow events persisted throughout much of the spawning season again in 2009 making redd observations difficult, particularly in the month of May when the majority of redds were observed in previous years. Although redd counts were low, the 2009 adult steelhead escapement estimate is the third greatest since the implementation of the EMAP sampling protocols in 2004 resulting from high fish/redd ratios. Redd counts at annual EMAP sites were the second lowest since 2004, exceeding only 2005.

Management Recommendations

1. Using the current data of steelhead spawning distribution and geographic landscape variables, redefine the sampling universe for *O. mykiss* in the John Day River Basin to improve our knowledge of steelhead spawning distribution.

2. Determine the level of change in the escapement estimate that we would consider to be biologically and statistically significant in order to determine short- and long-term population changes.

3. Increase effort in monitoring freshwater life history strategies and survival rates of key salmonid species in the John Day River Basin. Such information will be valuable in

assessing critical limiting factors for key species and provide greater guidance for restoration activities.

4. Continue to manage the John Day River basin exclusively for wild steelhead and determine the extent and distribution of hatchery steelhead in the basin through observations of hatchery fish during the spawning season and compiling information from other sources and projects. Consider using genetic analysis to understand the influence of hatchery stocks and wild strays on John Day River wild summer steelhead stock genetics.

ACKNOWLEDGEMENTS

We would like to acknowledge the assistance and cooperation of the many private landowners throughout the John Day River basin who allowed us access to survey on their property. The cooperation of private landowners and The Confederated Tribes of the Warm Springs Reservation were essential in meeting our project objectives. Additionally, we would like to thank Jeff Neal for providing guidance and advice regarding steelhead spawning ground surveys. The information he provided was extremely helpful for survey planning and landowner contacts. Furthermore, we would like to acknowledge our field crew and the Middle Fork IMW crew members for their assistance. This project was funded by the U. S. Department of Energy, Bonneville Power Administration, Environment, Fish, and Wildlife. Project Number: 199801600. Contract Number: 39054.

INTRODUCTION

The John Day River, located in northeastern Oregon, is unique in that it supports one of the last remaining wild populations of summer steelhead *Oncorhynchus mykiss* in the Columbia River Basin with no hatchery supplementation. However, this population remains depressed relative to historic levels. In 1999, the National Marine Fisheries Service (NMFS) listed the Middle Columbia River summer steelhead Distinct Population Segment (DPS), which includes John Day River summer steelhead, as threatened under the Endangered Species Act (ESA). Although numerous habitat protection and rehabilitation projects have been implemented within the John Day River basin to improve steelhead and other salmonid freshwater production and survival, it has been difficult to estimate the effectiveness of these projects without a systematic program in place to collect information on the status, trends, and distribution of salmonids and habitat conditions within the basin. Prior to the inception of this project, population and environmental monitoring of steelhead in the basin consisted of a combination of index surveys and periodic monitoring of some status and trend indicators. While index spawning data is useful in drawing inference about trends in adult steelhead abundance, it is limited in determining the status of steelhead escapement or distribution at the basin-wide scale because survey sites are not randomly selected, and are likely biased towards streams with higher redd densities. A broader approach to the monitoring and evaluation of status and trends in anadromous and resident salmonid populations and their habitats was needed to provide data to effectively support restoration efforts and guide alternative future management actions in the basin.

The Independent Scientific Review Panel (ISRP), in their guidance on monitoring, strongly recommended that the region move away from index surveys and embrace probabilistic sampling for most population and habitat monitoring. To meet the ISRP recommendation, the structure and methods employed by the Oregon Plan for Salmon and Watersheds Monitoring Program were extended to the John Day basin. This approach incorporates the sampling strategy of the United States Environmental Protection Agency's (EPA's) Environmental Monitoring and Assessment Program (EMAP). The EMAP is a long-term research effort with a statistically based and spatially explicit sampling design. This program applies a rigorous, Tier-2 sampling design to answer key monitoring questions, integrate on-going sampling efforts, and improve agency coordination. EMAP objectives specific to the John Day basin are to determine annual estimates of steelhead spawner escapement, hatchery to wild steelhead stray ratios, and track changes in the status and trends of these estimates over time. In addition, data from on-going projects in the basin, such as smolt monitoring, will be incorporated in future years to develop a more complete picture of status and trends in resources (e.g. life-stage specific survival) not targeted under the EMAP program.

This project provides information as directed by two measures of the Columbia River 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 the recommendations and needs of regional modeling efforts, the ISRP, the Fish and Wildlife Program, the Oregon Plan for Salmon and Watersheds, and the Columbia Basin Fish and Wildlife Authority Multi-Year Implementation Plan.

METHODS

Study Area

The John Day River basin is located in north central and northeastern Oregon (Figure 1), and is the fourth largest drainage in the state. 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. The John Day River originates in the Strawberry Mountains at an elevation near 1,800 m (5,900 ft) and flows approximately 457 km (284 miles) to its mouth, at an elevation of 90 m (295 ft), at river km 349 (river mile 217) of the Columbia River. It is the second longest free-flowing river in the continental United States, and along with the Yakima River it is one of only two major tributaries to the Columbia River managed for wild salmon and steelhead. There are no hydroelectric dams or hatcheries located on the John Day River, although numerous irrigation diversions dot the drainage. Major tributaries flowing into the mainstem John Day River include the North Fork, Middle Fork, and South Fork John Day rivers. The North Fork is the largest tributary, contributing approximately 60% of the flow to the mainstem. The John Day River basin contains 15,455 km of stream habitat available for fish, but only 4,628 km (30%) are known or assumed to be used for various anadromous salmonid life history stages (spawning, rearing, and migration; Figure 2; Table 1).

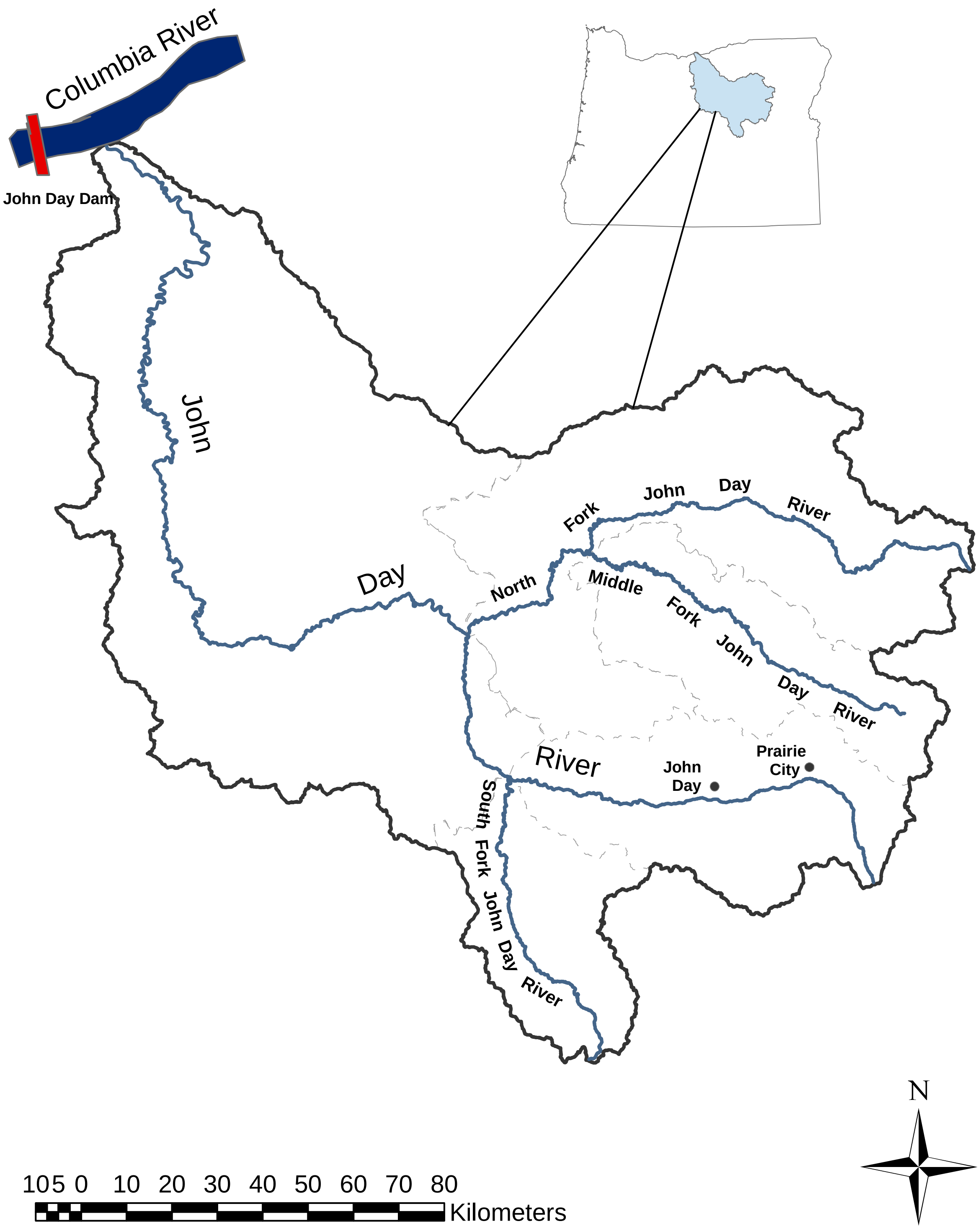

Figure 1. Map of the John Day River basin including the Mainstem John Day River and all three major forks (North Fork, Middle Fork, and South Fork). Dashed grey lines represent subbasin delineations (Lower Mainstem, Upper Mainstem, North Fork, Middle Fork, and South Fork subbasins).

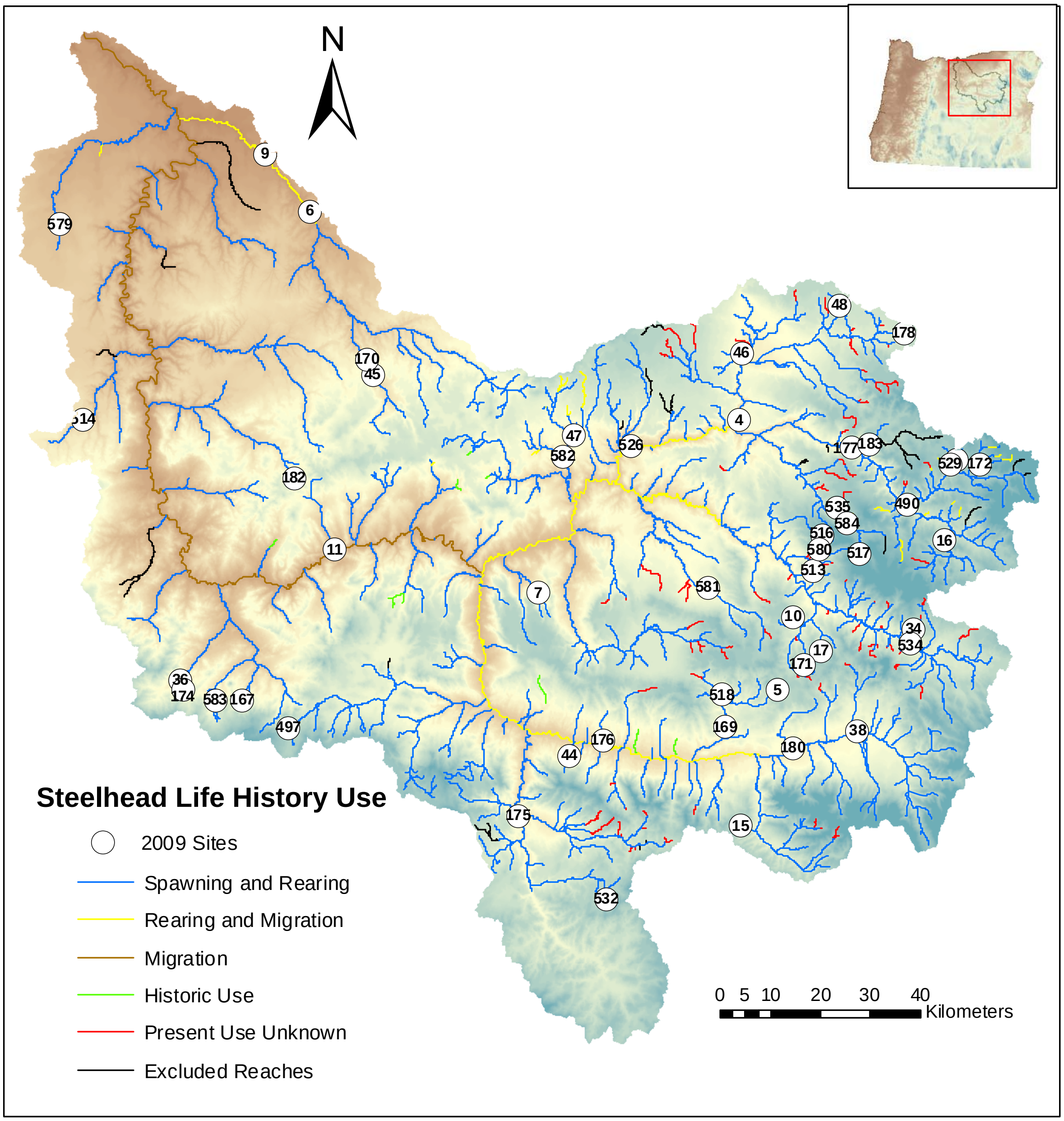

Figure 2. Map of summer steelhead life history use in the John Day River basin and 2009 EMAP sample sites with site numbers.

Sampling Domain and Site Selection

Sites were selected using the EMAP protocol which uses a spatially balanced random sampling design (Stevens 2002). The sampling universe for EMAP surveys is based on professional knowledge of steelhead life history use in the John Day River basin. This knowledge is derived from ODFW biologists as well as biologists from other natural resource entities, and is currently the best information available concerning the distribution and habitat use of steelhead in the John Day River basin (Figure 2). All reaches upstream of known barriers to anadromous fish passage were eliminated from the sampling universe. Fifty sample sites are targeted each year; however, we only surveyed 49 sites because we were denied access to Long Creek (Site 581; Four year panel) during the middle of the spawning season. In order to balance the needs of status (more random sites) and trend (more repeat sites) monitoring, the following rotating panel design was implemented for the basin:

- 17 sites repeated every year (annual)
- 16 sites repeated once every four years on a staggered basis (four)
- 17 sites new every year (new)

A Geographic Information System (GIS) incorporating a 1:100,000 digital stream network was used to insure an unbiased and spatially balanced selection of sample sites. The GIS site selection process provides geographic coordinates (i.e. latitude and longitude) of each candidate site. From these site coordinates, topographic maps were produced showing the location of each sample point. Landowner contacts were then developed based on county plat maps. With the assistance of ODFW District Biologists, permission was sought from landowners for survey sites. In the field, crews used a handheld Global Positioning System (GPS) to locate the established survey reaches which encompassed the selected EMAP points. Some candidate sites were not sampled due to a lack of permission from private landowners or because sites were located upstream of previously unknown fish passage barriers. In such events, replacement sites were drawn from a pre-selected list of over-sample sites. Every year the EMAP sampling universe is refined based on field observations of previously unknown barriers and other restrictions (e.g. dry streams) that limit fish life history stages (defined as "Excluded Reaches" in Figures 2 and 3; Table 1), or the removal of barriers (e.g. road culverts) that previously limited access to habitat. These stream reaches are removed or added into our sample universe accordingly. The current EMAP sample universe includes 4,335 km of stream (Table 1). The universe does not include sections of stream with use types classified as migration or excluded reaches (Table 1).

Table 1. Length of stream reaches (km) in the John Day River basin classified by life history use type and subbasin.

Use Type	LMJDR	NFJDR	MFJDR	UMJDR	SFJDR	Basin Totals
Spawning and Rearing	1,220	1,187	526	588	237	3,758
Rearing and Migration	94	144	40	57	0	335
Migration	292	1	0	0	0	293
Historic Use	18	2	0	9	0	29
Present Use Unknown	0	97	71	20	23	211
Excluded Reaches	64	71	0	0	12	147
TOTAL	1,688	1,502	637	674	272	4,773

Steelhead Redd Surveys

Steelhead redd surveys based on standard ODFW methods (Susac and Jacobs 1999; Jacobs et al. 2000; Jacobs et al. 2001) were conducted from March to June 2009 (Table 2). Individual sites were surveyed up to six times to quantify the number of redds constructed at each site, with approximately two week intervals between successive surveys to account for the temporal variation in spawning activity. Survey reaches were approximately 2 km in length and encompassed the sample point derived from the EMAP sample draw. Surveyors walked upstream from the downstream end of each reach and counted all redds, live fish, and carcasses observed. New redds were flagged and the location marked with a GPS unit (UTM, NAD 27).

During each visit, surveyors recorded the number of new redds and redds that had been identified and flagged during previous surveys. Redd visibility was estimated for redds that were found during previous surveys. Ideally, each site was to be visited by different surveyors on successive visits, however this was not always logistically possible with the number of personnel available.

Overall redd density (R_D) was estimated by:

$$R_D = \sum_{i=1}^{n} r_i/d_i \qquad (1)$$

where r_i is the number of unique redds observed at site i, d_i is the distance surveyed (km) at site i, and i is the individual sites surveyed. The total number of redds (R_T) occurring throughout the basin was estimated by:

$$R_T = R_D \cdot d_u \qquad (2)$$

where d_u is the total kilometers available to steelhead for spawning and rearing (4,269 km). Steelhead escapement (E_S) was then estimated by:

$$E_S = 3.81 \cdot R_T \qquad (3)$$

where 3.81 is a fish per redd constant. This constant is developed each year from repeat redd surveys of a tributary (Deer Creek) in the Grande Ronde River basin where a known number of adult steelhead are passed above a counting weir (Flesher et al. 2005; Gee et al. 2008; Lance Clarke and Jim Ruzycki, ODFW, unpublished data). A locally weighted neighborhood variance estimator (Stevens and Olsen 2004), which incorporates the pair-wise dependency of all points and the spatially constrained nature of the design, was used to estimate a 95% confidence interval of the escapement estimate using R statistical software (R Development Core Team 2005).

Steelhead carcasses were examined to obtain population and life history information (age, sex, length, and spawner origin). For all carcasses, surveyors collected scale samples from the key scale area (Nicholas and Van Dyke 1982) for age determination, recorded sex, measured MEPS length (middle of eye to posterior scale), and determined spawner origin (hatchery or wild) by inspecting carcasses for the presence (wild) or absence (hatchery) of an adipose fin. All carcasses found in 2009 were too decomposed to collect any age or length data. The hatchery : wild fish ratio was calculated by dividing the total number of fin marked fish by all fish that could be observed for marks (live fish only). The number of hatchery fish straying to the basin was estimated by multiplying this proportion of hatchery and wild steelhead by our estimate of steelhead escapement.

South Fork John Day River Spawning Subsample

Because of the limited area available for steelhead spawning in the South Fork subbasin, few sites, usually four or less, fall into our sampling frame in any given year. In 2009, we again surveyed 13 additional sites including two sites already in the 2009 sampling frame from the South Fork John Day River subbasin to gather additional spawning data (Figure 3) and to provide an escapement estimate for this subbasin. Subsample sites were determined by selecting the first 13 sites that occurred in the South Fork subbasin from the list of EMAP sample sites. Spawning surveys were conducted as previously outlined in this report and adult steelhead escapement to the South Fork subbasin was estimated using the same equations as noted above except that the distance in the sampling universe (d_u) only encompassed that area within the South Fork subbasin available for steelhead spawning and rearing and upstream of a rotary screw trap operated by Oregon Department of Fish and Wildlife (249 km).

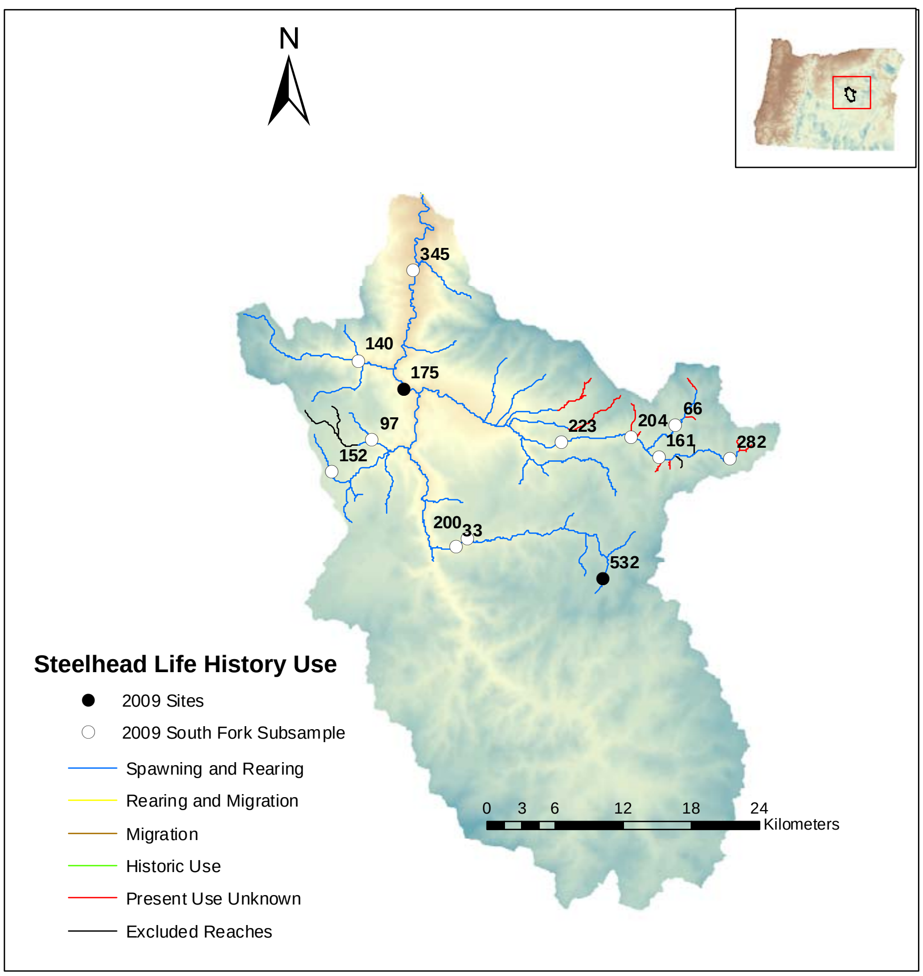

Figure 3. Map of sites selected for sub-sample spawning surveys in the South Fork John Day River subbasin in 2009. Black circles denote sites incorporated from the basin-wide sampling frame and white circles denote sites selected for subbasin sampling.

Table 2. Stream, site identification number, start and end coordinates (UTM-NAD27), panel type, number of visits, survey distance, and dates for steelhead spawning surveys conducted in the John Day River basin from March to July, 2009. (A); Annual site, (MF); Middle Fork IMW site, (F2); Four 2 site, (SF); South Fork Subsample and EMAP site, (SF Only); South Fork Subsample site only, (N6); New 6 site.

Stream	Site ID	UTM Zone	Start Coordinates Easting	Start Coordinates Northing	End Coordinates Easting	End Coordinates Northing	Panel Type	Length(km)	1	2	3	4	5	6	7
Lower John Day															
Rock Creek	006	10T	728344	503364	503236	729031	Annual	2	4/7	4/22	5/12	5/28			
Rock Creek	009	10T	718867	504443	504365	719995	Annual	2	4/7	4/22	5/12	5/28			
Service Creek	011	10T	737165	496456	496536	735738	Annual	1.8	3/11	3/31	4/13	4/22	4/29	5/11	5/18
Milk Creek	497	10T	728121	492871	492734	727445	Replacement (A)	1.7	5/6	5/26					
Rosebush Creek	579	10T	678831	503004	502823	679339	Replacement (A)	2	4/14						
Bear Creek	036	10T	707523	493889	493778	706131	Four2	2.1	3/26	4/9	4/22	5/1	5/15	6/11	
Lone Rock Creek	045	11T	270542	500118	499958	271008	Four2	2.1	3/17	4/2	4/13	4/30	5/11	5/26	
Big Pine Hollow	514	10T	685146	498926	498825	683915	Replacement (F2)	2	3/19	4/7	4/20	5/7			
Thompson Creek	167	10T	719072	493583	493405	718734	New6	2	4/21						
Lone Rock Creek	170	11T	268926	500411	500260	269805	New6	2	4/2	4/13	4/29	5/11	5/26		
Dodds Creek	174	10T	705772	493745	493580	706711	New6	2	3/26	4/9					
Butte Creek	182	10T	726584	498058	497898	727678	New6	2	3/24	4/13	5/11				
West Branch Bridge	583	10T	713210	493587	493398	713307	Replacement (N6)	2	4/9	4/21	5/26				
Middle Fork John Day															
Whiskey Creek	010	11T	354555	494688	494744	352921	Annual (MF)	2	4/13	4/29					
West Fork Lick Creek	017	11T	358255	494248	494053	358053	Annual (MF)	2	5/11	5/26	6/5				
Middle Fork John Day	534	11T	374803	494192	494139	376194	Replacement (A)	2	5/29						
Caribou Creek	034	11T	375830	494236	494402	376730	Four2 (MF)	2.1	4/13	4/29	5/6	5/20			
Mosquito Creek	513	11T	355384	495587	495654	357294	Replacement (F2)	2.1	4/30	5/12					
Indian Creek	516	11T	357783	496487	496362	359294	Four2 (MF)	2.1	5/27						
Big Creek	517	11T	364955	496062	495960	366487	Four2	2.1	6/15						
East Fork Big Creek	580	11T	357359	495962	496076	358819	Replacement (F2)	2	5/7						
Charlie Creek	171	11T	353682	493661	493793	354743	New6 (MF)	2	4/28						
North Fork John Day															
Camas Creek	004	11T	343517	498711	498914	343984	Annual	2.3	6/1						

Table 2. Continued.

Stream	Site ID	UTM Zone	Start Coordinates Easting	Start Coordinates Northing	End Coordinates Easting	End Coordinates Northing	Panel Type	Length(km)	1	2	3	4	5	6	7
Gilmore Creek	007	11T	302011	495444	495319	302611	Annual	1.7	4/15	4/29	5/14				
Clear Creek	016	11T	383722	496154	495965	383865	Annual	2.1	5/5	5/28					
Granite Creek	490	11T	376641	496898	496759	377626	Replacement (A)	2.1	6/4	6/17					
Trout Creek	529	11T	386082	497561	497697	385234	Replacement (A)	2	6/9						
Battle Creek	535	11T	361217	496853	496907	362942	Replacement (A)	2	6/1	6/22					
Deerlick Creek	046	11T	345761	499920	500071	344871	Four2	1.8	3/31	4/9	4/23	5/6	5/18		
Swale Creek	047	11T	311207	498645	498744	312520	Four2	2.1	5/4	5/19	6/3				
Bear Wallow Creek	048	11T	364552	500795	500947	364657	Four2	2.1	4/23	5/7	5/18	6/7			
North Fork John Day	526	11T	320938	498286	498300	322083	Replacement (F2)	2	6/17						
Desolation Creek	584	11T	363047	496695	496577	364457	Replacement (F2)	2	6/10	6/23					
South Trail Creek	172	11T	390431	497665	497643	392099	New6	2	5/28	6/10					
Unnamed Trib to Davis	173	11T	386973	497745	497681	388549	New 6	2	5/20	6/4	6/10				
North Fork John Day	177	11T	364233	498167	498080	365992	New6	2	6/15						
Camas Creek	178	11T	375564	500336	500336	377480	New6	2	3/31	4/9	4/30	5/7	5/18	6/2	
Big Creek	183	11T	368306	498144	498140	369970	New6	2	6/17						
Little Wall Creek	582	11T	308797	498026	498157	308143	Replacement (N6)	2	5/21	6/8					
South Fork John Day															
South Fork Deer Creek	532	11T	313523	489451	489274	313118	Replacement (A) (SF)	2	4/14	4/27					
South Fork John Day	175	11T	295528	491167	491010	296283	New6 (SF)	2	3/30	6/2					
Deer Creek	033	11T	300296	489620	489652	301918	Four1 (SF only)	2	3/25	4/6	4/27	5/6	5/18	6/2	
Tex Creek	066	11T	319108	490517	490592	320045	Four4 (SF only)	2	4/23	5/4	5/14	5/29	6/10		
North Fork Wind Creek	097	11T	293364	490574	490544	291598	New1 (SF only)	1.9	4/10	4/20	5/13	5/27			
Black Canyon Creek	140	11T	294017	491240	491285	292328	New4 (SF only)	2	3/30	4/6	4/16	4/30	5/13	5/27	
Wind Creek	152	11T	290945	490219	490315	289644	New5 (SF only)	2	4/9	4/20					
Murderers Creek	161	11T	317209	490413	490313	318443	New5 (SF only)	2	4/23	5/4	5/14	5/27			
Deer Creek	200	11T	300304	489619	489647	301914	New7 (SF only)	2	3/24	4/6	4/27	5/6	5/18	6/11	
Murderers Creek	204	11T	314723	490522	490505	316154	New8 (SF only)	2	4/23	5/5	5/14	5/27	6/10		
Murderers Creek	223	11T	308259	490481	490488	309974	New9 (SF only)	2	5/4	5/18	6/2				

Table 2. Continued.

Stream	Site ID	UTM Zone	Start Coordinates Easting	Start Coordinates Northing	End Coordinates Easting	End Coordinates Northing	Panel Type	Length(km)	1	2	3	4	5	6	7
Murderers Creek	282	11T	297815	492175	492020	297666	New12 (SF only)	2	4/23	5/4	5/14	5/29			
South Fork John Day	345	11T	297815	492175	492020	297666	New16 (SF only)	2	4/6	6/2					
Upper John Day															
Tinker Creek	005	11T	349136	493309	493471	349678	Annual	2	4/15	4/27	5/12				
Vance Creek	015	11T	342565	490527	490616	340702	Annual	2.1	4/8	4/27	5/12				
John Day River	038	11T	365051	492412	492335	366708	Four2	2.1	6/18						
Flat Creek	044	11T	307692	492364	492181	306809	Four2	2.1	3/23	4/14	4/28	5/19			
Beech Creek	518	11T	337926	493138	493314	337753	Replacement (F2)	2	4/15	4/30	5/12	5/29			
Beech Creek	169	11T	338097	492439	492617	338409	New6	2	4/1	5/12	5/29				
Cummings Creek	176	11T	313428	492360	492523	314034	New6	2	4/8	4/28	5/13	5/29			
Grub Creek	180	11T	352073	492120	492248	350747	New6	2	4/8	4/28	5/13	5/29			

RESULTS

Steelhead Redds and Escapement

We observed 44 steelhead redds while surveying 98.6 km of an estimated 4,335 km of steelhead spawning and rearing habitat within the John Day River basin in 2009 (Table 3). This resulted in a redd density of 0.45 redds/km. By expansion, an estimated 1,934 observable redds were constructed within the John Day River basin by an estimated 7,368 spawners (Table 4; Figures 4–6). Of all subbasins, the Lower Mainstem had the highest density of redds with 0.82 redds/km followed by the Upper Mainstem with 0.70 redds/km, the Middle Fork with 0.33 redds/km, the North Fork with 0.20 redds/km, and the South Fork with 0 redds/km (Table 5). Approximately 69% of sites surveyed in 2009 had no spawning occurring within the survey reaches (Figure 5). We observed redds at 46% of sites within the Lower Mainstem, 38% in the Upper Mainstem, 23% in the North Fork, 22% in the Middle Fork and 0% in the South Fork (Table 3; Figure 5).

Redd observations at annual sites were also the lowest since the implementation of EMAP surveys exceeding only the 2005 sample year. We observed redds at 29% of annual sites in 2009 (Table 6). Since 2004 we have only observed redds at 39% of these sites and 11 sites have never contained an observable redd (Table 6). Granite Creek (site 490) and Whiskey Creek (site 10) are the only annual sites where we observed redds during only one year, every other site where redds were observed has contained redds in multiple years (Table 6). We observed redds at 31% of sites in the four-year panel in 2009 (Table 7).

Redd counts and densities at annual sites were also the lowest since 2005 (Table 6). This trend was apparent within each subbasin with the exception of the Upper Mainstem, which has not varied with basin-wide redd densities since 2004 (Figure 4). Redd counts at four year sites were similar to what we observed in 2005 (Table 7). We observed redds at 35% and 31% of sites in 2005 and 2009 respectively, however we only observed redds at three of the six sites in 2009 where redds were observed during 2005 (Table 7).

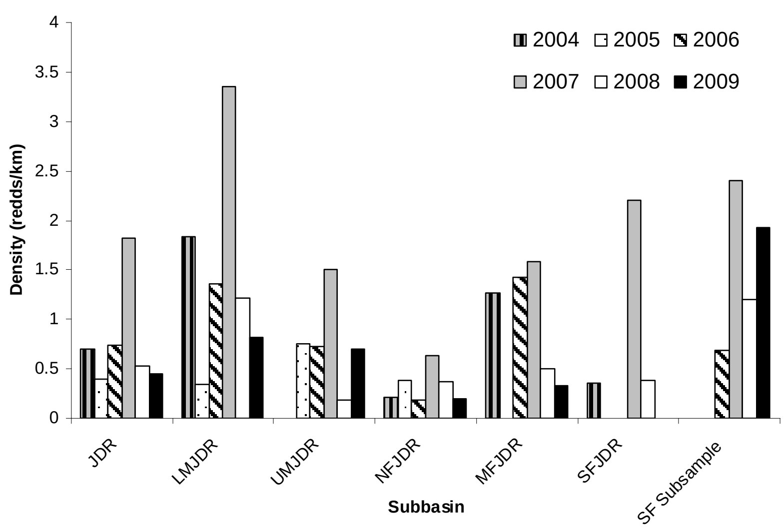

Figure 4. Average redd density (redds/km) observed in the John Day River basin (JDR Basin), Lower Mainstem (LMJDR), Upper Mainstem (UMJDR), North Fork (NFJDR), Middle Fork (MFJDR), and South Fork subbasins (SFJDR) from 2004-2009, and the South Fork subsample (SF-subsample) from 2006 to 2009.

Table 3. Total number of steelhead redds, and unmarked (wild), marked (hatchery), and unknown origin live and dead steelhead observed during spawning surveys conducted in the John Day River basin from March to June, 2009.

				Number of Live Fish				Number of Carcasses			
Stream	**Site ID**	**Redds**	**Redds/Km**	**Wild**	**Hatchery**	**Unknown**	**Total Live**	**Wild**	**Hatchery**	**Unknown**	**Total Dead**
LMJDR											
Rock Creek	006	2	1.00	0	0	0	0	0	0	0	0
Rock Creek	009	3	1.50	1	1	0	2	0	0	0	0
Service Creek	011	8	4.44	2	1	5	8	4	1	1	6
Bear Creek	036	6	2.86	1	0	1	2	0	0	0	0
Lone Rock Creek	045	1	0.48	0	0	0	0	0	0	0	0
Thompson Creek	167	0	0.00	0	0	0	0	0	0	0	0
Lone Rock Creek	170	1	0.50	1	0	0	1	0	0	0	0
Dodds Creek	174	0	0.00	0	0	0	0	0	0	0	0
Butte Creek	182	0	0.00	0	0	0	0	0	0	0	0
Milk Creek	497	0	0.00	0	0	0	0	0	0	0	0
Big Pine Hollow	514	0	0.00	0	0	0	0	0	0	0	0
Rosebush Creek	579	0	0.00	0	0	0	0	0	0	0	0
West Branch Bridge Creek	583	0	0.00	0	0	0	0	0	0	0	0
LMJDR TOTAL		**21**	**0.82**	**5**	**2**	**6**	**13**	**4**	**1**	**1**	**6**
MFJDR											
Whiskey Creek	010	0	0.00	0	0	0	0	0	0	0	0
West Fork Lick Creek	017	4	2.00	0	0	0	0	0	0	0	0
Caribou Creek	034	2	0.95	1	0	3	4	0	0	0	0
Charlie Creek	171	0	0.00	0	0	0	0	0	0	0	0
Mosquito Creek	513	0	0.00	0	0	0	0	0	0	0	0
Indian Creek	516	0	0.00	0	0	0	0	0	0	0	0
Big Creek	517	0	0.00	0	0	0	0	0	0	0	0
Middle Fork John Day River	534	0	0.00	0	0	0	0	0	0	0	0
East Fork Big Creek	580	0	0.00	0	0	0	0	0	0	0	0
MFJDR TOTAL		**6**	**0.33**	**1**	**0**	**3**	**4**	**0**	**0**	**0**	**0**

Table 3. Continued.

				Number of Live Fish				Number of Carcasses			
Stream	**Site ID**	**Redds**	**Redds/Km**	**Wild**	**Hatchery**	**Unknown**	**Total Live**	**Wild**	**Hatchery**	**Unknown**	**Total Dead**
NFJDR											
Camas Creek	004	0	0.00	0	0	0	0	0	0	0	0
Gilmore Creek	007	0	0.00	0	0	0	0	0	0	0	0
Clear Creek	016	2	0.95	0	0	0	0	0	0	0	0
Deerlick Creek	046	0	0.00	0	0	0	0	0	0	0	0
Swale Creek	047	0	0.00	1	0	0	1	0	0	0	0
Bear Wallow Creek	048	2	0.95	1	0	1	2	0	0	0	0
South Trail Creek	172	0	0.00	0	0	0	0	0	0	0	0
Unnamed Trib to Davis Creek	173	0	0.00	0	0	0	0	0	0	0	0
North Fork John Day River	177	0	0.00	0	0	0	0	0	0	0	0
Camas Creek	178	2	1.00	0	0	0	0	0	0	0	0
Big Creek	183	0	0.00	0	0	0	0	0	0	0	0
Granite Creek	490	0	0.00	0	0	1	1	0	0	0	0
North Fork John Day River	526	0	0.00	0	0	0	0	0	0	0	0
Trout Creek	529	0	0.00	0	0	0	0	0	0	0	0
Battle Creek	535	0	0.00	2	0	2	4	0	0	1	0
Little Wall Creek	582	1	0.50	0	0	1	1	1	0	0	0
Desolation Creek	584	0	0.00	0	0	0	0	0	0	0	0
NFJDR TOTAL		**7**	**0.20**	**4**	**0**	**5**	**9**	**1**	**0**	**1**	**2**
SFJDR											
South Fork John Day River	175	0	0.00	0	0	0	0	0	0	0	0
South Fork Deer Creek	532	0	0.00	0	0	0	0	0	0	0	0
SFJDR TOTAL		**0**	**0.00**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

Table 3. Continued.

Stream	Site ID	Redds	Redds/Km	Number of Live Fish				Number of Carcasses			
				Wild	Hatchery	Unknown	Total Live	Wild	Hatchery	Unknown	Total Dead
UMJDR											
Tinker Creek	005	0	0.00	0	0	0	0	0	0	0	0
Vance Creek	015	0	0.00	0	0	0	0	0	0	0	0
John Day River	038	0	0.00	0	0	0	0	0	0	0	0
Flat Creek	044	0	0.00	0	0	0	0	0	0	0	0
Beech Creek	169	1	0.50	0	0	0	0	0	0	0	0
Cummings Creek	176	7	3.50	4	0	2	6	0	0	0	0
Grub Creek	180	0	0.00	0	0	0	0	0	0	0	0
Beech Creek	518	2	1.00	4	0	1	5	0	0	0	0
UMJDR TOTAL		**10**	**0.70**	**8**	**0**	**3**	**11**	**0**	**0**	**0**	**0**
BASIN TOTAL		**44**	**0.45**	**18**	**2**	**17**	**37**	**5**	**1**	**2**	**8**

Table 4. Distance surveyed (km), number of unique redds observed, redd density (redds/km), estimated total number of redds, fish per redd estimate from Deer Creek, and spawner escapement with 95% C.I. for the John Day River basin from 2004 to 2009.

Year	km	Redds	Redds/km	Total Redds	Fish/Redd	Escapement	95% Lower	95% Upper
2004	94.7	66	0.7	3,071	1.46	4,484	1,657	7,310
2005	101.2	39	0.39	1,681	2.20	3,698	1,261	6,137
2006	90.5	67	0.74	3,202	1.66	5,315	2,189	8,441
2007	99.6	181	1.82	7,758	1.12	8,689	5,939	11,439
2008	105	56	0.53	2,277	4.07	9,260	4,742	13,775
2009	98.6	44	0.45	1,934	3.81	7,368	3,642	11,099

Table 5. Total redds observed, redd density (redds/km), and live fish observed throughout the John Day River basin (JDR) and by subbasin (LMJDR: Lower Mainstem subbasin; UMJDR: Upper Mainstem subbasin; NFJDR: North Fork subbasin; MFJDR: Middle Fork subbasin; SFJDR: South Fork subbasin) from 2004 to 2009.

	JDR			LMJDR			UMJDR			NFJDR			MFJDR			SFJDR		
Year	Redds	Density	Fish	Redds	Density	Fish	Redds	Density	Fish	Redds	Density	Fish	Redds	Density	Fish	Redds	Density	Fish
2004	66	0.70	50	38	1.83	35	0	0.00	0	8	0.21	7	17	1.27	0	3	0.35	1
2005	39	0.39	12	8	0.34	6	20	0.75	6	11	0.38	0	0	0.00	0	0	0.00	0
2006	67	0.74	32	29	1.36	18	13	0.73	2	6	0.18	4	19	1.42	8	0	0.00	0
2007	181	1.82	80	91	3.35	53	32	1.50	6	18	0.63	3	25	1.59	5	15	2.21	13
2008	56	0.53	31	26	1.21	13	3	0.19	1	16	0.37	9	8	0.50	8	3	0.38	0
2009	44	0.45	37	21	0.82	13	10	0.70	11	7	0.20	9	6	0.33	4	0	0.00	0

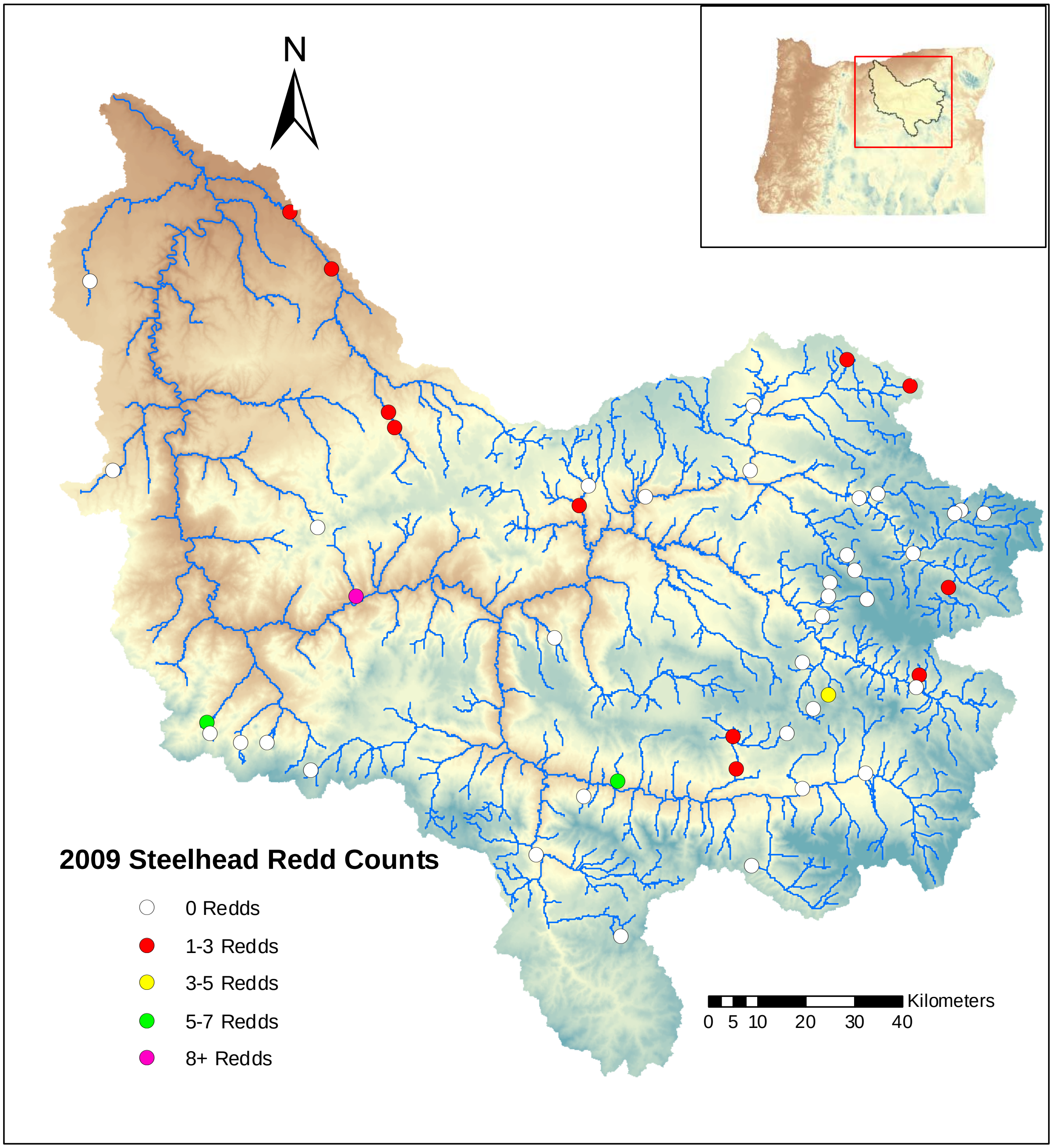

Figure 5. Distribution and number of summer steelhead redds observed in the John Day River basin during spawning surveys conducted in the spring of 2009.

Table 6. Redd observations at annual spawning survey sites in the John Day River basin conducted from February to July, 2004–2009. N/A represents sites that were not surveyed during that year but were added later to replace previous annual sites where access was revoked.

Stream	Site ID	Subbasin	2004	2005	2006	2007	2008	2009
Battle Creek	535	NFJDR	N/A	N/A	0	0	0	0
Camas Creek	4	NFJDR	0	0	0	0	0	0
Clear Creek	16	NFJDR	3	1	2	2	0	2
Gilmore Creek	7	NFJDR	0	0	0	0	0	0
Granite Creek	490	NFJDR	0	0	0	1	0	0
M.F. John Day	534	MFJDR	N/A	N/A	1	6	0	0
Milk Creek	497	LMJDR	0	0	0	0	0	0
Rail Creek	13	UMJDR	0	0	0	0	0	N/A
Rock Creek	6	LMJDR	3	1	6	7	6	2
Rock Creek	9	LMJDR	8	2	0	16	4	3
Service Creek	11	LMJDR	17	0	14	16	12	8
Tinker Creek	5	UMJDR	0	0	0	0	0	0
Vance Creek	15	UMJDR	0	0	0	0	0	0
WF Lick Creek	17	MFJDR	4	0	2	8	0	4
Whisky Creek	10	MFJDR	0	0	0	0	1	0
Trout Creek	529	NFJDR	N/A	N/A	0	0	0	0
S.F. Deer Creek	532	SFJDR	N/A	N/A	0	0	0	0
Rosebush Creek	579	LMJDR	N/A	N/A	N/A	N/A	N/A	0
TOTAL			**40**	**10**	**37**	**56**	**25**	**19**

Table 7. Redd observations at four year rotation spawning survey sites in the John Day River basin conducted in the spring of 2005 and 2009.

Stream	Site ID	Subbasin	2005	2009
Bear Creek	036	LMJDR	3	6
Bear Creek	519	UMJDR	0	N/A
Bear Wallow Creek	048	NFJDR	0	2
Beech Creek	518	UMJDR	3	2
Big Creek	517	MFJDR	0	0
Big Pine Hollow	514	LMJDR	0	0
Caribou Creek	034	MFJDR	0	2
Crawfish Creek	41	NFJDR	0	N/A
Deerlick Creek	046	NFJDR	1	0
Flat Creek	044	UMJDR	0	0
Indian Creek	516	MFJDR	0	0
John Day River	038	UMJDR	7	0
Lone Rock Creek	045	LMJDR	1	1
Mosquito Creek	513	MFJDR	0	0
NF John Day River	526	NFJDR	0	0
Rock Creek	42	LMJDR	0	N/A
Swale Creek	047	NFJDR	1	0
Desolation Creek	584	NFJDR	N/A	0
E Fk Big Creek	580	MFJDR	N/A	0
TOTAL			**16**	**13**

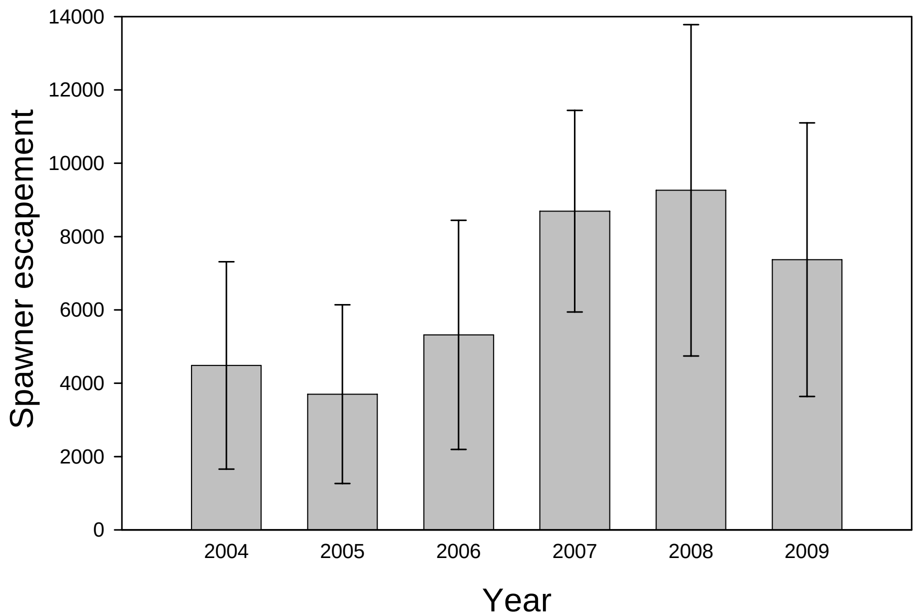

Figure 6. Annual adult steelhead escapement estimates for the John Day River basin from 2004 to 2009. Error bars indicate 95% confidence intervals.

Steelhead Spawning Timing

We observed new steelhead redds from 6 April 2009 to 11 June 2009 (Figure 6). Cumulatively, we observed 15% of the total new redds prior to 4 May 2009 and 85% of the total new redds were observed by 31 May 2009 (Figure 7). We observed over 30% of total redds during the week of 25 May 2009 to 31 May 2009. During the time period from early April to late May we had many high water flow events followed by periods of relatively low discharge due to short intervals of warm weather and greater than average snow pack (Figure 8).

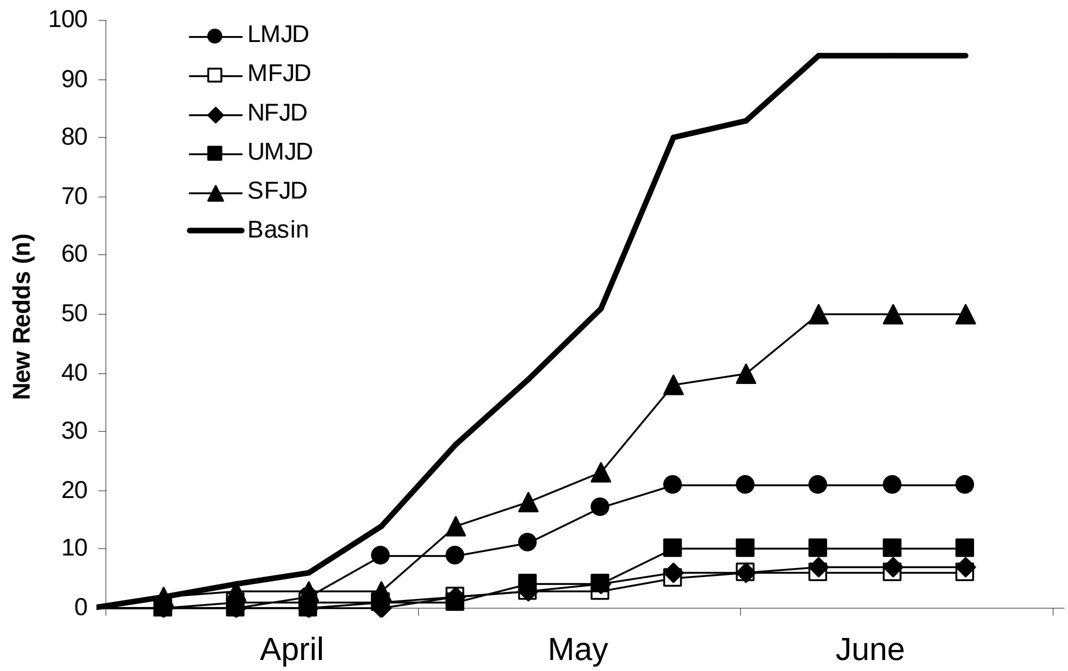

Figure 7. Cumulative number of new steelhead redds observed each week on EMAP spawning surveys in 2009.

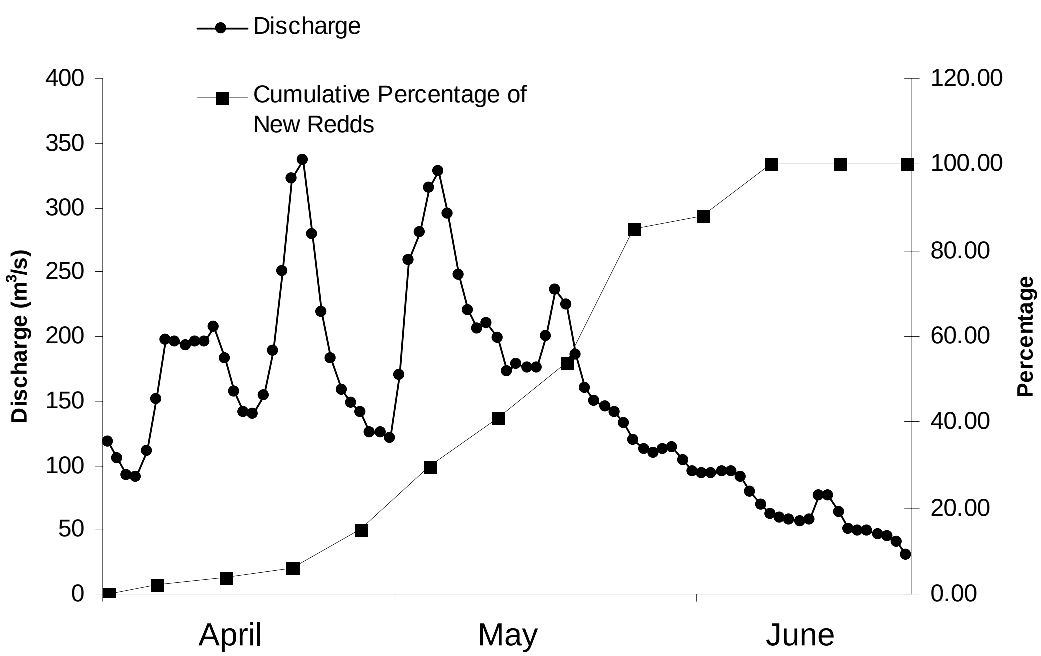

Figure 8. Mean daily discharge (m^3/s) in the John Day River at Service Creek from March 30, 2009 to June 23, 2009 and cumulative percentage of new redds observed.

South Fork John Day River Spawning Subsample

A total of 50 redds were observed while surveying 25.9 km of steelhead spawning and rearing habitat in the South Fork John Day River subbasin (Table 8; Figure 9). Redd densities at sites in the South Fork subbasin varied from zero to 7.5 redds/km (Table 8). Overall, the average redd density was 1.93 redds/km with an estimated total 481 redds constructed in the South Fork subbasin above the rotary screw trap (Table 9). We estimate that 1,833 adult steelhead spawners returned to the South Fork subbasin in 2009 (Table 9). We observed 45 live steelhead in the South Fork subsample, 23 of which were of wild origin, 1 was of hatchery origin and 21 were of unknown origin. In 2009 we replaced sites on Charlie Mack Creek (site 141) and Lemon Creek (site 187) with sites on Murderers Creek (site 282) and South Fork John Day River (site 282), we observed redds at both replacement sites (Table 10).

Table 8. Distance surveyed (km), observed redds, redd density (redds/km), estimated total number of redds, and estimated spawner escapement with 95% confidence intervals. for the South Fork John Day River subbasin from 2006 to 2009.

Year	km	Redds (n)	Redds/km	Total Redds	Fish/redd	Escapement	95% Lower	95% Upper
2006	25.9	18	0.69	186	1.66	309	145	472
2007	24.2	58	2.40	675	1.12	756	252	1,260
2008	24.2	29	1.20	301	4.07	1,224	624	1,824
2009	25.9	50	1.93	481	3.81	1,833	795	2,867

Table 9. Total number of steelhead redds observed during subbasin spawning surveys conducted in the South Fork John Day River subbasin from 2006 to 2009.

Stream	Site ID	2006	2007	2008	2009
Black Canyon Creek	140	1	14	2	5
Charlie Mack Creek	141	0	0	0	N/A
Deer Creek	33	1	3	2	6
Deer Creek	200	5	5	5	15
Lemon Creek	187	0	0	0	N/A
Murderers Creek	161	2	2	1	0
Murderers Creek	204	2	9	4	11
Murderers Creek	223	4	21	2	4
Murderers Creek	282	N/A	N/A	N/A	2
NF Wind Creek	97	0	0	8	2
SF Deer Creek	532	0	0	0	0
SF John Day River	175	0	3	2	0
SF John Day River	345	N/A	N/A	N/A	1
Tex Creek	66	3	1	3	4
Wind Creek	152	0	0	0	0
TOTAL		**18**	**58**	**29**	**50**

Table 10. Total number of steelhead redds, and unmarked (wild), marked (hatchery), and unknown origin live and dead steelhead observed during South Fork subsample spawning surveys conducted from March to June, 2009.

				Number of Live Fish				Number of Carcasses			
Stream	**Site ID**	**Redds**	**Redds/Km**	**Wild**	**Hatchery**	**Unknown**	**Total Live**	**Wild**	**Hatchery**	**Unknown**	**Total Dead**
Deer Creek	033	6	3.00	2	0	3	5	0	0	0	0
Tex Creek	066	4	2.00	1	0	0	1	0	0	0	0
North Fork Wind Creek	097	2	1.05	0	0	0	0	0	0	0	0
Black Canyon Creek	140	5	2.50	17	1	8	26	0	0	0	0
Wind Creek	152	0	0.00	0	0	0	0	0	0	0	0
Murderers Creek	161	0	0.00	0	0	0	0	0	0	0	0
Deer Creek	200	15	7.50	2	0	4	6	0	0	0	0
Murderers Creek	204	11	5.50	0	0	1	1	0	0	0	0
Murderers Creek	223	4	2.00	1	0	4	5	0	0	0	0
Murderers Creek	282	2	1.00	0	0	0	0	0	0	0	0
South Fork John Day River	345	1	0.50	0	0	1	1	0	0	0	0
South Fork John Day River	175	0	0.00	0	0	0	0	0	0	0	0
South Fork Deer Creek	532	0	0.00	0	0	0	0	0	0	0	0
SFJDR TOTAL		**50**	**1.93**	**23**	**1**	**21**	**45**	**0**	**0**	**0**	**0**

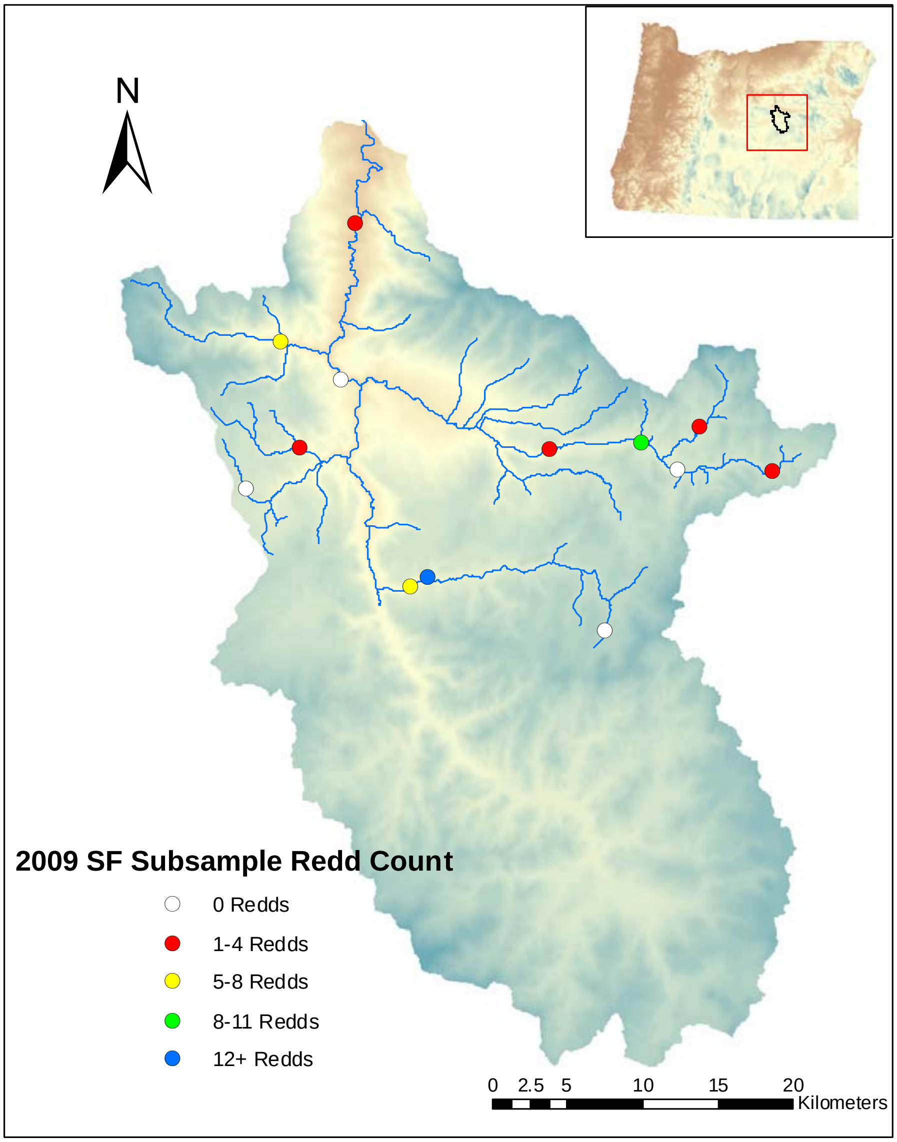

Figure 9. Distribution and number of summer steelhead redds observed in the South Fork John Day River during subbasin spawning surveys conducted in 2009.

Hatchery:Wild Observations

Hatchery steelhead composed 7% (3 of 44) of live steelhead observed in the John Day River basin in 2009 where the presence (unmarked, presumed wild) or absence (marked, presumed hatchery) of an adipose fin could be determined, however, origin was only determined for 54% of live fish (Table 11). Using the ratio of live clipped : unclipped steelhead (7% and 93%, respectively) observed in the John Day river basin, we estimate that of the 7,368 steelhead in the John Day River basin in 2009, 516 were of apparent hatchery origin and 6,852 were wild steelhead. The percentage of live adult hatchery steelhead observed in the John Day river basin has varied from approximately 40% to this year's low of 7% over the past six years (Figure 10). The majority of hatchery observations (66%) were observed in the LMJDR subbasin, a trend that has been consistent since 2004 (Table 11). Wild steelhead were also observed at every site where hatchery steelhead were observed (Figure 11).

We observed eight summer steelhead carcasses in 2009, six were in Service Creek (site 011), one was in Battle Creek (site 535), and one was in Little Wall Creek (site 582). We were able to determine origin of six of the eight carcasses, one of which was of hatchery origin and was observed in Service Creek. We determined sex of one carcass, a female hatchery fish in Service Creek (Table 11). Observed evidence suggests that the mortality of every carcass observed in Service Creek had been caused by wildlife predation.

Table 11. Number of live steelhead observed and determined for origin, number and percentage marked and unmarked, and number marked and unmarked steelhead near redds during surveys conducted during 2009. LMJDR: Lower Mainstem subbasin; UMJDR: Upper Mainstem subbasin; NFJDR: North Fork subbasin; MFJDR: Middle Fork subbasin; SFJDR: South Fork subbasin (includes steelhead observed during SF subsample surveys).

Subbasin	# Observed	# Determined	# Marked	% Marked	# Marked Near Redd	# Unmarked	# Unmarked Near Redd
LMJDR	13	7	2	29	0	5	1
UMJDR	11	8	0	0	0	8	1
NFJDR	9	4	0	0	0	4	1
MFJDR	4	1	0	0	0	1	0
SFJDR	45	24	1	4	0	23	6
BASIN TOTAL	**82**	**44**	**3**	**7**	**0**	**41**	**9**

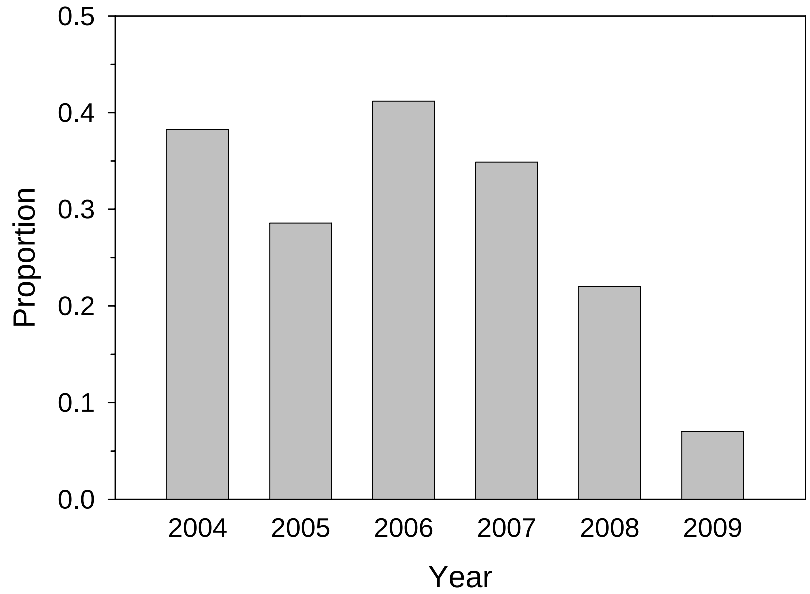

Figure 10. Proportion of steelhead spawners observed during spawning surveys in the John Day River subbasin that were identified as hatchery origin from 2004 to 2009.

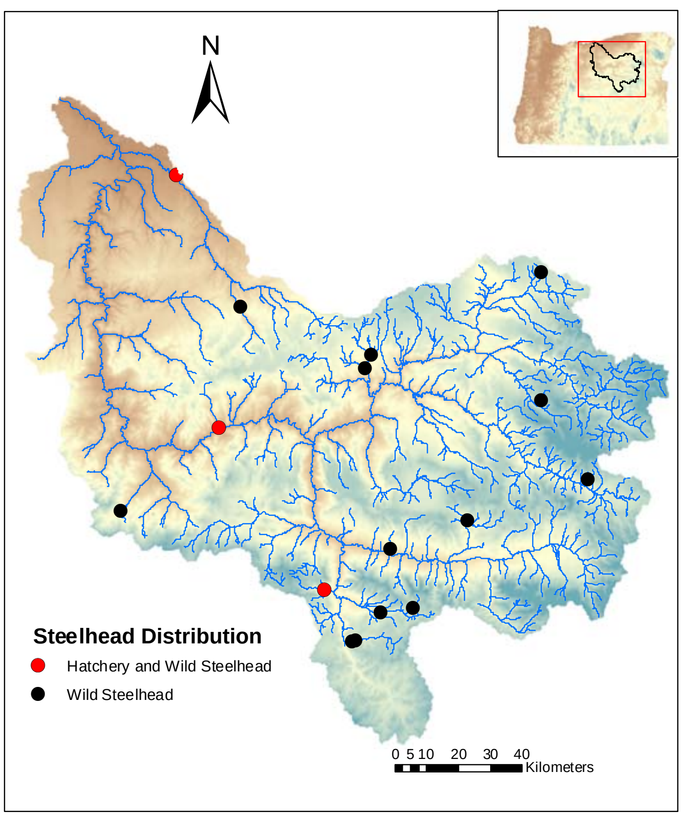

Figure 11. Distribution of hatchery and wild steelhead observations in the John Day River basin during summer steelhead spawning surveys conducted in the spring of 2009 (includes observations in the South Fork Subsample).

DISCUSSION

Although redd counts and densities were the lowest since 2005, the steelhead escapement estimate for the John Day River basin was above average since commencing the EMAP monitoring project in the basin in 2004. High flow events persisted throughout much of the spawning season again in 2009 making redd observations difficult, which resulted in a low redd density estimate. Index surveys in the John Day River basin conducted by Oregon Department of Fish and Wildlife Biologists in 2009 also resulted in below average redd densities. We corrected for this sampling artifact by using an annual fish/redd estimate from Deer Creek, a survey with a known adult escapement above a weir. Deer Creek had similar redd viewing conditions in 2009 as the John Day River basin. The fish per redd estimate at the Deer Creek weir was 3.81, the second highest since 2004, exceeded only by the 2008 estimate, when discharge was higher throughout both the Deer Creek and John Day River basins (McCormick et al. 2008).

We did not observe spawning activity again, at a large proportion of sites surveyed in 2009. In the past five years, greater than 50% of sites surveyed in any given year have been void of any observable spawning activity. Of the 17 sites that we survey annually, we also have observed spawning at less than 50% of sites. While the steelhead spawning distribution in the John Day River basin is likely variable year to year, the fact that over half the sites surveyed in any given year, including annual and four year sties, are not being utilized for steelhead spawning suggests we do not fully understand current steelhead spawning habitat use in the basin.

In 2006 we implemented the South Fork subsample which includes sites distributed using the EMAP sample design, but at a much higher density compared to the general basin wide sample. In 2009 we sampled 12% of the available habitat in the South Fork subbasin compared to 2% basin wide. Even with the increased sampling intensity, variability for redd and escapement estimates were relatively similar between the South Fork subsample and the basin wide sample. This suggests that it may require a large amount of additional sampling effort to achieve acceptable variance estimates and effort may be better applied to refining the steelhead sampling universe. However, increased sampling intensity inherently allows us to evaluate more spawning habitat while conducting spawning surveys thus further refining the sampling universe. Given our high variance levels, we may not be able to sufficiently detect short term changes in steelhead escapement which may effect our evaluation of restoration efforts and management decisions (Maxell 1999). In order to refine our sampling universe in 2009, we have removed sites on Simpson Creek (prior to 2009 sample), Charlie Creek (site 171), East Fork Big Creek (site 517), Rosebush Creek (site 579) and Thompson Creek (167) from the sample draw. These stream lengths have been removed from the sampling universe. Simpson Creek, Rosebush Creek, Charlie Creek and East Fork of Big Creek contain little to no spawning habitat and a cascade on Gable Creek that is a barrier to upstream adult fish passage prevents fish from entering Thompson Creek. We will continue to refine known spawning distribution through identification of barriers and habitat clearly unsuitable for redd construction due to overriding geomorphic conditions.

Lower Mainstem tributaries have accounted for the majority of redds constructed in any given year suggesting that the Lower Mainstem habitat is an important component of steelhead production within the John Day Basin (see Table 5). With the exception of 2005, when low water limited adult steelhead access to smaller tributaries (Wiley et al. 2005), the Lower Mainstem tributaries have accounted for 49% of redd observations in the basin since 2004. There is significant potential for smolt production in the Lower Mainstem habitat. Unfortunately, we are unable to effectively monitor this production due to logistical and monetary constraints.

In 2009 we estimated hatchery composition of adult steelhead at 7%, the lowest since we began using the EMAP sample design. Similarly, fewer than average hatchery strays were observed in other ongoing monitoring projects in the basin during 2009 (Appendix Table A). Visual observations during surveys potentially underestimate the hatchery fish component because of bias towards detecting an adipose fin rather than determining its absence (Susac 2005). Further, not all hatchery fish released in the Columbia River basin have adipose fin clips. In 2009, the lower mainstem had the majority of hatchery fish observations, a trend that has been apparent since 2004. In September 2007 a Passive Integrated Transponder (PIT) tag detection array became operational at McDonald's Ford at river kilometer 32 in the John Day River. Between 1 September 2008 and 15 June 2009, this array detected 141 adult steelhead. Of these, at least 30 were of hatchery origin and 22 of these fish were transported from the Snake River as smolts (DART 2007). The array also detected 15 adult steelhead of wild origin that were tagged out of the basin, of these 13 were transported from the Snake River as smolts (DART 2007). The continued operation of this array will be important for future monitoring of stray steelhead in the John Day River.

CONCLUSIONS

To improve our ability to estimate steelhead escapement in the John Day River basin, we need to further refine the current distribution of steelhead spawning habitat. Such refinements will allow us to better determine high priority areas for restoration projects and identify key areas where adequate spawning habitat exists but is not currently being utilized. We currently provide escapement estimates with 95% confidence intervals approximately 50% of the mean. Given similar high variance even with increased sampling intensity within the South Fork sub sample, increasing sample size alone may not be sufficient to reduce sample variance. We believe significant variance arises from the high frequency of reaches with no redds. Refining the current steelhead sampling universe will reduce the number of sample reaches with zero redd counts and thus, reduce the variance of our escapement estimates. The current methods used for assessing hatchery steelhead stray rates into the John Day River basin are not sufficient for measuring the impact of these strays. Additional effort is needed to measure the relative contributions of hatchery and wild fish to natural production, and the relative productivity of streams with hatchery fish compared to tributaries where they are still absent.

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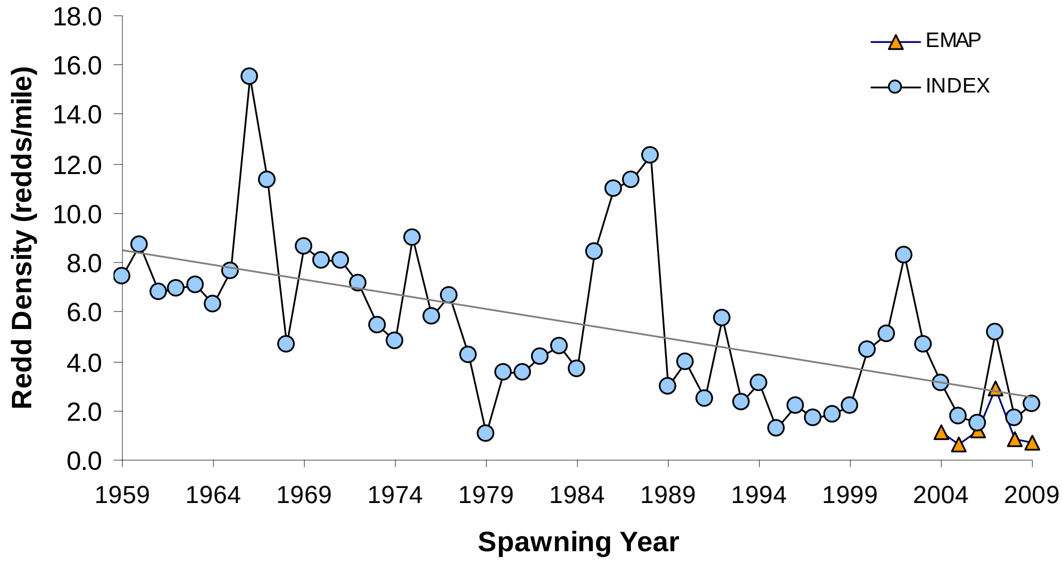
APPENDIX



Appendix Figure A. Decline ($P < 0.001$) in summer steelhead redd density (redds/mile) observed at index survey sites (circles) sampled by ODFW personnel in the John Day River basin from 1959 to 2009. Redd densities observed at EMAP sites (triangles) are shown for comparison.

Appendix Table A. Recovery year, number of wild steelhead, number of hatchery steelhead, and percent hatchery steelhead observed during index steelhead spawning surveys in the John Day River basin (Jeff Neal, unpublished data), seining in the Mainstem John Day River between Kimberly (rkm 298) and Spray (rkm 274), and operation of rotary screw traps in the Middle Fork, South Fork, and Mainstem John Day River. Seining and rotary screw trap data (includes both live fish and carcass observations) were compiled from the John Day Basin Spring Chinook Salmon Escapement and Productivity Monitoring Project (Ruzycki et al. 2002; Carmichael et al. 2002; Wilson et al. 2002; Wilson et al. 2005; Wayne Wilson, unpublished data).

Recovery	Index			Spring Chinook Monitoring Project		
Year	# of Wild Steelhead	# of Hatchery Steelhead	% Hatchery Steelhead	# of Wild Steelhead	# of Hatchery Steelhead	% Hatchery Steelhead
2000	--	--	--	11	1	8.3
2001	--	--	--	8	2	20
2002	173	16	8.5	20	13	39.4
2003	27	2	6.9	11	2	15.4
2004	12	1	7.7	16	6	27.3
2005	15	1	6.3	8	4	33.3
2006	22	4	15.4	10	5	33.3
2007	41	2	4.6	10	0	0
2008	28	2	6.6	19	1	5
2009	55	0	0	24	5	17
TOTAL	**373**	**28**	**7**	**137**	**39**	**22**