FISH RESEARCH PROJECT
OREGON

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

ANNUAL PROGRESS REPORT

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EXECUTIVE SUMMARY

Objectives

1. Monitor status and trends in the abundance of juvenile salmonids and stream and riparian habitats in the John Day River basin.

2. Monitor status and trends in steelhead redd abundance and spawners in the John Day River basin.

Accomplishments and Findings

We sampled 52 random, spatially-balanced sites throughout the John Day River basin during the spring (19 March–14 June) of 2007 to determine summer steelhead *Oncorhynchus mykiss* redd abundance. Survey sites encompassed 99.6 km (61.9 miles) of an estimated 4,269 km (2,653 miles) of steelhead spawning and rearing habitat within the basin. During these surveys, 181 redds and 80 live steelhead were observed. Redd and adult steelhead escapement estimates for the basin were 7,758 and 8,689, respectively. The adult steelhead escapement estimate in 2007 was significantly greater than the annual escapements from 2004 thru 2006. Redd counts at annual EMAP sites were also greater than any of the previous three years. Hatchery steelhead composed an estimated 35% (15 of 43) of live fish where the presence or absence of an adipose fin clip could be determined. The majority of marked hatchery fish were observed in the Lower Mainstem John Day River subbasin below the confluence with the North Fork John Day River. We estimate that of the 8,689 steelhead in the John Day River basin in 2007, 3,041 were of hatchery origin and 5,648 were natural-origin steelhead.

During the summer (28 June–26 September) we surveyed 47 sites to determine juvenile salmonid distribution and abundance. Salmonid abundance was quantified by one-pass upstream snorkeling or electrofishing through pools at each site. Steelhead were the most abundant salmonid observed occurring at 42 of 45 sites. Spring Chinook salmon *O. tshawytscha*, Westslope cutthroat trout *O. clarki*, and bull trout *Salvelinus confluentus* were observed at a smaller percentage of sites (17%, 21%, and 2%, respectively). Eastern brook trout *S. fontinalis* were observed at two survey sites during 2007. The mean percentage of pools with steelhead at sites where at least one conspecific individual was present was 71% (Subbasin Range; 53%–92%) while spring Chinook occurred in 70% of pools when at least one conspecific was present at a site (Subbasin Range; 41%–77%). However, spring Chinook were not observed in two subbasins in the drainage: the Lower and Upper Mainstem John Day River subbasins. Several annual sites had similar or increased densities of *O. mykiss* compared to previous years. However, Granite Creek (Site 490) continued to show declines in *O. mykiss* densities from 2004 to present. Westslope cutthroat trout, bull trout, and Eastern brook trout occurred infrequently during surveying and were less abundant in pools at sites where their respective species were present (44%, 20%, and 8%, respectively). In addition to salmonids, at least seven non-target species were observed during salmonid surveys, including; suckers *Catostomus* spp., sculpin *Cottus* spp., mountain whitefish *Prosopium williamsoni*, northern pikeminnow *Ptychocheilus oregonensis*, redside shiner *Richardsonius balteatus*, smallmouth bass *Micropterus dolomeiu*, catfish *Ictalurus* spp., and dace *Rhynichthys* spp.

Habitat sites surveyed during 2007 (n=49) were dominated by grass or shrub vegetation in the riparian zone and had constrained channel forms. Dominant land use type at sites varied from light or heavy grazing to riparian exclosures and wilderness area. Data analysis of selected 2007 habitat parameters across the five John Day River subbasins yielded only a few statistical differences. The Lower Mainstem had higher bank erosion and percent gravel in riffle habitats than the North Fork which is consistent with previous years. In addition, the North Fork had a greater active channel width than either the South Fork or Lower Mainstem and the Lower Mainstem had less wood volume than either the Upper Mainstem, Middle Fork, or North Fork. Future surveys should allow for a more comprehensive evaluation of habitat in the basin by providing more data and a larger time frame over which to compare habitat conditions.

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 increase our knowledge of steelhead spawning distribution.

2. Consider using genetic and pedigree analysis to understand the influence of hatchery steelhead on John Day River wild summer steelhead stocks.

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 habitat limiting factors for key salmonid species within the basin and give greater incentive and guidance for restoration projects.

4. Modify current sampling protocol to monitor steelhead at the population scale in addition to the John Day River subbasin scale.

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 also like to thank Tim Unterwegner and Jeff Neal for providing much needed guidance and advice regarding steelhead spawning ground surveys. Their information was extremely helpful for survey planning and landowner contacts. Furthermore, we would like to acknowledge our field crew members Kevyn Groot and Barbara McLean 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: 28894.

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 ESU, 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's 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 U.S. 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, juvenile steelhead and other salmonid rearing distributions, physical habitat conditions, 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 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 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 is one of only two 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 (9,603 miles) of stream habitat available for fish, but only 4,602 km (2,859 miles; 30%) are known or assumed to be used for various anadromous salmonid life history stages (spawning, rearing, and migration; Figure 2).

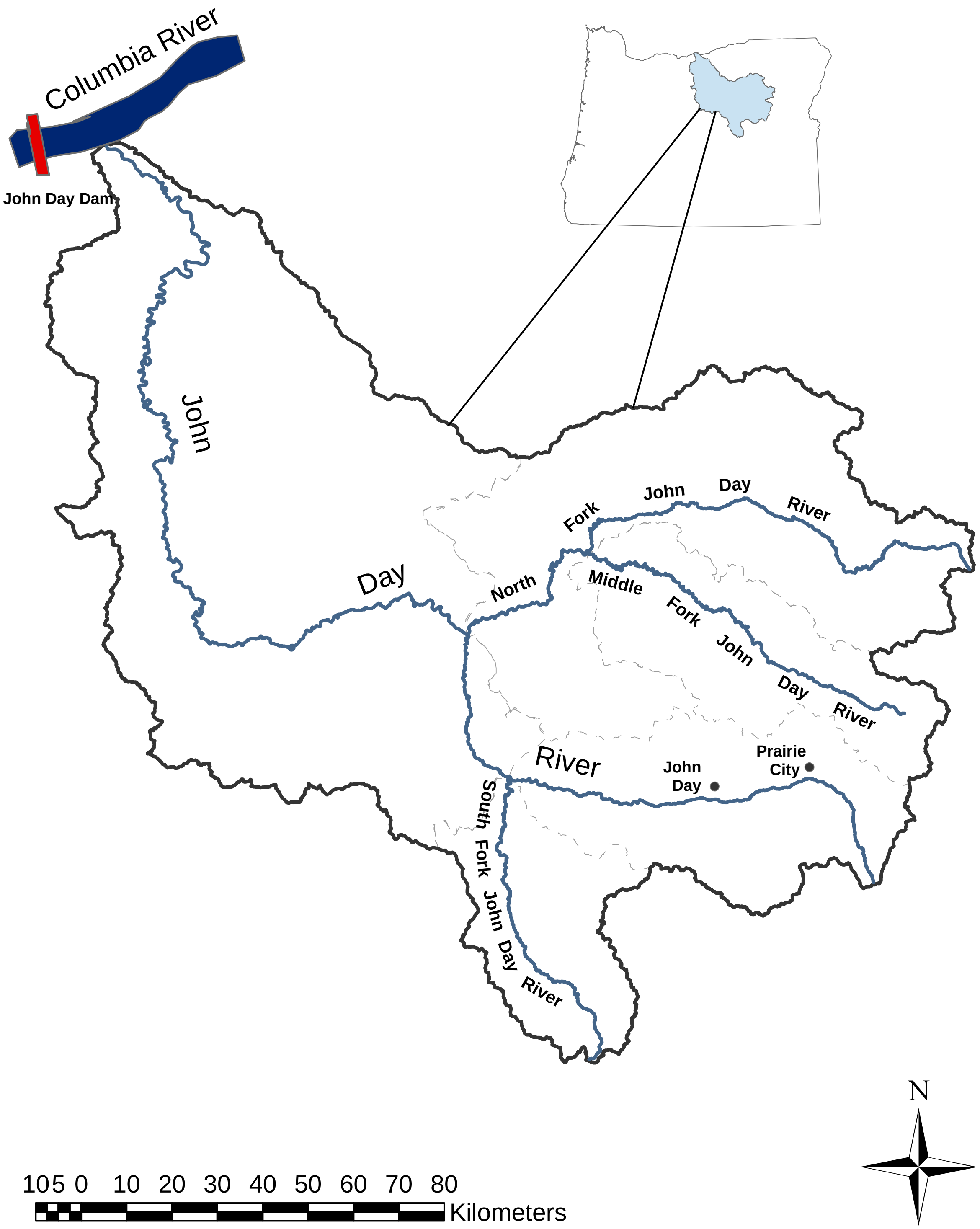

Figure 1. Map of the John Day River basin including the Mainstem John Day River and all three major forks (North Fork, Middle Fork, and South Fork). Dashed grey lines represent subbasin delineations (Lower Mainstem, Upper Mainstem, North Fork, Middle Fork, and South Fork subbasins).

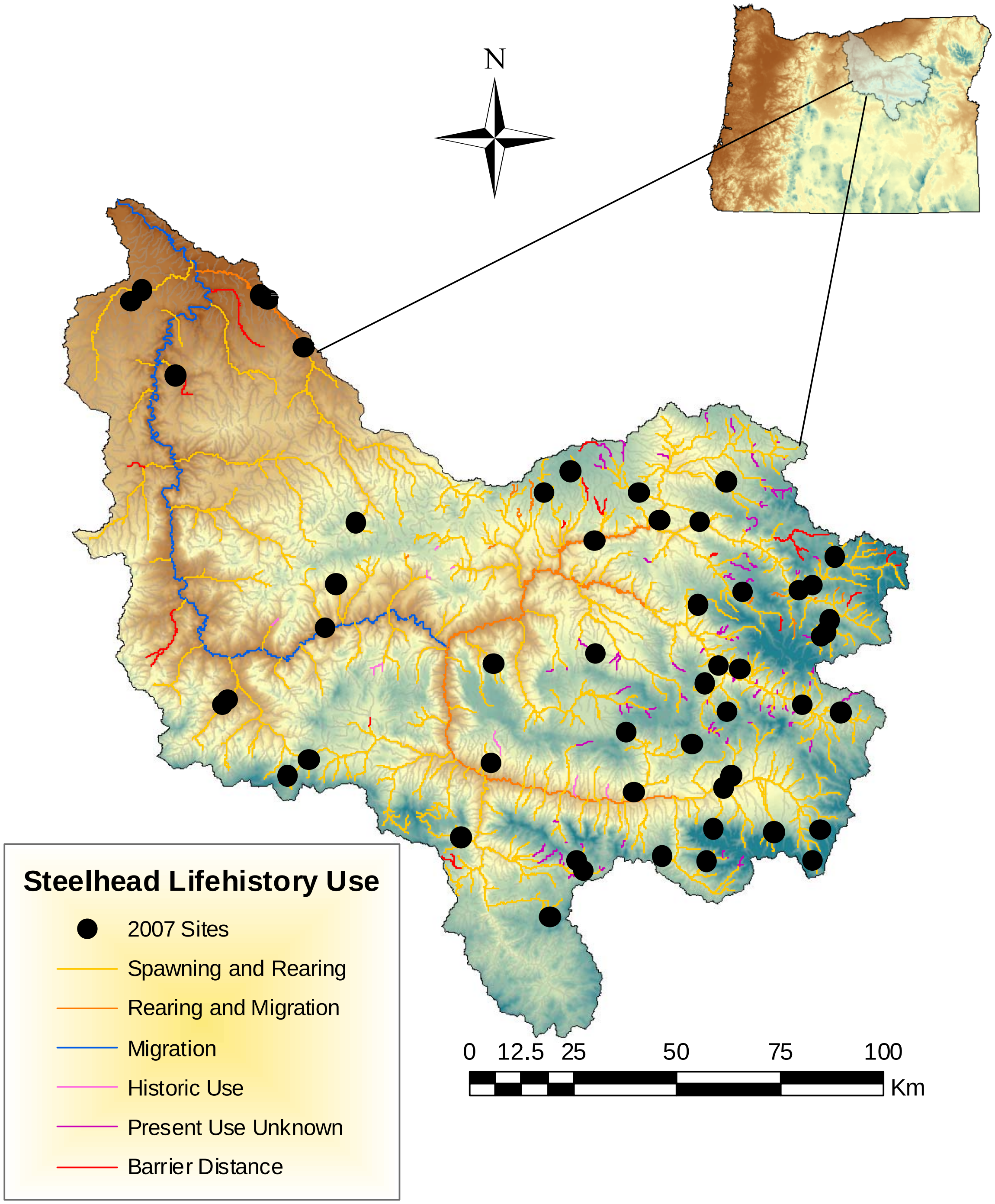

Figure 2. Map of summer steelhead life history use in the John Day River basin and 2007 EMAP sample sites.

Sampling Domain and Site Selection

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). Sample sites were derived from a 1:100,000 EPA River Reach file and all streams upstream of known barriers to anadromous fish passage were eliminated from the sampling universe. Fifty sample sites are targeted each year. In order to balance the needs of status (more random sites) and trend (more repeat sites) monitoring, the following rotating panel design was implemented in the John Day River 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 newly discovered 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 (EMAP blocked reaches; Figure 2), the removal of barriers (e.g. road culverts), and other restrictions (e.g. dry streams) that limit fish life history stages. These stream miles are removed or added back into our sampling universe accordingly.

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 February to June 2007 (Table 1). 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 sampling design. 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 flagged redds, new redds, and redds missed during the previous survey. Missed redds were distinguished from new redds by the amount of periphytic growth in the redd pocket. New redds were expected to be devoid of periphyton whereas older redds would be obscured by periphytic growth or sediment deposits.

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:

$$E_S = 1.12 \cdot R_T \qquad (3)$$

where 1.12 is a fish per redd constant developed from repeated spawner surveys in the Grande Ronde River basin during 2007. This fish per redd estimate is adjusted annually based on observations of repeat spawning ground surveys and weir counts on Deer Creek, a tributary to the Wallowa River that has a permanent counting weir for adult steelhead (Flesher et al. 2005; Jim Ruzycki, ODFW, unpublished data). A locally weighted neighborhood variance estimator (Stevens 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. 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 two or less, fall into our sampling frame in any given year. In 2007, we again surveyed 12 additional sites including four sites already in the 2007 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 12 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 (251 km).

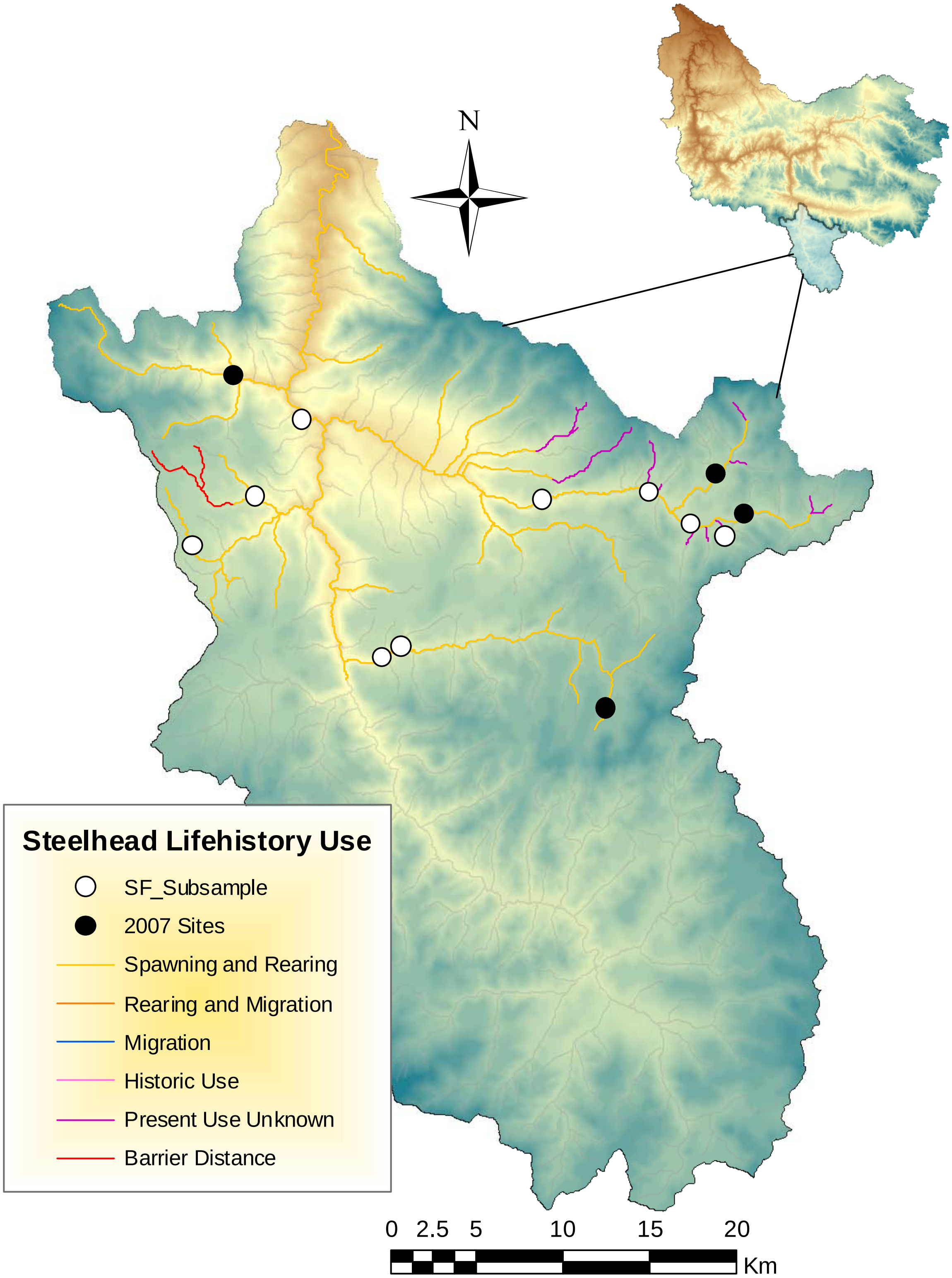

Figure 3. Map of sites selected for sub-sample spawning surveys in the South Fork John Day River subbasin in 2007. White circles denote sites incorporated from the basin-wide sampling frame and black circles denote sites selected for subbasin sampling.

Juvenile Salmonid Surveys

Juvenile salmonid surveys were conducted concurrently with habitat surveys from July to October to determine the distribution and abundance of salmonids and other fishes occurring in the basin (Table 2). Juvenile sampling was conducted in habitat units classified as a "pool". Pool habitats were electrofished if depths were shallow enough (average maximum pool depth < 60 cm) to safely and effectively sample them with a backpack electrofisher and water temperatures were below 18˚C. Pool habitats were snorkeled when electrofishing was not feasible, when the average maximum pool depth exceeded 40 cm, and when the site had adequate water clarity.

Electrofishing involved a single pass upstream through pools within the reach using one Smith-Root model 12-B backpack electrofisher (DC; variable voltage) following NMFS electrofishing guidelines for juvenile salmonid presence : absence. Stunned fish were captured with dip nets (0.32 cm mesh) and held in a bucket for identification after the pool was sampled. No block nets were used for this sampling. Snorkeling involved a single pass upstream through pools within the reach using a sufficient number of snorkelers to effectively cover each pool (generally 1–2 snorkelers). The number of juvenile (<152 mm; fork length, FL) and adult (>152 mm, FL) salmonids for each species were recorded for each pool. The length used for discriminating between juvenile versus adult salmonids (152 mm) is based on size classes developed from local data and standards used by ODFW and co-managers. Although this size distinction is used as a general guide, numerous juvenile steelhead larger than 152 mm FL have been recorded in the basin. Incidental species encountered during salmonid surveys were identified to genus and species, when possible, and recorded as present.

We also coordinated our juvenile salmonid surveys with personnel from the John Day integrated status and effectiveness monitoring program (ISEMP) group. This coordination included a quantitative analysis of our methods to enumerate juvenile salmonids. After our juvenile fish surveys were completed, each sample reach was surveyed using electrofishing and mark-recapture techniques. This calibration work should allow us to relate our qualitative fish density estimates to more quantitative estimates of fish abundance.

Salmonid distribution and abundance in the John Day River basin were assessed by determining the number and percentage of sites occupied by each species and by their respective juvenile (<152 mm) and adult (>152 mm) forms. Salmonid abundance was further assessed by calculating the percentage of pools occupied at sites where conspecifics occurred. Density estimates (number of fish/m^2) at annual sites were used to assess trends in steelhead and spring Chinook salmon *O. tshawytscha* (Chinook) observed during juvenile salmonid surveys. When juvenile steelhead are referenced in this document, we acknowledge the presence of alternate life-history forms and that some juveniles of all sizes may be resident fish (redband trout; steelhead). These alternate life-history forms are typically morphologically indistinguishable. We therefore refer to all juvenile *O. mykiss* as juvenile steelhead. In contrast, adult steelhead are generally easy to distinguish from resident redband adults based on body size. The distribution and frequency of occurrence of incidental species was also determined for each site, subbasin, and for the entire John Day River basin.

Habitat and Riparian Surveys

Habitat and riparian surveys were conducted from June to September 2007 (Table 2) and were designed to describe important attributes of fish habitat structure within and adjacent to the stream channel. The objectives of these surveys were to describe current habitat conditions (status) and to track their trends over time. Surveys were conducted as described by Moore et al. (2002) with two modifications. First, our surveys were 500 m in length for sites with an active channel width less than five meters, and 1,000 m in length for sites with an active channel width greater than five meters. Second, all wood (≥0.15 m DBH and ≥3.0 m length) within or intercepting the active channel and all habitat unit lengths and widths were measured (as opposed to estimating).

Once a sample reach was located, surveys were conducted by walking upstream from the downstream end of each survey reach identifying channel unit types (e.g. pools, riffles, rapids, cascades, etc.), measuring unit dimensions (length, width, and depth), and determining unit slope. Channel characteristics such as substrate composition, % eroded banks, and % undercut banks were estimated for each unit. The amount of large woody debris was quantified by measuring all wood pieces (≥ 0.15 m DBH and ≥ 3 m in length) within or intercepting the active channel. Three riparian transects were conducted within the reach which included estimating the percentage of canopy, grass, and shrub cover, quantifying the number and sizes of hardwood and conifer trees, and determining the slope of the riparian zone. These variables are indicators of habitat structure, sediment supply and quality, riparian-forest connectivity and health, and in-stream habitat complexity. They describe some of the key components for evaluating salmonid habitat, and are good indicators of habitat structure, and streamside and upland processes.

Statistical analysis was conducted on 16 selected habitat features from the data set. Each response was modeled using a One-Way ANOVA with subbasin (Lower Mainstem, Upper Mainstem, North Fork, Middle Fork, or South Fork) as the main effect. Prior to modeling, data were assessed for normality and equal variance in order to comply with parametric model assumptions. Non-normal response variables were transformed either with a Log_{10}, $Log_{10}(x+1)$, Square Root, or Arcsine-square root transformation. Significant model effects ($P<0.05$) were then tested using Tukey's Pairwise multiple comparisons in order to protect Type I error rates.

Table 1. 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 20 March to 12 June, 2007. LMJDR: Lower Mainstem subbasin; UMJDR: Upper Mainstem subbasin; NFJDR: North Fork subbasin; MFJDR: Middle Fork subbasin; SFJDR: South Fork subbasin.

Stream	Site ID	UTM Zone	Start Coordinates		End Coordinates		Panel Type	Distance (km)	Survey Dates					
			Easting	Northing	Easting	Northing			1	2	3	4	5	6
LMJDR														
Badger Creek	552	10	0734331	4933902	0733361	4932934	Four4	1.8	4/5	4/16	4/25	5/10	5/23	
Bear Creek	77	10	0714288	4947761	0713136	4946502	Four4	2.0	4/2	4/16	4/30			
Bear Creek	555	10	0713137	4946499	0711848	4945443	Four4	2.0	4/2	4/16	4/30			
Buckhorn Creek	145	11	0270712	4990558	0269196	4989596	New4	2.0	4/2	4/10	4/26	5/7		
Ferry Canyon	68	10	0697472	5026052	0698129	5024717	Four4	2.0	3/20	3/27				
Franks Creek	146	11	0299160	4929427	0300448	4930501	New4	2.0	3/29	4/10				
Grass Valley Canyon	79	10	0690421	5044691	0689313	5045021	Four4	1.9	3/27					
Hay Canyon	562	10	0687091	5043602	0686642	5041694	Oversample	2.0	3/27					
Lake Creek	76	11	0265575	4973776	0264870	4975292	Four4	2.0	4/5	4/12	4/26			
Milk Creek	497	10	0728121	4928713	0727445	4927348	Annual	1.7	5/23					
Rock Creek	557	10	0717842	5044985	0718870	5044428	New4	2.0	3/21	3/28	4/9	4/25		
Rock Creek	6	10	0728344	5033646	0729031	5032360	Annual	2.0	3/22	3/28	4/9	4/25		
Rock Creek	9	10	0718867	5044432	0719995	5043658	Annual	2.0	3/21	3/28	4/9	4/25		
Service Creek	11	10	0737165	4964565	0735738	4965368	Annual	1.8	3/22	3/29	4/5	4/19	4/26	5/7
UMJDR														
Bear Creek	134	11	0358624	4923321	0358415	4925051	New4	2.0	4/3	4/13	4/24			
Beech Creek	78	11	0334211	4922196	0335817	4922532	Four4	2.0	3/26	4/4	4/16	4/25	5/8	
Beech Creek	149	11	0334779	4935473	0333267	4936598	New4	2.0	3/26	4/9	4/18	4/25	5/9	
EF Canyon Creek	143	11	0350354	4903120	0351481	4904523	Four4	2.0	4/20	5/1	5/11	5/22	5/29	
John Day River	81	11	0376499	4905410	0377026	4903555	Four4	2.0	5/10	5/16	5/31	6/12		
John Day River	559	11	0355817	4922000	0356910	4922485	New4	1.2	4/5	4/17	5/10	5/30		
Pine Creek	138	11	0353694	4913700	0353652	4912051	New4	2.0	5/10	5/24	5/31			
Rail Creek	13	11	0377482	4910520	0379322	4911070	Annual	2.0	5/16	5/31				
Slide Creek	80	11	0367998	4910970	0367476	4909203	Four4	2.0	5/17	5/29	6/12			
Tinker Creek	5	11	0349136	4933091	0349678	4934711	Annual	2.0	4/9	4/30				
Vance Creek	15	11	0342565	4905270	0340702	4906162	Annual	2.1	4/19	5/22				

Table 1. (Cont.)

Stream	Site ID	UTM Zone	Start Coordinates Easting	Start Coordinates Northing	End Coordinates Easting	End Coordinates Northing	Panel Type	Distance (km)	Survey Dates 1	2	3	4	5	6
NFJDR														
Battle Creek	535	11	0361217	4968533	0362942	4969070	Annual	2.0	5/24					
Cable Creek	67	11	0359035	4997571	0360114	4996114	Four4	2.0	4/3	4/20	5/3	5/15		
Camas Creek	4	11	0343517	4987110	0343984	4989146	Annual	2.3	5/29					
Clear Creek	74	11	0382276	4958569	0381517	4957486	Four4	1.4	5/14	5/23	5/30	6/6		
Clear Creek	71	11	0383997	4958198	0382276	4958574	Four4	2.0	5/14	5/23	5/30	6/6		
Clear Creek	16	11	0383722	4961548	0383865	4959655	Annual	2.1	4/26	5/14	5/23	5/30	6/6	
Ditch Creek	561	11	0315895	4993491	0316027	4995233	Oversample	2.0	4/12	5/1				
Fivemile Creek	133	11	0340569	4994003	0338842	4994398	New4	2.0	3/23	5/1				
Gilmore Creek	7	11	0302011	4954449	0302611	4953198	Annual	1.7	4/9	4/18	5/2			
Granite Creek	490	11	0376641	4968983	0377626	4967590	Annual	2.1	5/15	6/5				
NF John Day River	73	11	0378745	4969938	0379937	4970081	Four4	2.0	5/15	5/23	6/5			
NF John Day River	70	11	0326285	4982723	0327806	4983025	Four4	2.0	3/19	4/4	5/29			
NF John Day River	136	11	0351622	4986052	0353371	4986482	New4	2.0	3/19	4/4	5/24	6/4	6/14	
Trout Creek	529	11	0386082	4975613	0385234	4976978	Annual	2.0	5/30					
Wilson Creek	553	11	0322674	5000015	0321803	5000512	Four4	1.0	5/15					
MFJDR														
Coyote Creek	148	11	0361742	4948729	0361626	4950565	New4	2.0	4/17					
Crawford Creek	137	11	0385290	4938154	0385617	4939708	New4	2.0	4/17	5/2				
Indian Creek	558	11	0350649	4967179	0352133	4966620	New4	2.0	4/19	5/14	5/22	6/4		
Little Basin Creek	139	11	0325885	4957334	0326728	4955943	New4	2.0	4/18					
MF John Day River	147	11	0355764	4953545	0356320	4951773	New4	2.0	4/3	4/23	5/8			
MF John Day River	534	11	0374803	4941921	0376194	4941394	Annual	2.0	4/3	4/23	5/8	5/22		
WF Lick Creek	17	11	0358255	4942481	0358053	4940539	Annual	2.0	4/17	4/23	4/30			
Whisky Creek	10	11	0354555	4946886	0353113	4947271	Annual	1.7	4/23					
SFJDR														
Black Canyon	140	11	0294017	4912403	0292328	4912850	New4	2.0	4/4	4/17	4/24	5/7	5/21	
Charlie Mack Creek	141	11	0321638	4903385	0321639	4904121	New4	0.8	4/11					
SF Deer Creek	532	11	0313523	4894513	0313118	4892743	Annual	2.0	4/11					
Tex Creek	66	11	0319100	4905182	0320098	4905983	Four4	2.0	4/11	4/24	5/2	5/17		

Table 2. Stream, site identification number, start and end coordinates (UTM-NAD27), panel type, and survey dates for juvenile salmonid and habitat surveys conducted in the John Day river basin from 27 June to 25 September, 2007. LMJDR: Lower Mainstem subbasin; UMJDR: Upper Mainstem subbasin; NFJDR: North Fork subbasin; MFJDR: Middle Fork subbasin; SFJDR: South Fork subbasin.

Stream	Site ID	UTM Zone	Start Coordinates Easting	Start Coordinates Northing	End Coordinates Easting	End Coordinates Northing	Panel Type	Juvenile Salmonid Survey	Habitat Survey
LMJDR									
Badger Creek	552	10	733536	4933273	733361	4932934	Four4	9/10	9/10
Bear Creek	555	10	712288	4946124	711850	4945440	Four4	9/13	9/13
Bear Creek	77	10	713586	4947283	713137	4946499	Four4	9/12	9/12
Buckhorn Creek	145	11	270188	4990004	269373	4989727	New4	7/10	7/10
Ferry Canyon	68	10	697715	5025359	698132	5024714	Four4	7/11	7/11
Franks Creek	146	11	300168	4930200	300448	4930498	New4	7/31	7/31
Grass Valley Canyon	79	10	690034	5045226	689360	5045022	Four4	7/12	7/12
Lake Creek	76	11	264829	4974884	264871	4975289	Four4	9/25	9/25
Milk Creek	497	10	728120	4928713	728108	4928347	Annual	9/11	9/11
Rock Creek	557	10	717842	5044985	718096	5044278	Four4	6/28	6/27
Rock Creek	9	10	718869	5044429	719291	5043791	Annual	6/28	6/27
Rock Creek	6	10	728345	5033643	728420	5032850	Annual	7/9	7/9
Service Creek	11	10	737166	4964562	736318	4964732	Annual	7/16	7/16
UMJDR									
Bear Creek	134	11	358414	4924590	358414	4925051	New4	7/2	7/2
Beech Creek	149	11	333615	4936297	333267	4936594	New4	7/31	7/31
Beech Creek	78	11	334212	4922192	335020	4922239	Four4	7/3	7/3
East Fork Canyon Creek	143	11	350871	4903905	351480	4904519	New4	8/27	8/27
John Day River	81	11	376696	4904413	376991	4903628	Four4	8/2	8/2
John Day River	559	11	355817	4922000	356693	4922402	New4		9/6
Pine Creek	138	11	353337	4912920	353651	4912048	New4	8/15	8/15
Slide Creek	80	11	368057	4910880	367869	4909980	Four4	8/1	8/1
Tinker Creek	5	11	348999	4932966	349335	4933296	Annual	7/30	7/30
Vance Creek	15	11	342566	4905270	342269	4905565	Annual	9/20	9/20
NFJDR									
Battle Creek	535	11	361988	4969010	362942	4969070	Annual	9/6	8/13
Cable Creek	67	11	359550	4996813	360114	4996112	Four4	8/14	8/13
Camas Creek	4	11	343754	4987349	344117	4988206	Annual	8/8	8/8
Clear Creek	16	11	383722	4961546	383469	4960708	Annual	8/20	8/20
Clear Creek	71	11	383608	4958191	382803	4958660	Four4	9/4	8/28
Clear Creek	74	11	381911	4958352	381517	4957486	Four4	9/4	8/30

Table 2. (Cont.)

Stream	Site ID	UTM Zone	Start Coordinates Easting	Start Coordinates Northing	End Coordinates Easting	End Coordinates Northing	Panel Type	Juvenile Salmonid Survey	Habitat Survey
NFJDR									
Ditch Creek	561	11	315968	4994379	316029	4995230	New4	8/6	8/6
Fivemile Creek	133	11	339644	4994220	338842	4994398	New4	7/18	7/18
Gilmore Creek	7	11	302012	4954446	302567	4953954	Annual	7/23	7/23
Granite Creek	490	11	376641	4968983	376944	4968127	Annual	8/22	8/22
North Fork John Day River	136	11	352498	4986113	353371	4986478	New4	7/19	7/19
North Fork John Day River	70	11	326963	4983075	327948	4983084	Four4	7/17	7/17
North Fork John Day River	73	11	379350	4970074	379937	4970078	Four4	8/21	8/21
Trout Creek	529	11	385693	4976405	385234	4976978	Annual	8/29	8/29
Wilson Creek	553	11	322673	5000015	322340	5000243	Four4	8/7	8/7
MFJDR									
Coyote Creek	148	11	361549	4950084	361626	4950561	New4	7/24	7/24
Crawford Creek	137	11	385309	4938322	385511	4939109	New4		7/26
Indian Creek	558	11	351281	4966423	352134	4966616	New4	9/5	9/5
Middle Fork John Day River	147	11	355787	4952597	356320	4951773	New4	7/25	7/25
Middle Fork John Day River	534	11	375376	4941755	376194	4941394	Annual	7/26	7/26
West Fork Lick Creek	17	11	358255	4942477	358243	4941732	Annual	8/9	8/9
Whisky Creek	10	11	354555	4946882	353714	4947189	Annual	8/23	8/23
SFJDR									
Black Canyon Creek	140	11	293218	4912589	292329	4912847	New4	9/18	9/18
Charlie Mack Creek	141	11	321548	4903618	321608	4904078	New4	9/26	9/26
South Fork Deer Creek	532	11	313322	4893182	313128	4892874	Annual	9/19	9/19
Tex Creek	66	11	319698	4905263	320003	4905917	Four4	9/17	9/17

RESULTS

Steelhead Redds and Escapement

We observed 181 steelhead redds while surveying 99.6 km (61.9 mi) of an estimated 4,269 km (2,653 mi) of steelhead spawning and rearing habitat within the John Day River basin during 2007 (Table 3). Of all subbasins, the Lower Mainstem had the highest number of redds (Table 3; Figure 4) followed by the Upper Mainstem (Table 3; Figure 5), the Middle Fork (Table 3; Figure 6), the North Fork (Table 3; Figure 7), and the South Fork (Table 3; Figure 8) subbasins. An estimated 7,758 redds were constructed within the John Day River basin in 2007 (1.817 redds/km) by an estimated 8,689 spawners (Table 4). This adult steelhead escapement is significantly greater than that observed in any of the previous three years of EMAP monitoring in the John Day River Basin ($P<0.05$; Figure 9).

Overall increases in redd counts and redd densities were apparent in each subbasin during 2007 (Table 5). More redds were observed within the Lower Mainstem subbasin (n=91) in 2007 than were observed throughout the entire John Day River basin during any of the previous three years (Table 5). Excluding the 2005 spawning season, redd densities in the Middle Fork John Day River subbasin in 2007 changed little compared with previous years (Figure 10). Redd densities in the North Fork and Upper Mainstem subbasins in 2007 were nearly twice as high as previous years (Table 5).

Approximately 52% of sites surveyed in 2007 had no spawning occurring within the survey reaches (Table 3). Within the South Fork and Upper Mainstem subbasins, the majority of redd production was observed at only a few sites in each subbasin (Table 3). Of the four sites surveyed in the South Fork subbasin for the basin wide escapement estimate, Black Canyon (Site 140) accounted for 93% of redds encountered (14 of 15 redds) while no redds were observed at either Charlie Mack Creek (Site 141) or S.F. Deer Creek (Site 532; Table 3; Figure 8). In the Upper Mainstem subbasin, Bear Creek (Site 134) and Beech Creek (Site 78) accounted for 78% of the total redds observed in that subbasin (Table 3). Even though redds were distributed more evenly between sites where spawning was observed in the North Fork subbasin, nearly 67% of the sites surveyed there had no observable spawning activity (Figure 7).

Results from annual survey sites also indicated an overall increase in redds, however nearly 60% of annual sites have had no steelhead redds observed in the past four years (Table 6). Fifty-seven percent of redds constructed in 2007 at annual sites were observed at two sites in the Lower Mainstem: Rock Creek (Site 9) and Service Creek (Site 11; Table 6). At sites where we have consistently observed steelhead redds in the past had observable redds again during 2007. Interestingly, Granite Creek (Site 7), where no redds had been observed during the previous three years had one redd in 2007 (Table 6).

South Fork John Day River Spawning Subsample — A total of 58 redds were observed at all surveyed sites (n=13) in the South Fork John Day River subbasin (Table 7). Redd densities at sites in the subbasin varied from zero to 10.5 redds/km (Table 7). Overall, the average redd density in the subbasin was 2.40 redds/km with an estimated total redd count of 628 redds (Table 8). We estimate that 756 adult steelhead spawners returned to the South Fork subbasin during 2007 (Table 8). This is more than twice the 2006 estimate of steelhead spawner escapement to the South Fork John Day River subbasin (Table 8).

Redd density was highly variable among sites in the South Fork John Day River subbasin. Over half of the redds observed in the South Fork subbasin in 2007 occurred at two sites, Black Canyon (n= 14 redds, Site 140) and Murderers Creek (n= 21 redds, Site 223; Table

7). While the overall redd count in the South Fork increased from 2006 to 2007, all other sites, besides the aforementioned, had similar results during both years (Table 7). Five of the twelve sites had no redds observed during the 2006 or 2007 spawning season (Table 7; Figure 11).

Hatchery:Wild Observations

Hatchery steelhead composed 35% of live steelhead observed in the John Day River basin in 2007 where the presence (unmarked, presumed wild) or absence (marked, presumed hatchery) of an adipose fin could be determined. Origin was determined for 54% of live fish (Table 9). Using the ratio of live clipped : unclipped steelhead (35% and 65%, respectively) observed in the John Day river basin, we estimate that 5,702 hatchery origin steelhead and 10,590 wild origin steelhead were present during spawning surveys in 2007. The majority of live fish verified as hatchery origin (n=14) were observed in the Lower Mainstem John Day River subbasin at three sites; Rock Creek (Sites 557 and 9) and Service Creek (Site 11; Figure 12). However, one hatchery origin fish was observed in Black Canyon Creek (Site 140) in the South Fork subbasin (Figure 12). Nine adult hatchery steelhead were observed near constructed redds (Table 9). The hatchery : wild ratio of live adult steelhead present in the John Day river basin has consistently remained approximately 35% over the past four years (Figure 13).

Table 3. Total number of steelhead redds, redd density (redd/km), and unmarked, marked, and unknown live and dead steelhead observed during spawning surveys conducted in the John Day River basin from February to June, 2007. LMJDR: Lower Mainstem subbasin; UMJDR: Upper Mainstem subbasin; NFJDR: North Fork subbasin; MFJDR: Middle Fork subbasin; SFJDR: South Fork subbasin.

				#Live Fish				# Dead Fish			
Stream	Site ID	# of Redds	Redds/km	Unmarked	Marked	Unknown	Total	Unmarked	Marked	Unknown	Total
LMJDR											
Badger Creek	552	6	3.33	1	0	1	2	0	0	0	0
Bear Creek	77	11	5.50	4	0	1	5	0	0	0	0
Bear Creek	555	13	6.50	2	0	3	5	0	0	0	0
Buckhorn Creek	145	3	1.50	0	0	0	0	0	0	0	0
Ferry Canyon	68	0	0.00	0	0	0	0	0	0	0	0
Franks Creek	146	0	0.00	0	0	0	0	0	0	0	0
Grass Valley Cyn.	79	0	0.00	0	0	0	0	0	0	0	0
Hay Canyon	562	0	0.00	0	0	0	0	0	0	0	0
Lake Creek	76	4	2.00	0	0	0	0	0	0	0	0
Milk Creek	497	0	0.00	0	0	0	0	0	0	0	0
Rock Creek	557	15	7.50	4	3	2	9	0	0	0	0
Rock Creek	6	7	3.50	0	0	2	2	0	0	0	0
Rock Creek	9	16	8.00	2	2	5	9	0	0	0	0
Service Creek	11	16	8.89	7	9	5	21	1	0	0	1
LMJDR TOTAL		**91**	**3.35**	**20**	**14**	**19**	**53**	**1**	**0**	**0**	**1**
UMJDR											
Bear Creek	134	12	6.00	1	0	2	3	0	0	0	0
Beech Creek	78	13	6.50	1	0	0	1	0	0	0	0
Beech Creek	149	1	0.50	0	0	0	0	0	0	0	0
EF Canyon Creek	143	5	2.50	0	0	1	1	0	0	0	0
John Day River	81	0	0.00	0	0	0	0	0	0	0	0
John Day River	559	1	0.83	0	0	1	1	0	0	0	0
Pine Creek	138	0	0.00	0	0	0	0	0	0	0	0
Rail Creek	13	0	0.00	0	0	0	0	0	0	0	0
Slide Creek	80	0	0.00	0	0	0	0	0	0	0	0
Tinker Creek	5	0	0.00	0	0	0	0	0	0	0	0
Vance Creek	15	0	0.00	0	0	0	0	0	0	0	0
UMJDR TOTAL		**32**	**1.50**	**2**	**0**	**4**	**6**	**0**	**0**	**0**	**0**
NFJDR											
Battle Creek	535	0	0.00	0	0	0	0	0	0	0	0
Cable Creek	67	9	4.50	0	0	0	0	0	0	0	0
Camas Creek	4	0	0.00	0	0	0	0	0	0	0	0
Clear Creek	74	0	0.00	0	0	1	1	0	0	0	0
Clear Creek	71	2	1.00	0	0	0	0	0	0	0	0
Clear Creek	16	2	0.95	0	0	0	0	0	0	0	0

Table 3. (Cont.)

Stream	Site ID	# of Redds	Redds/km	#Live Fish Unmarked	#Live Fish Marked	#Live Fish Unknown	#Live Fish Total	# Dead Fish Unmarked	# Dead Fish Marked	# Dead Fish Unknown	# Dead Fish Total
NFJDR (Cont.)											
Ditch Creek	561	0	0.00	0	0	0	0	0	0	0	0
Fivemile Creek	133	4	2.00	0	0	0	0	0	0	0	0
Gilmore Creek	7	0	0.00	0	0	0	0	0	0	0	0
Granite Creek	490	1	0.48	0	0	0	0	0	0	0	0
NF John Day River	73	0	0.00	0	0	2	2	0	0	0	0
NF John Day River	70	0	0.00	0	0	0	0	0	0	0	0
NF John Day River	136	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
Wilson Creek	553	0	0.00	0	0	0	0	0	0	0	0
NFJDR TOTAL		**18**	**0.63**	**0**	**0**	**3**	**3**	**0**	**0**	**0**	**0**
MFJDR											
Coyote Creek	148	0	0.00	0	0	0	0	0	0	0	0
Crawford Creek	137	0	0.00	0	0	0	0	0	0	0	0
Indian Creek	558	6	3.00	3	0	1	4	0	0	0	0
Little Basin Creek	139	0	0.00	0	0	0	0	0	0	0	0
MF John Day River	147	5	2.50	0	0	0	0	0	0	0	0
MF John Day River	534	6	3.00	0	0	1	1	0	0	0	0
WF Lick Creek	17	8	4.00	0	0	0	0	0	0	0	0
Whisky Creek	10	0	0.00	0	0	0	0	0	0	0	0
MFJDR TOTAL		**25**	**1.59**	**3**	**0**	**2**	**5**	**0**	**0**	**0**	**0**
SFJDR											
Black Canyon	140	14	7.00	3	1	9	13	0	0	0	0
Charlie Mack Creek	141	0	0.00	0	0	0	0	0	0	0	0
SF Deer Creek	532	0	0.00	0	0	0	0	0	0	0	0
Tex Creek	66	1	0.50	0	0	0	0	0	0	0	0
SFJDR TOTAL		**15**	**2.21**	**3**	**1**	**9**	**13**	**0**	**0**	**0**	**0**
BASIN TOTAL		**181**	**1.82**	**28**	**15**	**37**	**80**	**1**	**0**	**0**	**1**

Table 4. Distance surveyed, number of unique redds observed, redd densities (redds/km and redds/mi), estimated total number of redds and spawner escapement with 95% C.I. for the John Day River basin from 2004 to 2007. Fish per redd ratios were derived from surveys outside of John Day River basin by comparing repeat redd surveys with weir counts of spawners.

	Distance Surveyed		Summer Steelhead						95% C.I.	
Year	km	miles	Redds	Redds/km	Redds/mi	Total Redds	Fish/Redd	Escapement	Lower	Upper
2004	94.7	58.8	66	0.70	1.12	3,071	1.46	4,484	1,657	7,310
2005	101.2	62.9	39	0.39	0.62	1,681	2.20	3,698	1,261	6,137
2006	90.5	56.2	67	0.74	1.19	3,202	1.66	5,315	2,189	8,441
2007	99.6	61.9	181	1.82	2.92	7,758	1.12	8,689	5,939	11,439

Table 5. Total redds, redd density (redds/km), and live fish observed throughout the John Day River basin (JDR Basin) 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 2007.

	JDR Basin			LMJDR			UMJDR			NFJDR			MFJDR			SFJDR		
Year	Redds	Redds per km	Fish	Redds	Redds per km	Fish	Redds	Redds per km	Fish	Redds	Redds per km	Fish	Redds	Redds per km	Fish	Redds	Redds per km	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

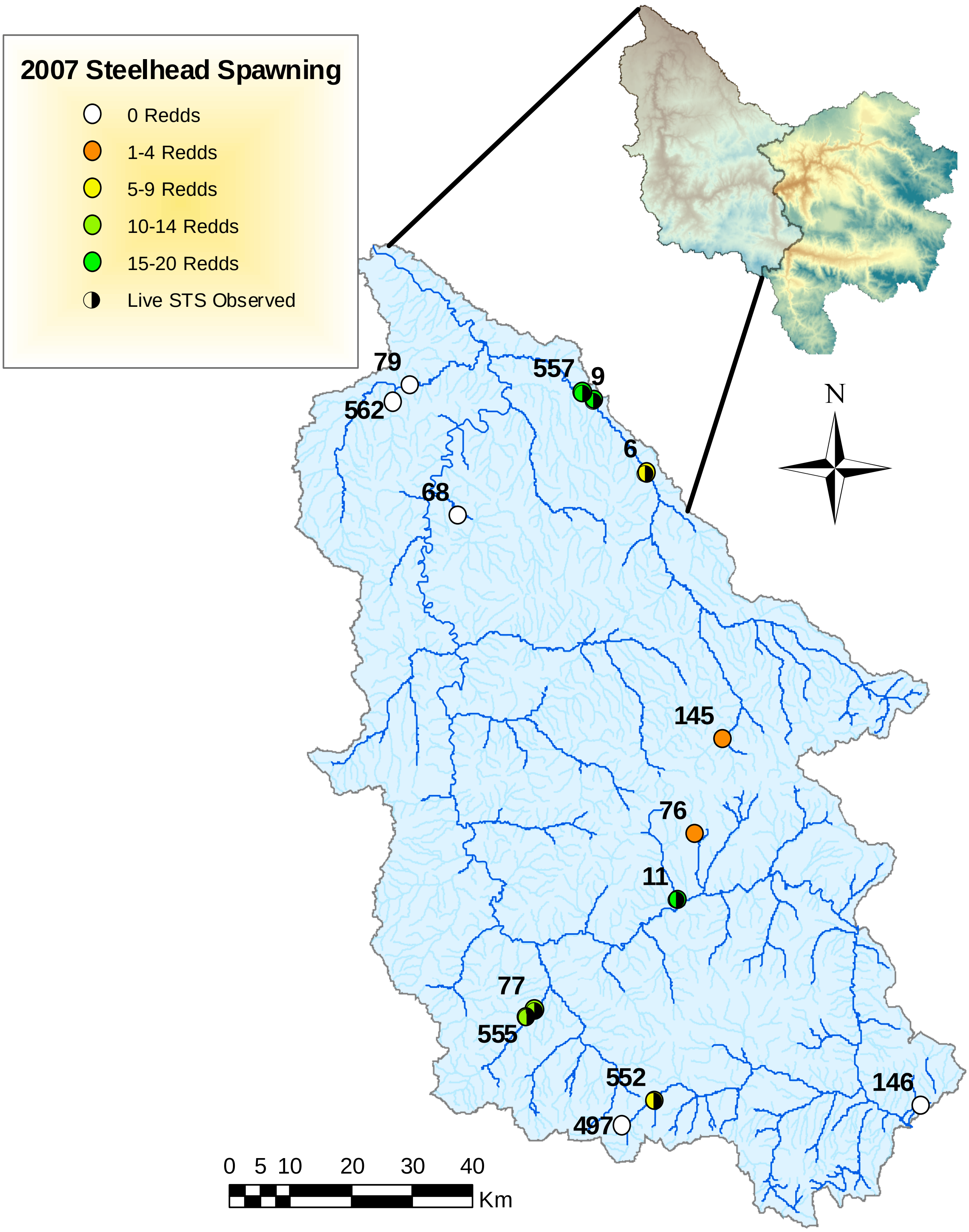

Figure 4. Map of the location and number of redds and live steelhead spawners observed in the Lower Mainstem John Day River during spawning surveys conducted during the spring of 2007. Site identification numbers are shown next to each point for reference.

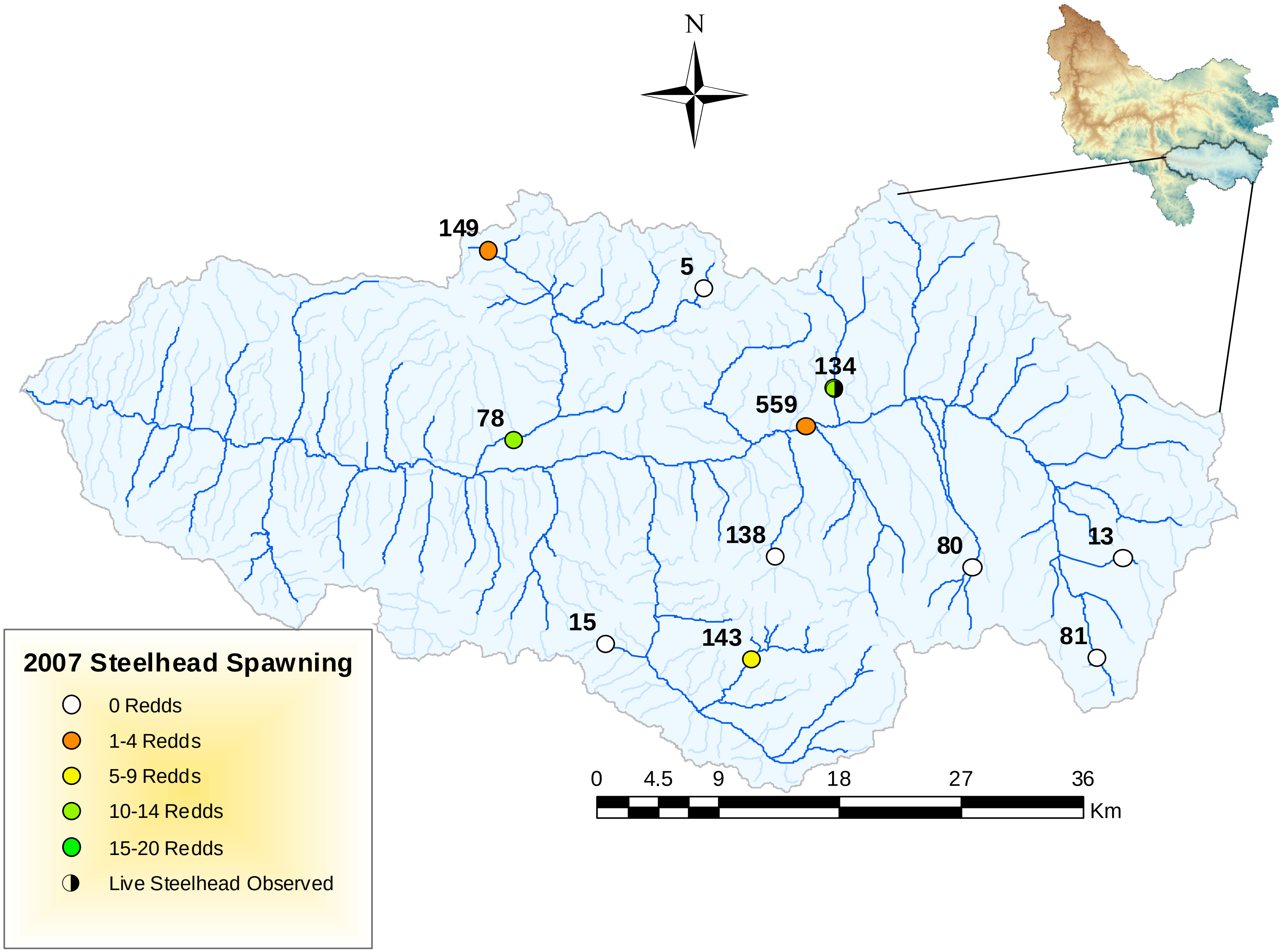

Figure 5. Map of the location and number of redds and live steelhead spawners observed in the Upper Mainstem John Day River during spawning surveys conducted between February and June, 2007. Site identification numbers are shown next to each point for reference.

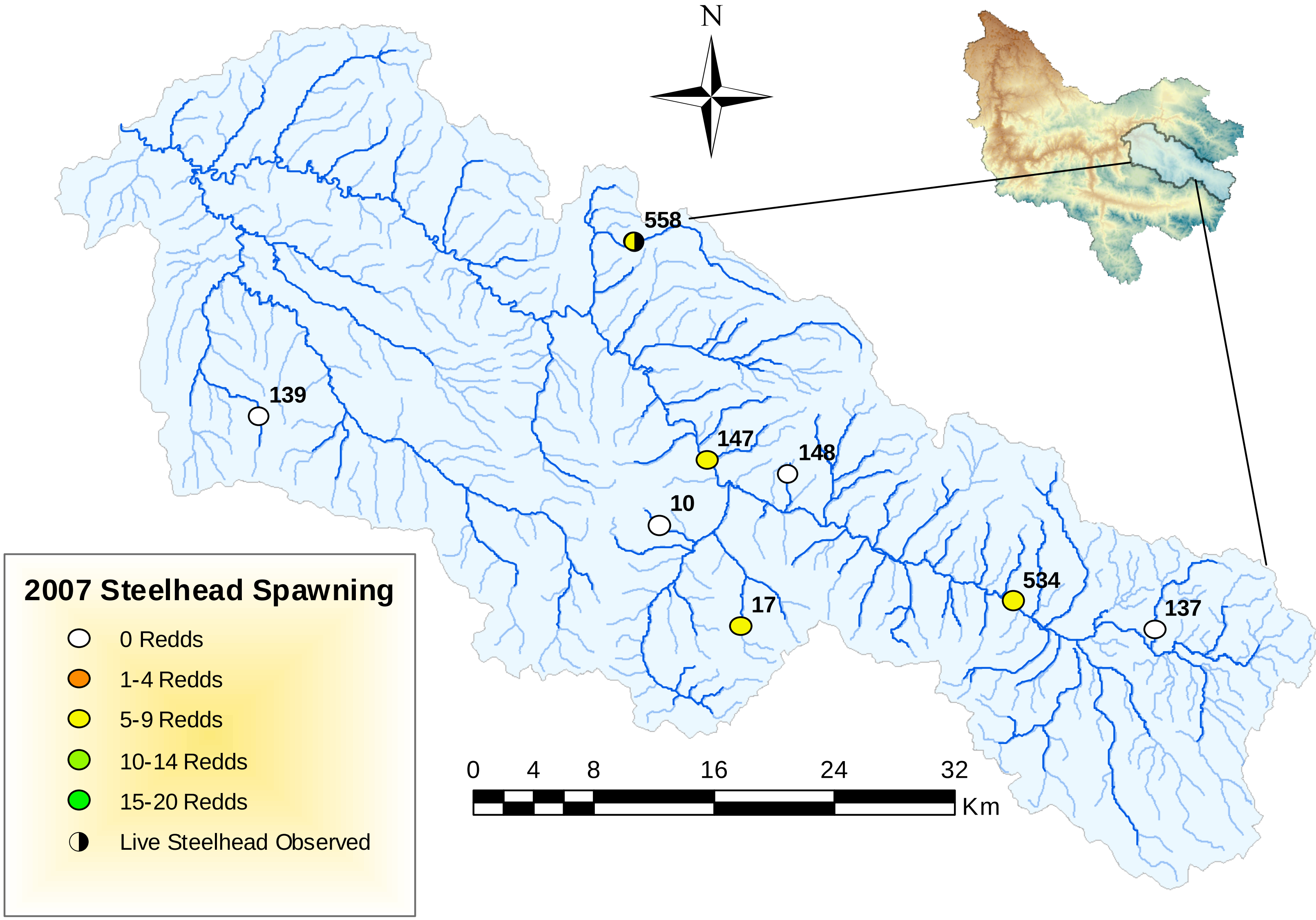

Figure 6. Map of the location and number of redds and live steelhead spawners observed in the Middle Fork John Day River during spawning surveys conducted between February and June, 2007. Site identification numbers are shown next to each point for reference.

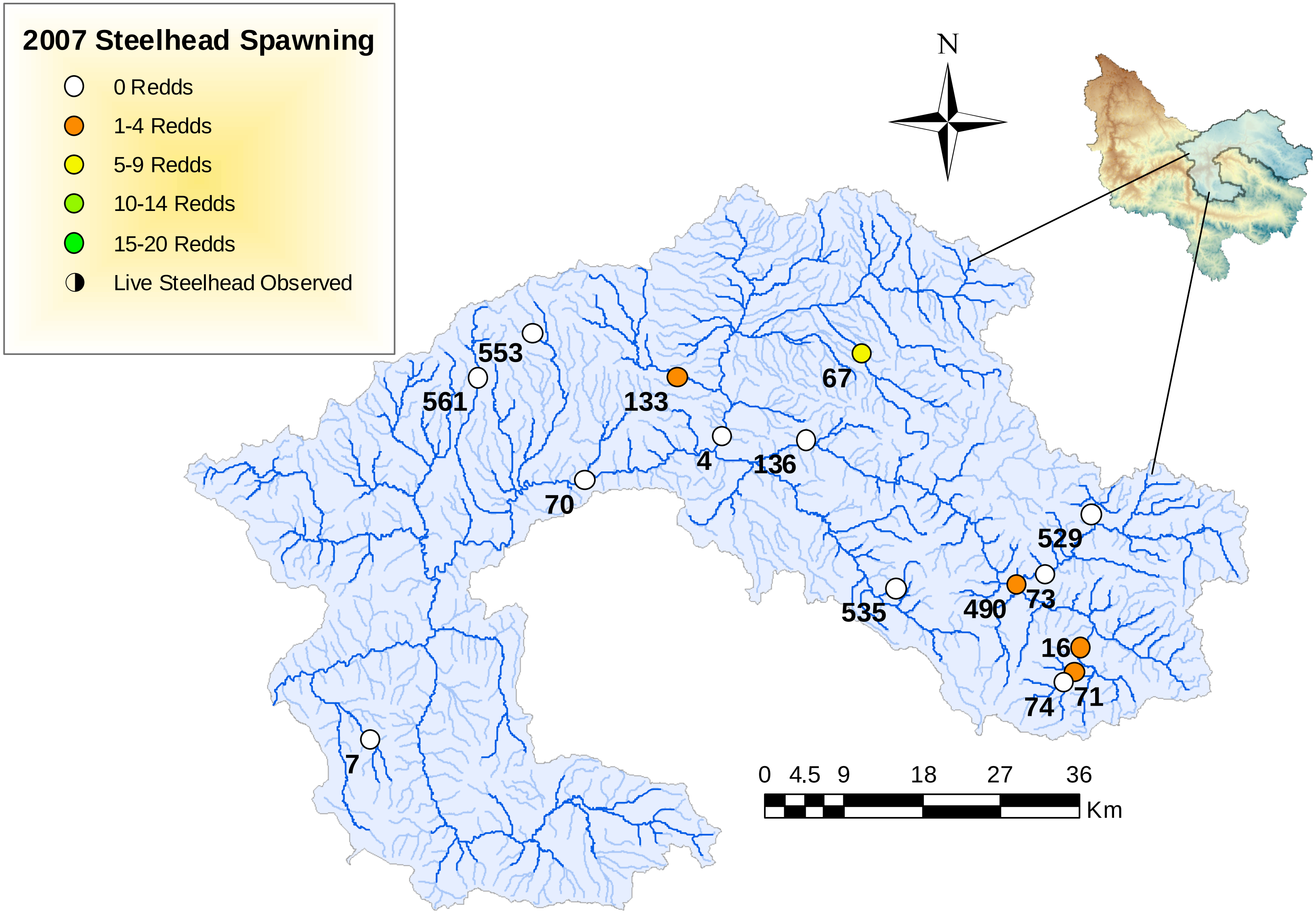

Figure 7. Map of the location and number of redds and live steelhead spawners observed in the North Fork John Day River during spawning surveys conducted between February and June, 2007. Site identification numbers are shown next to each point for reference.

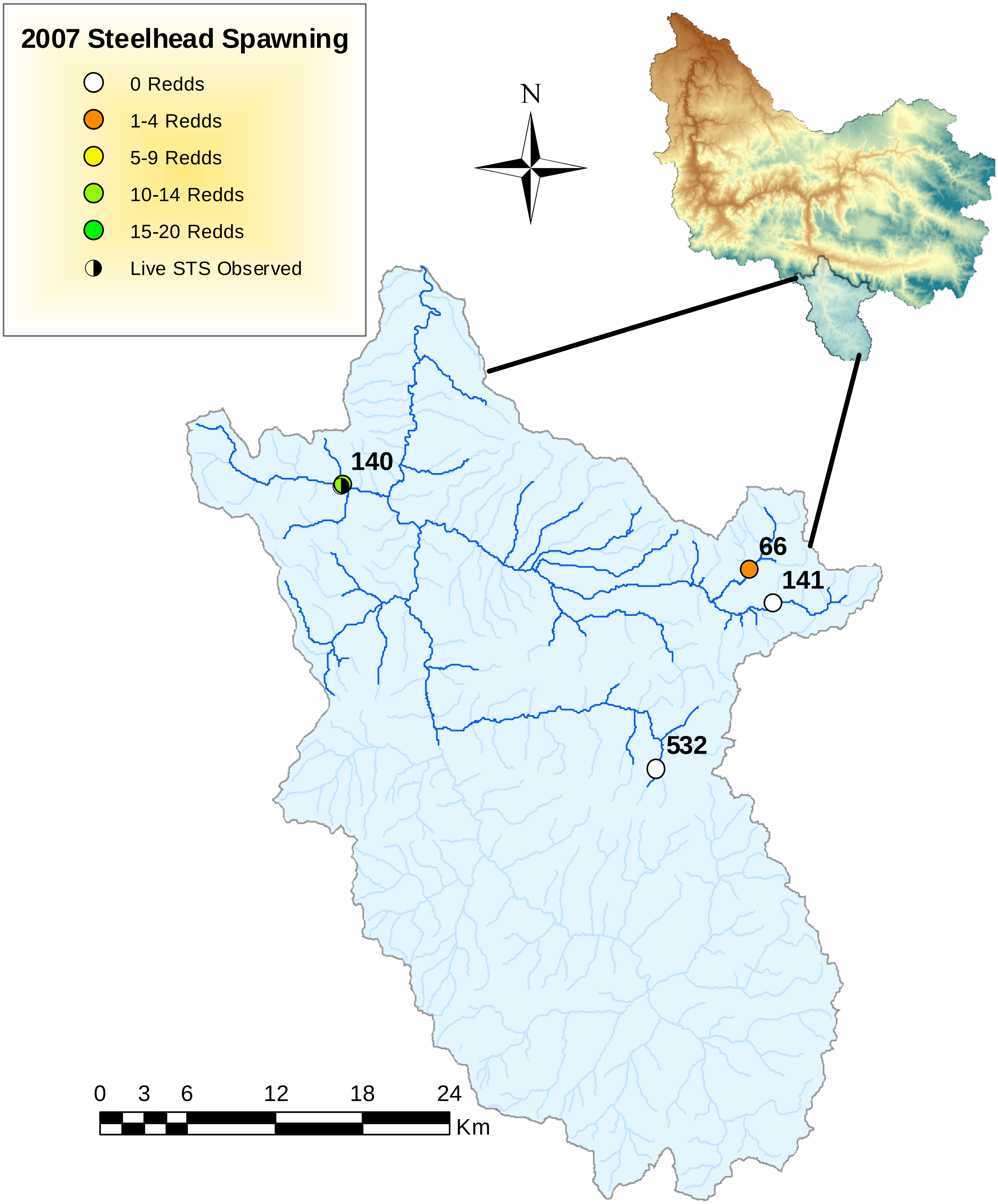

Figure 8. Map of the location and number of redds and live steelhead spawners observed in the South Fork John Day River during spawning surveys conducted between February and June, 2007. Site identification numbers are shown next to each point for reference.

Table 6. Redd observations at annual spawning survey sites in the John Day River basin conducted from February to June, 2004–2007. N/A represents sites which were not surveyed during that year but were added later to replace previous annual sites where access was revoked.

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

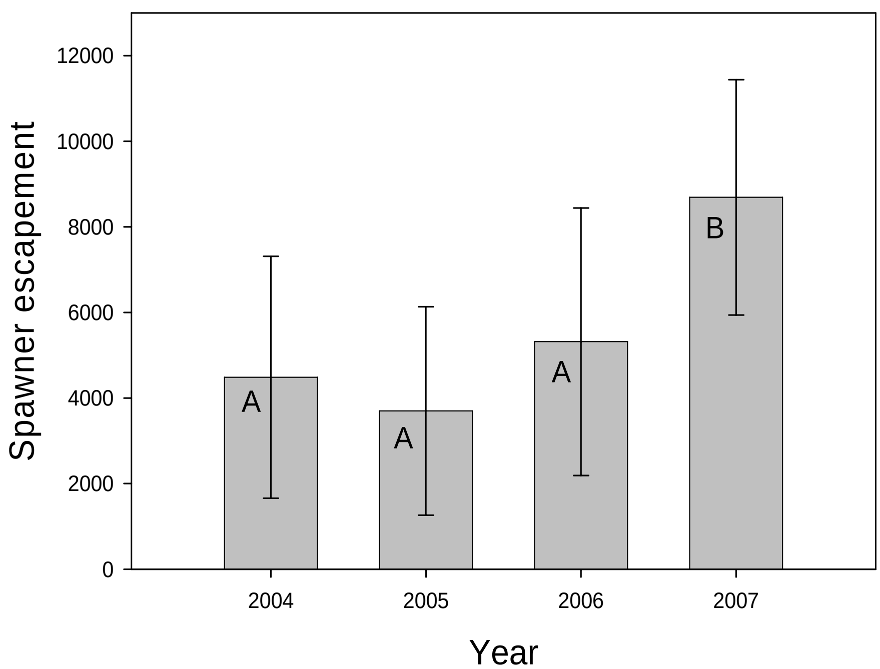

Figure 9. Annual adult steelhead escapement estimates for the John Day River basin from 2004 to 2007. Error bars indicate 95% C.I. Bars with different letters are statistically significant at the P=0.05 level.

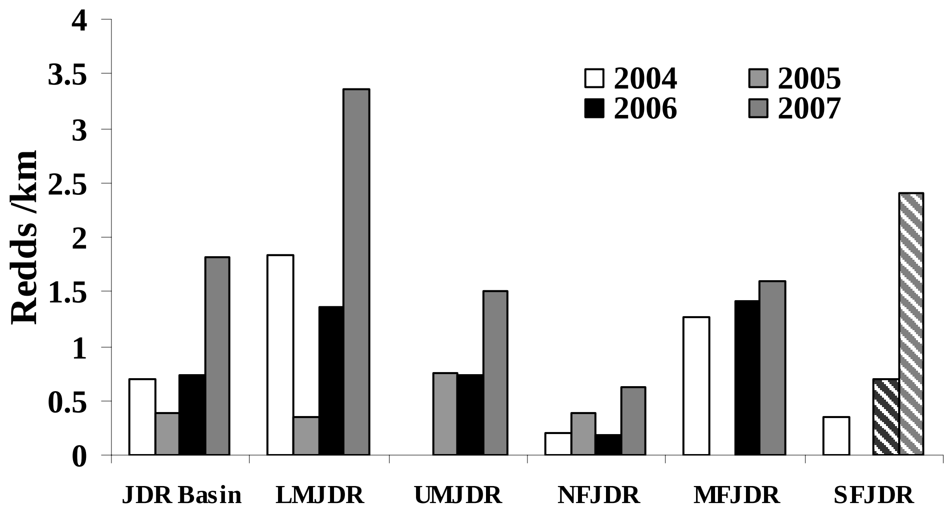

Figure 10. Average redd densities (redds/km) observed in the John Day River basin (JDR Basin), Lower Mainstem subbasin (LMJDR), Upper Mainstem subbasin (UMJDR), North Fork subbasin (NFJDR), Middle Fork subbasin (MFJDR), and South Fork subbasin (SFJDR) from 2004 to 2007. Data for SFJDR in 2006 and 2007 (diagonally striped bars) are from additional subsample spawning sites surveyed each year in the subbasin.

Table 7. Total number of steelhead redds observed during subbasin spawning surveys conducted in the South Fork John Day River subbasin in 2006 and 2007.

Stream	Site ID	2006	2007
Black Canyon Creek	140	1	14
Charlie Mack Creek	141	0	0
Deer Creek	33	1	3
Deer Creek	200	5	5
Lemon Creek	187	0	0
Murderers Creek	161	2	2
Murderers Creek	204	2	9
Murderers Creek	223	4	21
NF Wind Creek	97	0	0
SF Deer Creek	532	0	0
SF John Day River	175	0	3
Tex Creek	66	3	1
Wind Creek	152	0	0
TOTAL		**18**	**58**

Table 8. Distance surveyed (km and miles), observed redds, redd densities (redds/km and redds/mi), estimated total number of redds and spawner escapement with 95% C.I. for the South Fork John Day River subbasin subsample in 2006 and 2007.

SFJDR Subbasin	Distance		Summer Steelhead					95% Confidence Interval	
	Km	Miles	Redds	Redds/km	Redds/Mi	Total Redds	Escapement	Lower	Upper
2006	25.9	16.1	18	0.69	1.12	186	309	145	472
2007	24.2	15.0	58	2.40	3.86	675	756	252	1,260

Table 9. Number of live steelhead observed and determined for origin, number and percentage marked and unmarked, and number and percentage marked and unmarked steelhead near redds during surveys conducted during 2007. LMJDR: Lower Mainstem subbasin; UMJDR: Upper Mainstem subbasin; NFJDR: North Fork subbasin; MFJDR: Middle Fork subbasin; SFJDR: South Fork subbasin.

Subbasin	# Observed	# Determined	# Marked	% Marked	# Marked Near Redd	% Marked Near Redd	# Unmarked	% Unmarked	# Unmarked Near Redd	% Unmarked Near Redd
LMJDR	53	34	14	41.2	8	57.1	20	58.8	10	50.0
UMJDR	6	2	0	0.0	0	0.0	2	100.0	1	50.0
NFJDR	3	0	0	0.0	0	0.0	0	0.0	0	0.0
MFJDR	5	3	0	0.0	0	0.0	3	100.0	3	100.0
SFJDR	13	4	1	25.0	1	100.0	3	75.0	0	0.0
BASIN TOTAL	**80**	**43**	**15**	**34.9**	**9**	**60.0**	**28**	**65.1**	**14**	**50.0**

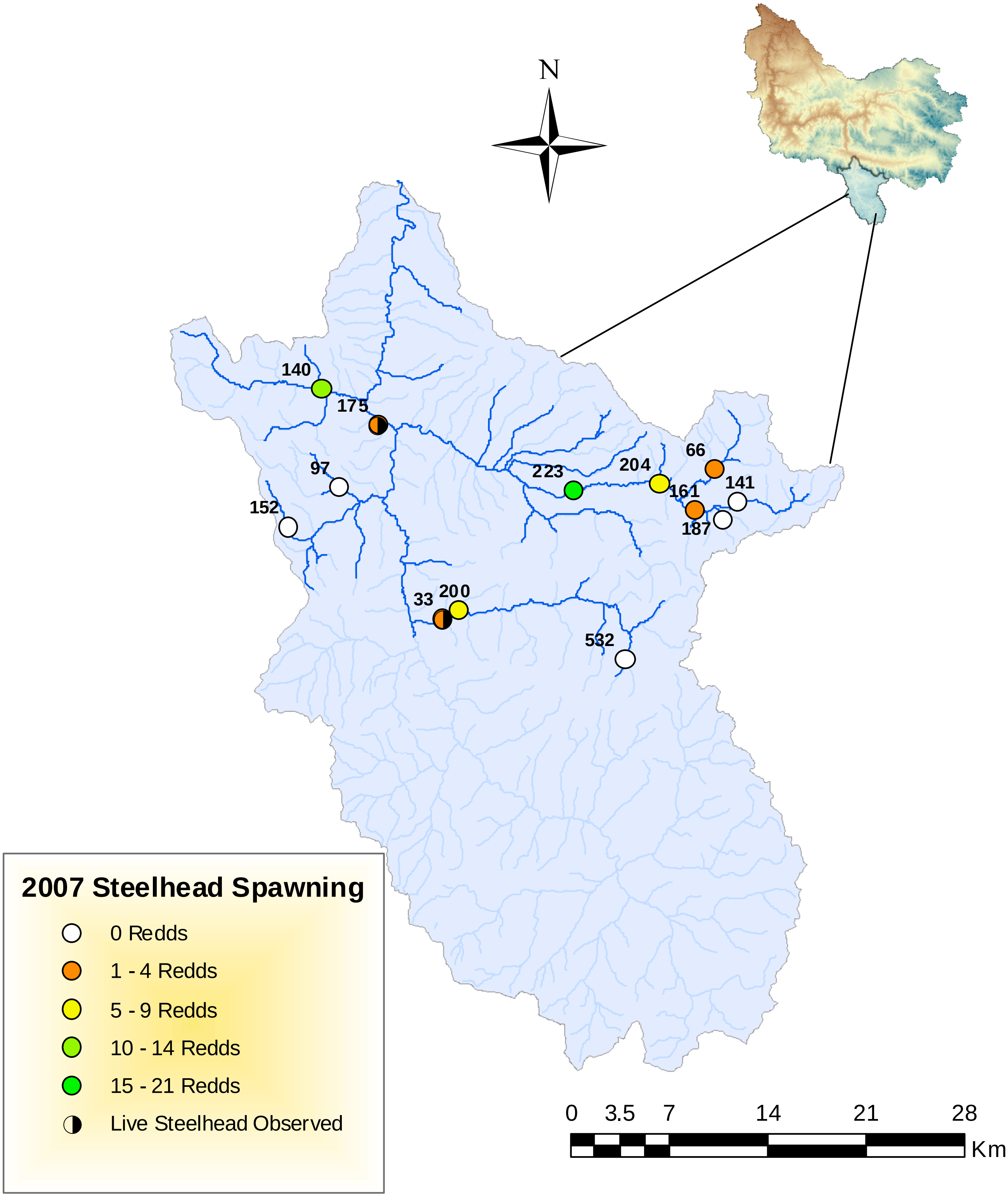

Figure 11. Map of the location and number of redds and live steelhead spawners observed in the South Fork John Day River during subbasin spawning surveys conducted in 2007. Site identification numbers are shown next to each point for reference.

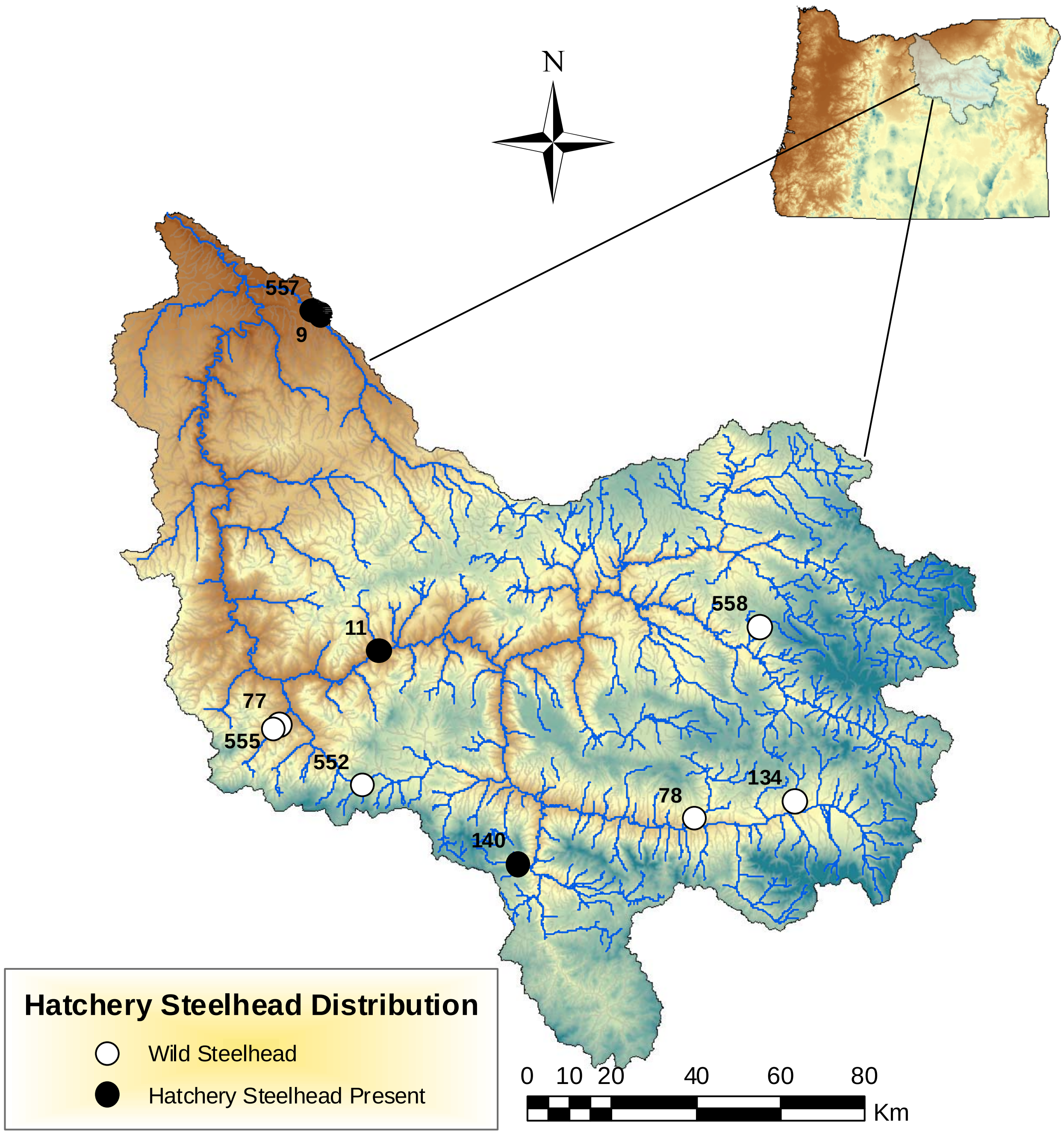

Figure 12. Distribution of live hatchery and wild steelhead observations in the John Day River basin during spawner surveys conducted between February and June, 2007. Site ID numbers are included next to each point for reference.

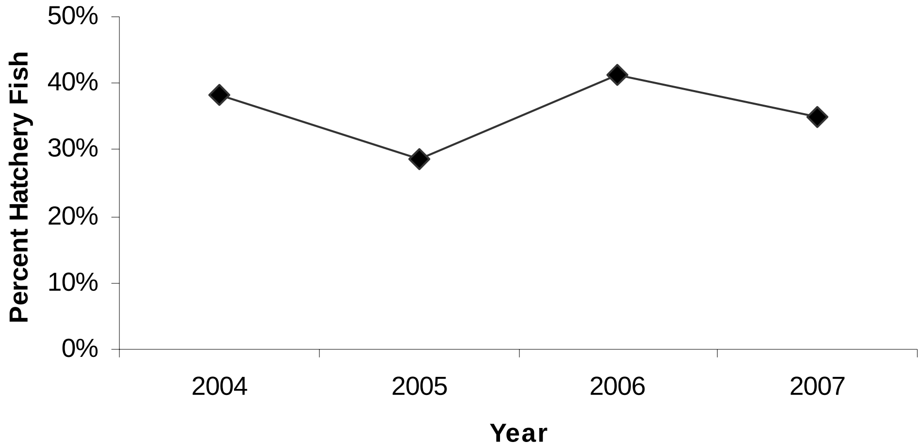

Figure 13. Percent of hatchery to wild fish observed during spawning surveys in the John Day River subbasin from 2004 to 2007.

Juvenile Salmonid Surveys

During the summer of 2007, 47 sites were sampled to assess salmonid distribution and abundance in the John Day River basin. Salmonids were observed at 44 of 47 sites sampled during this period (Table 10). Steelhead *O. mykiss* were the most abundant salmonid observed occurring at 42 sites (Table 11) with both adult (>152 mm) and juvenile (<152 mm) *O. mykiss* co-occurring at 24 sites (Table 12). Westslope cutthroat trout *O. clarki* were the second most abundant salmonid occurring at ten of 47 sites (Table 11). Juvenile Westslope cutthroat were present at seven sites and adult Westslope cutthroat were observed at nine of the sites (Table 12). Spring Chinook salmon *O. tshawytscha* were present at eight sites (Table 11) with juveniles occurring at all sites and mature adult Chinook salmon observed at four sites (Table 12). Adult bull trout *Salvelinus confluentus* were observed at one site (John Day River, Site 81), but no juveniles (<152 mm) were detected (Table 12). Eastern brook trout *S. fontinalis* were observed at two sites during 2007 (Table 11). Adult brook trout were detected in both Ditch Creek (Site 561) and Trout Creek (Site 529), while juveniles were only detected at Trout Creek (Table 12).

The proportion of sites with salmonids present varied by subbasin and species. In the Lower Mainstem, steelhead were the only salmonid observed occurring at 11 of 13 sites (Figure 14). Steelhead were observed at nearly all sites in the Upper Mainstem (Figure 15) and North Fork (Figure 16) and at all sites in the Middle Fork (Figure 17) and South Fork (Figure 18). Spring Chinook occurred in the Middle Fork (Figure 17), the North Fork (Figure 16), and the South Fork (Figure 18) but were absent at sites in the Lower and Upper Mainstem (Figures 14 and 15, respectively). Westslope cutthroat trout were found in both the Upper Mainstem and North Fork subbasins (Figure 19) while bull trout were only observed in the Upper Mainstem (Figure 20) and Eastern brook trout were only observed in the North Fork (Figure 21).

Pool abundances for the four salmonid species observed at sites where the respective species was present varied by subbasin and species. Steelhead and Chinook salmon were the most abundant salmonids observed, occupying ~70% of pools at sites where they were present (Tables 13 and 14, respectively). However, steelhead were present within all subbasins (Table

13) while Chinook were present in only three (Table 14). Westslope cutthroat trout and bull trout were present in 44% and 20% of pools, respectively, at sites where they were observed (Tables 15 and 16, respectively). Eastern brook trout were less abundant only occurring in 8% of pools at the two sites where they were detected (Table 17).

Density estimates for steelhead and spring Chinook salmon at annual sites surveyed from 2004 to 2007 showed variability from year to year (Figure 21). Steelhead density estimates at eight sites (Battle Creek, Gilmore Creek, M.F. John Day, Milk Creek, Rock Creek Sites 6 and 9, S.F. Deer Creek, and Tinker Creek) were the highest in 2007 compared with previous years sampled (Table 18). However, three sites (Camas Creek, Clear Creek, and Granite Creek) had lower densities than previously detected while five sites (Service Creek, Trout Creek, Vance Creek, W.F. Lick Creek, and Whisky Creek) maintained fairly consistent density estimates (Table 18). Overall, average densities of steelhead at annual sites showed a slight increase during 2007 compare with previous years (Figure 21). Spring Chinook density estimates were considerably lower during 2007 at two sites where they were observed (Camas Cr. and Clear Cr.) during previous years (Table 19). Granite Creek (Site 490) had a higher density of spring Chinook in 2007 compared to 2006 but this estimate is still much lower than that observed in 2004 or 2005 (Table 19). Density estimates in the Middle Fork John Day River (Site 534) showed an increase in spring Chinook from 2006 to 2007 (Table 19). Overall, spring Chinook density estimates for 2007 were comparable to 2006 estimates but lower than 2004 or 2005 (Table 19; Figure 23).

Eight incidental species were observed during salmonid surveys in 2007 (Table 20). Dace *Rhinichthys* spp., sucker *Catastomus* spp., sculpin *Cottus* spp., Northern Pikeminnow *Ptychocheilus oregonensis*, and redside shiner *Richardsonius balteatus* were the most common incidental species encountered (Table 21). Although less frequently encountered, smallmouth bass *Micropterus dolomieu*, mountain whitefish *Prosopium williamsoni*, and catfish *Ictalurus* spp. were also observed during salmonid surveys (Table 21).

Table 10. Stream, site identification number, sampling method, number of pools surveyed, and percentage of pools with salmonids present at juvenile survey sites in the John Day River basin in 2007. Sampling methods included electrofishing (E) and snorkeling (S). LMJDR=Lower Mainstem John Day River subbasin, UMJDR=Upper Mainstem John Day River subbasin, NFJDR=North Fork John Day River subbasin, MFJDR=Middle Fork John Day River subbasin, SFJDR=South Fork John Day River subbasin.

Stream	Site ID	Sampling Method	# Pools	*O. mykiss*	Spring Chinook	Cutthroat Trout	Bull Trout	Brook Trout
LMJDR								
Badger Creek	552	E	20	75.0	0.0	0.0	0.0	0.0
Bear Creek	77	E	18	61.1	0.0	0.0	0.0	0.0
Bear Creek	555	E	21	61.9	0.0	0.0	0.0	0.0
Buckhorn Creek	145	S	19	42.1	0.0	0.0	0.0	0.0
Ferry Canyon	68	S	20	70.0	0.0	0.0	0.0	0.0
Franks Creek	146	E	5	0.0	0.0	0.0	0.0	0.0
Grass Valley Canyon	79	S	20	0.0	0.0	0.0	0.0	0.0
Lake Creek	76	E	20	75.0	0.0	0.0	0.0	0.0
Milk Creek	497	E	20	90.0	0.0	0.0	0.0	0.0
Rock Creek	9	S	10	100.0	0.0	0.0	0.0	0.0
Rock Creek	557	E	5	80.0	0.0	0.0	0.0	0.0
Rock Creek	6	S	18	100.0	0.0	0.0	0.0	0.0
Service Creek	11	E	14	92.9	0.0	0.0	0.0	0.0
LMJDR Total			**210**	**66.2**	**0.0**	**0.0**	**0.0**	**0.0**
UMJDR								
Bear Creek	134	E	15	33.3	0.0	0.0	0.0	0.0
Beech Creek	78	S	19	100.0	0.0	0.0	0.0	0.0
Beech Creek	149	E	2	0.0	0.0	50.0	0.0	0.0
East Fork Canyon Creek	143	S	20	45.0	0.0	55.0	0.0	0.0
John Day River	81	S	20	25.0	0.0	40.0	20.0	0.0
Pine Creek	138	S	20	20.0	0.0	85.0	0.0	0.0
Slide Creek	80	E	20	0.0	0.0	60.0	0.0	0.0
Tinker Creek	5	E	20	75.0	0.0	0.0	0.0	0.0
Vance Creek	15	E	18	77.8	0.0	22.2	0.0	0.0
UMJDR Total			**154**	**46.1**	**0.0**	**34.4**	**2.6**	**0.0**
NFJDR								
Battle Creek	535	E	16	100.0	0.0	0.0	0.0	0.0
Cable Creek	67	S	21	100.0	0.0	0.0	0.0	0.0
Camas Creek	4	S	7	28.6	0.0	0.0	0.0	0.0
Clear Creek	71	S	4	100.0	100.0	50.0	0.0	0.0
Clear Creek	16	S	19	68.4	73.7	5.3	0.0	0.0
Clear Creek	74	S	12	75.0	25.0	91.7	0.0	0.0
Ditch Creek	561	E	20	80.0	0.0	5.0	0.0	5.0
Fivemile Creek	133	S	10	100.0	0.0	0.0	0.0	0.0
Gilmore Creek	7	E	18	50.0	0.0	0.0	0.0	0.0
Granite Creek	490	S	17	58.8	100.0	0.0	0.0	0.0

Table 10. (cont.)

Stream	Site ID	Sampling Method	# Pools	*O. mykiss*	Spring Chinook	Cutthroat Trout	Bull Trout	Brook Trout
NFJDR								
North Fork John Day River	73	S	9	66.7	100.0	0.0	0.0	0.0
North Fork John Day River	136	S	3	33.3	66.7	0.0	0.0	0.0
North Fork John Day River	70	S	5	0.0	0.0	0.0	0.0	0.0
Trout Creek	529	S	16	43.8	0.0	0.0	0.0	12.5
Wilson Creek	553	E	4	25.0	0.0	0.0	0.0	0.0
NFJDR Total			**181**	**69.1**	**27.1**	**8.3**	**0.0**	**1.7**
MFJDR								
Coyote Creek	148	E	19	42.1	0.0	0.0	0.0	0.0
Indian Creek	558	E	20	100.0	0.0	0.0	0.0	0.0
Middle Fork John Day River	534	S	17	76.5	41.2	0.0	0.0	0.0
Middle Fork John Day River	147	S	7	28.6	0.0	0.0	0.0	0.0
West Fork Lick Creek	17	E	20	90.0	0.0	0.0	0.0	0.0
Whisky Creek	10	E	20	70.0	0.0	0.0	0.0	0.0
MFJDR Total			**103**	**72.8**	**6.8**	**0.0**	**0.0**	**0.0**
SFJDR								
Black Canyon Creek	140	S	8	100.0	75.0	0.0	0.0	0.0
Charlie Mack Creek	141	E	4	100.0	0.0	0.0	0.0	0.0
South Fork Deer Creek	532	E	20	90.0	0.0	0.0	0.0	0.0
Tex Creek	66	E	20	90.0	0.0	0.0	0.0	0.0
SFJDR Total			**52**	**92.3**	**11.5**	**0.0**	**0.0**	**0.0**
Basin Total			**700**	**65.4**	**8.9**	**9.7**	**0.6**	**0.4**

Table 11. Number and percentage of sites with juvenile (<152 mm) and adult (≥152 mm) salmonids collected during juvenile surveys in the John Day River basin during 2007.

Salmonids	# Sites Present	% Sites Present	# Sites w/Juveniles	% Sites w/Juveniles	# Sites w/Adults	% Sites w/Adults
Oncorhynchus mykiss	42	89.4	41	87.2	35	74.5
Spring Chinook Salmon	8	17.0	8	17.0	4	8.5
Westslope Cutthroat Trout	10	21.3	7	14.9	9	19.1
Oncorhynchus spp.	7	14.9	6	12.8	6	12.8
Bull Trout	1	2.1	0	0.0	1	2.1
Brook Trout	2	4.3	1	2.1	2	4.3
Salvelinus spp.	0	0.0	0	0.0	0	0.0

Table 12. Stream, site identification number, and abundance of juvenile and adult salmonids at juvenile survey sites in the John Day River basin in 2007. LMJDR=Lower Mainstem John Day River subbasin, UMJDR=Upper Mainstem John Day River subbasin, NFJDR=North Fork John Day River subbasin, MFJDR=Middle Fork John Day River subbasin, SFJDR=South Fork John Day River subbasin.

		Juvenile (< 152 mm)				Adult (> 152 mm)				Spring Chinook	
Stream	Site ID	*O. mykiss*	Westslope Cutthroat	Bull Trout	Brook Trout	*O. mykiss*	Westslope Cutthroat	Bull Trout	Brook Trout	Juvenile	Adult
LMJDR											
Badger Creek	552	23	0	0	0	5	0	0	0	0	0
Bear Creek	77	24	0	0	0	0	0	0	0	0	0
Bear Creek	555	75	0	0	0	4	0	0	0	0	0
Buckhorn Creek	145	16	0	0	0	1	0	0	0	0	0
Ferry Canyon	68	23	0	0	0	15	0	0	0	0	0
Franks Creek	146	0	0	0	0	0	0	0	0	0	0
Grass Valley Canyon	79	0	0	0	0	0	0	0	0	0	0
Lake Creek	76	25	0	0	0	3	0	0	0	0	0
Milk Creek	497	54	0	0	0	0	0	0	0	0	0
Rock Creek	9	1663	0	0	0	0	0	0	0	0	0
Rock Creek	557	30	0	0	0	0	0	0	0	0	0
Rock Creek	6	2220	0	0	0	1	0	0	0	0	0
Service Creek	11	38	0	0	0	7	0	0	0	0	0
LMJDR Total		**4191**	**0**	**0**	**0**	**36**	**0**	**0**	**0**	**0**	**0**
UMJDR											
Bear Creek	134	8	0	0	0	1	0	0	0	0	0
Beech Creek	78	116	0	0	0	32	0	0	0	0	0
Beech Creek	149	0	1	0	0	0	0	0	0	0	0
East Fork Canyon Creek	143	0	0	0	0	17	19	0	0	0	0
John Day River	81	4	5	0	0	2	6	5	0	0	0
Pine Creek	138	10	33	0	0	0	24	0	0	0	0
Slide Creek	80	0	18	0	0	0	3	0	0	0	0
Tinker Creek	5	32	0	0	0	0	0	0	0	0	0
Vance Creek	15	26	2	0	0	3	4	0	0	0	0
UMJDR Total		**196**	**59**	**0**	**0**	**55**	**56**	**5**	**0**	**0**	**0**
NFJDR											
Battle Creek	535	89	0	0	0	5	0	0	0	0	0
Cable Creek	67	353	0	0	0	58	0	0	0	0	0

Table 12. (Cont.)

Stream	Site ID	Juvenile (< 152 mm) *O. mykiss*	Juvenile (< 152 mm) Westslope Cutthroat	Juvenile (< 152 mm) Bull Trout	Juvenile (< 152 mm) Brook Trout	Adult (> 152 mm) *O. mykiss*	Adult (> 152 mm) Westslope Cutthroat	Adult (> 152 mm) Bull Trout	Adult (> 152 mm) Brook Trout	Spring Chinook Juvenile	Spring Chinook Adult
NFJDR											
Camas Creek	4	3	0	0	0	3	0	0	0	0	0
Clear Creek	71	22	3	0	0	8	2	0	0	53	0
Clear Creek	16	200	0	0	0	27	3	0	0	223	2
Clear Creek	74	7	13	0	0	15	26	0	0	4	1
Ditch Creek	561	39	0	0	0	19	1	0	1	0	0
Fivemile Creek	133	85	0	0	0	9	0	0	0	0	0
Gilmore Creek	7	22	0	0	0	8	0	0	0	0	0
Granite Creek	490	20	0	0	0	8	0	0	0	104	1
North Fork John Day River	73	13	0	0	0	5	0	0	0	75	1
North Fork John Day River	136	5	0	0	0	0	0	0	0	3	0
North Fork John Day River	70	0	0	0	0	0	0	0	0	0	0
Trout Creek	529	16	0	0	1	4	0	0	4	0	0
Wilson Creek	553	4	0	0	0	2	0	0	0	0	0
NFJDR Total		**878**	**16**	**0**	**1**	**171**	**32**	**0**	**5**	**462**	**5**
MFJDR											
Coyote Creek	148	8	0	0	0	3	0	0	0	0	0
Indian Creek	558	145	0	0	0	18	0	0	0	0	0
Middle Fork John Day River	534	13	0	0	0	23	0	0	0	52	0
Middle Fork John Day River	147	2	0	0	0	2	0	0	0	0	0
West Fork Lick Creek	17	63	0	0	0	1	0	0	0	0	0
Whisky Creek	10	37	0	0	0	3	0	0	0	0	0
MFJDR Total		**268**	**0**	**0**	**0**	**50**	**0**	**0**	**0**	**52**	**0**
SFJDR											
Black Canyon Creek	140	191	0	0	0	61	0	0	0	35	0
Charlie Mack Creek	141	6	0	0	0	1	0	0	0	0	0
South Fork Deer Creek	532	64	0	0	0	2	0	0	0	0	0
Tex Creek	66	256	0	0	0	33	0	0	0	0	0
SFJDR Total		**517**	**0**	**0**	**0**	**97**	**0**	**0**	**0**	**35**	**0**
Basin Total		**6050**	**75**	**0**	**1**	**409**	**88**	**5**	**5**	**549**	**5**

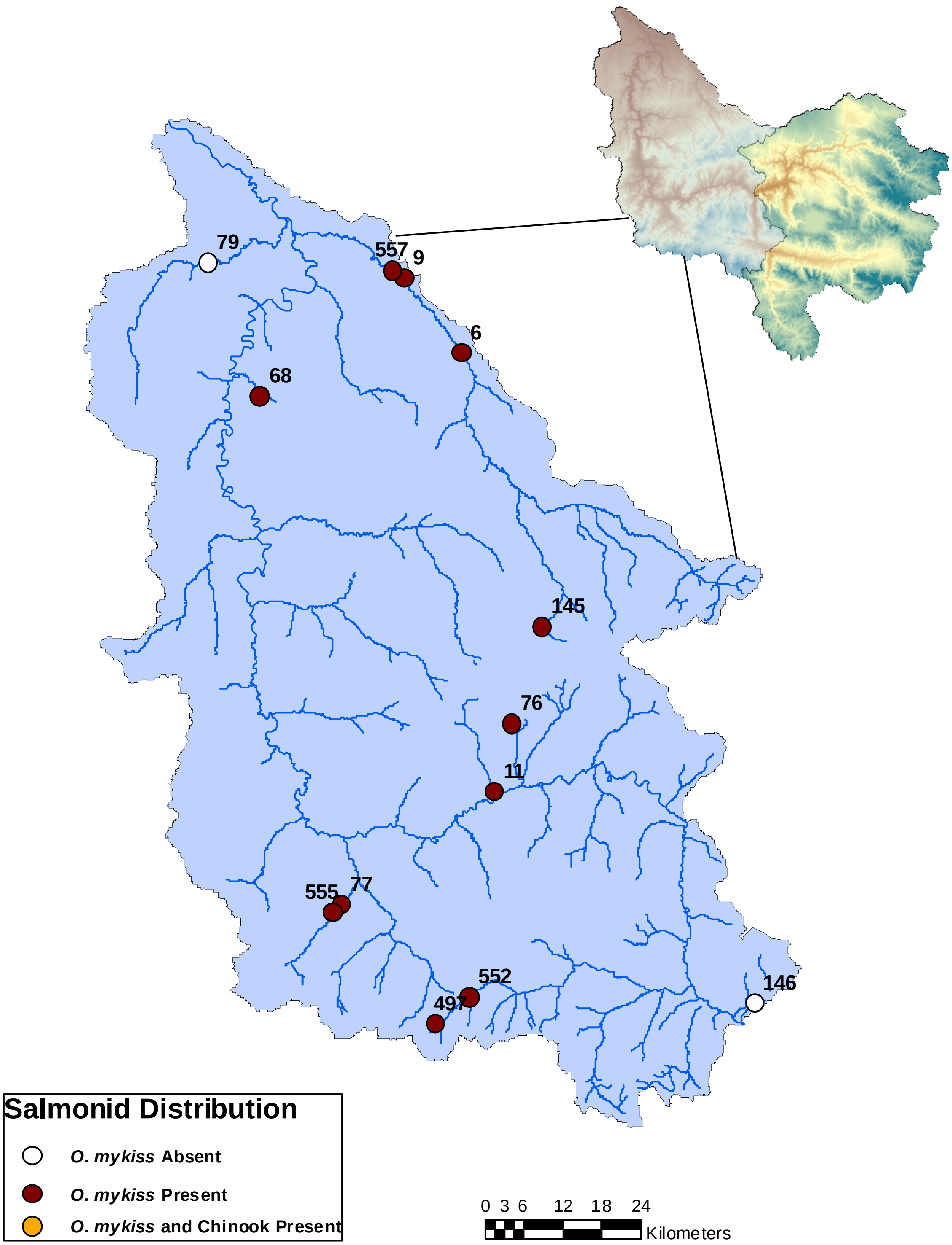

Figure 14. Distribution of juvenile steelhead and spring Chinook observations in the Lower Mainstem John Day River from snorkeling and electrofishing surveys conducted during summer 2007. Site identification numbers are shown next to each point for reference.

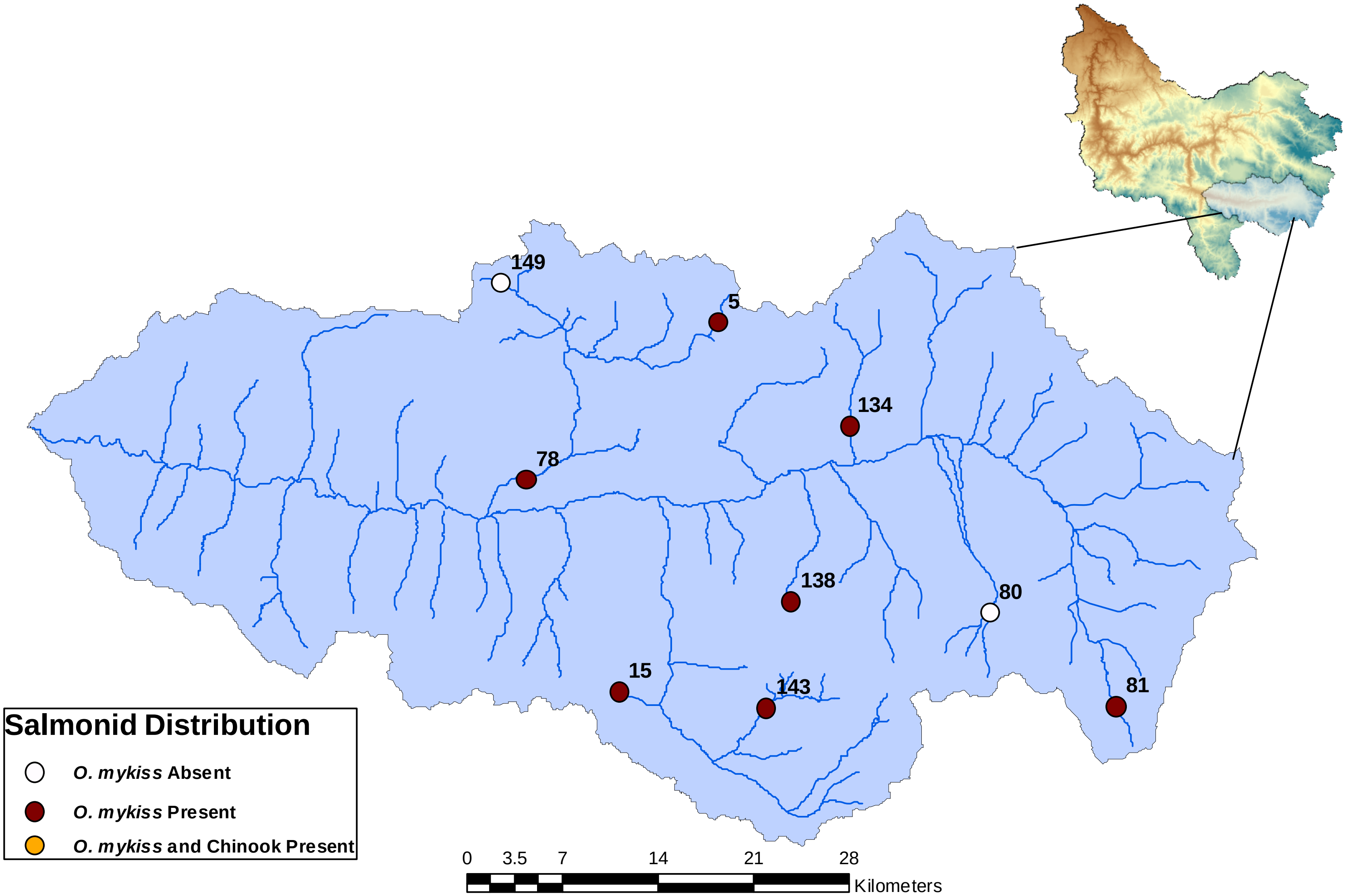

Figure 15. Distribution of juvenile steelhead and spring Chinook observations in the Upper Mainstem John Day River from snorkeling and electrofishing surveys conducted during summer 2007. Site identification numbers are shown next to each point for reference.

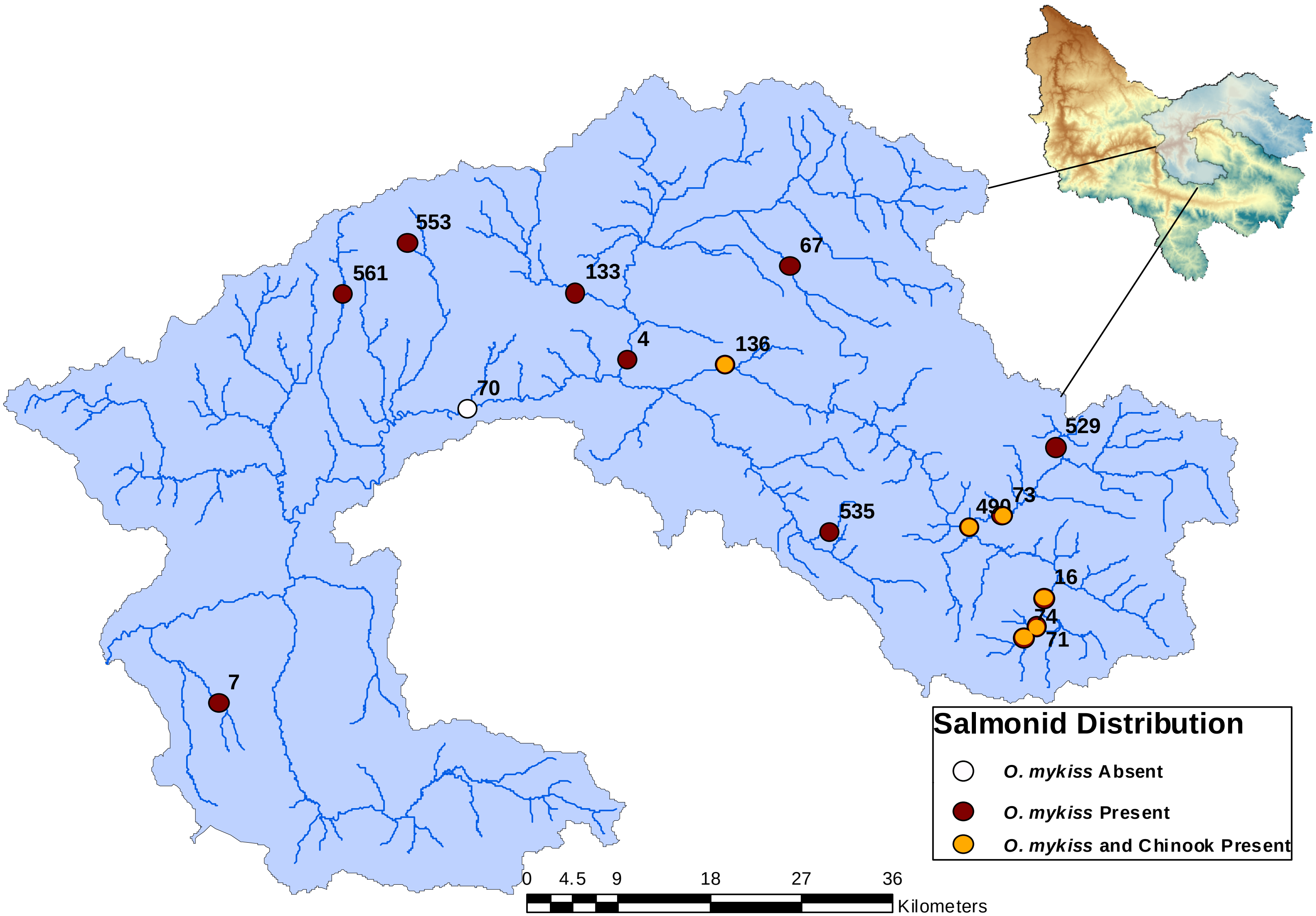

Figure 16. Distribution of juvenile steelhead and spring Chinook observations in the North Fork John Day River from snorkeling and electrofishing surveys conducted during summer 2007. Site identification numbers are shown next to each point for reference.

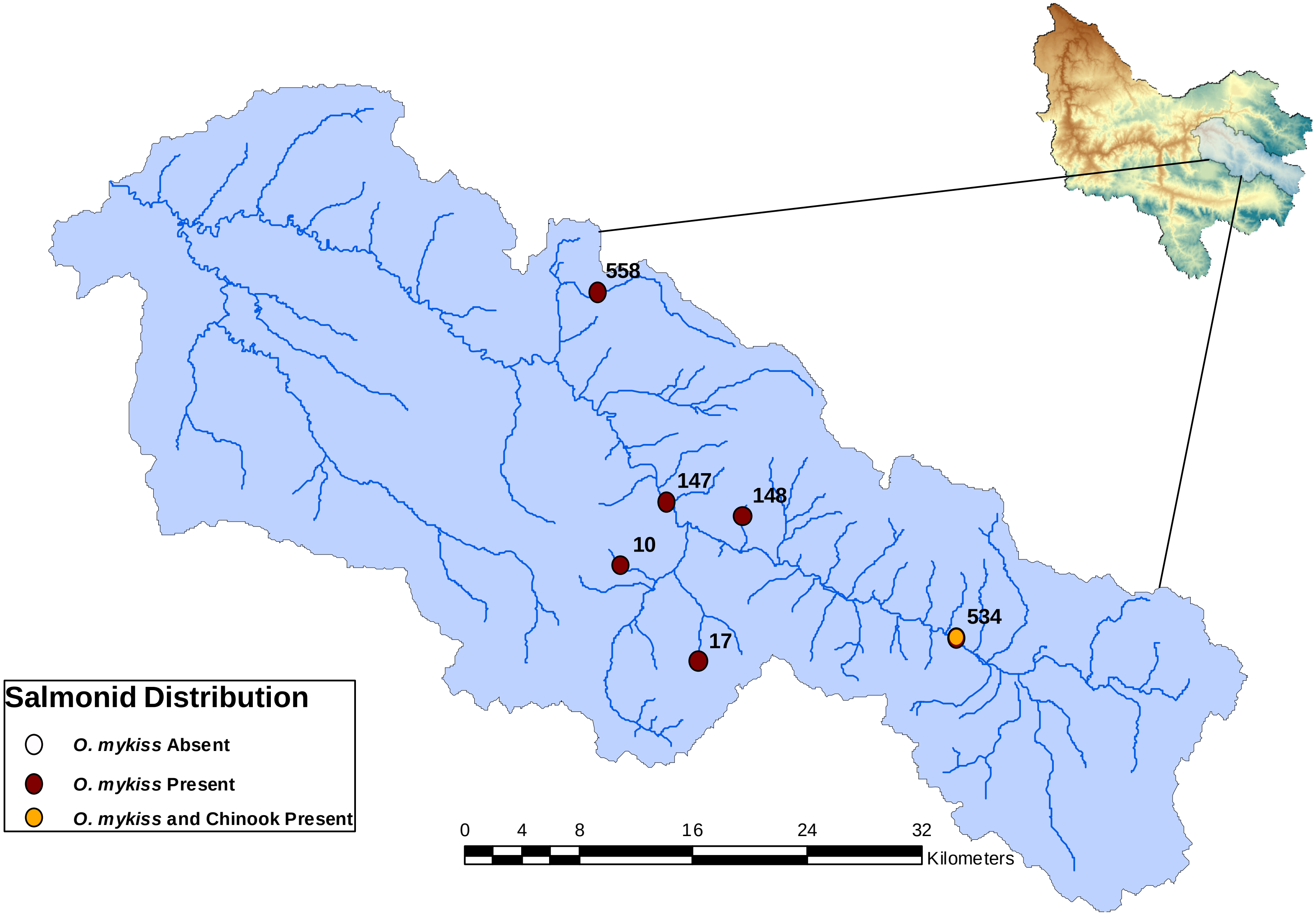

Figure 17. Distribution of juvenile steelhead and spring Chinook observations in the Middle Fork John Day River from snorkeling and electrofishing surveys conducted during summer 2007. Site identification numbers are shown next to each point for reference.

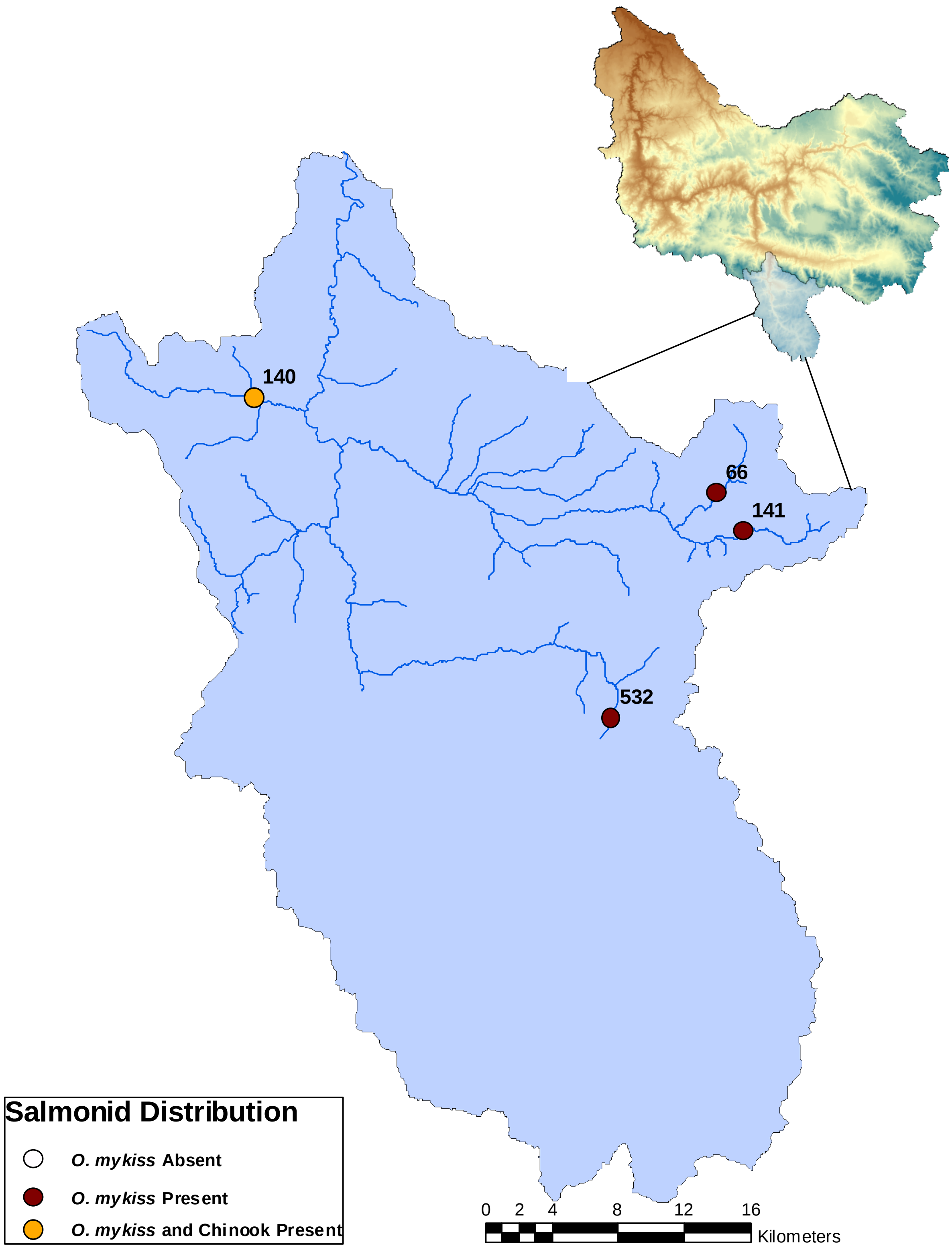

Figure 18. Distribution of juvenile steelhead and spring Chinook observations in the South Fork John Day River from snorkeling and electrofishing surveys conducted during summer 2007. Site identification numbers are shown next to each point for reference.

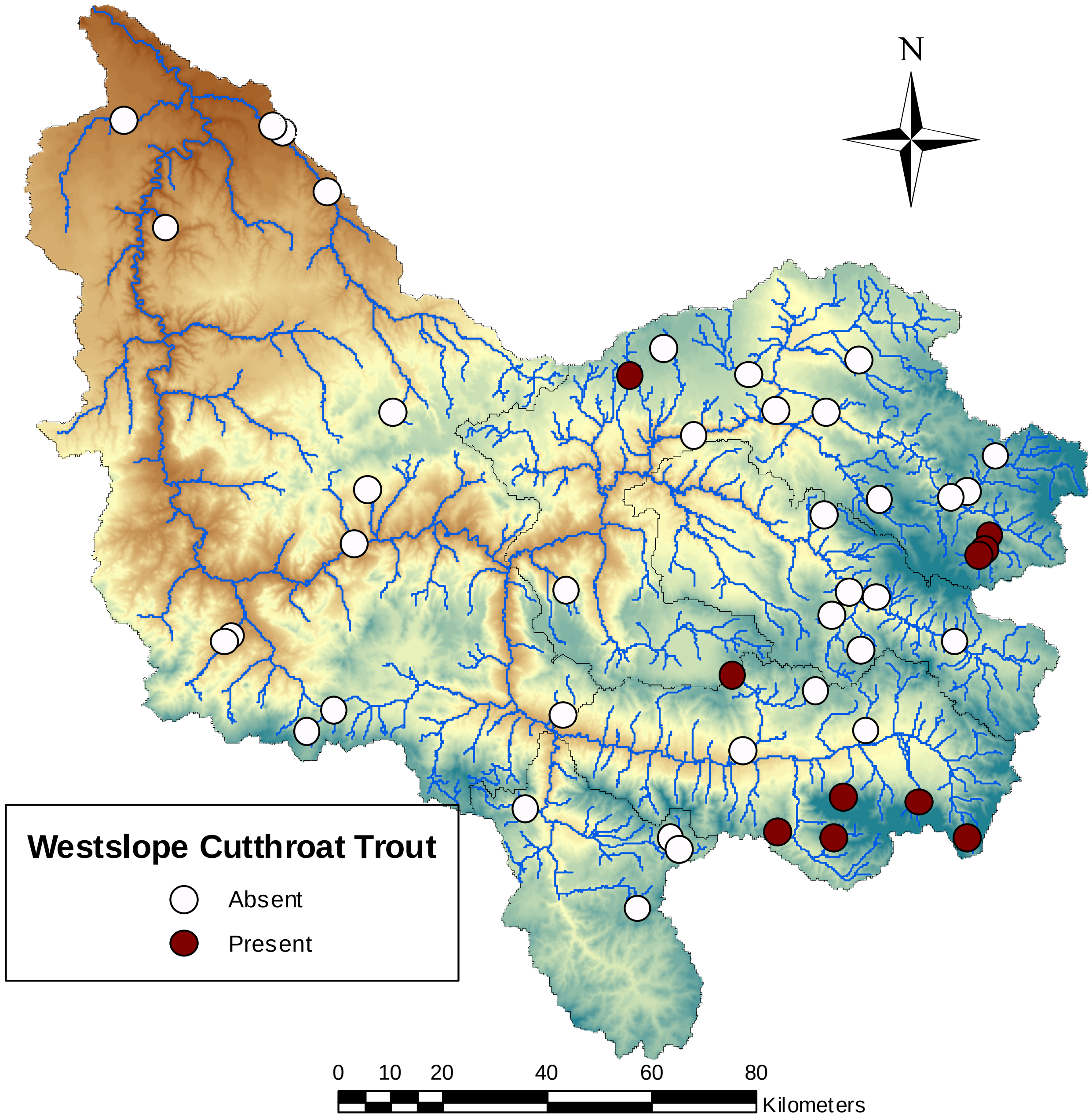

Figure 19. Distribution of Westslope cutthroat trout observations in the John Day River basin from snorkeling and electrofishing surveys conducted during summer 2007.

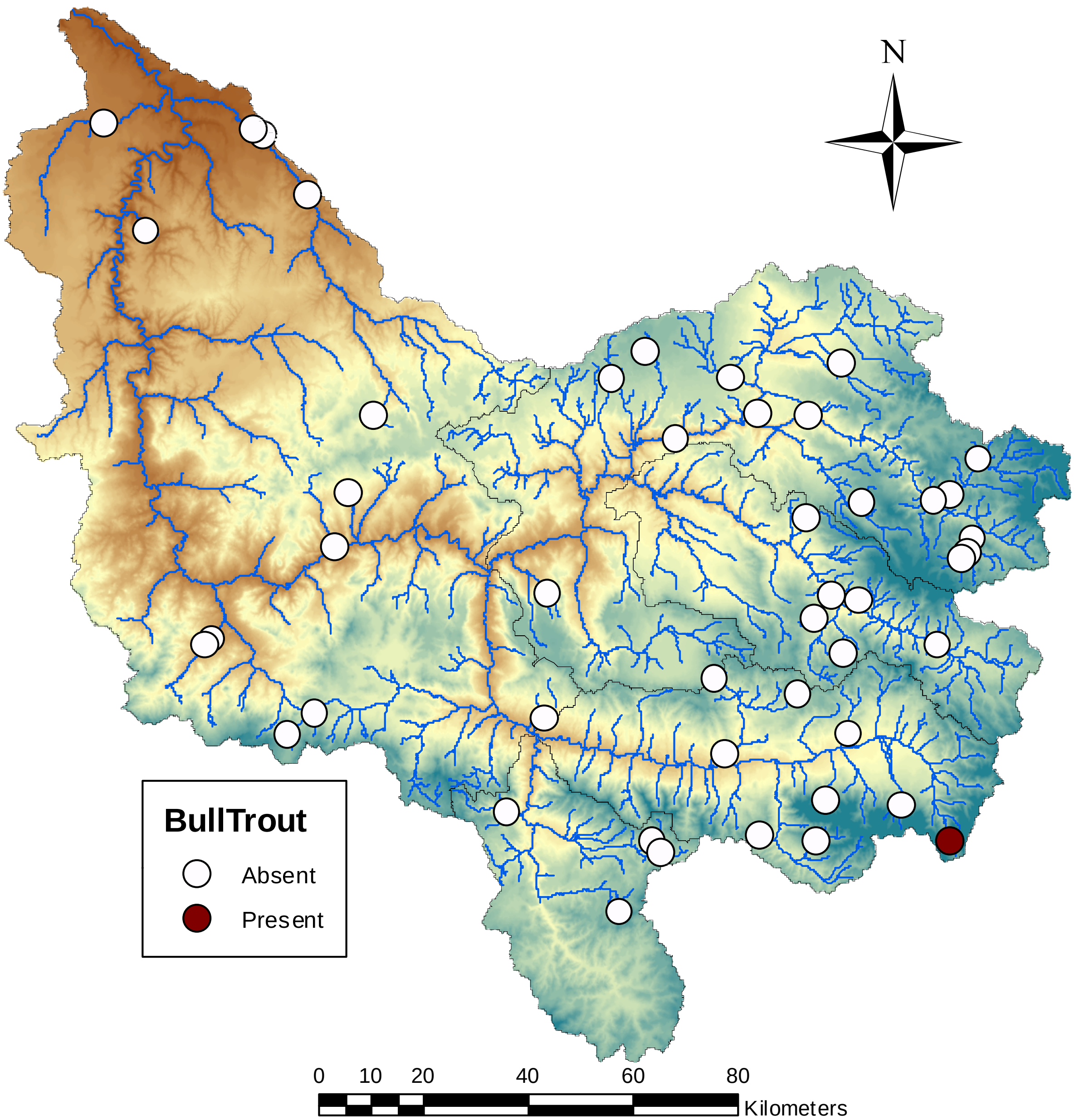

Figure 20. Distribution of bull trout observations in the John Day River basin from snorkeling and electrofishing surveys conducted during summer 2007.

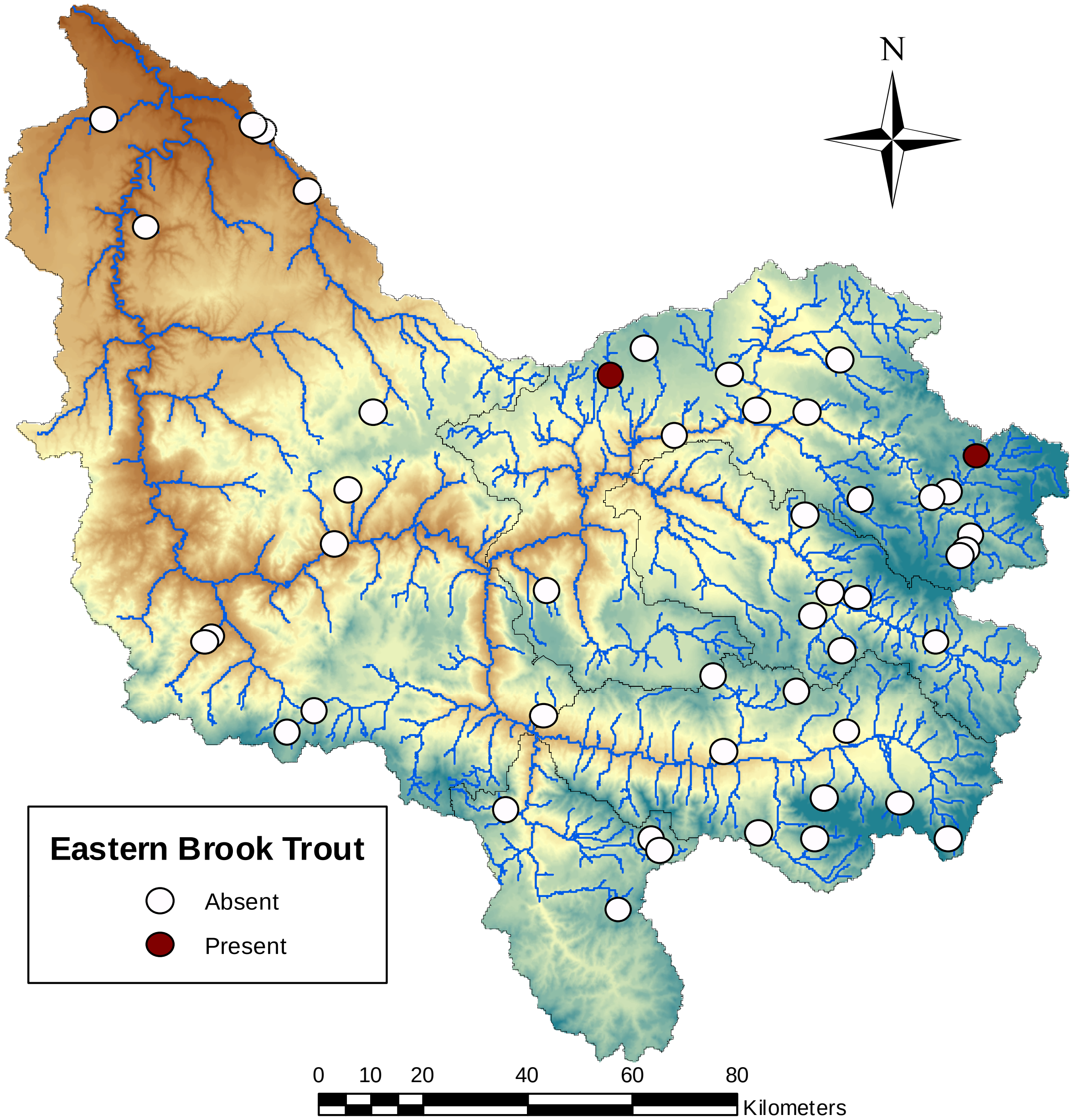

Figure 21. Distribution of Eastern brook trout observations in the John Day River basin from snorkeling and electrofishing surveys conducted during summer 2007.

Table 13. Number and percentage of pools with steelhead present at juvenile survey sites in the John Day River basin in 2007. Only sites where juvenile steelhead were present are included.

Subbasin	# of Pools	# Pools w/O. mykiss	% Pools w/O. mykiss
Lower Mainstem John Day River	185	139	75.1
Upper Mainstem John Day River	132	71	53.8
North Fork John Day River	176	125	71.0
Middle Fork John Day River	103	75	72.8
South Fork John Day River	52	48	92.3
John Day River Basin	**648**	**458**	**70.7**

Table 14. Number and percentage of pools with spring Chinook present at juvenile survey sites in the John Day River basin during 2007. Only sites where spring Chinook were present are included.

Subbasin	# of Pools	# Pools w/Chinook	% Pools w/Chinook
Lower Mainstem John Day River	0	0	0.0
Upper Mainstem John Day River	0	0	0.0
North Fork John Day River	64	49	76.6
Middle Fork John Day River	17	7	41.2
South Fork John Day River	8	6	75.0
John Day River Basin	**89**	**62**	**69.7**

Table 15. Number and percentage of pools with Westslope cutthroat trout present at juvenile survey sites in the John Day River basin during 2007. Only sites where Westslope cutthroat trout were present are included.

Subbasin	# of Pools	# Pools w/Cutthroat	% Pools w/Cutthroat
Lower Mainstem John Day River	0	0	0.0
Upper Mainstem John Day River	100	53	53.0
North Fork John Day River	55	15	27.3
Middle Fork John Day River	0	0	0.0
South Fork John Day River	0	0	0.0
John Day River Basin	**155**	**68**	**43.9**

Table 16. Number and percentage of pools with bull trout present at juvenile survey sites in the John Day River basin during 2007. Only sites where bull trout were present are included.

Subbasin	# of Pools	# Pools w/Bull Trout	% Pools w/Bull Trout
Lower Mainstem John Day River	0	0	0.0
Upper Mainstem John Day River	20	4	20.0
North Fork John Day River	0	0	0.0
Middle Fork John Day River	0	0	0.0
South Fork John Day River	0	0	0.0
John Day River Basin	**20**	**4**	**20.0**

Table 17. Number and percentage of pools with Eastern brook trout present at juvenile survey sites in the John Day River basin during 2007. Only sites where Eastern brook trout were present are included.

Subbasin	# of Pools	# Pools w/Brook Trout	% Pools w/Brook Trout
Lower Mainstem John Day River	0	0	0.0
Upper Mainstem John Day River	0	0	0.0
North Fork John Day River	36	3	8.3
Middle Fork John Day River	0	0	0.0
South Fork John Day River	0	0	0.0
John Day River Basin	**36**	**3**	**8.3**

Table 18. Variability in density (fish/m^2) estimates for steelhead annual sites surveyed during juvenile fish surveys from 2004 to 2007.

		Steelhead Density (#/m^2)			
Stream	Site ID	2004	2005	2006	2007
Battle Creek	535	N/A	N/A	0.064	0.357
Camas Creek	4	0.004	0.002	0.002	0.001
Clear Creek	16	0.128	0.080	0.107	0.060
Gilmore Creek	7	0.044	0.074	0.055	0.170
Granite Creek	490	0.052	0.079	0.044	0.017
M.F. John Day	534	N/A	N/A	0.001	0.008
Milk Creek	497	0.240	0.386	0.174	0.768
Rock Creek	6	0.098	0.000	0.072	0.570
Rock Creek	9	0.074	0.000	0.101	1.062
Service Creek	11	1.106	0.283	0.125	0.136
S.F. Deer Creek	532	N/A	N/A	0.239	0.515
Trout Creek	529	N/A	N/A	0.067	0.061
Tinker Creek	5	0.283	0.454	0.174	0.563
Vance Creek	15	0.098	0.375	0.150	0.209
WF Lick Creek	17	0.309	0.181	0.104	0.271
Whisky Creek	10	0.282	0.394	0.495	0.451
Average		**0.229**	**0.206**	**0.126**	**0.326**

Table 19. Variability in density (fish/m^2) estimates for Chinook salmon at annual sites surveyed during juvenile fish surveys from 2004 to 2007.

		Spring Chinook Density (#/m^2)			
Stream	**Site ID**	**2004**	**2005**	**2006**	**2007**
Battle Creek	535	N/A	N/A	0.000	0.000
Camas Creek	4	0.002	0.004	0.000	0.000
Clear Creek	16	0.190	0.211	0.137	0.060
Gilmore Creek	7	0.000	0.000	0.000	0.000
Granite Creek	490	0.103	0.141	0.017	0.065
M.F. John Day	534	N/A	N/A	0.001	0.012
Milk Creek	497	0.000	0.000	0.000	0.000
Rock Creek	6	0.000	0.000	0.000	0.000
Rock Creek	9	0.000	0.000	0.000	0.000
Service Creek	11	0.000	0.000	0.000	0.000
S.F. Deer Creek	532	N/A	N/A	0.000	0.000
Trout Creek	529	N/A	N/A	0.000	0.000
Tinker Creek	5	0.000	0.000	0.000	0.000
Vance Creek	15	0.000	0.000	0.000	0.000
WF Lick Creek	17	0.000	0.000	0.000	0.000
Whisky Creek	10	0.000	0.000	0.000	0.000
Average		**0.020**	**0.024**	**0.008**	**0.008**

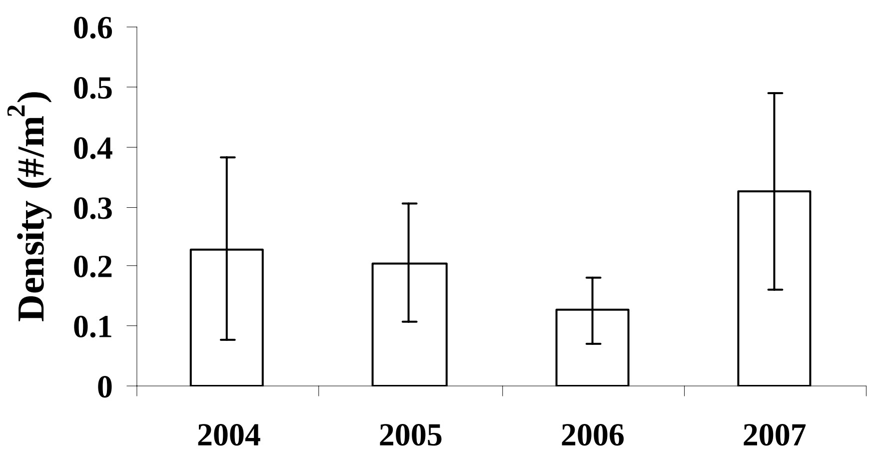

Figure 22. Average density of juvenile steelhead (± 95% CI) observed at EMAP annual sites from 2004-2007.

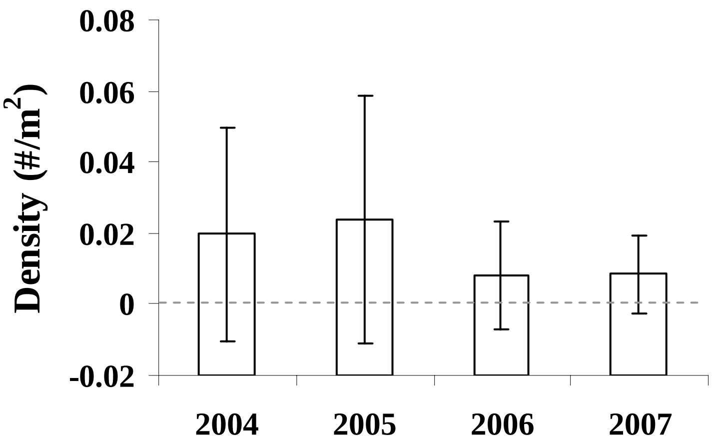

Figure 23. Average density of juvenile spring Chinook (± 95% CI) observed at EMAP annual sites from 2004-2007. Dashed line is included for reference of zero fish/m^2.

Table 20. Stream, site identification number, sampling method, number of pools surveyed, and presence (X) of incidental species collected during juvenile fish surveys in the John Day River basin during 2007. Sampling methods include electrofishing (E) and snorkeling (S). LMJDR=Lower Mainstem John Day River subbasin, UMJDR=Upper Mainstem John Day River subbasin, NFJDR=North Fork John Day River subbasin, MFJDR=Middle Fork John Day River subbasin, SFJDR=South Fork John Day River subbasin.

Stream	Site ID	Sampling Method	# Pools	Mountain Whitefish	Northern Pikeminnow	Redside Shiner	Smallmouth Bass	*Catostomus* spp.	*Cottus* spp.	*Ictalurus* spp.	*Rhynichthys* spp.
LMJDR											
Badger Creek	552	E	20			X		X	X		X
Bear Creek	77	E	18								X
Bear Creek	555	E	21					X			X
Buckhorn Creek	145	S	19			X		X			X
Ferry Canyon	68	S	20					X			X
Franks Creek	146	E	5								X
Grass Valley Canyon	79	S	20		X	X		X			X
Lake Creek	76	E	20								
Milk Creek	497	E	20								
Rock Creek	9	S	10		X	X		X			X
Rock Creek	557	E	5		X	X		X			X
Rock Creek	6	S	18			X		X			X
Service Creek	11	E	14					X			
UMJDR											
Bear Creek	134	E	15			X		X			X
Beech Creek	78	S	19		X	X		X			X
Beech Creek	149	E	2								
East Fork Canyon Creek	143	S	20						X		
John Day River	81	S	20								
Pine Creek	138	S	20								
Slide Creek	80	E	20						X		
Tinker Creek	5	E	20								
Vance Creek	15	E	18								

Table 20. (Cont.)

Stream	Site ID	Sampling Method	# Pools	Mountain Whitefish	Northern Pikeminnow	Redside Shiner	Smallmouth Bass	*Catostomus* spp.	*Cottus* spp.	*Ictalurus* spp.	*Rhynichthys* spp.
NFJDR											
Battle Creek	535	E	16								
Cable Creek	67	S	21			X					X
Camas Creek	4	S	7		X	X	X	X			X
Clear Creek	71	S	4								
Clear Creek	16	S	19			X		X	X		X
Clear Creek	74	S	12								
Ditch Creek	561	E	20					X			X
Fivemile Creek	133	S	10					X			X
Gilmore Creek	7	E	18								
Granite Creek	490	S	17	X					X		X
North Fork John Day River	73	S	9								
North Fork John Day River	136	S	3		X	X		X			X
North Fork John Day River	70	S	5		X		X	X			X
Trout Creek	529	S	16								
Wilson Creek	553	E	4								
MFJDR											
Coyote Creek	148	E	19								
Indian Creek	558	E	20						X		
Middle Fork John Day River	534	S	17	X	X	X		X			X
Middle Fork John Day River	147	S	7	X	X	X		X		X	X
West Fork Lick Creek	17	E	20								
Whisky Creek	10	E	20								
SFJDR											
Black Canyon Creek	140	S	8						X		X
Charlie Mack Creek	141	E	4								
South Fork Deer Creek	532	E	20								
Tex Creek	66	E	20						X		

Table 21. Number and percentage of sites with incidental species collected during juvenile surveys in the John Day River basin (JDR) during 2007. LMJDR=Lower Mainstem John Day River subbasin, UMJDR=Upper Mainstem John Day River subbasin, NFJDR=North Fork John Day River subbasin, MFJDR=Middle Fork John Day River subbasin, SFJDR=South Fork John Day River subbasin.

	JDR		% Sites Present				
Incidental Species	**# Sites Present**	**% Sites Present**	**LMJDR (n= 13)**	**UMJDR (n= 9)**	**NFJDR (n= 15)**	**MFJDR (n= 6)**	**SFJDR (n= 4)**
Catostomus spp.	19	40.4	69.2	22.2	40.0	33.3	0.0
Cottus spp.	8	17.0	7.7	22.2	13.3	16.7	50.0
ssp. Ictalurus	1	2.1	0.0	0.0	0.0	16.7	0.0
spp Rhinichthys	23	48.9	76.9	22.2	53.3	33.3	25.0
Redside Shiner	14	29.8	46.2	22.2	26.7	33.3	0.0
Northern Pikeminnow	9	19.1	23.1	11.1	20.0	33.3	0.0
Smallmouth Bass	2	4.3	0.0	0.0	13.3	0.0	0.0
Mountain Whitefish	3	6.4	0.0	0.0	6.7	33.3	0.0

Habitat and Riparian Surveys

We surveyed 50.2 km of stream habitat (primary & secondary channels) at 49 sites in the John Day River basin in 2007. Dominant land use varied by site ranging from light and heavy grazing to riparian exclosures and wilderness (Table 22). In the riparian zone, annual grasses and shrubs were common dominant vegetation constituents, occurring at 37 sites (Table 22). Most streams had a constrained channel form with terraces, hillslopes, or land use as the constraining feature (Table 22). Several sites throughout the John Day River basin had puddled or dry flows during 2007 (Table 22). In the Middle Fork subbasin, all sites had either low flow or dry stream channels (Table 22).

Few statistical differences were observed in the selected habitat characteristics tested. Only active channel width, percent gravel in riffles, percent bank erosion, and wood volume (m^3/100m) had any statistically detectable differences (P<0.05; Table 23) across subbasins. *Post hoc* analysis identified the North Fork as having a greater active channel width than either the South Fork or Lower Mainstem subbasin (Tables 23 and 24). Additional *Post hoc* analysis indicated that the Lower Mainstem had a higher percentage of gravel in riffles and greater bank erosion than the North Fork subbasin (Tables 23 and 24). Furthermore, the Lower Mainstem had a lower wood volume per 100m than either the Upper Mainstem, Middle Fork, or North Fork subbasins (Tables 23 and 24).

DISCUSSION

The steelhead escapement estimate to the John Day River basin in 2007 was the highest return since commencing the EMAP monitoring project in the basin in 2004. Index surveys in the John Day River basin conducted by Oregon Department of Fish and Wildlife Fish Biologists in 2007 also resulted in the highest basin redd densities since 2002 (Appendix G). This apparent increase in spawning in the basin may have been, in part, a result of optimal surveying conditions experienced throughout the basin in 2007. Since 2004, flows at the USGS gauging station on the John Day River at Service Creek have generally peaked during the month of May at over 10,000 cfs. In 2007, the peak flow occurred in March at just over 6,000 cfs. These lower flows provided excellent water clarity with reduced turbidity and better viewing of stream substrates in many streams allowing easier detection of constructed redds.

While water conditions during the 2007 spawning season may have been ideal for detection of redds during the spawning survey season, the high redd densities appeared to have resulted in increased juvenile steelhead production in some streams. For instance, Rock Creek on the Lower Mainstem John Day River had substantial spawning with 38 redds constructed at three sites (Site IDs 6, 9, and 557) and juvenile steelhead abundance estimates of 1,663, 2,220, and 30 fish, respectively. While Site 557 only had 30 juvenile steelhead observed, the low abundance is probably attributable to the lack of sufficient habitat. Only five pools were present during the fish/habitat survey and fish likely vacated the area for better quality habitat, such as the other two Rock Creek sites (Sites 6 and 9) where the pool habitat was more abundant. In these Rock Creek sites (6 and 9) 67% and 40% of the habitat units were pools as opposed to site 557 which only had 7% of the habitat units as pools. Other sites however, such as Service Creek (Site 11), Lower Mainstem Bear Creek (Sites 77 and 555), and Upper Mainstem Bear Creek

Table 22. Stream, site identification, channel length surveyed, channel type, land use, and reach information for habitat surveys conducted in the John Day River basin during 2007. Description of codes used for channel form, land use, riparian vegetation, and stream flow are located in Appendices A - D. LMJDR=Lower Mainstem John Day River subbasin, UMJDR=Upper Mainstem John Day River subbasin, NFJDR=North Fork John Day River subbasin, MFJDR=Middle Fork John Day River subbasin, SFJDR=South Fork John Day River subbasin.

Stream	SiteID	Channel Length (m) Primary	Channel Length (m) Secondary	Channel Form	Dominant Land Use	Riparian Veg.	Active Channel Width (m)	Gradient (%)	Stream Flow	Temp (°C)	% of Site w/Pools	Depth (m) Residual Pool	Depth (m) Riffle
LMJDR													
Badger Creek	552	501	1	US	EX	G	4.9	0.7	LF	9.5	90.0	0.44	0.08
Bear Creek	77	1050	0	CT	LG	S	11.9	1.2	LF	14.0	18.1	0.26	0.11
Bear Creek	555	1057	17	US	RR	S	10.7	1.3	LF	12.0	31.2	0.31	0.10
Buckhorn Creek	145	1017	75	CH	ST	D3	8.0	2.7	LF	14.0	12.6	0.24	0.12
Ferry Canyon	68	1072	8	US	LG	B	9.7	1.4	MF	16.0	32.8	0.31	0.21
Franks Creek	146	500	0	CH	LG	S	4.5	2.7	PD	19.5	1.6	0.17	0.06
Grass Valley Canyon	79	1048	17	CA	EX	B	15.7	0.7	LF	19.0	85.2	0.40	0.23
Lake Creek	76	545	0	CH	ST	S	5.0	3.0	LF	6.0	19.4	0.21	0.08
Milk Creek	497	477	26	US	HG	C3	2.8	4.0	LF	6.5	14.1	0.21	0.06
Rock Creek	557	1001	0	CT	AG	G	13.2	1.2	PD	23.0	7.2	0.75	0.15
Rock Creek	6	1006	68	CT	AG	G	16.1	0.5	LF	21.0	67.2	0.63	0.11
Rock Creek	9	965	10	CA	AG	G	11.7	0.8	PD	23.0	40.2	0.70	0.11
Service Creek	11	1059	0	CA	RR	G	7.2	1.5	LF	17.5	36.5	0.27	0.17
UMJDR													
Bear Creek	134	616	239	US	LG	S	13.8	1.4	LF	15.0	70.1	0.35	0.11
Beech Creek	78	986	34	CA	RR	S	10.7	0.8	LF	15.0	65.6	0.44	0.15
Beech Creek	149	496	46	US	LG	S	3.4	3.2	DR		0.4	0.16	
East Fork Canyon Creek	143	1137	127	US	WA	M3	16.6	1.6	LF	9.0	27.5	0.42	0.13
John Day River	81	985	24	US	ST	S	6.0	2.8	MF	9.5	14.8	0.38	0.24
John Day River	559	975	0	US	LG	G	25.7	0.7	LF	13.0	22.9	0.47	0.33
Pine Creek	138	1072	156	CH	ST	C3	9.0	7.4	MF	10.0	12.3	0.44	0.19
Slide Creek	80	1005	112	US	WA	S	8.3	7.1	LF	10.5	11.4	0.31	
Tinker Creek	5	543	14	CH	PT	G	6.4	1.9	PD	12.5	4.6	0.16	0.08
Vance Creek	15	501	0	CL	ST	S	5.1	2.0	LF	7.0	19.2	0.19	0.06
NFJDR													
Battle Creek	535	1141	43	CH	YT	S	10.2	4.2	LF	10.0	10.1	0.28	0.10
Cable Creek	67	1003	461	UA	LG	C3	12.3	1.4	LF	19.5	21.0	0.37	0.13

Table 22. (cont.)

Stream	SiteID	Channel Length (m) Primary	Secondary	Channel Form	Dominant Land Use	Riparian Veg.	Active Channel Width (m)	Gradient (%)	Stream Flow	Temp (°C)	% of Site w/Pools	Depth (m) Residual Pool	Riffle
NFJDR													
Camas Creek	4	1007	110	CH	FF	S	34.3	0.6	LF	16.0	41.6	0.69	0.25
Clear Creek	74	1023	437	UA	ST	S	17.0	3.4	LF	11.0	10.8	0.34	0.28
Clear Creek	71	949	878	UA	ST	C3	16.1	2.8	LF	9.0	6.4	0.30	0.20
Clear Creek	16	1023	376	CL	MI	G	18.9	1.1	LF	14.5	46.8	0.57	0.23
Ditch Creek	561	1018	476	UA	YT	G	15.3	2.6	LF	15.0	20.4	0.29	0.11
Fivemile Creek	133	990	87	CH	ST	S	13.3	4.9	LF	17.5	10.6	0.58	0.08
Gilmore Creek	7	959	0	CA	EX	S	5.7	1.4	PD	19.5	12.3	0.29	0.03
Granite Creek	490	1028	146	CH	WA	S	18.9	2.5	MF	9.5	12.4	0.42	0.39
North Fork John Day River	73	1061	10	CH	WA	S	22.4	1.3	LF	14.0	13.5	0.42	0.30
North Fork John Day River	136	1043	13	CH	ST	P	38.3	0.8	MF		27.1	0.86	0.38
North Fork John Day River	70	999	85	CH	ST	G	61.3	0.6	MF	22.0	46.6	0.54	0.34
Trout Creek	529	949	38	CH	WA	S	9.9	6.5	LF	10.5	9.7	0.51	0.26
Wilson Creek	553	510	219	US	YT	G	7.9	2.9	DR	12.0	11.8	0.72	
MFJDR													
Coyote Creek	148	549	15	CH	HG	G	2.4	5.5	LF	15.0	8.3	0.19	0.07
Crawford Creek	137	1043	12	US	LG	G	7.7	1.5	DR	24.0	0.2	0.22	0.08
Indian Creek	558	1026	117	CH	NU	M3	10.9	4.8	LF	12.0	13.0	0.50	0.20
Middle Fork John Day River	534	1128	10	US	EX	G	19.8	0.3	LF	18.5	58.6	0.57	0.35
Middle Fork John Day River	147	959	482	US	RR	S	36.9	0.2	LF	18.0	72.4	0.51	0.23
West Fork Lick Creek	17	971	44	CH	LG	C3	5.4	2.1	LF	11.0	20.2	0.21	0.09
Whisky Creek	10	986	125	CH	HG	S	5.2	7.5	LF	13.0	8.7	0.26	
SFJDR													
Black Canyon Creek	140	1054	28	CA	FF	S	9.4	4.1	MF	9.5	4.4	0.50	0.40
Charlie Mack Creek	141	501	15	US	PT	S	2.6	2.1	PD	5.0	1.8	0.09	0.03
South Fork Deer Creek	532	526	0	US	HG	D1	5.2	1.5	LF	5.5	30.1	0.28	0.13
Tex Creek	66	1009	30	US	ST	D3	7.5	1.2	PD	10.0	16.4	0.35	0.04

Table 23. Test for statistical significance of selected habitat parameters collected in 2007 across John Day River subbasins. *P*-values ≤ 0.05 indicate statistically significant differences.

Habitat Variable	P-Value	Differences
Gradient (%)	0.659	
Active Channel Width (m)	0.012	NFJDR> (SFJDR And LMJDR)
Pools (%)	0.447	
Riffle Depth (m)	0.234	
Organics (%)	0.108	
Gravel (%)	0.483	
Riffle Organics (%)	0.175	
Riffle Gravel (%)	0.046	LMJDR > NFJDR
Shading (%)	0.117	
Bank Erosion (%)	0.011	LMJDR > NFJDR
Bank Undercut (%)	0.112	
Wood Volume (m^3/100 m)	<0.001	LMJDR < (UMJDR And MFJDR And NFJDR)
Residual Pool Depth (m)	0.143	
Boulders (#/100 m)	0.070	
Conifers (#/1000 ft)	0.124	
Hardwoods (#/1000 ft)	0.104	

(Site 134) which had a sufficient number of redds constructed did not show a strong relationship to juvenile steelhead abundance. Fish sampling efficiency may have been a factor in this apparent departure, especially in the Upper Mainstem subbasin Bear Creek and Service Creek where extensive riparian vegetation hampered the sampling crew's visibility of the stream and overall mobility with sampling equipment. Prior to a flash flood event at sites in the Lower Mainstem Bear Creek ~1-2 weeks before juvenile and habitat surveys occurred, the stream channel was mostly dry except for a few small, isolated pools. Fish sought refuge in these isolated pools, resulting in significant mortality of a number of fish and reduced growth rates (Ian Tattam, OSU, personal communication).

We did not observe spawning activity at a large proportion of sites surveyed in 2007. In the past four years, more than 50% of sites surveyed in any given year have been void of any observable spawning activity. Even with the ideal surveying conditions for redd detection this year, only 48% of sites had any observable redds. 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 more than half of our annual sites, are not being utilized for steelhead spawning suggests we do not fully understand current steelhead spawning habitat use in the basin or habitat is not fully utilized at the recent adult escapement levels.

Because the Lower Mainstem tributaries account for the majority of redds observed in during any given year indicates this is an important component of steelhead production within the John Day Basin. During 2007, 91 redds were observed in the Lower Mainstem subbasin, more than the amount of redds observed basin wide in any of the previous years. Except for 2005 when low water flows limited adult steelhead access to smaller tributaries (Wiley et al. 2005), the Lower Mainstem John Day River subbasin tributaries have accounted for ~50% of the observed spawning in the basin. With the majority of redds constructed in the Lower Mainstem in any given year, it would seem likely that a portion of smolt production in the basin would also occur in these tributaries. In fact, recent PIT-tagging efforts in the Bridge Creek drainage of the Lower Mainstem subbasin near Mitchell, Oregon have resulted in 69 detections of steelhead smolts at juvenile or adult detection facilities on the lower Columbia River (DART 2007).

Table 24. Average, minimum, and maximum values of habitat parameters at survey sites in the John Day River basin during 2007. LMJDR=Lower Mainstem John Day River subbasin, UMJDR=Upper Mainstem John Day River subbasin, NFJDR=North Fork John Day River subbasin, MFJDR=Middle Fork John Day River subbasin, SFJDR=South Fork John Day River subbasin.

							Substrate					Large Woody Debris			Riparian Trees	
Subbasin	Survey Length (km)	ACW (m)	% Gradient	Temp (ºC)	% of Site w/ Pools	Large Bldrs /100 m	% Fines	% Gravel	% Shade	% Bank Erosion	% Undercut	# /100 m	Volume /100 m	# Key /100 m	Conifers /1000 ft	Deciduous /1000 ft
LMJDR	11.5															
Average		9.3	1.7	15.5	35.1	0.6	27.7	34.0	43.4	34.2	7.2	3.5	0.3	5.0	256	122
Min		2.8	0.5	6.0	1.6	0.0	4.9	15.6	21.3	12.4	0.0	0.2	0.0	0.0	0	0
Max		16.1	4.0	23.0	90.0	1.6	81.2	76.8	76.9	54.6	45.4	23.3	3.4	46.3	1646	589
UMJDR	9.3															
Average		10.5	2.9	11.3	24.6	0.5	26.1	31.5	61.7	17.1	14.0	14.3	0.5	12.5	823	506
Min		3.4	0.7	7.0	0.4	0.0	6.1	16.7	20.1	0.9	0.5	2.0	0.0	1.0	20	0
Max		25.7	7.2	15.0	70.1	1.9	53.3	46.8	86.1	54.6	51.9	35.5	1.6	34.6	2195	2195
NFJDR	18.7															
Average		20.2	2.5	14.3	20.4	2.0	14.4	25.2	51.1	17.5	5.5	19.2	0.5	15.9	763	176
Min		5.7	0.6	9.0	6.4	0.1	2.2	9.1	30.6	0.2	0.0	3.0	0.0	3.4	41	0
Max		61.3	6.5	22.0	46.8	6.4	28.6	63.7	72.6	65.5	19.0	43.2	1.7	45.1	1402	711
MFJDR	7.6															
Average		12.6	3.1	15.9	25.7	0.9	19.4	27.1	53.3	28.2	8.4	9.8	0.3	7.8	839	131
Min		2.4	0.2	11.0	0.2	0.0	16.6	13.0	20.7	4.6	0.0	0.5	0.0	0.5	61	0
Max		36.9	7.5	24.0	72.4	3.0	25.5	37.8	75.7	74.8	22.0	26.6	0.9	20.1	2540	386
SFJDR	3.2															
Average		6.2	2.2	7.5	13.1	0.6	42.4	29.7	58.6	31.4	15.3	9.9	0.5	10.3	813	386
Min		2.6	1.2	5.0	1.8	0.0	10.7	21.5	38.5	16.3	3.7	7.2	0.4	6.5	20	61
Max		9.4	4.1	10.0	30.1	2.3	75.0	47.3	72.5	44.9	34.3	12.0	0.6	14.9	1300	1280

We again attempted to estimate steelhead hatchery stray rates into the John Day River basin. Surprisingly, the percentage of hatchery fish observed this year, and in previous years, has remained around 35%. While estimates of hatchery steelhead strays based on EMAP data have remained consistent, current year estimates by other observers in the John Day River basin are not consistent with previous records. In fact very few hatchery strays were observed in ongoing monitoring projects in the basin (Appendix F). Although we only report positively identifiable observations, caution should be exercised when using our estimates because they rely upon visual observations of the presence or absence of an adipose fin on fish that we never handle—potentially leading to mis-identification. Furthermore, the fact that we only determine ~50% of the fish we observe could impact our estimate if the majority of the fish we do not identify are of either wild or hatchery origin. In addition, we have no way of accounting for multiple observations of the same fish upon repeat visits to our sites. It is possible that individual fish are re-sampled on subsequent visits to the same site. Therefore, any estimates of hatchery stray rates must be done so with caution, except to address the concern of hatchery origin fish straying into the John Day River and likely impacting wild steelhead production.

CONCLUSIONS

In order to improve our ability to estimate steelhead escapement in the John Day River basin, we need to 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 utilized. Furthermore, increased monitoring efforts of juvenile survival rates will be important in determining critical habitat components that may be limiting juvenile production in the basin. Such data would be valuable in guiding additional restoration efforts to maximize resource inputs. Given the extensive steelhead spawning that is occurring in the Lower Mainstem John Day subbasin, juvenile and smolt production monitoring efforts need to be initiated in the tributaries of this subbasin. Including tributaries of the Lower Mainstem will be important for a full assessment of basin smolt production. The current methods used in the monitoring project for assessing hatchery steelhead stray rates into the John Day River basin need to be expanded. To truly assess the rate of hatchery strays into the basin a thorough program needs to be developed that can more accurately determine hatchery fish presence and more importantly, influence in the basin.

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APPENDIX

Appendix A. Description of codes used to classify stream channel form during habitat and riparian surveys.

Code	Description
CA	Constrained by Alternating terraces and hill slope. The stream channel is confined by contact with hill slopes and high terraces.
CB	Constrained by Bedrock (bedrock dominated gorge)
CF	Constrained by alluvial Fan
CH	Constrained by Hill slope
CL	Constrained by Land use (road, dike, landfill)
CT	Constraining Terraces. (terrace height > floodprone height and floodprone width < 2.5 X active channel width).
UA	Unconstrained-Anastomosing (several complex, interconnecting channels)
UB	Unconstrained-Braided channel (numerous, small channels often flowing over alluvial deposits)
US	Unconstrained-predominantly Single channel.

Appendix B. Description of codes used to classify land use (beyond the riparian zone) during habitat and riparian surveys.

Code	Description
AG	Agricultural crop or dairy land.
BK	Bug Kill. Eastside forests with > 60% mortality from pests and diseases.
CR	Conservation area or wildlife Refuge.
EX	Exclosure. Fenced area that excludes cattle from a portion of range land
FF	Forest Fire. Evidence of recent charring and tree mortality.
GN	Green way. Designated Green Way areas, Parks (city, county, state).
HG	Heavy Grazing Pressure. Broken banks, well established cow paths. Primarily bare earth or early successional stages of grasses and forbs present.
IN	Industrial
LG	Light Grazing Pressure. Grasses, forbs and shrubs present, banks not broken down, animal presence obvious only at limited points such as water crossings. Cow pies evident.
LT	Large Timber (30-50 cm dbh)
MI	Mining
MT	Mature Timber (50-90 cm dbh)
NU	No Use identified.
OG	Old Growth Forest. Many trees with 90+ cm dbh and plant community with old growth characteristics.
PT	Partial cut Timber. Selection cut or shelterwood cut with partial removal of large trees. Combination of stumps and standing timber.
RR	Rural Residential
ST	Second growth Timber. Trees 15-30 cm dbh in generally dense, rapidly growing, uniform stands.
TH	Timber Harvest. Active timber management including tree felling, logging, etc. Not yet replanted.
UR	Urban
WA	Designated Wilderness Area
WL	Wetland.
YT	Young Forest Trees. Can range from recently planted harvest units to stands with trees up to 15 cm dbh.

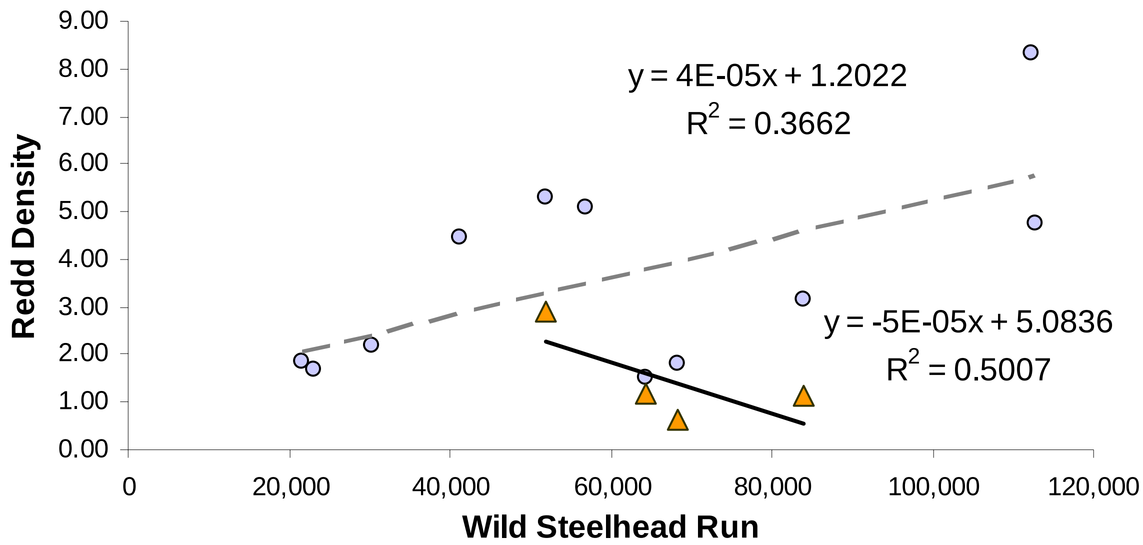
Appendix C. Description of codes used to classify riparian vegetation during habitat and riparian surveys.

Code	Description
B	SageBrush (sagebrush, greasewood, rabbit brush, etc.)
C1	Coniferous Dominated (canopy more than 70% conifer) Size class: Seedlings and new plantings.
C15	Coniferous Dominated (canopy more than 70% conifer) Size class: Typical sizes for second growth stands.
C3	Coniferous Dominated (canopy more than 70% conifer) Size class: Young established trees or saplings.
C30	Coniferous Dominated (canopy more than 70% conifer) Size class: Mature timber. Developing understory of trees and shrubs.
C50	Coniferous Dominated (canopy more than 70% conifer) Size class: Mature timber. Developing understory of trees and shrubs.
C90	Coniferous Dominated (canopy more than 70% conifer) Size class: Old growth. Very large trees, nearly always conifers. Plant community likely to include a combination of big trees, snags, down woody debris, and a multi-layered canopy.
D1	Deciduous Dominated (canopy more than 70% alder, cottonwood, big leaf maple, or other deciduous spp.) Size class: Seedlings and new plantings.
D15	Deciduous Dominated (canopy more than 70% alder, cottonwood, big leaf maple, or other deciduous spp.) Size class: Typical sizes for second growth stands.
D3	Deciduous Dominated (canopy more than 70% alder, cottonwood, big leaf maple, or other deciduous spp.) Size class: Young established trees or saplings.
D30	Deciduous Dominated (canopy more than 70% alder, cottonwood, big leaf maple, or other deciduous spp.) Size class: Large trees in established stands.
D50	Deciduous Dominated (canopy more than 70% alder, cottonwood, big leaf maple, or other deciduous spp.) Size class: Mature timber. Developing understory of trees and shrubs.
D90	Deciduous Dominated (canopy more than 70% alder, cottonwood, big leaf maple, or other deciduous spp.) Size class: Old growth; very large trees, nearly always conifers.
G	Annual Grasses, herbs, and forbs.
M1	Mixed conifer/deciduous (approx. a 50:50 distribution). Size class: Seedlings and new plantings.
M15	Mixed conifer/deciduous (approx. a 50:50 distribution). Size class: Typical sizes for second growth stands.
M3	Mixed conifer/deciduous (approx. a 50:50 distribution). Size class: Young established trees or saplings.
M30	Mixed conifer/deciduous (approx. a 50:50 distribution). Size class: Mature timber. Developing understory of trees and shrubs.
M50	Mixed conifer/deciduous (approx. a 50:50 distribution). Size class: Mature timber. Developing understory of trees and shrubs.
N	No Vegetation (bare soil, rock)
P	Perennial grasses, sedges and rushes
S	Shrubs (willow, salmonberry, some alder)

Appendix D. Description of codes used to classify stream flow during habitat and riparian surveys.

Code	Description
BF	Bankfull Flow. Stream flowing at the upper level of the active channel bank.
DR	Dry
FF	Flood Flow. Stream flowing over banks onto low terraces or flood plain.
HF	High Flow. Stream flowing completely across active channel surface but not at bankfull.
LF	Low Flow. Surface water flowing across 50 to 75 percent of the active channel surface. Consider general indications of low flow conditions.
MF	Moderate Flow. Surface water flowing across 75 to 90 percent of the active channel surface.
PD	Puddled. Series of isolated pools connected by surface trickle or subsurface flow.

a.)



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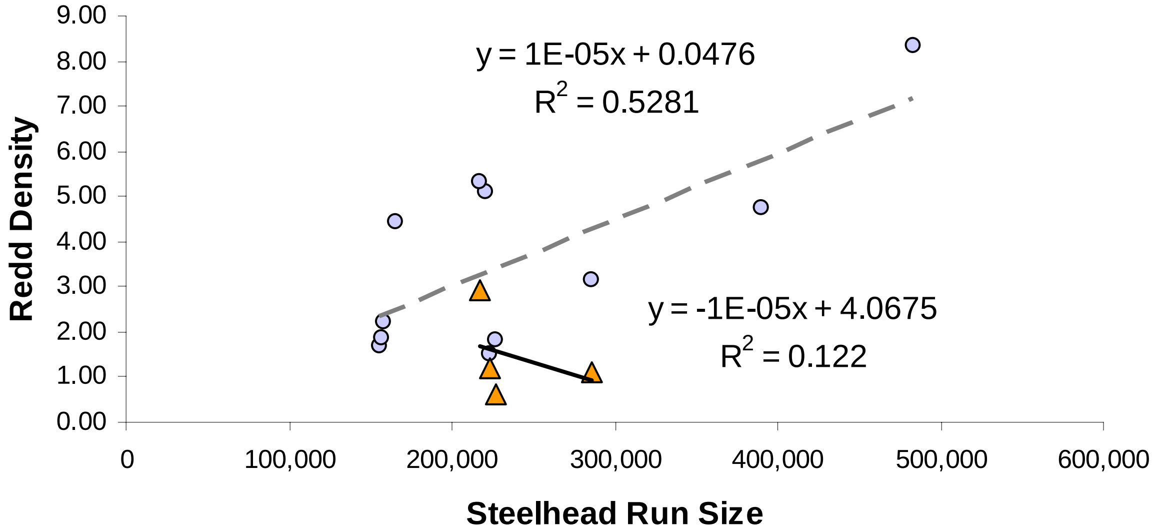
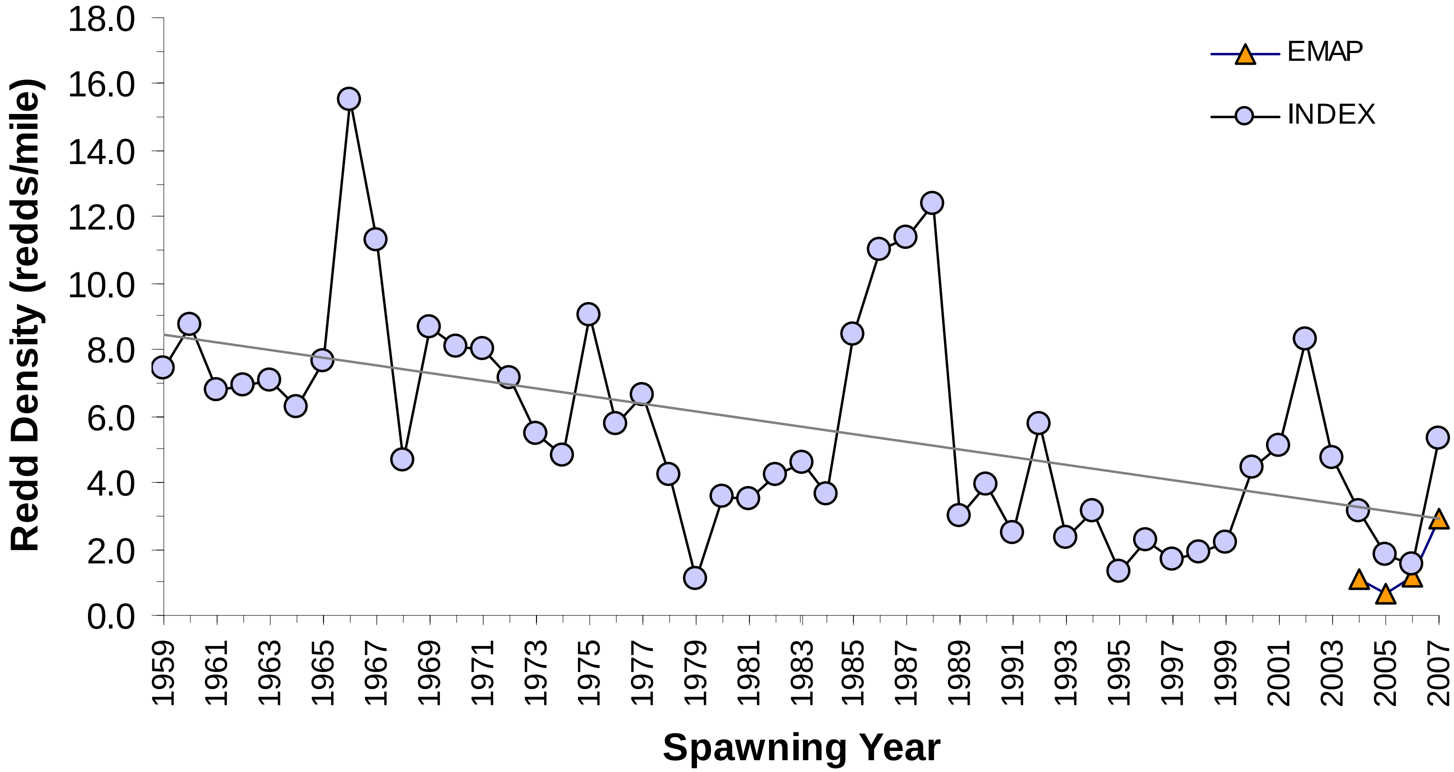


Appendix E. Relationship between passage of wild steelhead (a) and all steelhead (b; wild and hatchery combined) at John Day Dam and index (circles) and EMAP (triangles) steelhead redd counts conducted by ODFW personnel in the John Day River basin from 1996 to 2007 (Index) and 2004 to 2007 (EMAP).

Appendix F. 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 (Tim Unterwegner, 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).

		Index			Spring Chinook Monitoring Project	
Recovery Year	**# of Wild Steelhead**	**# of Hatchery Steelhead**	**% Hatchery Steelhead**	**# of Wild Steelhead**	**# of Hatchery Steelhead**	**% Hatchery Steelhead**
2007	41	2	4.6	10	0	0.0
2006	22	4	15.4	10	5	33.3
2005	15	1	6.3	8	4	33.3
2004	12	1	7.7	16	6	27.3
2003	27	2	6.9	11	2	15.4
2002	173	16	8.5	20	13	39.4
2001				8	2	20.0
2000				11	1	8.3
TOTAL	249	24	8.8	84	33	28.2



Appendix G. 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 2007. Redd densities observed at EMAP sites (triangles) are shown for comparison.