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 trends in abundance of juvenile trout and salmon and status and trends in stream and riparian habitats in the John Day River basin.

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

Accomplishments and Findings

We sampled 50 spatially-balanced random sites throughout the John Day River basin during the spring (8 March - 9 June) of 2005 to determine summer steelhead (*Oncorhynchus mykiss*) redd abundance. Survey sites encompassed 101.2 km (62.9 miles) of an estimated 4,067 km (2,527 miles; 2%) of steelhead spawning and rearing habitat within the basin. We observed 39 redds, 12 live fish, and sampled one carcass during these surveys. Redd and spawner escapement estimates for the basin were 1,567 redds and 3,291 adult spawners. The steelhead spawner escapement estimate for 2005 was significantly lower than that reported from EMAP surveys in 2004 (2,862 redds; 6011 adult spawners) and was consistent with a decline in redds observed during index surveys from 2004 to 2005 (3.1 redds/mile to 1.8 redds/mile, respectively; Tim Unterwegner, personal communication). Annual sites re-surveyed in 2005 yielded 36 fewer redds and 42 fewer fish observations than 2004. This decline at annual sites was most pronounced in several Lower Mainstem tributaries such as Service Creek (rkm 245) where no redds or steelhead were observed in 2005 compared to 17 redds and 27 steelhead in 2004. Low water flows in early spring may have reduced spawning in Lower Mainstem tributaries which typically have earlier spawning than other tributaries in the basin. Despite few steelhead observations during 2005, hatchery steelhead comprised a high percentage of both live (2 fish; 29%) and dead (1 fish; 100%) fish where the presence or absence of an adipose fin clip could be determined. This finding is consistent with hatchery compositions of steelhead observations from EMAP surveys in 2004 (38% of live steelhead; 60% of steelhead carcasses) and hatchery steelhead observations from the Spring Chinook Salmon Escapement and Productivity Monitoring project since 2000 (Range; 8% - 39%). We estimate 954 hatchery and 2,337 wild steelhead were present during the spawning season. However, our hatchery:wild steelhead estimate is based on a very small number of live steelhead observations and all hatchery steelhead were observed in one stream (Rock Creek). During summer (15 June - 10 October) we surveyed 50 sites to determine juvenile salmonid distribution and abundance and habitat and riparian conditions. Salmonid abundance was quantified by one-pass upstream snorkeling or electrofishing through pools at each site. Salmonids were observed at the majority of sites (90%) surveyed during this period. *O. mykiss* were the most abundant salmonid observed occurring at 44 of 50 sites (88%). Spring Chinook salmon (*O. tshawytscha)*, westslope cutthroat trout (*O. clarki),* bull trout (*Salvelinus confluentus)* and brook trout (*S. fontinalis*) were observed at a small percentage of sites (14%, 8%, 6%, and 6%, respectively). The mean percentage of pools with *O. mykiss*, when at least one individual was present at a site, was 74% basinwide (Subbasin Range; 70% - 95%). Spring Chinook were the next most abundant salmonid basinwide, occurring in

54% of pools when at least one individual was present at a site (Subbasin Range; 9% - 69%). Westslope cutthroat trout, bull trout, and brook trout occurred infrequently during surveying and were less abundant in pools at sites where these species were present (36%, 25%, and 38%, respectively). Several annual sites (Rock Creek, Service Creek, and West Fork Lick Creek) showed a significant decline in *O. mykiss* density from 2004 to 2005 that was consistent with declines in redd abundance observed at those sites during spawning surveys. However, most annual sites showed an increase in *O. mykiss* density over the two years. In addition to salmonids, at least eight non-target species (brown bullhead, *Catostomus* spp., *Cottus* spp., mountain whitefish, northern pikeminnow, redside shiner, smallmouth bass, and speckled dace) were observed during salmonid surveys. The majority of habitat sites surveyed in 2004 and 2005 were dominated by grass or shrub vegetation and had constrained channels. A high percentage of these sites also had grazing as a dominant land use. Data analysis of various habitat parameters among John Day subbasins yielded few statistical differences. The Lower Mainstem had higher bank erosion than the North Fork in both years and, in 2005, had a lower number of wood pieces than the Middle Fork and lower wood volume than the Middle Fork and North Fork. The North Fork also had more pool habitat than the Middle Fork in 2004. However, few strong patterns were evident in the analysis of habitat data among subbasins in 2004 and 2005. Future years of conducting surveys should allow for a more comprehensive evaluation of habitats in the basin by providing more data and a larger time frame over which to compare habitat conditions.

Management Recommendations

1. Continue to monitor steelhead redd abundance in the John Day River basin using the EMAP random, rotating site selection process in order to refine the current knowledge of steelhead spawning distribution in the basin and to determine the status and trend of the population. Comparison of EMAP results with that of index surveys will allow for a more comprehensive and accurate assessment of the current health and condition of steelhead in the basin.

2. Continue to manage the John Day River basin exclusively for wild steelhead and determine the extent and distribution of hatchery steelhead in the basin through observations of hatchery fish during the spawning season and compiling hatchery steelhead information from other sources and projects. Recovery of hatchery steelhead with coded wire tags (CWT) will allow for the sources of hatchery strays to be determined.

3. Use channel and riparian habitat data to assess the current condition of stream habitat available to juvenile and adult salmonids in the John Day River basin. Continued sampling will allow for baseline habitat conditions and areas with high quality salmonid habitat to be determined throughout the basin.

4. Continue to monitor juvenile *O. mykiss* and other juvenile salmonids in the John Day River basin in order to refine the current knowledge of juvenile salmonid distribution in the basin and to determine the status and trend of these populations. An assessment of the trend in abundance and distribution of juvenile *O. mykiss* can be used as a separate indicator of population status.

ACKNOWLEDGEMENTS

We would like to acknowledge the assistance and cooperation of many private landowners throughout the John Day River basin who allowed us to survey on their property. The cooperation of private landowners and The Confederated Tribes of the Warm Springs Reservation was essential in meeting our random survey design and other 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. This information was extremely helpful for survey planning and landowner contacts. This project was funded by the U. S. Department of Energy, Bonneville Power Administration, Environment, Fish, and Wildlife. Project Number: 1998-016-01. Contract Number: 15113.

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 (*O. mykiss*) in the Columbia River Basin with no hatchery supplementation. This population, however, remains depressed relative to historic levels and, 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 in 2004, 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 steelhead escapement or distribution at the basin spatial 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 real-time 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, we extended the structure and methods employed by the Oregon Plan for Salmon and Watersheds Monitoring Program 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. We began to meet these objectives in 2004 by conducting steelhead spawning ground surveys during spring and juvenile salmonid and habitat surveys during summer. In addition, data from on-going projects in the basin, such as smolt to adult 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. We believe implementation of the EMAP sampling design in the John Day River basin will be the project needed to synthesize all related fish population and habitat monitoring data at the provincial and subbasin scales.

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, and the Columbia Basin Fish and Wildlife Authority Multi-Year Implementation Plan.

STUDY AREA

The John Day River basin is located in north central and Northeastern Oregon, and is the fourth largest drainage in the state (Figure 1). 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. Major rivers 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 basin contains 15,455 km (9,603 miles) of stream habitat available for fish, but only 4,476 km (2,780 miles; 28%), is known to be used for various anadromous salmonid life history stages (spawning, rearing, and migration; Figure 2).

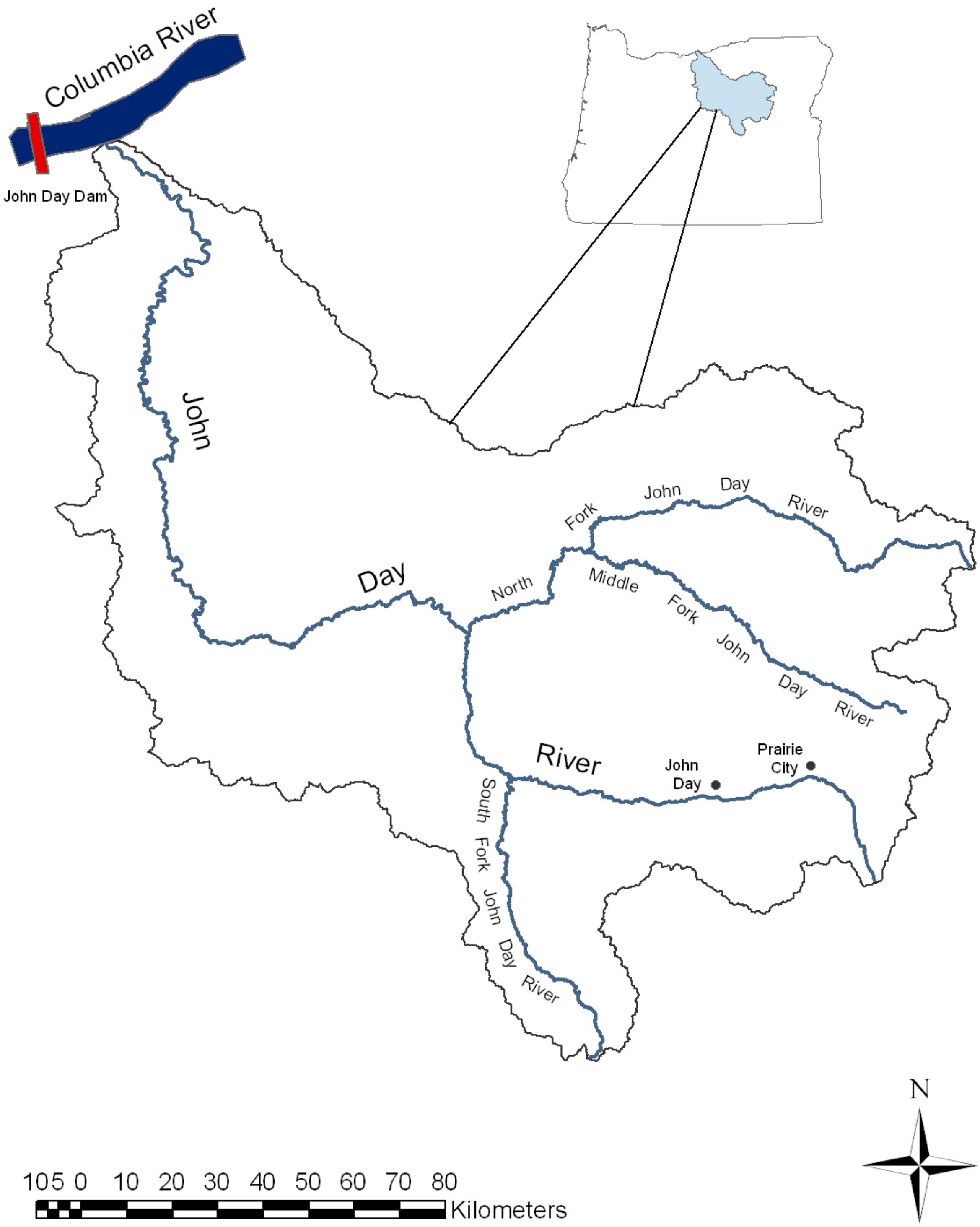


Figure 1. Map of the John Day River basin including the Mainstem John Day River and all three major forks.

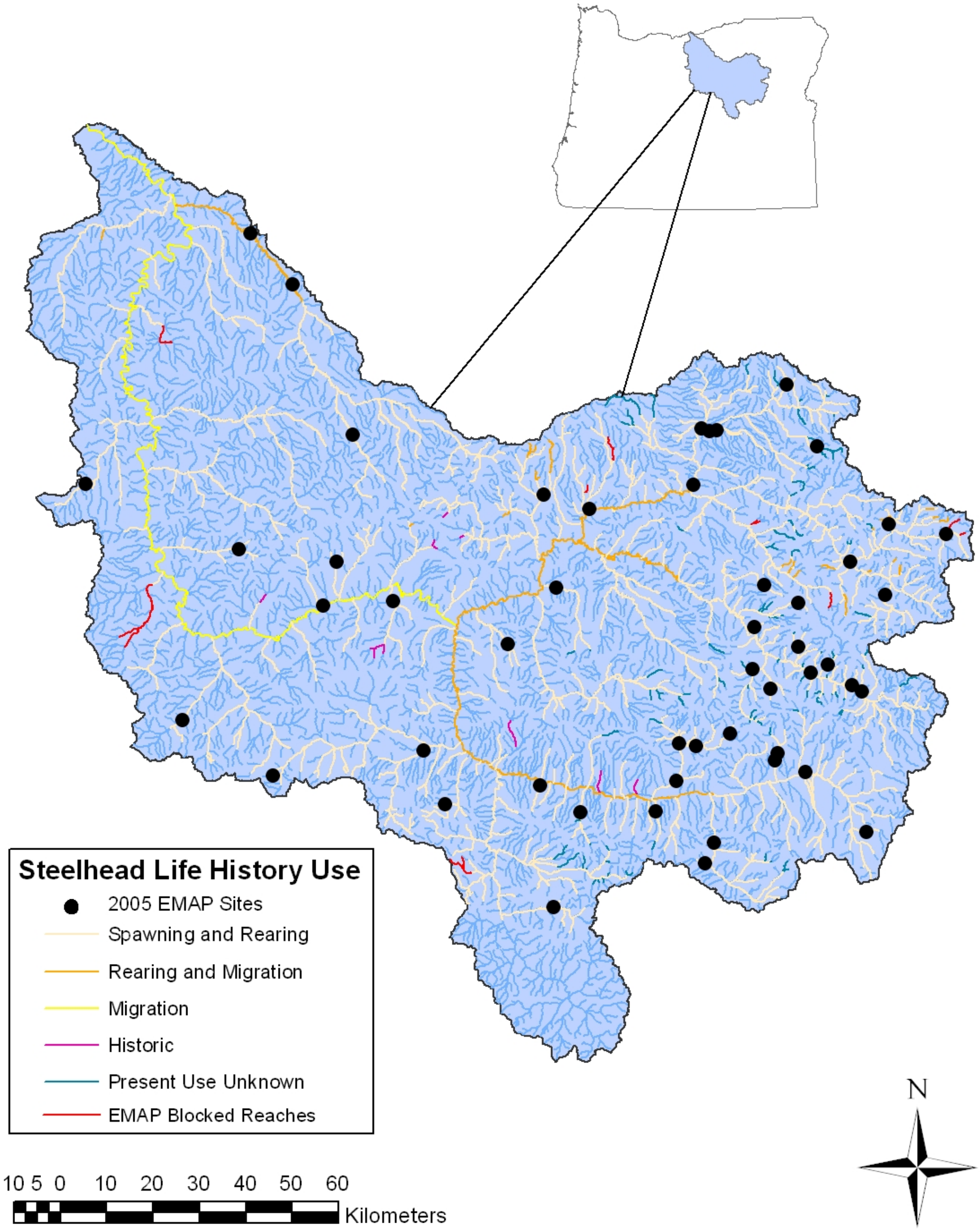


Figure 2. Map of summer steelhead life history use in the John Day River basin and 2005 EMAP sample sites.

METHODS

Sampling Domains 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 *O. mykiss* in the John Day River basin (Figure 2). Sample sites were derived from the 1:100k 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 surveyed each year. To balance the needs of status (more random sites) and trend (more repeat sites) monitoring, we implemented the following rotating panel design 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 1:100k 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 of the candidate sites. From these site coordinates we produced topographic maps showing the location of each sample point. We then developed landowner contacts based on county plat maps. With these contacts we worked with ODFW District Biologists to obtain permission from landowners for survey sites. In the field, crews used a handheld Global Positioning System (GPS) to find the location of EMAP selected sample points and established survey reaches that encompassed these points. Some survey sites were not sampled due to lack of permission from private landowners or because sites were located upstream of previously unknown fish passage barriers. Replacement sites were drawn from a pre-selected list of oversample 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 migration. These stream miles are removed or added back into our sampling universe accordingly.

Steelhead Redd Surveys

Steelhead redd surveys were conducted from March to June (Table 1), and based on standard ODFW methods (Susac and Jacobs 1999; Jacobs et al. 2000; Jacobs et al. 2001). Sites were surveyed up to four times, with approximately two week intervals between surveys to account for temporal variation in spawning activity and to quantify the cumulative redd count at each site. Survey reaches were approximately 2 km in length and encompassed the sample point. Surveyors walked upstream from the downstream end of each survey reach and counted all redds, live fish, and carcasses observed. All new redds were flagged and the location of redds were marked with a GPS (UTM - NAD 27).

To limit observer error we implemented the following procedures. Each site was visited approximately every two weeks and different surveyors were used to sample a site on successive surveys. 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 become obscured by periphytic growth. Visibility of previously flagged redds was recorded to determine redd longevity.

The number of redds per mile was calculated by dividing the cumulative number of redds observed during spawner surveys by the total number of stream miles surveyed. We estimated the total number of redds occurring throughout the basin by multiplying our redds per mile calculation by the total number of miles available to steelhead for spawning and rearing (2,527 miles). We then estimated steelhead escapement to the basin by multiplying the total number of redds by the number of fish per redd observed in the Grande Ronde River basin (2.1 fish/redd). This ratio was developed from repeated spawner surveys conducted every two weeks on a stream above a weir where exact counts of adult steelhead passed upstream could be determined (Flesher et al. 2005; Gerold Grant and Jim Ruzycki, ODFW, unpublished data).

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 live fish for the presence (hatchery) or absence (wild) of an adipose clip (fin mark). The hatchery:wild fish ratio was calculated by dividing the total number of marked fish by all fish that could be observed for marks (live fish only). The number of hatchery fish escaping to the basin was estimated by multiplying the hatchery:wild fish ratio by our estimate of steelhead escapement.

Habitat and Riparian Surveys

Habitat and riparian surveys were conducted from June to October (Table 2) and were designed to describe important attributes of habitat structure within and adjacent to the stream channel. The objective of these surveys is to describe current habitat conditions and track trends in habitat condition over time. All 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 < 5 m, and 1000 m in length for sites with an active channel width > 5 m. Second, all wood pieces within or intercepting the active channel and all habitat unit lengths and widths were measured (as opposed to estimating).

Once a sample site was located, surveys were conducted by walking upstream from the downstream end of each survey reach and identifying channel unit types (e.g. pools, riffles, rapids, cascades), 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 diameter at breast height, ≥ 3 m in length) within or intercepting the active channel. Three riparian transects were conducted within the reach which included estimating shading and the percentage of grasses and shrubs, quantifying the number and sizes of hardwoods and conifer trees, and determining 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.

Juvenile Salmonid Surveys

Juvenile salmonid surveys were conducted from June to October to determine the distribution and abundance of salmonids and other fishes occurring in the basin. Juvenile sampling was conducted after completion of the habitat survey in units classified as a "pool". Sites were electrofished if pool depths were shallow enough to effectively cover all habitat with a backpack electrofisher (generally average maximum pool depth < 60 cm) and water temperatures were below 18˚ C. Sites were snorkeled when electrofishing was not feasible, the average maximum pool depth was $\geq$ 40 cm, and 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 thoroughly 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 and species of juvenile (< 152 mm) and adult (> 152 mm) salmonids were recorded for each pool. The length used for determining juvenile versus adult salmonids (152 mm) is based on size classes developed from local data and standards used by ODFW and co-managers. Incidental species encountered during salmonid surveys were identified and recorded as present.

Electrofishing and snorkeling data were used in combination to determine the distribution and abundance of all fishes occurring at EMAP sites. More specifically, these data were used to quantify the number and percentage of sites in the John Day River basin with juvenile and adult salmonids, the number of juvenile and adult salmonids occurring at each site and in each subbasin (e.g. Middle Fork John Day River), the percentage of pools with salmonids present at each site and in each subbasin, the percentage of pools with salmonids present in each subbasin and within each subbasin only at sites where the respective species was present, and for a comparison of salmonid density estimates at annual sites for trend detection. In addition, data were also used to determine distribution and site, subbasin, and basin abundance for incidental species encountered at EMAP sites.

Table 1. Stream, site identification number, start and end coordinates (UTM - NAD27), panel type, # of visits, and survey distance and dates for steelhead spawning surveys conducted in the John Day River basin from 8 March to 9 June, 2005.

Stream	Site ID	UTM Zone	Start Coordinates Easting	Start Coordinates Northing	End Coordinates Easting	End Coordinates Northing	Panel Type	# of Visits	Distance (km)	Survey Dates 1	Survey Dates 2	Survey Dates 3	Survey Dates 4
LMJDR													
Bear Creek	36	10	707523	4938897	706131	4937784	Four2	4	2.1	3/24	4/7	4/14	4/26
Big Pine Hollow	514	10	685146	4989268	683915	4988252	Four2	2	2.0	3/29	4/12		
Camp Creek	510	11	265767	4973918			Annual	1	2.0	3/14			
Cougar Creek	112	11	286961	4920398	285239	4919806	New2	1	2.0	6/2			
Lone Rock Creek	45	11	270542	5001183	271008	4999582	Four2	1	2.1	5/25			
Milk Creek	497	10	728121	4928713	727445	4927348	Annual	1	1.7	5/10			
Parrish Creek	525	11	277723	4964821	278239	4963304	New2	2	2.0	4/14	4/28		
Rock Creek	42	11	282910	4932332	281548	4931486	Four2	3	2.1	3/31	5/4	5/25	
Rock Creek	9	10	718867	5044432	719995	5043658	Annual	4	2.0	3/8	3/22	4/5	4/19
Rock Creek	6	10	728344	5033646	729031	5032360	Annual	4	2.0	3/8	3/22	4/5	4/19
Service Creek	11	10	737165	4964565	735738	4965368	Annual	3	1.8	3/14	3/28	4/14	
Steers Canyon	521	10	718491	4976198			New2	1	2.0	3/10			
UMJDR													
Bear Creek	106	11	359090	4928497	359793	4930179	New2	3	2.0	4/5	4/19	5/2	
Bear Creek	519	11	358529	4926871	359090	4928497	Four2	3	2.0	4/5	4/19	5/2	
Beech Creek	99	11	336996	4923291	338057	4924743	New2	4	2.2	3/23	4/6	4/20	5/3
Beech Creek	518	11	337926	4931386	337753	4933149	Four2	4	2.0	3/23	4/4	4/18	5/3
Canyon Creek	109	11	344710	4909614	344606	4907689	New2	2	2.2	4/11	5/5		
EF Beech Creek	111	11	341576	4930817	343123	4930659	New2	4	2.1	3/23	4/6	4/20	5/2
Fields Creek	493	11	316090	4917418	316053	4915794	Annual	4	2.0	3/21	4/4	4/18	5/4
Flat Creek	44	11	307692	4923643	306809	4921816	Four2	2	2.1	4/11	4/28		
Ingle Creek	114	11	332357	4916972	332708	4915127	New2	3	2.0	3/21	4/4	4/18	
John Day River	38	11	365051	4924127	366708	4923357	Four2	2	2.1	4/22	5/27		
Rail Creek	13	11	377482	4910520	379322	4911070	Annual	2	2.0	5/19	6/6		
Tinker Creek	5	11	349136	4933091	349678	4934711	Annual	3	2.0	4/4	4/19	5/2	
Vance Creek	15	11	342566	4905274	340714	4906205	Annual	2	2.1	4/11	4/25		
NFJDR													
Bear Wallow	48	11	364552	5007956	364657	5009477	Four2	3	2.1	4/6	4/20	5/4	
Camas Creek	4	11	343517	4987110	343984	4989146	Annual	2	2.3	4/13	6/9		

Table 1. Continued.

Stream	Site ID	UTM Zone	Start Coordinates Easting	Start Coordinates Northing	End Coordinates Easting	End Coordinates Northing	Panel Type	# of Visits	Distance (km)	Survey Dates 1	Survey Dates 2	Survey Dates 3	Survey Dates 4
NFJDR													
Clear Creek	16	11	383722	4961548	383865	4959655	Annual	3	2.1	5/17	5/25	6/8	
Crawfish Creek	41	11	397590	4974123	398328	4975703	Four2	3	2.0	5/18	6/1	6/7	
Deer Creek	102	11	313018	4966289	315072	4965486	New2	3	2.1	4/7	4/21	5/26	
Deerlick Creek	46	11	345761	4999205	344871	5000710	Four2	2	1.8	4/12	4/27		
Gilmore Creek	7	11	302011	4954449	302611	4953198	Annual	2	1.7	4/7	4/21		
Granite Creek	490	11	376641	4968983	377626	4967590	Annual	1	2.1	6/8			
Hidaway Creek	115	11	370458	4994433	372242	4993662	New2	4	2.1	4/6	4/20	5/4	5/17
NF John Day River	526	11	320938	4982868	322083	4983008	Four2	2	2.0	4/13	6/9		
Pine Creek	520	11	347532	4998608	349091	4998735	New2	3	2.0	4/12	4/27	5/26	
Pine Creek	511	11	349090	4998738	349085	4998741	Annual	3	2.1	4/12	4/27	5/26	
Swale Creek	47	11	311207	4986456	312520	4987445	Four2	3	2.1	4/11	4/28	5/31	
Trout Creek	103	11	385308	4976870	385237	4977101	New2	2	2.1	5/5	6/7		
MFJDR													
Beaver Creek	522	11	367083	4945508	368154	4947086	New2	4	2.0	4/4	4/18	5/3	5/18
Big Creek	517	11	364955	4960620	366487	4959608	Four2	2	2.1	5/17	5/25		
Caribou Creek	34	11	375830	4942365	376730	4944021	Four2	3	2.1	4/4	4/18	5/2	
Granite Boulder Creek	108	11	370765	4947051	372221	4948427	New2	3	2.1	4/14	4/18	5/3	
Indian Creek	516	11	357783	4964877	359294	4963625	Four2	2	2.1	5/16	6/3		
Mosquito Creek	513	11	355384	4955875	357294	4956549	Four2	1	2.1	3/28			
Myrtle Creek	107	11	364512	4951141	363797	4952629	New2	2	2.0	4/13	5/5		
Vincent Creek	2	11	377837	4940909	377982	4942453	Annual	3	1.7	4/4	4/18	5/2	
WF Lick Creek	17	11	358255	4942481	358053	4940539	Annual	3	2.0	4/6	4/20	5/2	
Whisky Creek	10	11	354555	4946886	353113	4947271	Annual	3	1.7	4/6	4/20	5/2	
SFJDR													
Deer Creek	524	11	309393	4897256	311160	4896872	New2	4	2.1	3/30	4/11	4/25	5/18

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 15 June to 10 October, 2005.

Stream	Site ID	UTM Zone	Start Coordinates Easting	Start Coordinates Northing	End Coordinates Easting	End Coordinates Northing	Panel Type	Juvenile Salmonid Survey Date	Habitat Survey Date
LMJDR									
Bear Creek	36	10	706850	4938309	706443	4938040	Four2	8/10	8/10
Big Pine Hollow	514	10	685148	4989265	684374	4988986	Four2	7/5	7/5
Camp Creek	510	11	266904	4974855	267172	4975210	Annual	7/11	7/11
Cougar Creek	112	11	286923	4920418	286548	4920275	New2	10/6	10/6
Lone Rock Creek	45	11	270652	5000201	271008	4999582	Four2	6/29	6/28
Milk Creek	497	10	728120	4928713	728108	4928347	Annual	10/5	10/5
Parrish Creek	525	11	278106	4964377	278349	4964007	New2	7/20	7/18
Rock Creek	42	11	282236	4931761	281548	4931486	Four2	9/1	9/1
Rock Creek	6	10	728344	5033646	728417	5032853	Annual	6/28	6/28
Rock Creek	9	10	718867	5044432	719289	5043794	Annual	6/28	6/27
Service Creek	11	10	737166	4964562	736318	4964732	Annual	7/7	7/7
Steers Canyon	521	10	719445	4977324	719893	4977507	New2	7/12	7/12
West Fork Butte Creek	104	10	710047	4987726	710495	4987619	New2	7/13	7/13
UMJDR									
Bear Creek	106	11	359452	4929363	359793	4930175	New2	6/16	6/16
Bear Creek	519	11	358784	4927652	359090	4928497	Four2	7/15	6/30
Beech Creek	518	11	337940	4932160	337801	4933081	Four2	7/14	7/14
Beech Creek	99	11	337898	4923824	338057	4924743	New2	7/14	7/14
Canyon Creek	109	11	344482	4908554	344606	4907685	New2	9/6	9/6
East Fork Beech Creek	111	11	342250	4930655	343123	4930655	New2	6/15	6/15
Fields Creek	493	11	316091	4917414	315682	4916598	Annual	8/25	8/25
Flat Creek	44	11	307111	4922180	306809	4921813	Four2	10/3	10/3
Ingle Creek	114	11	332514	4915569	332708	4915127	New2	7/6	7/6
John Day River	38	11	365051	4924118	365881	4923885	Four2	10/10	9/8
Rail Creek	13	11	378096	4910758	378854	4911037	Annual	10/10	9/29
Tinker Creek	5	11	348999	4932966	349329	4933319	Annual	7/26	7/26
Vance Creek	15	11	342566	4905274	342269	4905569	Annual	9/7	9/7
NFJDR									
Bear Wallow Creek	48	11	365103	5009255	364658	5009475	Four2	9/15	9/15
Camas Creek	4	11	343754	4987353	344117	4988210	Annual	8/16	8/16
Clear Creek	16	11	383722	4961548	383469	4960711	Annual	8/22	8/22

Table 2. Continued.

Stream	Site ID	UTM Zone	Start Coordinates Easting	Start Coordinates Northing	End Coordinates Easting	End Coordinates Northing	Panel Type	Juvenile Salmonid Survey Date	Habitat Survey Date
NFJDR									
Crawfish Creek	41	11	398308	4974669	398338	4975408	Four2	8/31	8/31
Deer Creek	102	11	314481	4965722	315072	4965486	New2	7/21	7/21
Deerlick Creek	46	11	345442	4999918	344872	5000707	Four2		8/1
Gilmore Creek	7	11	302012	4954446	302567	4953954	Annual	7/21	7/20
Granite Creek	490	11	376641	4968985	376944	4968129	Annual	8/23	8/23
Hidaway Creek	115	11	371634	4993711	372380	4993621	New2	9/14	9/13
North Fork John Day River	526	11	321350	4982931	321958	4983077	Four2	8/15	8/15
Pine Creek	520	11	347680	4998557	348353	4998580	New2	8/2	8/1
Pine Creek	511	11	349812	4998843	350570	4999043	Annual	8/3	8/2
Swale Creek	47	11	311207	4986456	312026	4986504	Four2	10/4	10/4
Trout Creek	103	11	386084	4975627	385758	4976357	New2	8/30	8/30
MFJDR									
Beaver Creek	522	11	367155	4945573	367448	4945910	New2	7/28	7/28
Big Creek	517	11	366218	4959861	366560	4959571	Four2	8/24	8/24
Caribou Creek	34	11	376563	4943586	376730	4944021	Four2	7/26	7/25
Granite Boulder Creek	108	11	371477	4947777	372221	4948423	New2	7/26	7/26
Indian Creek	516	11	359294	4963625	359582	4963344	Four2	8/18	8/17
Mosquito Creek	513	11	356817	4956457	357294	4956545	Four2	7/19	7/19
Myrtle Creek	107	11	363785	4952624	363595	4953077	New2	7/21	7/27
Vincent Creek	2	11	377837	4940906	377997	4941757	Annual	7/25	7/25
West Fork Lick Creek	17	11	358255	4942481	358195	4941648	Annual	8/8	8/8
Whisky Creek	10	11	354555	4946882	353715	4947193	Annual	8/9	8/9
SFJDR									
Deer Creek	524	11	310768	4897044	311159	4896869	New2	9/28	9/26

RESULTS

Steelhead Redds and Escapement

During the spring (8 March - 9 June) of 2005, we observed 39 steelhead redds while surveying 101.2 km (62.9 miles) of an estimated 4,067 km (2,527 miles; 2%) of steelhead spawning and rearing habitat within the John Day River basin (50 sites; Figure 2, Table 3). Of all subbasins, 20.5% of steelhead redds were observed in the Lower Mainstem (8 redds; Figure 3), 51.3% were observed in the Upper Mainstem (20 redds; Figure 4), 28.2% were observed in the North Fork (11 redds**;** Figure 5), 0.0% were observed in the Middle Fork (0 redds; Figure 6), and 0.0% were observed in the South Fork (0 redds; Figure 7). Using our estimate for the number of redds per mile for all sites (0.62 redds/mile) and the total number of stream miles supporting steelhead spawning and rearing (2,527) we estimate that there were 1,567 steelhead redds within the basin (Table 4). Using the ratio of 2.1 spawners/redd developed from the study stream in the Grande Ronde River basin, we estimate that adult steelhead escapement to the John Day River basin was 3,291 spawners in 2005 (Table 4). The majority of all redds (25 redds; 64%) counted during spawner surveys were observed in the John Day River (Site ID 38; Figure 4) and Beech Creek (Site ID 99 and 518; Figure 4) in the Upper Mainstem and Pine Creek (Site ID 511; Figure 5) in the North Fork.

EMAP redd observations in the John Day River basin in 2005 (39 redds) were significantly lower than those reported from EMAP surveys in 2004 (66 redds; Wiley et al. 2004; Table 4). This was most evident at annual sites which had 36 fewer redds and 42 fewer fish (live fish and carcasses) in 2005 (Table 5). Service Creek (Site ID 11; Figure 3) exhibited the most dramatic decrease in spawning activity with 17 redds and 27 live steelhead observed in 2004 compared to no redds or steelhead observed in 2005. Two subbasins, the Middle Fork and South Fork, showed a 100% decline in redds and steelhead observations. These subbasins had no redds or steelhead observations in 2005 compared to twenty redds (30% of all redds observed) and eight steelhead observations (16% of all steelhead observations) in 2004.

Redd observations in the John Day River basin in 2005 also showed a significant shift in distribution compared to those reported from EMAP surveys in 2004 (Wiley et al. 2004). In 2004, the majority of redds (37 redds; 56%) were observed at Rock Creek (Site ID 6 and 9; Figure 3), Service Creek (Site ID 11; Figure 3), and Thirtymile Creek in the Lower Mainstem. In 2005, many redds (19 redds; 49%) were observed in the John Day River (Site ID 38; Figure 4) and Beech Creek (Site ID 99 and 518; Figure 4) in the Upper Mainstem.

Hatchery:Wild Observations

We observed 12 live fish and sampled one steelhead carcass during spawner surveys in 2005 (Table 3). We were able to identify seven steelhead as hatchery or wild at three of four sites where steelhead were observed (Figure 8; Rock & Beech Creeks). Hatchery steelhead (2 fish) comprised 29% of live fish observations and were found at one of the three sites where identifications could be made (Figure 8; Rock Creek; rkm 320). The one carcass sampled during spawner surveys also came from Rock Creek and was of hatchery origin. Wild steelhead (5 fish) comprised 71% of live fish observations and were found at Rock Creek and both Beech Creek sites. We estimate 954 hatchery and 2,337 wild steelhead were present during the spawning season based upon the hatchery:wild ratio of live fish observed during spawner surveys.

Although few live steelhead were observed in 2005, the hatchery:wild ratio (29%) was similar to that reported from EMAP surveys in 2004 (38%; Wiley et al. 2004) and to observations from the Spring Chinook Salmon Escapement and Productivity Monitoring project (Ruzycki et al. 2002; Carmichael et al. 2002; Wilson et al. 2002; Wilson et al. 2005; Appendix Table 1). In both 2004 and 2005, all hatchery steelhead observed during EMAP spawning surveys were observed in the Lower Mainstem (Figure 8). Overall in this subbasin, 50% of all steelhead identified for origin were marked (Table 6). The majority of hatchery steelhead observed in the Lower Mainstem were either on or near redds which demonstrates that hatchery fish are spawning in the basin (Table 6).

Table 3. Total number of steelhead redds, and unmarked (wild), marked (hatchery), and unknown origin live and dead steelhead observed during spawning surveys conducted in the John Day River basin from 8 March to 9 June, 2005.

Stream	Site ID	# of Redds	#Live Fish				# Dead Fish			
			Unmarked	Marked	Unknown	Total	Unmarked	Marked	Unknown	Total
LMJDR										
Bear Creek	36	3	0	0	0	0	0	0	0	0
Big Pine Hollow	514	0	0	0	0	0	0	0	0	0
Camp Creek	510	0	0	0	0	0	0	0	0	0
Cougar Creek	112	0	0	0	0	0	0	0	0	0
Lone Rock Creek	45	1	0	0	0	0	0	0	0	0
Milk Creek	497	0	0	0	0	0	0	0	0	0
Parrish Creek	525	0	0	0	0	0	0	0	0	0
Rock Creek	42	1	2	2	2	6	0	1	0	1
Rock Creek	9	2	0	0	0	0	0	0	0	0
Rock Creek	6	1	0	0	0	0	0	0	0	0
Service Creek	11	0	0	0	0	0	0	0	0	0
Steers Canyon	521	0	0	0	0	0	0	0	0	0
TOTAL		**8**	**2**	**2**	**2**	**6**	**0**	**1**	**0**	**1**
UMJDR										
Bear Creek	519	0	0	0	0	0	0	0	0	0
Bear Creek	106	0	0	0	0	0	0	0	0	0
Beech Creek	99	9	1	0	2	3	0	0	0	0
Beech Creek	518	3	2	0	0	2	0	0	0	0
Canyon Creek	109	1	0	0	0	0	0	0	0	0
EF Beech Creek	111	0	0	0	0	0	0	0	0	0
Fields Creek	493	0	0	0	0	0	0	0	0	0
Flat Creek	44	0	0	0	0	0	0	0	0	0
Ingle Creek	114	0	0	0	0	0	0	0	0	0
John Day River	38	7	0	0	1	1	0	0	0	0
Rail Creek	13	0	0	0	0	0	0	0	0	0
Tinker Creek	5	0	0	0	0	0	0	0	0	0
Vance Creek	15	0	0	0	0	0	0	0	0	0
TOTAL		**20**	**3**	**0**	**3**	**6**	**0**	**0**	**0**	**0**
NFJDR										
Bear Wallow	48	0	0	0	0	0	0	0	0	0
Camas Creek	4	0	0	0	0	0	0	0	0	0
Clear Creek	16	1	0	0	0	0	0	0	0	0
Crawfish Creek	41	0	0	0	0	0	0	0	0	0
Deer Creek	102	0	0	0	0	0	0	0	0	0
Deerlick Creek	46	1	0	0	0	0	0	0	0	0
Gilmore Creek	7	0	0	0	0	0	0	0	0	0

Table 3. Continued.

Stream	Site ID	# of Redds	#Live Fish				# Dead Fish			
			Unmarked	Marked	Unknown	Total	Unmarked	Marked	Unknown	Total
NFJDR										
Granite Creek	490	0	0	0	0	0	0	0	0	0
Hidaway Creek	115	0	0	0	0	0	0	0	0	0
NF John Day River	526	0	0	0	0	0	0	0	0	0
Pine Creek	520	2	0	0	0	0	0	0	0	0
Pine Creek	511	6	0	0	0	0	0	0	0	0
Swale Creek	47	1	0	0	0	0	0	0	0	0
Trout Creek	103	0	0	0	0	0	0	0	0	0
TOTAL		**11**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
MFJDR										
Beaver Creek	522	0	0	0	0	0	0	0	0	0
Big Creek	517	0	0	0	0	0	0	0	0	0
Caribou Creek	34	0	0	0	0	0	0	0	0	0
Granite Boulder Creek	108	0	0	0	0	0	0	0	0	0
Indian Creek	516	0	0	0	0	0	0	0	0	0
Mosquito Creek	513	0	0	0	0	0	0	0	0	0
Myrtle Creek	107	0	0	0	0	0	0	0	0	0
Vincent Creek	2	0	0	0	0	0	0	0	0	0
WF Lick Creek	17	0	0	0	0	0	0	0	0	0
Whisky Creek	10	0	0	0	0	0	0	0	0	0
TOTAL		**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
SFJDR										
Deer Creek	524	0	0	0	0	0	0	0	0	0
TOTAL		**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
BASIN TOTAL		**39**	**5**	**2**	**5**	**12**	**0**	**1**	**0**	**1**

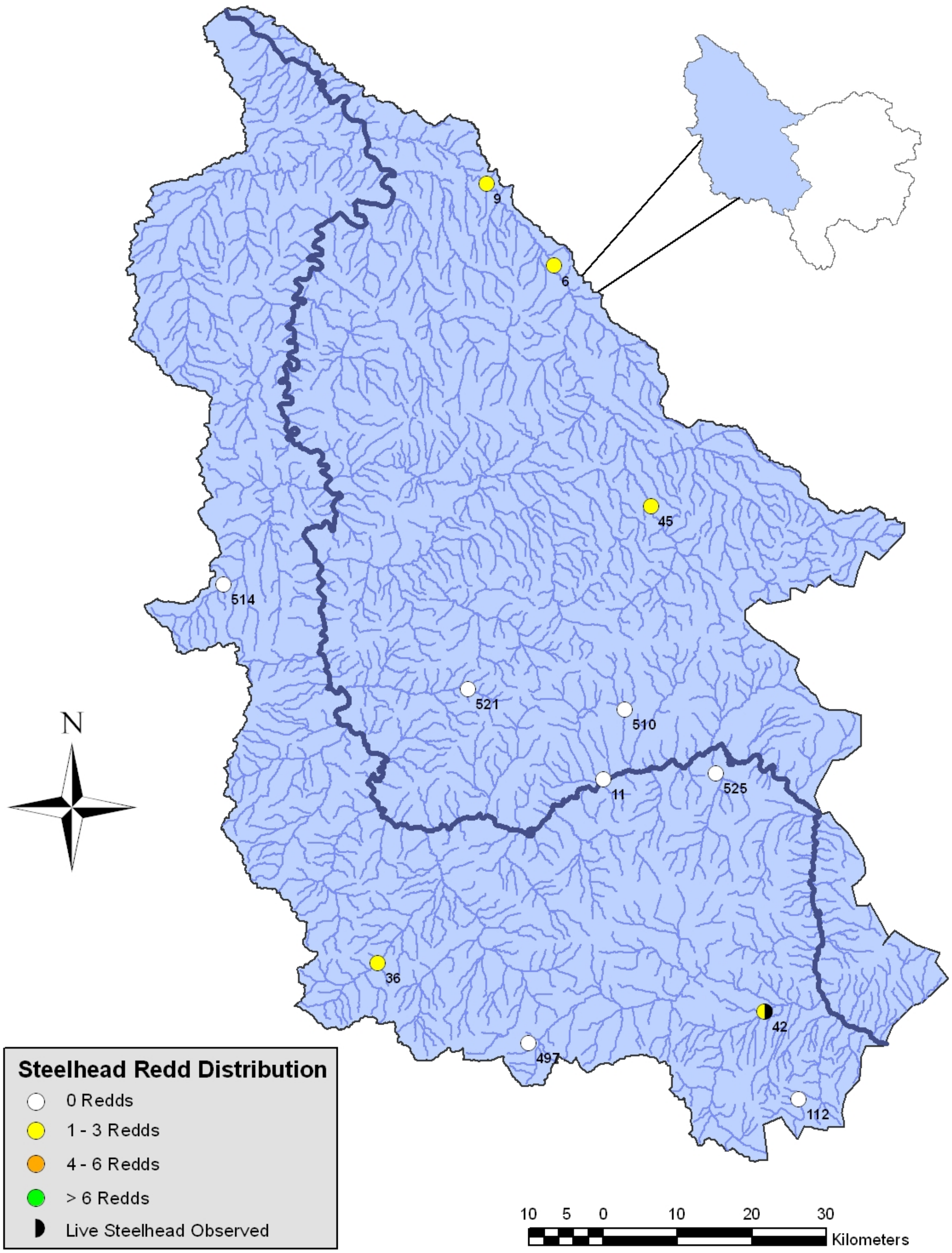


Figure 3. Map of the location and number of redds and live steelhead observed in the Lower Mainstem John Day River during spawning surveys conducted between 8 March and 9 June, 2005. Site identification numbers are shown next to each point for reference.

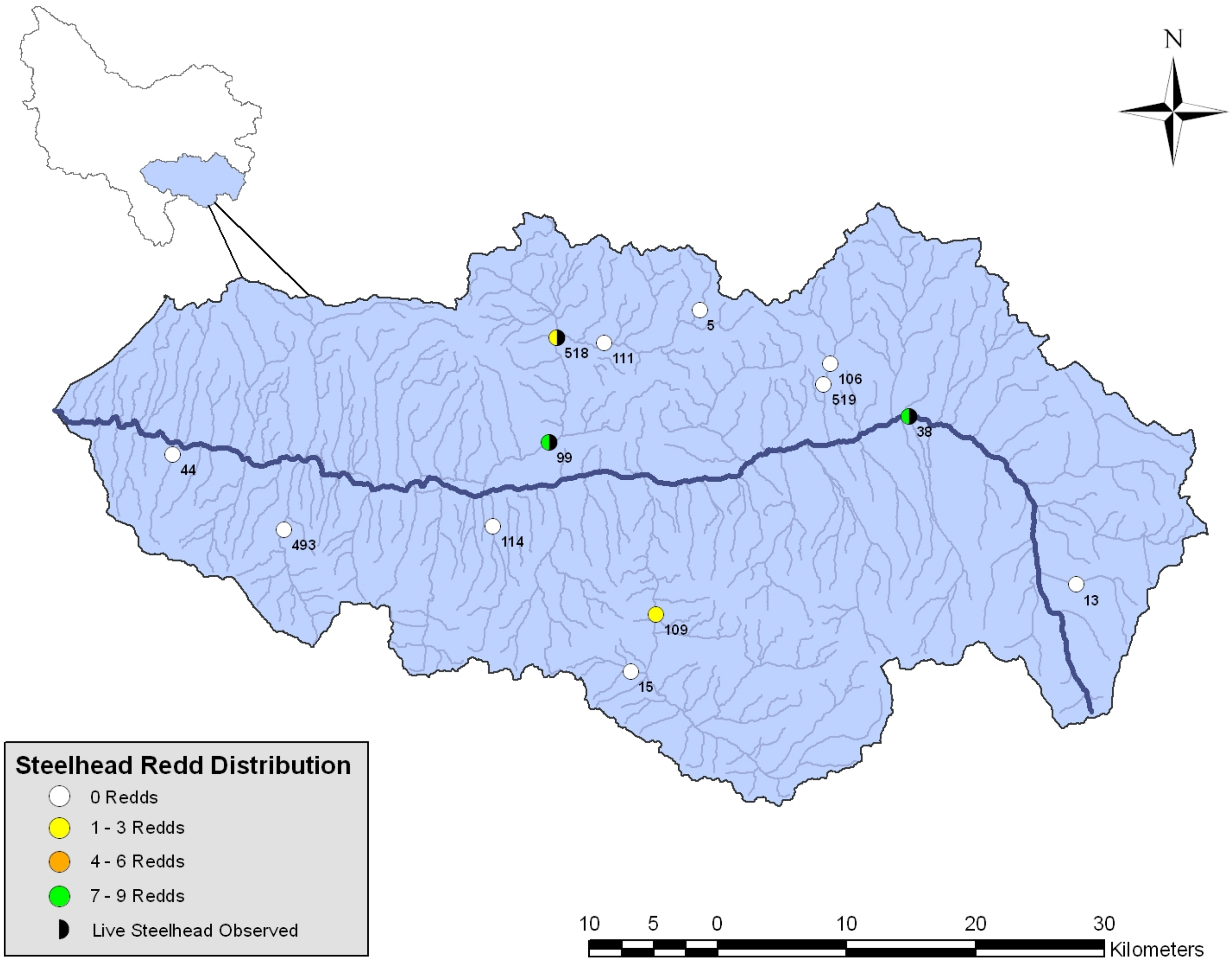


Figure 4. Map of the location and number of redds and live steelhead observed in the Upper Mainstem John Day River during spawning surveys conducted between 8 March and 9 June, 2005. Site identification numbers are shown next to each point for reference.

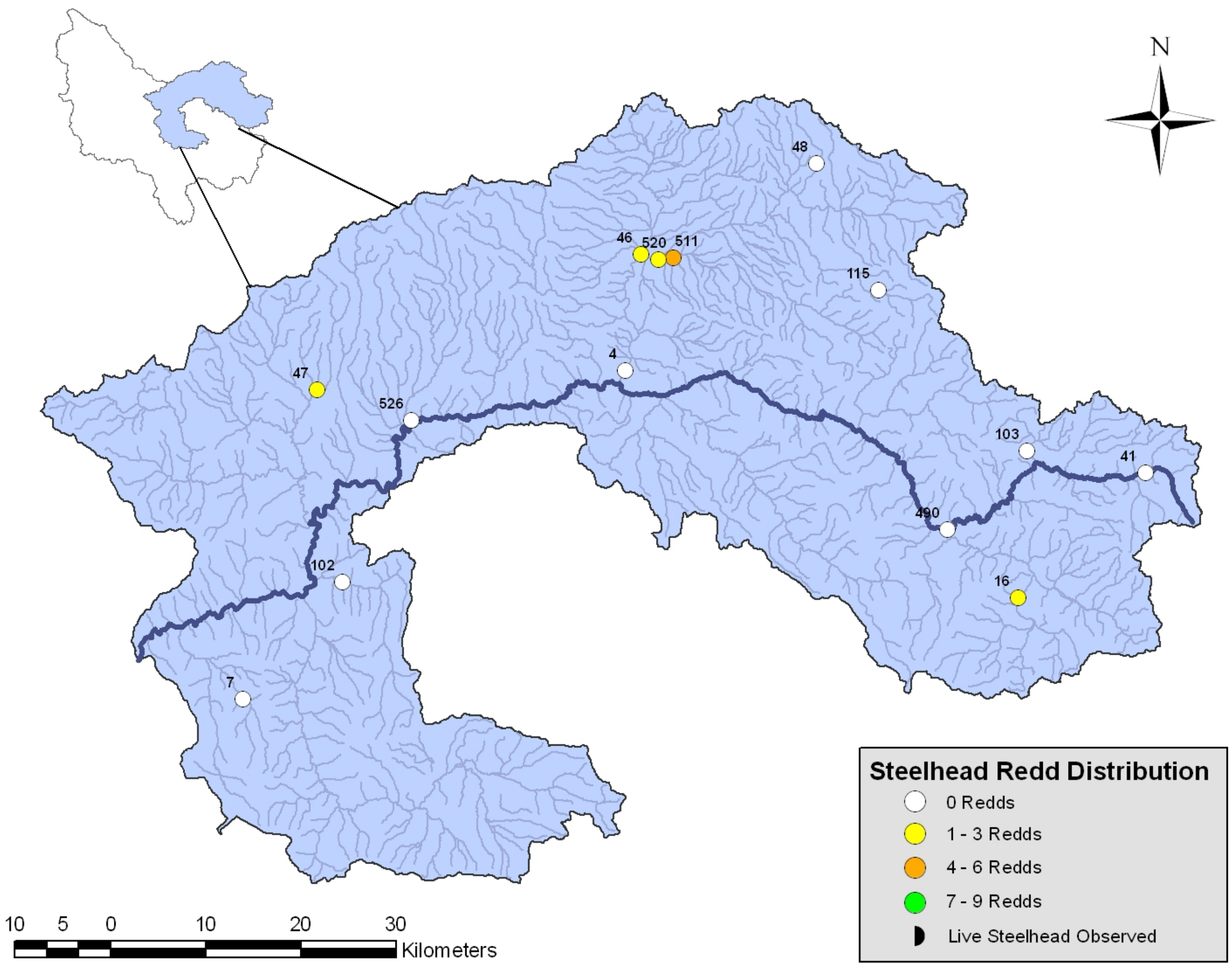


Figure 5. Map of the location and number of redds and live steelhead observed in the North Fork John Day River during spawning surveys conducted between 8 March and 9 June, 2005. Site identification numbers are shown next to each point for reference.

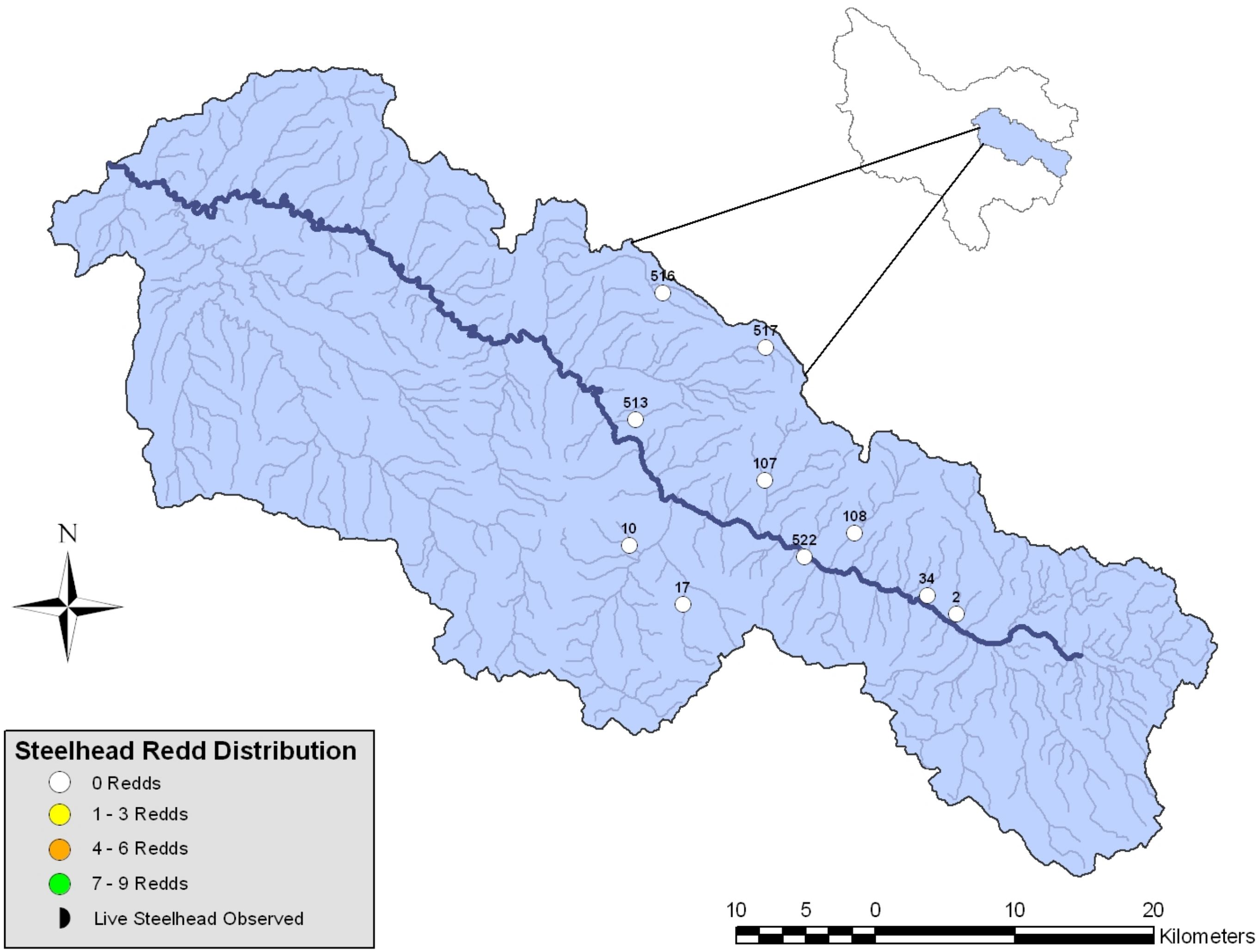


Figure 6. Map of the location and number of redds and live steelhead observed in the Middle Fork John Day River during spawning surveys conducted between 8 March and 9 June, 2005. Site identification numbers are shown next to each point for reference.

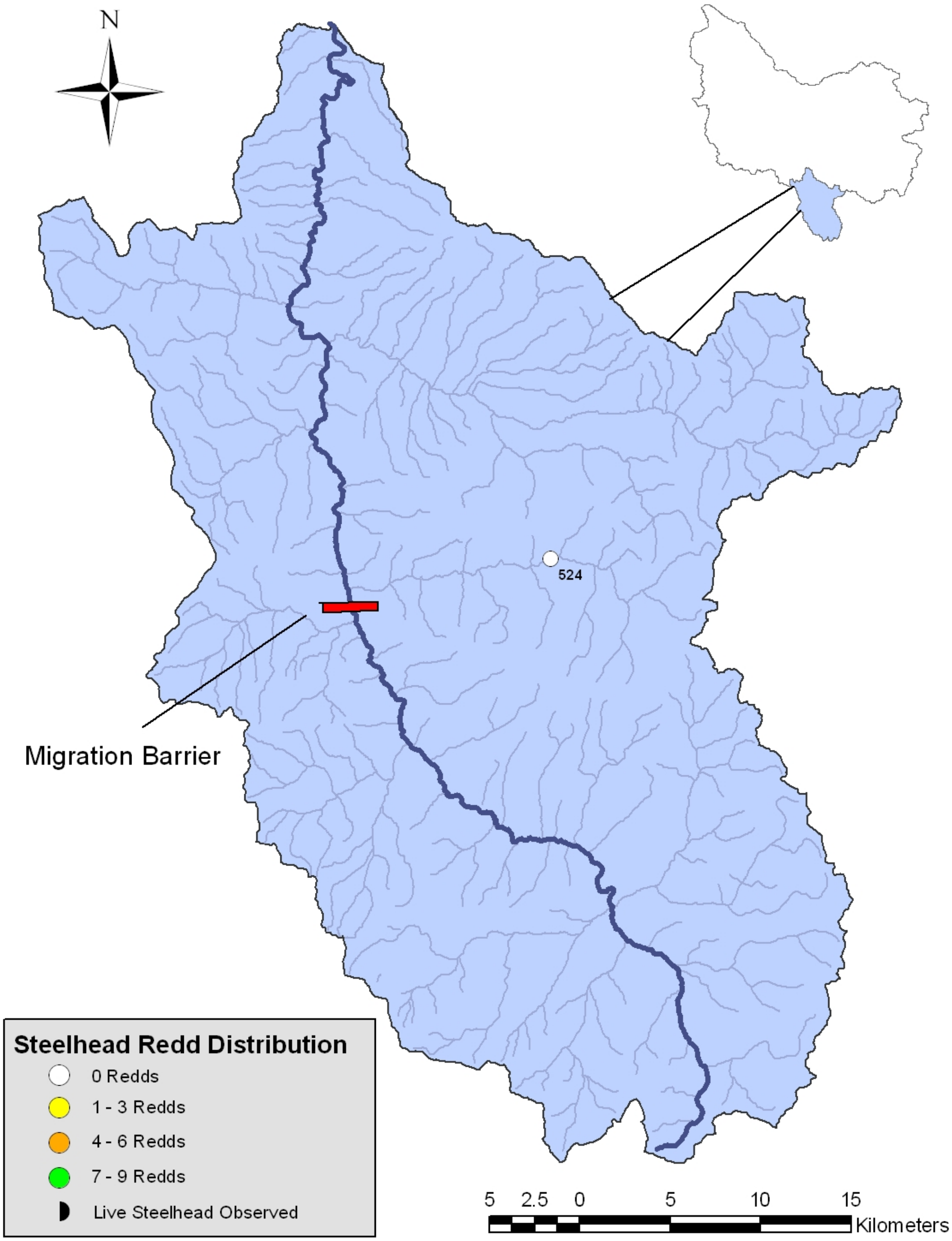


Figure 7. Map of the location and number of redds and live steelhead observed in the South Fork John Day River during spawning surveys conducted between 8 March and 9 June, 2005. Site identification numbers are shown next to each point for reference.

Table 4. Distance surveyed, observed redds, redds/km, redds/mile, total number of redds, and spawning escapement with 95% confidence intervals for steelhead from spawning surveys conducted in the John Day River basin from March to June, 2004 and 2005.

John Day River Basin	Km Distance	Mile Distance	Summer Steelhead Redds	Redds/Km	Redds/MI	Total Redds	Spawner Escapement	95% Confidence Intervals Lower	Upper
2005	101.2	62.9	39	0.39	0.62	1567	3291	1383	5200
2004	94.7	58.8	66	0.70	1.12	2862	6011	3119	8903

Table 5. Variability in redd and steelhead observations at annual spawning survey sites in the John Day River basin conducted from March to June, 2004 and 2005.

		# of Redds			# Live Steelhead			# Dead Steelhead		
Stream	Site ID	2004	2005	Difference	2004	2005	Difference	2004	2005	Difference
Camas Creek	4	0	0	0	0	0	0	0	0	0
Clear Creek	16	3	1	-2	4	0	-4	0	0	0
Fields Creek	493	0	0	0	0	0	0	0	0	0
Gilmore Creek	7	0	0	0	0	0	0	0	0	0
Granite Creek	490	0	0	0	0	0	0	0	0	0
Milk Creek	497	0	0	0	0	0	0	0	0	0
Rail Creek	13	0	0	0	0	0	0	0	0	0
Rock Creek	6	3	1	-2	1	0	-1	1	0	-1
Rock Creek	9	8	2	-6	5	0	-5	0	0	0
Service Creek	11	17	0	-17	27	0	-27	4	0	-4
Tinker Creek	5	0	0	0	0	0	0	0	0	0
Vance Creek	15	0	0	0	0	0	0	0	0	0
Vincent Creek	2	5	0	-5	0	0	0	0	0	0
WF Lick Creek	17	4	0	-4	0	0	0	0	0	0
Whisky Creek	10	0	0	0	0	0	0	0	0	0
TOTAL		**40**	**4**	**-36**	**37**	**0**	**-37**	**5**	**0**	**-5**

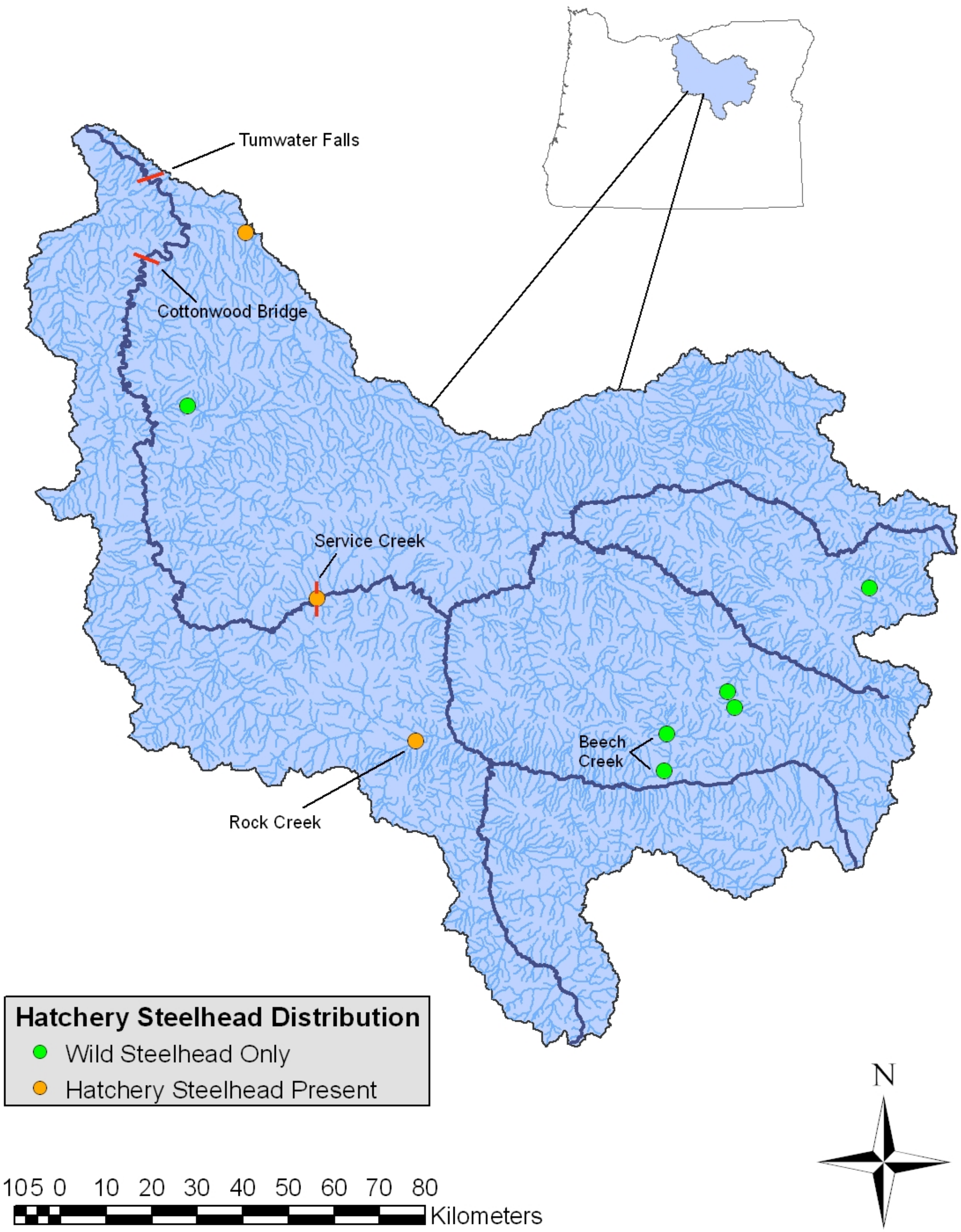


Figure 8. Distribution of hatchery and wild steelhead observations in the John Day River basin during spawning surveys conducted between 8 March and 14 June, 2004 and 2005. Red bars indicate mainstem John Day River sections used to describe the distribution of marked steelhead adults and steelhead coded wire tag recoveries.

Table 6. Number of live steelhead observed, number determined for origin, number and percentage marked and unmarked, and number and percentage marked and unmarked near redds from steelhead spawning surveys conducted in the John Day River basin from March to June, 2004 and 2005.

Subbasin	# Observed	# Determined	# Marked	% Marked	# Marked Near Redd	% Marked Near Redd	# Unmarked	% Unmarked	# Unmarked Near Redd	% Unmarked Near Redd
LMJDR	41	30	15	50.0	8	53.3	15	50.0	9	60.0
UMJDR	6	3	0	0.0	0	0.0	3	100.0	2	66.7
NFJDR	7	2	0	0.0	0	0.0	2	100.0	2	100.0
MFJDR	7	6	0	0.0	0	0.0	6	100.0	0	0.0
SFJDR	1	0	0	0.0	0	0.0	0	0.0	0	0.0
BASIN TOTAL	62	41	15	36.6	8	53.3	26	63.4	13	50.0

Juvenile Salmonid Surveys

During the summer (15 June - 10 October) of 2005 we sampled 50 sites to determine salmonid distribution and abundance. All sites were either electrofished (38 sites; DC; 175 - 325 voltage) or snorkeled (12 sites). Salmonids were observed at 45 of 50 sites (90.0%) sampled during this period. *O. mykiss* were the most abundant salmonid observed occurring at 44 of 50 sites (88.0%; Table 7). Nearly all of these sites contained both adult (> 152 mm; 43 sites; 97.7%) and juvenile (< 152 mm; 43 sites; 97.7%) *O. mykiss* (Table 8). Spring Chinook salmon (*O. tshawytscha)* were the next most abundant salmonid occurring at 7 of 50 sites (14.0%; Table 7). Juvenile Chinook were observed at all 7 sites (100.0%) but only one site contained adult Chinook (14.3%; Clear Creek; Site ID 16; Table 8). We did observe spawning Chinook during our habitat survey in the John Day River (Site ID 38; Figure 9) in September, however, to avoid disturbing spawning Chinook we chose to return in early October to conduct our salmonid survey and no live adult Chinook were observed at this later date. Adult westslope cutthroat trout (*O. clarki*), bull trout (*S. confluentus)*, and brook trout (*S. fontinalis*) were observed at a small percentage of sites (8.0%, 6.0%, and 6.0%, respectively). Adults (> 152 mm) of each species were encountered at all sites where these respective species were present (Table 8). However, westslope cutthroat trout juveniles (< 152 mm) were only found at 3 of 4 sites (75.0%) where this species was encountered, and both both bull and brook trout juveniles were only found at 2 of 3 sites (66.7%) where these respective species were encountered (Table 8).

In the Lower Mainstem, *O. mykiss* were observed at 9 of 13 sites (69.2%) and occurred with spring Chinook at one site (Rock Creek; Site ID 42; Figure 9). *O. mykiss* were observed at nearly all sites in the Upper Mainstem (12 sites; 92.3%; Figure 10) and North Fork (12 sites; 92.3%; Figure 11) and at all sites (10 sites; 100.0%) in the Middle Fork (Figure 12). In the South Fork, *O. mykiss* were observed at the only site surveyed for juvenile salmonids in this subbasin (Figure 13). Spring Chinook occurred with *O. mykiss* at two sites in the Upper Mainstem (16.7%, Figure 10) and at four sites in the North Fork (33.3%; Figure 11) but were absent at sites in the Middle Fork and South Fork. Westslope cutthroat trout were only found in the Upper Mainstem (4 sites; Figure 14). Bull trout were observed at one site in the Upper Mainstem, one site in the North Fork, and one site in the Middle Fork (Figure 15). Brook trout were only observed in the North Fork (3 sites; Figure 16).

Although *O. mykiss* were present at the majority of sites surveyed for salmonids in 2005, Table 9 shows the variability in *O. mykiss* abundance in pools between sites and subbasins. *O. mykiss* were present at nearly 70% of all sites in the Lower Mainstem but only in 55.1% of all pools surveyed in this subbasin. This was significantly lower than all other subbasins (Range; 70.1% - 95.0%; Table 9). Similarly, despite *O. mykiss* occurrence in all sites in the Middle Fork, and nearly all sites in the North Fork and Upper Mainstem, less than 75% off all pools in each subbasin contained *O. mykiss* (Range; 70.1% - 73.2%; Table 9). Overall, *O. mykiss* were present in 68.6% of all pools surveyed basinwide. Spring Chinook, westslope cutthroat trout, bull trout, and brook trout were significantly less prevalent during salmonid surveys occurring in less than 6% of pools basinwide (5.1%, 2.6%, 1.3%, 2.3%, respectively; Table 9). Spring Chinook and brook trout had the highest occurrence in pools in the North Fork (18.4% & 9.5%, respectively; Table 9). Westslope cutthroat trout were most prevalent in pools in the Upper Mainstem (9.2%) and bull trout were most prevalent in pools in the Middle Fork (2.6%).

Pool abundance for all five salmonid species at sites where the respective species was present is shown in Tables 10-14. This analysis was conducted to avoid the negative bias of site absences on the species abundance in pools when all sites are considered.   As expected, *O. mykiss* pool abundance shows only a small increase basinwide because this species was present at most sites (73.8%; Table 10). However, Chinook, when present at a site, were present in over half of all pools surveyed (53.8%; Table 11), westslope cutthroat trout and brook trout were present in over one third of all pools surveyed (35.5% and 38.0%, respectively; Tables 12, 13), and bull trout were present in one quarter of all pools surveyed (25.0%; Table 14). These results indicate that, even when present, westslope cutthroat trout, brook trout, and bull trout were not very abundant or distributed evenly in streams surveyed for salmonids in 2005.

Variability in density estimates for *O. mykiss* and spring Chinook from 2004 to 2005 are shown in Table 15. Several sites in the Lower Mainstem (Rock Creek, Site ID 6 & 9; Service Creek, Site ID 11; Figure 9) and one site in the Middle Fork (West Fork Lick Creek; Site ID 017; Figure 12) show significant declines in *O. mykiss* density over the two years (Table 15). No *O. mykiss* juveniles were observed at either Rock Creek site compared to high numbers in 2004. Similarly, juvenile *O. mykiss* density in Service Creek and West Fork Lick Creek was low compared to high numbers in 2004. These results coincide with significant declines in redd abundance at both Rock Creek sites, Service Creek, and West Fork Lick Creek over the two years. The majority of annual sites, however, showed an increase in juvenile abundance from 2004 to 2005 (8 sites; Table 15). Spring Chinook density estimates were relatively consistent over the two years (Table 15).

In addtion to salmonids, at least eight incidental species were observed during salmonid surveys (Table 16). Speckled dace (*Rhinichthys osculus*), sucker (*Catastomus* spp.), sculpin (*Cottus* spp.), and redside shiner (*Richardsonius balteatus*) were the most abundant species occurring at 42.0%, 30.0%, 24.0%, and 18.0% of sites in the basin, respectively (Table 17). Northern pikeminnow (*Ptychocheilus oregonensis*), smallmouth bass (*Micropterus dolomieu*), mountain whitefish (*Prosopium williamsoni*), and brown bullhead (*Ictalurus nebulosus*) occurred infrequently during salmonid surveys (8.0%, 6.0%, 4.0%, and 2.0%, respectively; Table 17). Surprisingly, no incidental species were observed in the Middle Fork or South Fork (Table 17). One goldfish (*Carassius auratus*) was observed at a site (Big Pine Hollow; Site ID 514; Figure 9) in the Lower Mainstem but did not occur in a pool surveyed at the site.

Table 7. Number and percentage of sites with juvenile and adult salmonids collected during juvenile surveys in the John Day River basin from 15 June to 10 October, 2005.

Salmonids	**# Sites Present**	**% Sites Present**	**# Sites w/Juveniles**	**% Sites w/Juveniles**	**# Sites w/Adults**	**% Sites w/Adults**
Oncorhynchus mykiss	44	88.0	43	86.0	43	86.0
Spring Chinook Salmon *(O. tshawytscha)*	7	14.0	7	14.0	1	2.0
Westslope Cutthroat Trout *(O. clarki)*	4	8.0	3	6.0	4	8.0
O. spp.	2	4.0	— —	— —	— —	— —
Bull Trout *(Salvelinus confluentus)*	3	6.0	2	4.0	3	6.0
Brook Trout *(S. fontinalis)*	3	6.0	2	4.0	3	6.0
Salmonid spp.	0	0.0	— —	— —	— —	— —

Table 8. Stream, site identification number, and abundance of juvenile and adult salmonids at juvenile survey sites in the John Day River basin from 15 June to 10 October, 2005.

Stream	Site ID	(> 152 mm) *O. mykiss*	(> 152 mm) Westslope Cutthroat	(> 152 mm) Bull Trout	(> 152 mm) Brook Trout	(< 152 mm) *O. mykiss*	(< 152 mm) Westslope Cutthroat	(< 152 mm) Bull Trout	(< 152 mm) Brook Trout	Juvenile Spring Chinook	Adult Spring Chinook
LMJDR											
Bear Creek	36	0	0	0	0	25	0	0	0	0	0
Big Pine Hollow	514	106	0	0	0	245	0	0	0	0	0
Camp Creek	510	3	0	0	0	12	0	0	0	0	0
Cougar Creek	112	0	0	0	0	0	0	0	0	0	0
Lone Rock Creek	45	21	0	0	0	10	0	0	0	0	0
Milk Creek	497	2	0	0	0	25	0	0	0	0	0
Parrish Creek	525	39	0	0	0	94	0	0	0	0	0
Rock Creek	42	7	0	0	0	143	0	0	0	1	0
Rock Creek	6	0	0	0	0	0	0	0	0	0	0
Rock Creek	9	0	0	0	0	0	0	0	0	0	0
Service Creek	11	25	0	0	0	152	0	0	0	0	0
Steers Canyon	521	0	0	0	0	0	0	0	0	0	0
West Fork Butte Creek	104	27	0	0	0	13	0	0	0	0	0
Total		**230**	**0**	**0**	**0**	**719**	**0**	**0**	**0**	**1**	**0**
UMJDR											
Bear Creek	519	10	0	0	0	33	0	0	0	0	0
Bear Creek	106	6	0	0	0	10	0	0	0	0	0
Beech Creek	99	4	0	0	0	24	0	0	0	0	0
Beech Creek	518	22	2	0	0	135	3	0	0	0	0
Canyon Creek	109	57	1	0	0	283	0	0	0	1	0
East Fork Beech Creek	111	18	0	0	0	61	0	0	0	0	0
Fields Creek	493	23	0	0	0	226	0	0	0	0	0
Flat Creek	44	5	0	0	0	11	0	0	0	0	0
Ingle Creek	114	9	0	0	0	17	0	0	0	0	0
John Day River	38	1	0	0	0	2	0	0	0	142	0
Rail Creek	13	0	5	1	0	0	4	8	0	0	0
Tinker Creek	5	4	0	0	0	36	0	0	0	0	0
Vance Creek	15	8	4	0	0	25	12	0	0	0	0
Total		**167**	**12**	**1**	**0**	**863**	**19**	**8**	**0**	**143**	**0**

Table 8. Continued.

Stream	Site ID	(> 152 mm) *O. mykiss*	Westslope Cutthroat	Bull Trout	Brook Trout	(< 152 mm) *O. mykiss*	Westslope Cutthroat	Bull Trout	Brook Trout	Spring Chinook Juvenile	Spring Chinook Adult
NFJDR											
Bear Wallow Creek	48	8	0	0	0	62	0	0	0	0	0
Camas Creek	4	3	0	0	0	12	0	0	0	21	0
Clear Creek	16	75	0	1	0	229	0	0	0	794	7
Crawfish Creek	41	2	0	0	6	0	0	0	13	0	0
Deer Creek	102	32	0	0	0	46	0	0	0	0	0
Gilmore Creek	7	15	0	0	0	15	0	0	0	0	0
Granite Creek	490	20	0	0	0	101	0	0	0	216	0
Hidaway Creek	115	14	0	0	1	79	0	0	10	0	0
North Fork John Day River	526	0	0	0	0	0	0	0	0	0	0
Pine Creek	520	18	0	0	2	40	0	0	0	5	0
Pine Creek	511	2	0	0	0	9	0	0	0	0	0
Swale Creek	47	15	0	0	0	122	0	0	0	0	0
Trout Creek	103	12	0	0	0	61	0	0	0	0	0
Total		**216**	**0**	**1**	**9**	**776**	**0**	**0**	**23**	**1036**	**7**
MFJDR											
Beaver Creek	522	7	0	0	0	47	0	0	0	0	0
Big Creek	517	3	0	1	0	17	0	4	0	0	0
Caribou Creek	34	1	0	0	0	10	0	0	0	0	0
Granite Boulder Creek	108	7	0	0	0	48	0	0	0	0	0
Indian Creek	516	1	0	0	0	18	0	0	0	0	0
Mosquito Creek	513	4	0	0	0	1	0	0	0	0	0
Myrtle Creek	107	7	0	0	0	31	0	0	0	0	0
Vincent Creek	2	6	0	0	0	67	0	0	0	0	0
West Fork Lick Creek	17	7	0	0	0	43	0	0	0	0	0
Whisky Creek	10	11	0	0	0	28	0	0	0	0	0
Total		**54**	**0**	**1**	**0**	**310**	**0**	**4**	**0**	**0**	**0**
SFJDR											
Deer Creek	524	20	0	0	0	307	0	0	0	0	0
Total		**20**	**0**	**0**	**0**	**307**	**0**	**0**	**0**	**0**	**0**
Basin Total		**687**	**12**	**3**	**9**	**2975**	**19**	**12**	**23**	**1180**	**7**

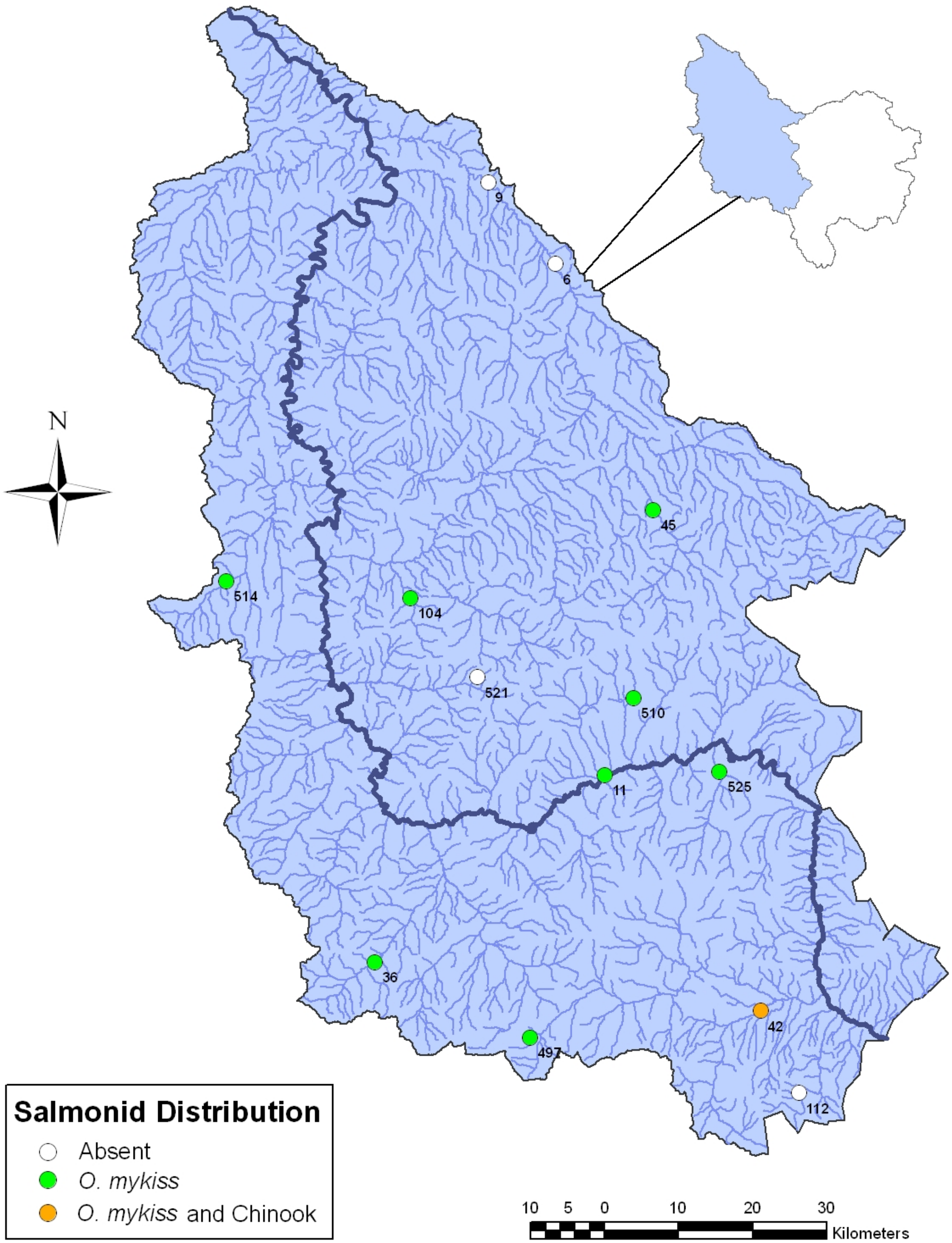


Figure 9. Distribution of *O. mykiss* and spring Chinook observations in the Lower Mainstem John Day River from snorkeling and electrofishing surveys conducted between 15 June and 10 October, 2005. Site identification numbers are shown next to each point for reference.

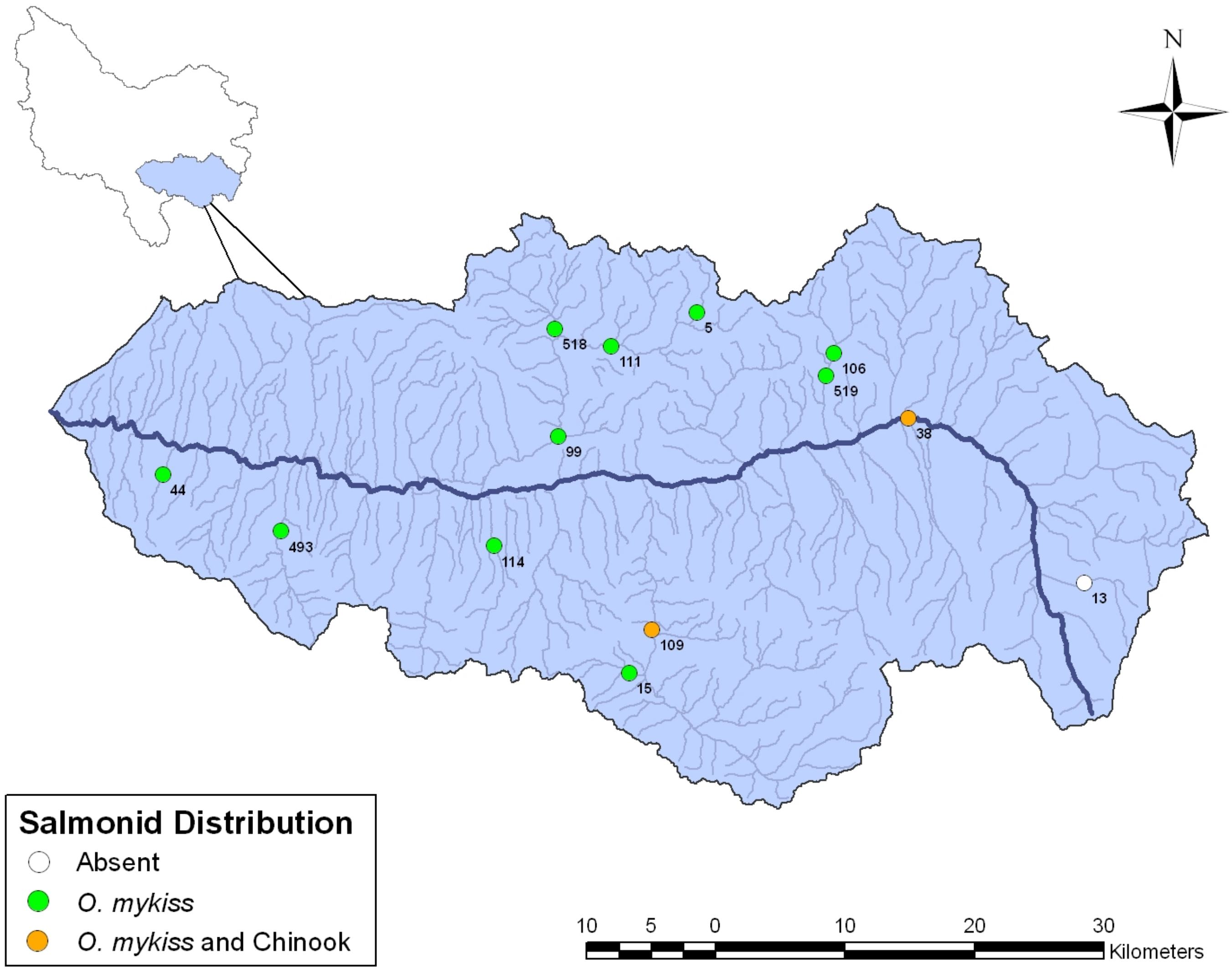


Figure 10. Distribution of *O. mykiss* and spring Chinook observations in the Upper Mainstem John Day River from snorkeling and electrofishing surveys conducted between 15 June and 10 October, 2005. Site identification numbers are shown next to each point for reference.

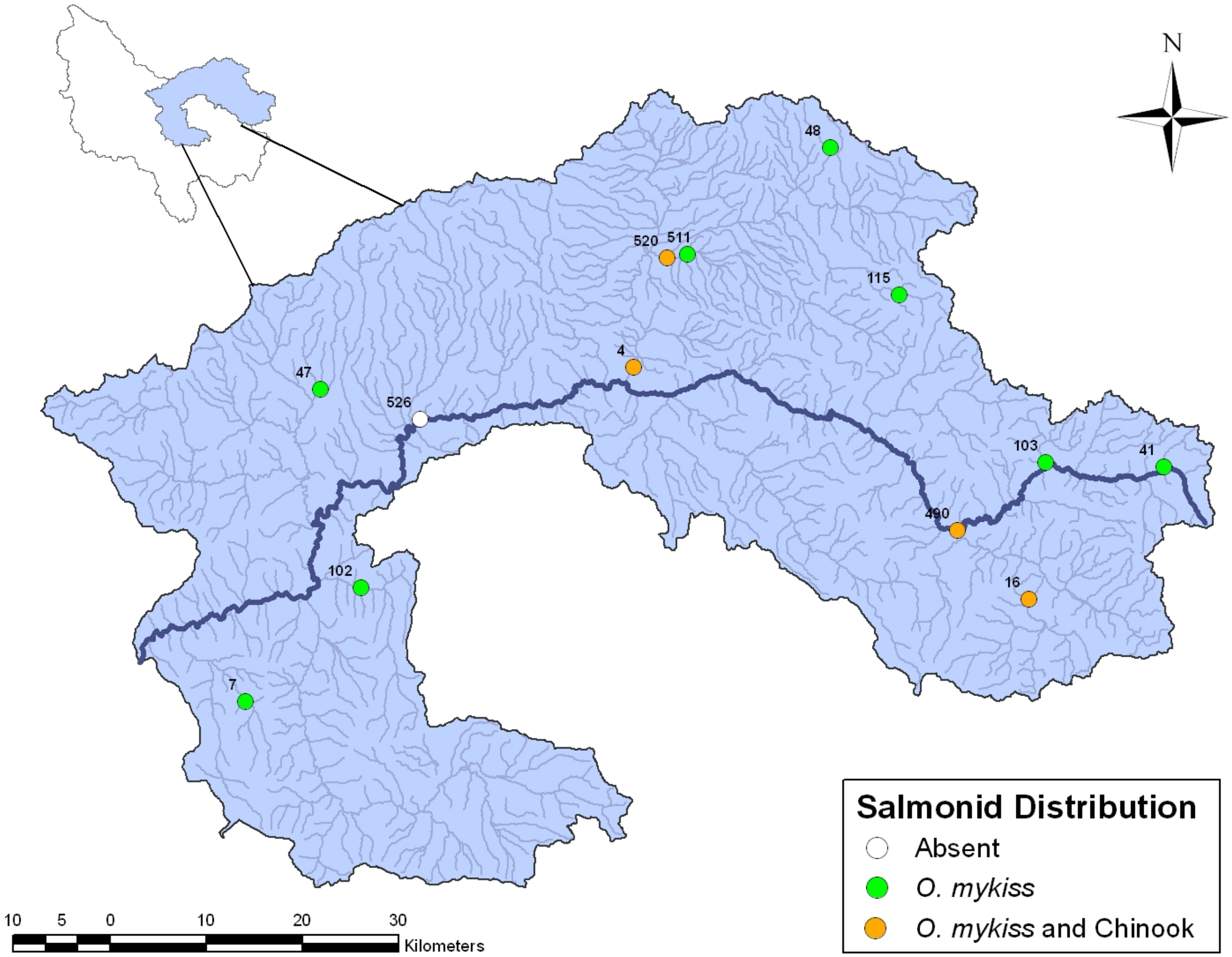


Figure 11. Distribution of *O. mykiss* and spring Chinook observations in the North Fork John Day River from snorkeling and electrofishing surveys conducted between 15 June and 10 October, 2005. Site identification numbers are shown next to each point for reference.

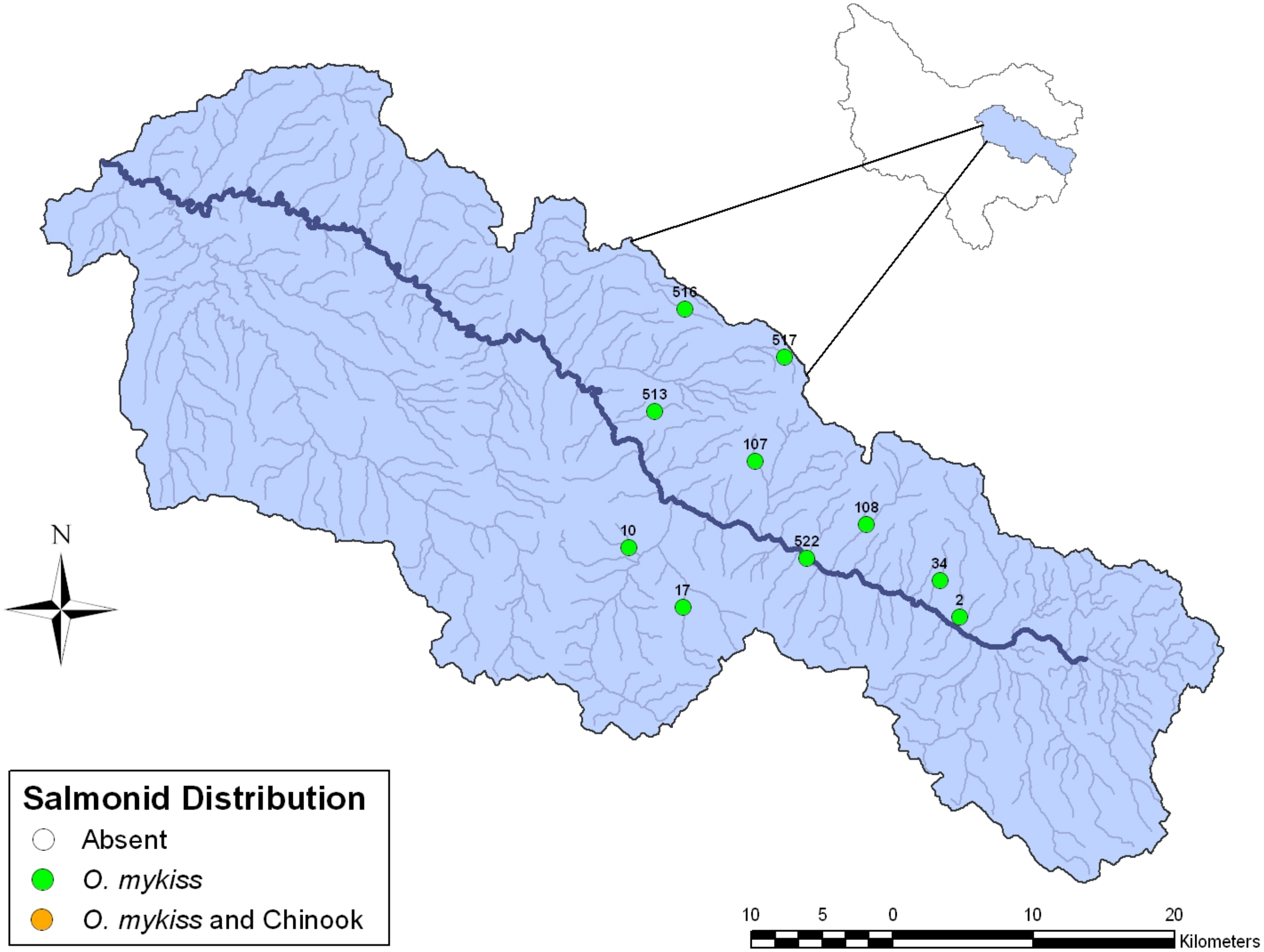


Figure 12. Distribution of *O. mykiss* and spring Chinook observations in the Middle Fork John Day River from snorkeling and electrofishing surveys conducted between 15 June and 10 October, 2005. Site identification numbers are shown next to each point for reference.

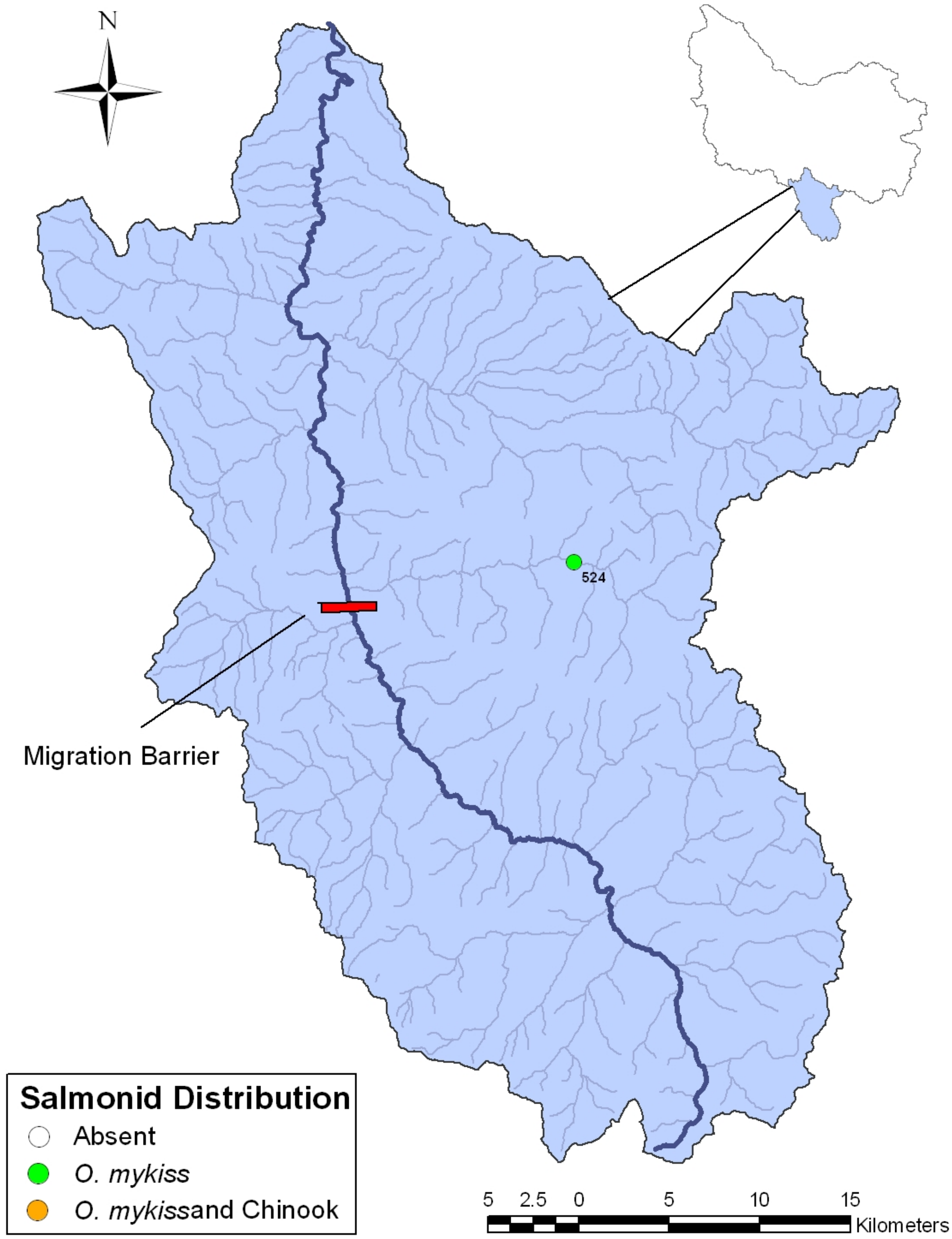


Figure 13. Distribution of *O. mykiss* and spring Chinook observations in the South Fork John Day River from snorkeling and electrofishing surveys conducted between 15 June and 10 October, 2005. Site identification numbers are shown next to each point for reference.

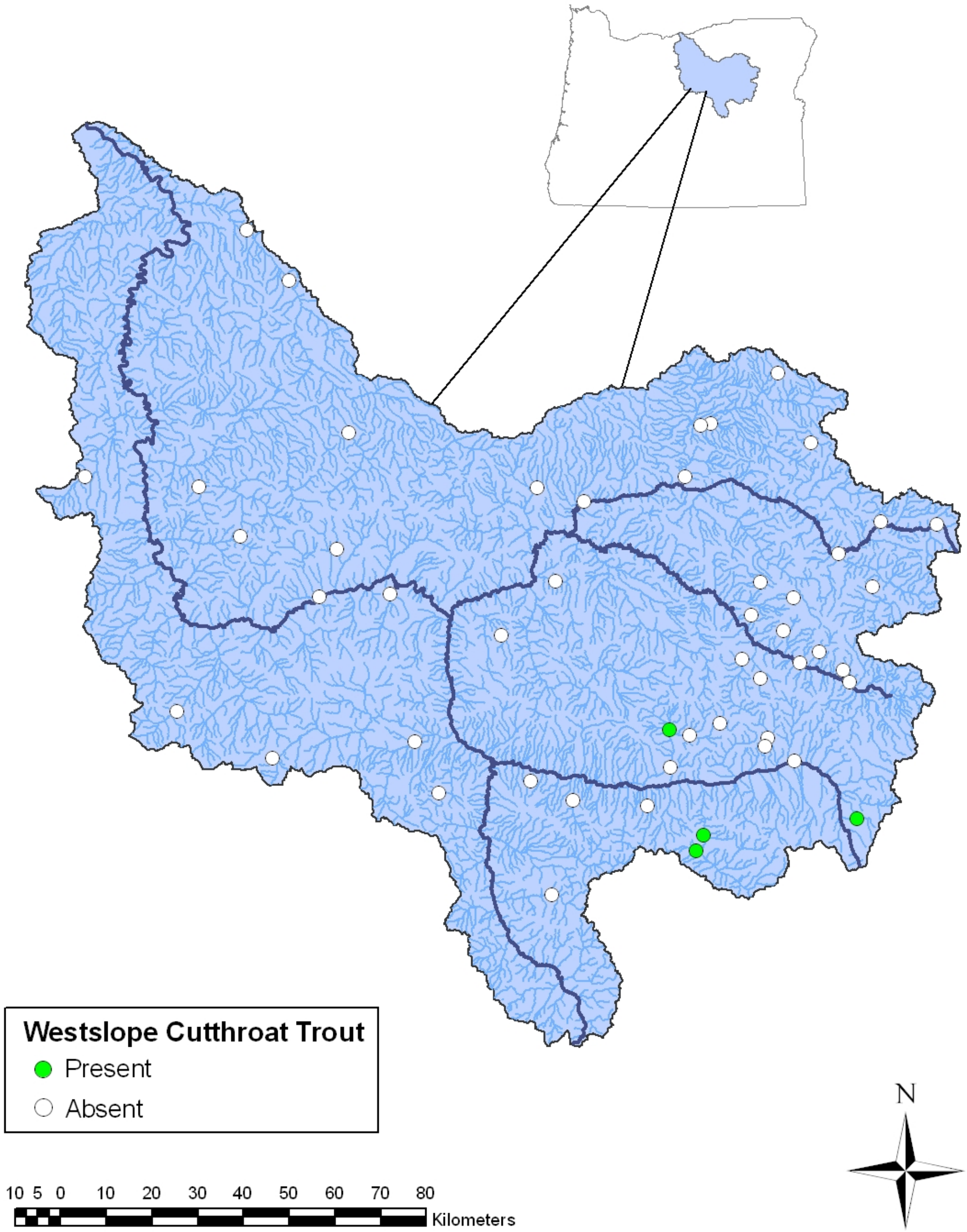


Figure 14. Distribution of westslope cutthroat trout observations in the John Day River basin from snorkeling and electrofishing surveys conducted between 15 June and 10 October, 2005.

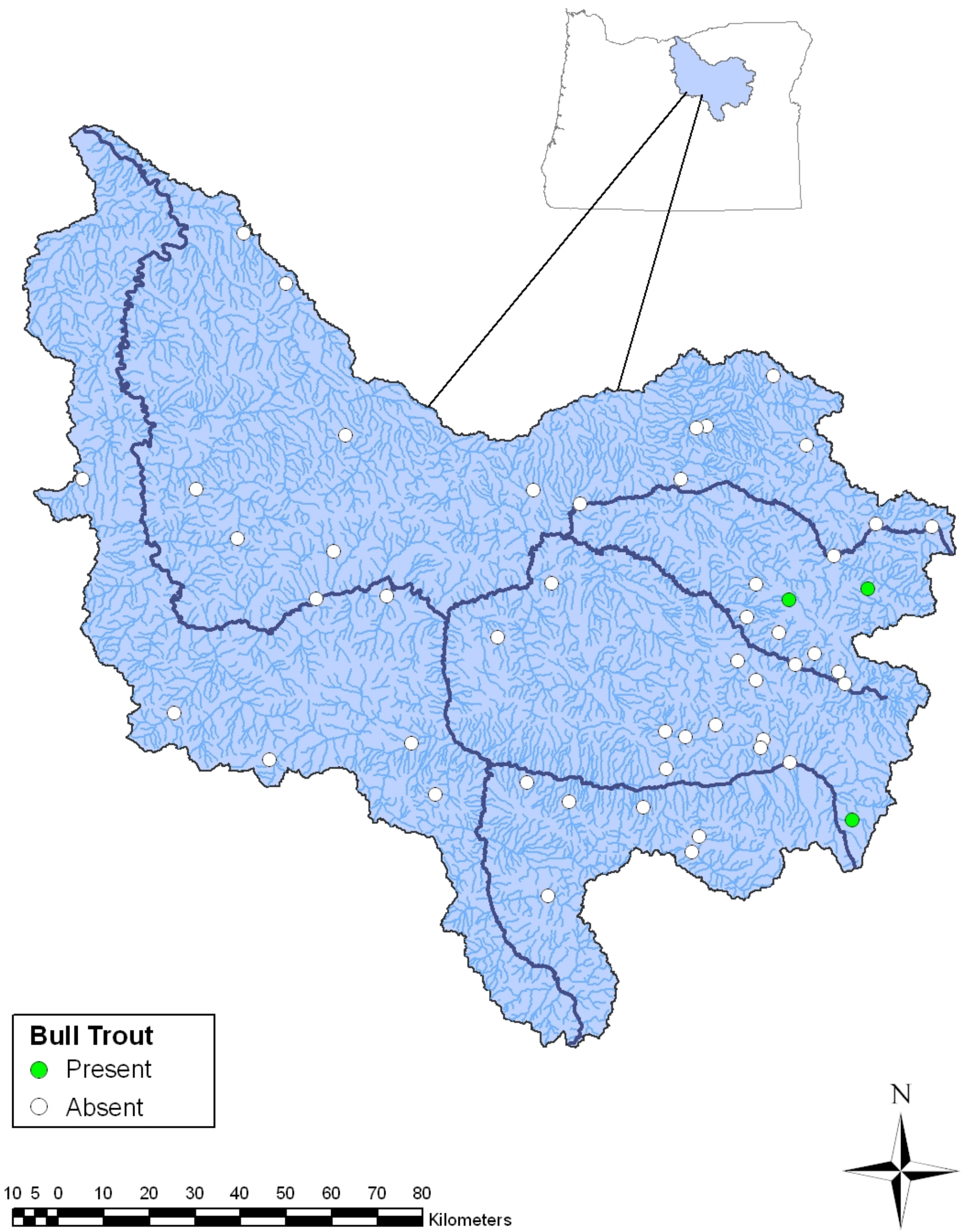


Figure 15. Distribution of bull trout observations in the John Day River basin from snorkeling and electrofishing surveys conducted between 15 June and 10 October, 2005.

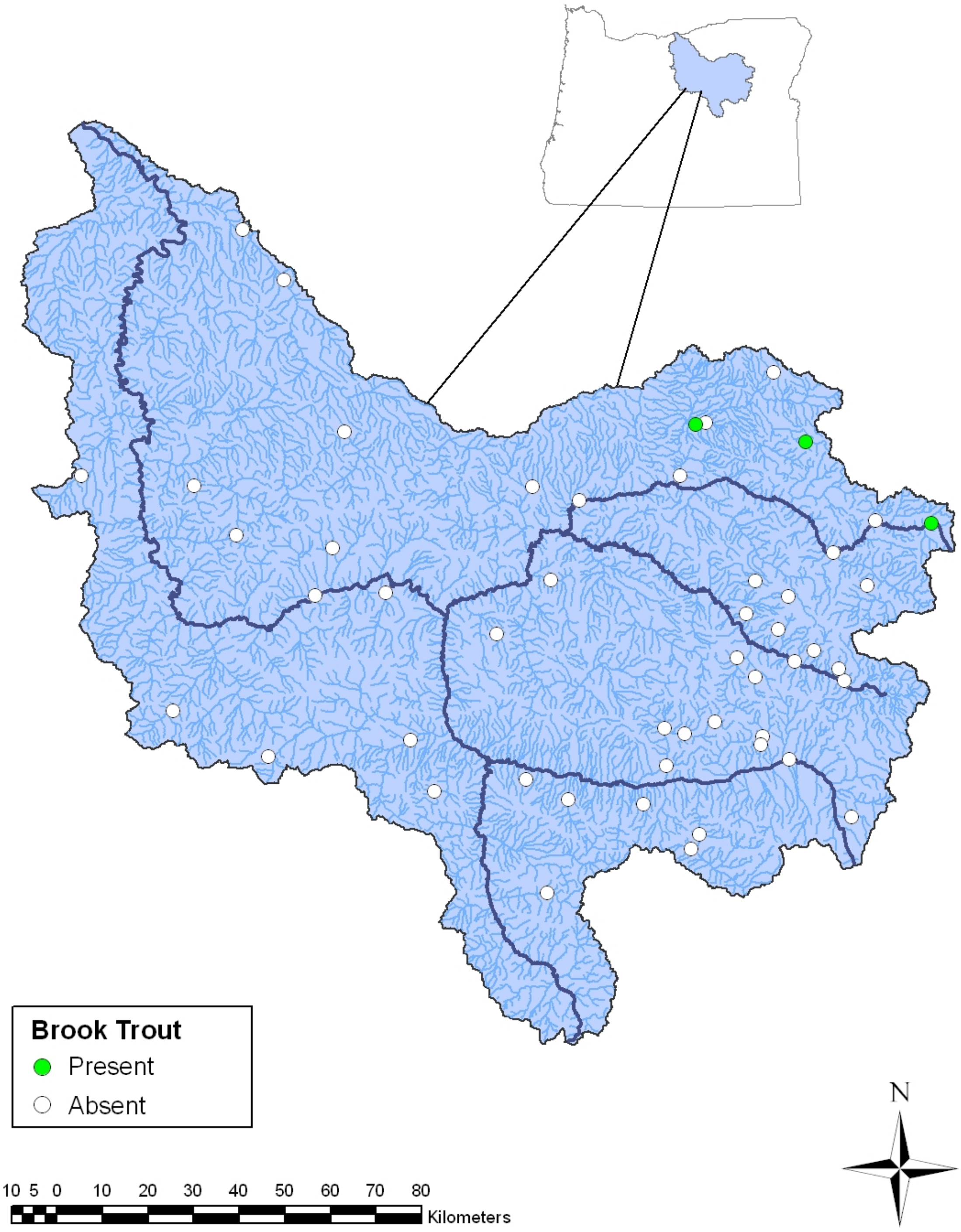


Figure 16. Distribution of brook trout observations in the John Day River basin from snorkeling and electrofishing surveys conducted between 15 June and 10 October, 2005.

Table 9. 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 from 15 June to 10 October, 2005. For sampling method, one denotes electrofishing and two denotes snorkeling.

Stream	Site ID	Sampling Method	# Pools	*O. mykiss*	Spring Chinook	Cutthroat Trout	Bull Trout	Brook Trout
LMJDR								
Bear Creek	36	2	7	85.7	0.0	0.0	0.0	0.0
Big Pine Hollow	514	2	12	100.0	0.0	0.0	0.0	0.0
Camp Creek	510	1	17	47.1	0.0	0.0	0.0	0.0
Cougar Creek	112	1	6	0.0	0.0	0.0	0.0	0.0
Lone Rock Creek	45	2	22	27.3	0.0	0.0	0.0	0.0
Milk Creek	497	1	15	73.3	0.0	0.0	0.0	0.0
Parrish Creek	525	1	18	88.9	0.0	0.0	0.0	0.0
Rock Creek	42	1	11	100.0	9.1	0.0	0.0	0.0
Rock Creek	6	2	11	0.0	0.0	0.0	0.0	0.0
Rock Creek	9	2	6	0.0	0.0	0.0	0.0	0.0
Service Creek	11	1	26	92.3	0.0	0.0	0.0	0.0
Steers Canyon	521	1	17	0.0	0.0	0.0	0.0	0.0
West Fork Butte Creek	104	1	19	47.4	0.0	0.0	0.0	0.0
Total			**187**	**55.1**	**0.5**	**0.0**	**0.0**	**0.0**
UMJDR								
Bear Creek	519	1	33	69.7	0.0	0.0	0.0	0.0
Bear Creek	106	1	25	52.0	0.0	0.0	0.0	0.0
Beech Creek	99	2	21	61.9	0.0	0.0	0.0	0.0
Beech Creek	518	1	27	96.3	0.0	14.8	0.0	0.0
Canyon Creek	109	1	11	100.0	9.1	9.1	0.0	0.0
East Fork Beech Creek	111	1	29	72.4	0.0	0.0	0.0	0.0
Fields Creek	493	1	24	100.0	0.0	0.0	0.0	0.0
Flat Creek	44	1	4	100.0	0.0	0.0	0.0	0.0
Ingle Creek	114	1	18	50.0	0.0	0.0	0.0	0.0
John Day River	38	2	4	50.0	100.0	0.0	0.0	0.0
Rail Creek	13	1	14	0.0	0.0	50.0	35.7	0.0
Tinker Creek	5	1	18	83.3	0.0	0.0	0.0	0.0
Vance Creek	15	1	10	100.0	0.0	100.0	0.0	0.0
Total			**238**	**71.8**	**2.1**	**9.2**	**2.1**	**0.0**
NFJDR								
Bear Wallow Creek	48	1	24	66.7	0.0	0.0	0.0	0.0
Camas Creek	4	2	4	75.0	100.0	0.0	0.0	0.0
Clear Creek	16	2	17	100.0	100.0	0.0	5.9	0.0
Crawfish Creek	41	1	11	9.1	0.0	0.0	0.0	90.9
Deer Creek	102	1	17	94.1	0.0	0.0	0.0	0.0
Gilmore Creek	7	1	33	30.3	0.0	0.0	0.0	0.0

Table 9. Continued.

Stream	Site ID	Sampling Method	# Pools	*O. mykiss*	Spring Chinook	Cutthroat Trout	Bull Trout	Brook Trout
NFJDR								
Granite Creek	490	2	12	100.0	100.0	0.0	0.0	0.0
Hidaway Creek	115	1	18	100.0	0.0	0.0	0.0	44.4
North Fork John Day River	526	2	5	0.0	0.0	0.0	0.0	0.0
Pine Creek	520	1	21	85.7	19.0	0.0	0.0	4.8
Pine Creek	511	1	10	50.0	0.0	0.0	0.0	0.0
Swale Creek	47	1	16	75.0	0.0	0.0	0.0	0.0
Trout Creek	103	1	13	100.0	0.0	0.0	0.0	0.0
Total			**201**	**70.1**	**18.4**	**0.0**	**0.5**	**9.5**
MFJDR								
Beaver Creek	522	1	26	96.2	0.0	0.0	0.0	0.0
Big Creek	517	1	13	84.6	0.0	0.0	38.5	0.0
Caribou Creek	34	1	14	42.9	0.0	0.0	0.0	0.0
Granite Boulder Creek	108	2	15	86.7	0.0	0.0	0.0	0.0
Indian Creek	516	1	17	47.1	0.0	0.0	0.0	0.0
Mosquito Creek	513	1	23	13.0	0.0	0.0	0.0	0.0
Myrtle Creek	107	1	24	87.5	0.0	0.0	0.0	0.0
Vincent Creek	2	1	20	80.0	0.0	0.0	0.0	0.0
West Fork Lick Creek	17	1	22	100.0	0.0	0.0	0.0	0.0
Whisky Creek	10	1	20	85.0	0.0	0.0	0.0	0.0
Total			**194**	**73.2**	**0.0**	**0.0**	**2.6**	**0.0**
SFJDR								
Deer Creek	524	1	20	95.0	0.0	0.0	0.0	0.0
Total			**20**	**95.0**	**0.0**	**0.0**	**0.0**	**0.0**
Basin Total			**840**	**68.6**	**5.1**	**2.6**	**1.3**	**2.3**

Table 10. Number and percentage of pools with *O. mykiss* present at juvenile survey sites in the John Day River basin from 15 June to 10 October, 2005. Table only includes data for sites where *O. mykiss* were present.

Subbasin	# of Pools	# Pools w/O. mykiss	% Pools w/O. mykiss
Lower Mainstem John Day River	147	103	70.1
Upper Mainstem John Day River	224	171	76.3
North Fork John Day River	196	141	71.9
Middle Fork John Day River	194	142	73.2
South Fork John Day River	20	19	95.0
John Day River Basin	**781**	**576**	**73.8**

Table 11. Number and percentage of pools with spring Chinook present at juvenile survey sites in the John Day River basin from 15 June to 10 October, 2005. Table only includes data for sites where spring Chinook were present.

Subbasin	# of Pools	# Pools w/Chinook	% Pools w/Chinook
Lower Mainstem John Day River	11	1	9.1
Upper Mainstem John Day River	15	5	33.3
North Fork John Day River	54	37	68.5
Middle Fork John Day River	0	0	0.0
South Fork John Day River	0	0	0.0
John Day River Basin	**80**	**43**	**53.8**

Table 12. Number and percentage of pools with westslope cutthroat trout present at juvenile survey sites in the John Day River basin from 15 June to 10 October, 2005. Table only includes data for sites where westslope cutthroat trout were present.

Subbasin	# of Pools	# Pools w/Cutthroat	% Pools w/Cutthroat
Lower Mainstem John Day River	0	0	0.0
Upper Mainstem John Day River	62	22	35.5
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	**62**	**22**	**35.5**

Table 13. Number and percentage of pools with brook trout present at juvenile survey sites in the John Day River basin from 15 June to 10 October, 2005. Table only includes data for sites where brook trout were present.

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	50	19	38.0
Middle Fork John Day River	0	0	0.0
South Fork John Day River	0	0	0.0
John Day River Basin	**50**	**19**	**38.0**

Table 14. Number and percentage of pools with bull trout present at juvenile survey sites in the John Day River basin from 15 June to 10 October, 2005. Table only includes data for sites where bull trout were present.

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	14	5	35.7
North Fork John Day River	17	1	5.9
Middle Fork John Day River	13	5	38.5
South Fork John Day River	0	0	0.0
John Day River Basin	**44**	**11**	**25.0**

Table 15. Variability in density (#/m^2) estimates for *O. mykiss* and spring Chinook at annual sites surveyed from June to October, 2004 and 2005.

		***O. mykiss* Density (#/m^2)**			**Spring Chinook Density (#/m^2)**		
Stream	**Site ID**	**2004**	**2005**	**Difference**	**2004**	**2005**	**Difference**
Camas Creek	4	0.004	0.003	-0.002	0.002	0.004	0.002
Clear Creek	16	0.128	0.080	-0.048	0.190	0.211	0.021
Fields Creek	493	0.406	0.458	0.052	0.000	0.000	– – –
Gilmore Creek	7	0.044	0.075	0.030	0.000	0.000	– – –
Granite Creek	490	0.052	0.079	0.027	0.103	0.141	0.039
Milk Creek	497	0.240	0.386	0.146	0.000	0.000	– – –
Rail Creek	13	0.000	0.000	– – –	0.000	0.000	– – –
Rock Creek	6	0.098	0.000	-0.098	0.000	0.000	– – –
Rock Creek	9	0.074	0.000	-0.074	0.000	0.000	– – –
Service Creek	11	1.106	0.283	-0.823	0.000	0.000	– – –
Tinker Creek	5	0.283	0.454	0.171	0.000	0.000	– – –
Vance Creek	15	0.098	0.375	0.277	0.000	0.000	– – –
Vincent Creek	2	0.311	0.356	0.045	0.000	0.000	– – –
WF Lick Creek	17	0.309	0.181	-0.128	0.000	0.000	– – –
Whisky Creek	10	0.282	0.394	0.113	0.000	0.000	– – –

Table 16. Stream, site identification number, sampling method, number of pools surveyed, and presence (x) of incidental species collected during juvenile surveys in the John Day River basin from 15 June to 10 October, 2005. For sampling method, one denotes electrofishing and two denotes snorkeling.

Stream	Site ID	Sampling Method	# Pools	Brown Bullhead	*Catostomus* spp.	*Cottus* Spp.	Mountain Whitefish	Northern Pikeminnow	Redside Shiner	Smallmouth Bass	Speckled Dace
LMJDR											
Bear Creek	36	2	7		X						X
Big Pine Hollow	514	2	12		X						X
Camp Creek	510	1	17								
Cougar Creek	112	1	6								
Lone Rock Creek	45	2	22		X				X		X
Milk Creek	497	1	15								
Parrish Creek	525	1	18		X						X
Rock Creek	42	1	11		X	X					X
Rock Creek	6	2	11		X				X		X
Rock Creek	9	2	6		X			X	X		X
Service Creek	11	1	26	X						X	
Steers Canyon	521	1	17								
West Fork Butte Creek	104	1	19								
UMJDR											
Bear Creek	519	1	33								X
Bear Creek	106	1	25								X
Beech Creek	99	2	21		X				X		X
Beech Creek	518	1	27			X					
Canyon Creek	109	1	11			X					X
East Fork Beech Creek	111	1	29		X	X					X
Fields Creek	493	1	24			X					
Flat Creek	44	1	4								
Ingle Creek	114	1	18								
John Day River	38	2	4			X	X		X		X
Rail Creek	13	1	14								
Tinker Creek	5	1	18								
Vance Creek	15	1	10								
NFJDR											
Bear Wallow Creek	48	1	24								X

Table 16. Continued.

Stream	Site ID	Sampling Method	# Pools	Brown Bullhead	*Catostomus* spp.	*Cottus* Spp.	Mountain Whitefish	Northern Pikeminnow	Redside Shiner	Smallmouth Bass	Speckled Dace
NFJDR											
Camas Creek	4	2	4		X			X	X	X	X
Clear Creek	16	2	17		X	X					X
Crawfish Creek	41	1	11								
Deer Creek	102	1	17		X						X
Gilmore Creek	7	1	33								
Granite Creek	490	2	12				X				X
Hidaway Creek	115	1	18			X					
North Fork John Day River	526	2	5		X			X	X	X	
Pine Creek	520	1	21		X	X		X	X		X
Pine Creek	511	1	10		X	X			X		X
Swale Creek	47	1	16			X					X
Trout Creek	103	1	13			X					
MFJDR											
Beaver Creek	522	1	26								
Big Creek	517	1	13								
Caribou Creek	34	1	14								
Granite Boulder Creek	108	2	15								
Indian Creek	516	1	17								
Mosquito Creek	513	1	23								
Myrtle Creek	107	1	24								
Vincent Creek	2	1	20								
West Fork Lick Creek	17	1	22								
Whisky Creek	10	1	20								
SFJDR											
Deer Creek	524	1	20								

Table 17. Number and percentage of sites with incidental species collected during juvenile surveys in the John Day River basin from 15 June to 10 October, 2005.

	# Sites Present	% Sites Present	% Sites Present				
Incidental Species	**JDR**		**LMJDR**	**UMJDR**	**NFJDR**	**MFJDR**	**SFJDR**
Speckled Dace *(Rhinichthys osculus)*	21	42.0	53.8	46.2	61.5	0.0	0.0
Sucker *(Catostomus* spp.)	15	30.0	53.8	15.4	46.2	0.0	0.0
Sculpin *(Cottus* spp.)	12	24.0	7.7	38.5	46.2	0.0	0.0
Redside Shiner *(Richardsonius balteatus)*	9	18.0	23.1	15.4	30.8	0.0	0.0
Northern Pikeminnow *(Pytocheilus oregonensis)*	4	8.0	7.7	0.0	23.1	0.0	0.0
Smallmouth Bass *(Micropterus dolomieu)*	3	6.0	7.7	0.0	15.4	0.0	0.0
Mountain Whitefish *(Prosopium williamsoni)*	2	4.0	0.0	7.7	7.7	0.0	0.0
Brown Bullhead *(Ictalurus nebulosus)*	1	2.0	7.7	0.0	0.0	0.0	0.0

2004 Habitat and Riparian Surveys

We made several observations from reach information collected from habitat surveys conducted in the John Day River basin in 2004 (Tables 18, 19). Many sites had grazing as a dominant land use (11 sites; 24%). The majority of sites were also dominated by grass or shrub riparian vegetation (28 sites; 61%) and had constrained channels (35 sites; 76%). Hillslopes constrained half of the sites with constrained channels (7 sites) in the North Fork, and a combination of terraces, hillslopes, and land use constrained sites in the Lower Mainstem, Upper Mainstem, Middle Fork, and South Fork.

Table 20 shows a comparison of habitat data among subbasins. Overall, we surveyed 51.6 km of stream habitat (primary & secondary channels) in the basin. All subbasins were well represented in our surveys although the South Fork was the only subbasin to contribute to less than 10% of the total distance surveyed for habitat in 2004. There were no statistically significant differences (Kruskal-Wallis; $P > 0.05$; Table 21) in average active channel width between subbasins although the North Fork was the only basin to have an average active channel width over 10 m. Most other variables were also not significantly different between subbasins (Table 21). Variables that did have signficant differences between subbasins were the percentage of pools, shading, and bank erosion in the reach, the number of key woody debris pieces (#/100 m), and residual pool depth (Kruskal-Wallis; $P < 0.05$; Table 21). The North Fork had a higher average percentage of pools (30.7%) than the Middle Fork (11.3%). The Upper Mainstem had a higher average percentage of shading (76.8%) than the North Fork (50.4%), Middle Fork (47.2%), and Lower Mainstem (42.2%) and more key woody debris pieces (0.6 pieces/100 m) than the North Fork (0.2 pieces/100 m). Bank Erosion was higher in the Lower Mainstem (36.1%) than in the North Fork (13.9%) and residual pool depth was higher in the North Fork (0.45 m) than in the Upper Mainstem (0.26 m).

2005 Habitat and Riparian Surveys

We observed several similarities between reach information collected from habitat surveys sampled in the John Day River basin in 2005 (Tables 22, 23) and surveys conducted in 2004. Again, a high percentage of sites had grazing as a dominant land use (23 sites; 45%). The majority of sites in 2005 were also dominated by grass or shrub riparian vegetation (41 sites; 80%), and had constrained channels (36 sites; 71%). Hillslopes constrained the majority of sites with constrained channesl (70%) in the North Fork and terraces constrained the majority of the sites with constrained channels (55%) in the Lower Mainstem. A combination of terraces, hillslopes, and land use constrained sites in the Upper Mainstem and Middle Fork.

Table 24 shows a comparison of habitat data among subbasins. Overall, we surveyed 52.3 km of stream habitat (primary & secondary channels) in the basin. Most subbasins were represented well in our surveys except for the South Fork which had only one site and only contributed to 1% (0.6 km) of the total distance surveyed for habitat in 2005. Consequently, all results presented from this point forward will focus on the four subbasins with sufficient representation to adequately make comparisons. In general, average active channel width of sites in each subbasin was small (< 8 m) although there was a statistically significant difference (Kruskal-Wallis; $P = 0.022$; Table 21) between sites in the North Fork (Average; 14.1 m) and Middle Fork (Average; 3.8 m). The large average active channel width in the North Fork was due primarily to surveys on the the North Fork John Day River and Camas Creek. Gradient (Range; 2.7% - 4.3%) and percentage of site with pool habitat (Range; 17.1% - 23.9%) had similar averages across subbasins and were not significantly different. However, Middle Fork sites on average were of higher gradient and contained less pool habitat. The Middle Fork also had on average the highest percentage of gravel (37.5%), the highest percentage of shading (63.2%), the lowest percentage of bank erosion (4.0%), the highest number (18.0 pieces/100 m) and volume of large woody debris (14.0 m^3/100 m), the highest number of key woody debris pieces (0.3 pieces/100 m), and the highest number of riparian conifers (695 conifers/1000 ft) than all other subbasins. However, only number and volume of large woody debris was significantly different (Kruskal-Wallis; $P < 0.05$; Table 21) between subbasins. The Middle Fork had significantly more large woody debris pieces (18.0 pieces/100 m) than the Lower Mainstem (4.7 pieces/100 m) and both the Middle Fork (14.0 m^3/100 m) and North Fork (9.2 m^3/100 m) had a significantly higher wood volume than the Lower Mainstem (4.7 m^3/100 m). The North Fork on average had the most large boulders (2.0 boulders/100m) and the lowest percentage of fines (11.5%) of any subbasin. The Lower Mainstem had the highest percentage of fines (26.6%) and bank erosion (14.4%), and the lowest percentage of shading (46.5%) and undercut banks (3.6%) of any subbasin. However, bank erosion was the only one of these variables that was significantly different (Kruskal-Wallis; $P = 0.025$; Table 21) between subbasins. Bank erosion was higher in the Lower Mainstem (14.4%) than in the North Fork (5.8%). The North Fork also had a significantly higher residual pool depth (0.44 m) than the Middle Fork (0.26 m).

Table 18. Stream, site ID, and channel, land use, and reach information for habitat sites conducted in the John Day River basin from 29 June to 28 September, 2004. Descriptions of codes used for channel form, land use, riparian vegetation, and stream flow are found in appendix tables 5 - 8.

Stream	SiteID	Channel Length (m)		Channel	Dominant		Active Channel Width	Gradient	Stream	Temp	% of Site w/	Depth (m)	
		Primary	Secondary	Form	Land Use	Riparian Veg	(m)	(%)	Flow	(C)	Pools	Resid Pool	Riffle
LMJDR													
Baldy Creek	87	988	35	US	YT	C3	2.9	3.4	MF	6.0	14.0	0.28	0.09
Buckhorn Creek	91	1010	77	CA	LG	S	8.5	1.7	MF	17.0	30.4	0.49	0.06
Cottonwood Creek	503	1018	266	CH	LT	C3	5.1	4.2	LF	9.0	7.8	0.32	0.12
Fort Creek	29	880	229	US	HG	G	2.2	2.8	MF	16.0	8.1	0.24	0.13
Indian Creek	94	993	86	US	LT	C15	5.5	3.7	MF	12.0	17.5	0.26	0.24
Milk Creek	497	982	52	CA	LT	C15	2.0	6.2	LF	8.0	6.8	0.27	0.12
Mountain Creek	25	1002	82	US	HG	G	7.0	0.8	LF	19.0	51.4	0.48	0.21
Rock Creek	6	1003	113	CT	AG	G	11.5	0.8	LF	21.0	59.1	0.62	0.12
Rock Creek	9	964	16	CT	AG	P	9.8	0.5	PD	28.0	25.4	0.75	
Service Creek	11	1001	0	CT	RR	G	5.5	2.8	MF	19.0	28.7	0.35	0.17
Thirtymile Creek	82	1059	0	CA	HG	S	19.2	1.2	LF	22.0	18.0	0.49	0.14
UMJDR													
Bear Creek	88	996	82	US	ST	S	2.3	6.1	MF	6.0	1.8	0.19	0.05
Belshaw Creek	20	981	57	CH	MT	C50	2.6	5.2	MF	8.0	6.7	0.24	0.12
East Fork Canyon Creek	84	1007	141	CA	WA	M3	5.8	3.0	MF	10.0	36.1	0.39	0.18
Fields Creek	493	1004	22	CH	LT	M3	5.9	4.5	MF	14.0	16.5	0.31	0.17
Rail Creek	13	1017	172	CA	LT	S	5.1	3.8	MF	5.0	8.1	0.26	0.25
Tinker Creek	5	1010	37	CA	LT	P	3.0	2.6	LF	12.0	13.7	0.19	0.08
Vance Creek	15	1010	12	CH	LG	D3	4.0	1.9	MF	8.0	10.0	0.28	0.14
NFJDR													
Bear Creek	21	1016	223	CH	LT	S	6.8	4.3	PD	18.0	0.6	0.30	
Beaver Creek	496	998	81	US	ST	P	1.9	0.6	LF	14.5	79.5	0.47	0.14
Big Creek	498	1019	150	CH	WA	M3	15.8	4.2	MF	12.0	21.3	0.64	
Big Wall Creek	85	962	36	CT	LG	G	11.9	0.7	LF	20.0	69.0	0.48	0.13
Camas Creek	4	1074	114	CH	MT	S	21.8	1.0	MF	16.5	37.2	0.85	0.36
Clear Creek	16	1006	311	CL	MI	C15	15.7	1.5	MF	18.5	33.6	0.52	0.20

Table 18. Continued.

Stream	SiteID	Channel Length (m) Primary	Channel Length (m) Secondary	Channel Form	Dominant Land Use	Dominant Riparian Veg	Active Channel Width (m)	Gradient (%)	Stream Flow	Temp (C)	% of Site w/ Pools	Depth (m) Resid Pool	Depth (m) Riffle
NFJDR													
Ellis Creek	8	972	86	CH	LT	S	5.0	4.6	LF	17.0	13.6	0.50	0.05
Gilmore Creek	7	994	0	CT	LG	S	2.8	2.4	LF	19.5	19.1	0.29	0.07
Granite Creek	95	1002	395	CL	MI	S	2.2	3.5	MF	12.0	11.7	0.32	0.15
Granite Creek	490	1001	299	CH	WA	S	18.9	2.5	MF	13.0	9.5	0.52	0.33
Hidaway Creek	86	986	17	US	NU	C3	8.8	1.3	MF	17.0	24.8	0.38	0.23
North Fork Desolation Creek	90	947	372	CT	ST	C15	6.6	2.3	LF	14.0	27.3	0.37	0.14
North Fork John Day River	92	1018	0	CH	LT	S	31.2	0.8	MF	14.0	9.7	0.45	0.47
North Fork Ruby Creek	492	1081	235	US	ST	P	2.6	1.4	LF	13.0	38.4	0.37	0.10
Swale Creek	28	987	42	CH	LG	S	8.7	2.7	LF	14.0	10.2	0.35	0.02
Tribble Creek	19	987	82	CT	HG	P	4.8	0.7	LF	11.0	74.6	0.25	0.06
Wilson Creek	507	970	9	CA	LT	C1	6.9	2.3	MF	19.0	42.6	0.62	0.11
MFJDR													
Camp Creek	31	998	228	US	LT	C30	4.9	1.7	LF	12.5	20.8	0.38	0.15
Camp Creek	505	1088	254	CA	WA	P	5.0	2.3	MF	15.0	7.6	0.22	0.15
Indian Creek	500	1061	369	CH	YT	C1	6.3	4.8	LF	8.0	6.7	0.32	0.05
Middle Fork John Day River	27	979	200	US	LT	P	17.3	0.8	MF	18.0	8.8	0.38	0.33
Vincent Creek	2	978	68	US	MI	G	3.8	2.4	PD	14.0	12.4	0.31	0.08
West Fork Lick Creek	17	979	42	CT	LT	C30	3.9	4.9	LF	13.0	15.7	0.34	0.13
Whisky Creek	10	992	102	CH	HG	S	2.0	7.6	LF	15.0	7.3	0.33	
SFJDR													
Deer Creek	33	1001	64	CA	LG	S	6.2	2.1	LF	11.0	25.8	0.49	0.23
Murderers Creek	32	1007	103	CA	LT	S	6.5	1.5	MF	15.0	34.7	0.30	0.20
North Fork Wind Creek	18	995	8	CH	ST	C15	3.0	4.0	LF	17.0	27.6	0.18	0.08
North Fork Wind Creek	97	1133	84	CH	NU	D3	4.9	8.0	MF	15.0	16.8	0.37	0.14

Table 19. Stream, site ID, and reach information for substrate, shading, bank stability, large woody debris, and riparian trees collected at habitat sites in the John Day River basin from 29 June to 28 September, 2004.

			Substrate							Large Woody Debris			Riparian Trees	
			Total		Riffles									
Stream	**SiteID**	**# Large Bldrs**	**Fines %**	**Gravel %**	**Fines %**	**Gravel %**	**Open Sky % of 180**	**Bank Erosion %**	**Undercut %**	**# Pieces**	**# Key Pieces**	**Volume /100 m**	**Deciduous #/1000 ft**	**Coniferous #/1000 ft**
LMJDR														
Baldy Creek	87	166	27.8	31.7	23.3	41.7	61.3	9.6	4.0	267	9	20.9	122	2235
Buckhorn Creek	91	101	14.4	31.7	10.8	31.9	38.7	21.4	4.0	5	0	0.1	41	203
Cottonwood Creek	503	104	37.3	29.6	48.9	27.5	76.9	29.6	0.9	234	10	19.4	0	1483
Fort Creek	29	9	63.6	15.2	66.1	14.9	45.5	26.9	6.1	18	0	0.7	508	163
Indian Creek	94	15	48.2	36.8	47.7	38.9	61.9	8.6	36.0	126	4	8.5	0	874
Milk Creek	497	0	53.5	46.3	73.0	27.0	75.4	72.7	22.5	234	30	39.4	0	792
Mountain Creek	25	101	32.0	30.3	29.2	35.8	4.5	79.8	0.8				20	0
Rock Creek	6	213	16.0	54.5	8.9	49.3	24.8	33.1	0.5	6	0	0.2	20	20
Rock Creek	9	475	5.7	30.2			23.3	12.1	0.6	1	0	0.0	41	0
Service Creek	11	54	39.7	31.4	21.5	42.5	35.3	61.7	0.0	4	0	0.3	41	0
Thirtymile Creek	82	119	10.0	41.6	4.9	45.6	16.8	41.1	0.3	8	1	1.4	41	41
UMJDR														
Bear Creek	88	64	32.6	37.3	30.0	40.0	87.8	1.9	3.1	146	5	14.1	549	792
Belshaw Creek	20	293	33.0	34.5	33.0	41.4	79.3	23.7	8.3	152	10	21.4	325	1118
East Fork Canyon Creek	84	99	25.2	46.4	12.5	45.3	69.5	15.6	8.8	233	9	21.0	772	2337
Fields Creek	493	774	13.8	31.6	9.9	39.7	82.5	6.7	0.9	55	2	3.0	549	528
Rail Creek	13	107	15.7	38.0	19.4	39.2	74.4	1.4	26.0	263	8	15.7	244	1930
Tinker Creek	5	160	37.4	41.0	38.9	37.7	60.4	35.7	2.9	157	4	14.1	0	650
Vance Creek	15	8	63.9	33.6	63.7	33.4	83.9	36.3	9.1	82	4	7.0	1463	1057
NFJDR														
Bear Creek	21	1093	20.9	24.3			56.0	0.0	0.0	86	3	5.9	0	345
Beaver Creek	496	0	25.7	13.4	29.9	17.5	22.3	27.3	21.6	24	0	1.2	0	447
Big Creek	498	3209	1.8	8.0			64.3	0.0	0.0	69	0	3.2	914	1300
Big Wall Creek	85	262	7.7	35.2	6.2	31.1	28.3	6.3	0.0	3	0	0.9	508	0
Camas Creek	4	889	2.4	27.8	1.9	30.0	55.3	0.0	0.0	20	0	2.0	41	325
Clear Creek	16	333	11.6	34.8	9.7	37.1	33.2	17.2	0.4	49	0	2.4	41	691
Ellis Creek	8	1581	0.6	19.4	0.0	50.0	60.1	1.1	0.2	163	4	12.3	0	183
Gilmore Creek	7	53	34.7	37.4	28.7	43.0	33.9	63.6	0.1	10	1	1.0	671	122
Granite Creek	95	25	43.8	29.4	51.1	31.8	56.4	0.0	1.3	59	2	3.2	122	955

Table 19. Continued.

Stream	SiteID	# Large Bldrs	Substrate: Total Fines %	Substrate: Total Gravel %	Substrate: Riffles Fines %	Substrate: Riffles Gravel %	Open Sky % of 180	Bank Erosion %	Undercut %	Large Woody Debris: # Pieces	Large Woody Debris: # Key Pieces	Large Woody Debris: Volume /100 m	Riparian Trees: Deciduous #/1000 ft	Riparian Trees: Coniferous #/1000 ft
NFJDR														
Granite Creek	490	1974	17.2	25.2	15.6	24.2	50.6	0.0	0.3	173	3	12.7	183	955
Hidaway Creek	86	25	17.6	43.6	9.3	41.7	61.9	17.0	8.2				0	2377
North Fork Desolation Creek	90	50	34.3	33.6	33.4	34.5	69.4	25.1	29.3	525	7	27.5	0	1077
North Fork John Day River	92	353	15.4	23.3	15.7	22.6	45.5	0.0	0.0	9	1	1.3	691	122
North Fork Ruby Creek	492	17	25.3	61.9	20.0	67.4	50.1	34.8	19.1	388	4	15.9	0	1097
Swale Creek	28	676	10.3	23.5	8.3	27.4	65.5	13.9	3.3	68	3	7.1	102	427
Tribble Creek	19	0	41.5	31.0	41.5	29.4	49.6	26.3	0.8	208	0	12.8	0	1504
Wilson Creek	507	1386	8.8	12.9	9.3	15.8	53.7	3.3	0.4	29	1	3.0	853	996
MFJDR														
Camp Creek	31	373	10.8	33.3	3.2	31.1	28.1	11.2	4.5	108	5	9.4	0	955
Camp Creek	505	226	16.8	37.3	15.7	37.1	46.9	46.7	12.4	40	0	2.8	0	1240
Indian Creek	500	59	24.1	43.5	20.6	43.8	64.7	5.6	3.5	674	18	43.9	0	1605
Middle Fork John Day River	27	170	18.2	27.9	13.9	27.4	31.5	8.5	1.3	20	2	6.9	732	142
Vincent Creek	2	159	18.2	37.2	23.5	36.9	31.6	16.5	1.2	47	1	3.0	0	650
West Fork Lick Creek	17	545	26.2	31.0	23.6	33.4	64.9	2.1	5.4	90	6	10.8	325	2804
Whisky Creek	10	264	17.0	34.7			62.5	97.9	5.2	48	3	6.0	122	345
SFJDR														
Deer Creek	33	304	33.0	29.5	25.5	34.3	58.1	0.0	0.1	33	1	2.5	467	122
Murderers Creek	32	193	21.2	38.5	17.0	43.4	55.1	20.2	5.0	60	5	7.3	1036	163
North Fork Wind Creek	18	509	28.0	32.9	15.0	28.4	60.5	8.8	0.6	155	6	19.4	20	1707
North Fork Wind Creek	97	3752	27.4	24.6	25.7	36.5	62.8	0.0	0.0	82	3	6.9	508	549

Table 20. Average, minimum, and maximum values of habitat parameters estimated or quantified at habitat sites conducted in the John Day River basin from 29 June to 28 September, 2004.

Subbasin	Total Length Surveyed (km)	ACW (m)	Gradient %	Temp (C)	% of Site w/ Pools	Large Bldrs /100 m	Substrate: Fines %	Substrate: Gravel %	Shade % of 180	Bank Erosion %	Bank Undercut %	Large Woody Debris: # /100 m	Large Woody Debris: # Key /100 m	Large Woody Debris: Volume /100 m	Riparian Trees: Conifers /1000 ft	Riparian Trees: Deciduous /1000 ft
LMJDR	11.9															
Average		7.2	2.5	16.1	24.3	0.3	31.6	34.5	42.2	36.1	6.9	8.3	0.5	9.1	528	76
Min		2.0	0.5	6.0	6.8	0.0	5.7	15.2	4.5	8.6	0.0	0.1	0.0	0.0	0	0
Max		19.2	6.2	28.0	59.1	1.7	63.6	54.5	76.9	79.8	36.0	26.1	2.9	39.4	2235	508
% of Total	23%															
UMJDR	7.5															
Average		4.1	3.9	9.0	13.3	0.4	31.7	37.5	76.8	17.3	8.5	14.1	0.6	13.7	1202	557
Min		2.3	1.9	5.0	1.8	0.0	13.8	31.6	60.4	1.4	0.9	5.4	0.2	3.0	528	0
Max		5.9	6.1	14.0	36.1	1.3	63.9	46.4	87.8	36.3	26.0	22.1	1.0	21.4	2337	1463
% of Total	15%															
NFJDR	19.5															
Average		10.1	2.2	15.5	30.7	1.5	18.8	28.5	50.4	13.9	5.0	9.6	0.2	7.0	760	243
Min		1.9	0.6	11.0	0.6	0.0	0.6	8.0	22.3	0.0	0.0	0.3	0.0	0.9	0	0
Max		31.2	4.6	20.0	79.5	5.3	43.8	61.9	69.4	63.6	29.3	39.8	0.5	27.5	2377	914
% of Total	38%															
MFJDR	8.3															
Average		6.2	3.5	13.6	11.3	0.4	18.7	35.0	47.2	26.9	4.8	11.2	0.4	11.8	1106	168
Min		2.0	0.8	8.0	6.7	0.1	10.8	27.9	28.1	2.1	1.2	1.7	0.0	2.8	142	0
Max		17.3	7.6	18.0	20.8	0.6	26.2	43.5	64.9	97.9	12.4	47.1	1.3	43.9	2804	732
% of Total	16%															
SFJDR	4.4															
Average		5.1	3.9	14.5	26.2	1.3	27.4	31.4	59.1	7.2	1.4	7.7	0.3	9.0	635	508
Min		3.0	1.5	11.0	16.8	0.2	21.2	24.6	55.1	0.0	0.0	3.1	0.1	2.5	122	20
Max		6.5	8.0	17.0	34.7	4.1	33.0	38.5	62.8	20.2	5.0	15.5	0.6	19.4	1707	1036
% of Total	9%															
Basin Total	51.6															

Table 21. Test for statistical significance (P < 0.05) of various habitat parameters among John Day subbasins. P-values shaded in grey indicate statistically significant differences.

Habitat Variable	P-Value 2004	P-Value 2005	Differences 2004	Differences 2005
Gradient (%)	0.145	0.142	None	None
Active Channel Width (m)	0.317	0.022	None	NFJDR higher MFJDR
Pools (%)	0.036	0.725	NFJDR higher MFJDR	None
Riffle Depth (m)	0.981	0.145	None	None
Organics (%)	0.183	0.123	None	None
Gravel (%)	0.266	0.409	None	None
Riffle Organics (%)	0.194	0.474	None	None
Riffle Gravel (%)	0.793	0.309	None	None
Shading (%)	0.005	0.152	UMJDR higher NFJDR, MFJDR, LMJDR	None
Bank Erosion (%)	0.040	0.025	LMJDR higher NFJDR	LMJDR higher NFJDR
Bank Undercut (%)	0.053	0.584	None	None
Wood Pieces (#/100 m)	0.284	0.008	None	MFJDR higher LMJDR
Wood Volume (m3/100 m)	0.161	0.005	None	MFJDR & NFJDR higher LMJDR
Key Wood Pieces (#/100 m)	0.045	0.657	UMJDR higher NFJDR	None
Residual Pool Depth (m)	0.025	0.028	NFJDR higher UMJDR	NFJDR higher MFJDR
Boulders (#/100 m)	0.343	0.496	None	None
Conifers (#/1000 ft)	0.132	0.144	None	None
Hardwoods (#/1000 ft)	0.087	0.021	None	UMJDR higher NFJDR

Table 22. Stream, site ID, and channel, land use, and reach information for habitat sites conducted in the John Day River basin from 15 June to 6 October, 2005. Descriptions of codes used for channel form, land use, riparian vegetation, and stream flow are found in appendix tables 5 - 8.

		Channel Length (m)			Dominant		Active Channel Width	Gradient	Stream	Temp	% of Site w/	Depth (m)	
Stream	SiteID	Primary	Secondary	Channel Form	Land Use	Riparian Veg	(m)	(%)	Flow	(C)	Pools	Resid Pool	Riffle
LMJDR													
Bear Creek	36	511	121	CT	RR	D3	4.7	1.7	MF	17.0	12.4	0.26	0.11
Big Pine Hollow	514	1074	510	CA	LG	G	9.8	1.9	LF	22.0	28.2	0.56	0.07
Camp Creek	510	612	0	CT	LG	G	1.8	3.9	MF	19.5	8.8	0.17	0.13
Cougar Creek	112	481	0	CH	ST	S	1.7	10.1	LF	6.0	4.8	0.25	
Lone Rock Creek	45	1083	284	CH	LG	G	10.1	1.9	LF	15.0	28.5	0.42	0.15
Milk Creek	497	499	32	US	HG	C30	3.6	3.7	MF	3.5	10.3	0.27	0.10
Parrish Creek	525	548	236	US	HG	G	4.7	2.2	LF	21.0	32.0	0.29	0.06
Rock Creek	6	1015	110	CT	AG	G	12.2	0.7	LF	15.0	50.9	0.72	0.09
Rock Creek	42	1056	284	CT	LG	S	8.7	1.7	LF	13.0	10.2	0.45	0.21
Rock Creek	9	948	7	CT	AG	G	9.9	0.7	LF	21.0	30.8	0.90	0.16
Service Creek	11	1170	393	CT	RR	G	3.5	1.7	MF	16.0	18.7	0.35	0.16
Steers Canyon	521	554	11	CA	HG	G	1.7	6.4	LF	14.5	11.4	0.13	0.10
West Fork Butte Creek	104	531	19	CA	HG	S	3.6	2.9	MF	14.0	62.9	0.37	0.12
UMJDR													
Bear Creek	519	1176	93	CT	ST	G	2.6	1.8	MF	15.0	22.9	0.30	0.14
Bear Creek	106	1176	24	US	LT	G	3.4	2.1	MF	11.0	12.1	0.20	0.24
Beech Creek	518	1038	6	CL	LG	S	5.2	1.9	MF	17.5	22.6	0.24	0.17
Beech Creek	99	1137	12	CT	AG	S	9.3	0.6	MF	14.5	62.6	0.52	0.19
Canyon Creek	109	1079	10	CL	RR	S	9.8	1.2	LF	14.0	30.3	0.28	0.18
East Fork Beech Creek	111	1077	266	CA	LG	S	7.7	1.0	MF	10.0	27.9	0.30	0.18
Fields Creek	493	1009	18	CH	NU	S	5.1	3.2	MF	9.5	18.4	0.31	0.17
Flat Creek	44	580	6	CA	LG	S	4.6	8.9	MF	7.0	2.2	0.31	0.08
Ingle Creek	114	627	0	CA	HG	C15	4.0	3.3	MF	14.0	13.6	0.22	0.08
John Day River	38	1009	33	US	LG	G	29.1	1.0	LF	13.0	9.1	0.69	0.31
Rail Creek	13	1031	337	US	ST	M3	9.7	5.5	MF	4.0	5.1	0.35	0.16
Tinker Creek	5	566	69	US	HG	C3	2.0	2.5	MF	11.5	13.3	0.15	0.06
Vance Creek	15	504	0	CH	LT	S	2.4	2.2	MF	8.5	13.0	0.24	0.10

Table 22. Continued.

Stream	SiteID	Channel Length (m) Primary	Channel Length (m) Secondary	Channel Form	Dominant Land Use	Dominant Riparian Veg	Active Channel Width (m)	Gradient (%)	Stream Flow	Temp (C)	% of Site w/ Pools	Depth (m) Resid Pool	Depth (m) Riffle
NFJDR													
Bear Wallow Creek	48	594	73	US	ST	G	2.6	1.7	LF	6.5	31.5	0.20	0.09
Camas Creek	4	1003	136	CH	FF	S	28.7	0.5	LF	13.0	39.3	0.82	0.23
Clear Creek	16	1024	428	CL	MI	G	19.1	1.1	LF	14.0	36.0	0.57	0.16
Crawfish Creek	41	1009	36	CH	ST	S	7.4	8.4	MF	5.0	6.5	0.43	0.15
Deer Creek	102	895	101	CA	LG	G	5.0	3.4	MF	15.0	12.8	0.23	0.11
Deerlick Creek	46	1070	502	US	LT	G	7.9	2.4	DR		0.0		
Gilmore Creek	7	1031	6	CA	HG	S	2.4	2.4	LF	19.5	27.7	0.29	0.04
Granite Creek	490	1011	271	CH	WA	S	16.3	2.0	MF	12.0	10.9	0.47	0.27
Hidaway Creek	115	982	194	CH	FF	C1	9.5	3.1	LF	4.0	15.2	0.32	0.12
North Fork John Day River	526	976	489	CH	PT	C15	60.9	0.5	LF	22.0	39.6	0.45	0.43
Pine Creek	520	1019	755	UA	LG	G	8.7	0.3	MF	21.0	43.2	0.44	0.15
Pine Creek	511	991	1397	UA	HG	G	13.7	0.5	LF	17.5	39.2	0.58	0.12
Swale Creek	47	989	28	CH	LG	S	6.1	4.3	LF	9.0	8.7	0.38	0.10
Trout Creek	103	1001	130	CH	WA	S	9.1	7.1	LF	8.5	10.1	0.55	
MFJDR													
Beaver Creek	522	560	133	US	LG	S	3.0	2.6	MF	14.0	19.9	0.21	0.10
Big Creek	517	502	26	CA	FF	G	4.5	2.1	MF	9.0	45.3	0.34	0.10
Caribou Creek	34	598	6	US	LT	G	2.5	2.6	MF	13.0	7.5	0.19	0.27
Granite Boulder Creek	108	1062	379	CA	ST	S	7.2	5.8	MF	8.5	6.3	0.37	0.24
Indian Creek	516	513	150	CH	BK	C15	4.4	5.1	LF	9.5	21.2	0.27	0.04
Mosquito Creek	513	675	36	US	LT	C3	1.4	6.5	LF	10.5	21.1	0.19	0.03
Myrtle Creek	107	659	4	CH	FF	G	3.7	7.8	MF	17.0	11.9	0.19	
Vincent Creek	2	974	139	CT	LT	C3	4.0	2.1	PD	13.0	10.1	0.29	0.06
West Fork Lick Creek	17	1008	68	US	LG	S	3.7	2.5	MF	12.0	20.2	0.26	0.08
Whisky Creek	10	1008	138	CH	HG	G	3.3	6.2	PD	17.0	7.4	0.27	0.04
SFJDR													
Deer Creek	524	572	20	US	LG	S	4.3	1.8	LF	7.0	47.5	0.39	0.09

Table 23. Stream, site ID, and reach information for substrate, shading, bank stability, large woody debris, and riparian trees collected at habitat sites in the John Day River basin from 15 June to 6 October, 2005.

			Substrate											
			Total		Riffles					Large Woody Debris			Riparian Trees	
Stream	**SiteID**	**# Large Bldrs**	**Fines %**	**Gravel %**	**Fines %**	**Gravel %**	**Open Sky % of 180**	**Bank Erosion %**	**Undercut %**	**# Pieces**	**# Key Pieces**	**Volume /100 m**	**Deciduous #/1000 ft**	**Coniferous #/1000 ft**
LMJDR														
Bear Creek	36	471	23.5	30.8	21.8	36.0	52.2	5.1	4.6	5	0	0.1	467	81
Big Pine Hollow	514	561	3.3	34.6	3.0	35.1	35.0	11.8	1.8	1	0	0.1	0	41
Camp Creek	510	24	78.4	13.1	80.2	18.4	53.7	2.4	13.5	7	0	0.4	894	345
Cougar Creek	112	24	38.5	24.7			72.1	9.8	8.4	98	5	19.8	20	1666
Lone Rock Creek	45	1151	2.3	29.0	2.1	38.3	45.8	2.5	1.8	20	0	0.2	0	122
Milk Creek	497	0	52.6	44.4	50.0	49.4	70.0	34.9	8.7	128	7	35.9	0	1626
Parrish Creek	525	55	22.5	29.9	11.6	39.7	25.5	23.4	0.0	11	0	0.2	0	102
Rock Creek	6	329	5.7	42.2	5.1	38.6	27.0	25.0	0.6	14	0	0.4	0	0
Rock Creek	42	490	8.8	38.5	4.9	40.6	38.7	1.9	1.0	15	0	0.1	2174	41
Rock Creek	9	419	11.2	30.4	8.4	35.6	28.8	34.9	2.2	1	0	0.0	0	0
Service Creek	11	72	33.6	33.1	12.5	45.5	33.7	13.5	3.1	12	0	0.1	0	102
Steers Canyon	521	37	45.4	27.6	65.0	25.0	73.6	14.0	0.2	11	0	0.2	264	467
West Fork Butte Creek	104	183	20.1	25.9	21.4	24.3	47.9	8.4	0.8	35	2	4.2	508	61
UMJDR														
Bear Creek	519	159	26.8	27.5	18.2	32.8	42.8	1.4	0.3	13	1	1.5	203	81
Bear Creek	106	70	29.5	27.3	23.0	30.7	54.3	8.9	3.0	5	0	0.1	975	244
Beech Creek	518	901	3.8	13.8	3.5	14.2	60.4	1.1	1.3	20	0	0.7	386	183
Beech Creek	99	481	13.3	27.2	6.7	30.9	36.3	4.4	0.0	13	0	0.3	386	81
Canyon Creek	109	714	2.6	23.3	1.3	25.0	51.7	10.7	1.5	38	0	1.8	305	61
East Fork Beech Creek	111	391	18.3	26.5	15.4	25.5	46.5	9.9	7.6	27	3	3.1	1341	224
Fields Creek	493	757	5.9	18.0	6.8	24.6	62.6	2.2	0.4	46	1	2.9	447	183
Flat Creek	44	584	21.4	24.3	15.0	70.0	58.7	25.0	0.5	11	0	0.9	183	284
Ingle Creek	114	100	25.5	30.2	23.8	32.2	43.6	51.6	2.9	45	0	1.7	102	467
John Day River	38	56	2.1	43.7	0.2	43.6	14.1	5.6	15.8	21	0	1.0	20	0
Rail Creek	13	82	18.5	37.8	13.9	68.1	71.7	0.0	20.7	230	10	15.9	305	1808
Tinker Creek	5	116	18.8	40.3	15.6	39.7	59.4	1.1	1.0	73	3	13.9	0	610
Vance Creek	15	13	50.6	49.2	51.3	48.8	67.0	17.0	8.9	31	2	7.1	650	488
NFJDR														
Bear Wallow Creek	48	30	16.2	40.1	20.6	36.8	52.8	12.9	19.5	91	0	6.2	61	1280

Table 23. Continued.

Stream	SiteID	# Large Bldrs	Substrate Total Fines %	Substrate Total Gravel %	Substrate Riffles Fines %	Substrate Riffles Gravel %	Open Sky % of 180	Bank Erosion %	Undercut %	Large Woody Debris # Pieces	Large Woody Debris # Key Pieces	Large Woody Debris Volume /100 m	Riparian Trees Deciduous #/1000 ft	Riparian Trees Coniferous #/1000 ft
NFJDR														
Camas Creek	4	1833	9.5	28.2	9.5	23.6	57.1	0.0	0.0	40	2	4.4	102	81
Clear Creek	16	328	9.6	32.4	2.7	35.9	26.6	10.0	0.7	66	0	2.8	0	224
Crawfish Creek	41	1692	15.5	5.9	29.7	9.9	71.5	3.6	4.0	420	5	22.3	0	1199
Deer Creek	102	632	7.2	15.4	7.8	19.5	65.2	8.0	0.0	43	0	1.9	163	447
Deerlick Creek	46	746	0.1	45.3			67.0	0.0	0.0	55	0	1.7	0	264
Gilmore Creek	7	70	24.1	61.5	17.0	73.6	35.5	21.8	2.7	69	8	7.6	224	81
Granite Creek	490	2449	1.5	11.3	0.2	8.9	59.3	0.0	0.2	193	0	8.7	0	732
Hidaway Creek	115	389	11.8	44.3	11.4	52.5	45.2	0.7	6.8	598	8	34.5	0	2032
North Fork John Day River	526	1803	8.9	29.8	5.3	31.4	35.6	0.0	0.3	26	4	3.9	0	264
Pine Creek	520	7	11.4	44.5	2.2	48.9	18.8	0.0	15.9	6	0	0.3	0	61
Pine Creek	511	0	32.6	43.9	26.2	46.5	5.2	22.6	16.7	1	0	0.0	0	0
Swale Creek	47	800	7.8	16.7	10.0	10.0	79.1	1.9	0.1	158	8	16.5	122	406
Trout Creek	103	2994	4.6	9.3			68.1	0.0	0.0	252	3	17.9	102	284
MFJDR														
Beaver Creek	522	71	26.5	52.6	20.5	64.5	72.6	11.8	8.8	17	0	1.0	589	427
Big Creek	517	464	45.7	32.7	46.3	49.1	52.9	4.5	10.9	271	0	40.7	0	61
Caribou Creek	34	73	19.5	40.8	18.0	47.0	60.3	1.8	5.9	22	0	1.9	0	345
Granite Boulder Creek	108	2078	14.9	21.0	16.8	41.2	78.5	4.6	6.4	353	15	22.9	528	752
Indian Creek	516	293	13.3	41.1	8.7	59.9	72.4	1.2	5.8	271	5	33.7	0	874
Mosquito Creek	513	16	33.5	53.2	22.7	72.4	79.8	0.0	0.0	58	0	7.2	650	1097
Myrtle Creek	107	127	9.3	41.1			30.9	2.2	3.8	202	1	13.7	41	61
Vincent Creek	2	185	20.9	33.3	32.2	20.1	47.4	2.8	0.2	38	0	1.8	0	752
West Fork Lick Creek	17	290	12.4	37.5	7.7	37.4	65.2	1.5	7.4	108	4	10.0	102	2113
Whisky Creek	10	414	14.8	22.2	10.0	25.0	72.0	9.8	2.5	62	4	6.7	61	467
SFJDR														
Deer Creek	524	165	17.2	34.2	12.4	34.5	52.6	5.4	6.6	34	1	3.6	427	305

Table 24. Average, minimum, and maximum values of habitat parameters estimated or quantified at habitat sites conducted in the John Day River basin from 15 June to 6 October, 2005.

Subbasin	Total Length Surveyed (km)	ACW (m)	Gradient %	Temp (C)	% of Site w/ Pools	Large Bldrs /100 m	Substrate Fines %	Substrate Gravel %	Shade % of 180	Bank Erosion %	Bank Undercut %	Large Woody Debris # /100 m	Large Woody Debris # Key /100 m	Large Woody Debris Volume /100 m	Riparian Trees Conifers /1000 ft	Riparian Trees Deciduous /1000 ft
LMJDR	12.1															
Average		5.8	3.0	15.2	23.9	0.6	26.6	31.1	46.5	14.4	3.6	4.7	0.2	4.7	358	333
Min		1.7	0.7	3.5	4.8	0.0	2.3	13.1	25.5	1.9	0.0	0.1	0.0	0.0	0	0
Max		12.2	10.1	22.0	62.9	1.8	78.4	44.4	73.6	34.9	13.5	24.1	1.3	35.9	1666	2174
% of Total	23%															
UMJDR	12.9															
Average		7.3	2.7	11.5	19.5	0.6	18.2	29.9	51.5	10.7	4.9	4.6	0.2	3.9	363	408
Min		2.0	0.6	4.0	2.2	0.1	2.1	13.8	14.1	0.0	0.0	0.4	0.0	0.1	0	0
Max		29.1	8.9	17.5	62.6	2.7	50.6	49.2	71.7	51.6	20.7	16.8	0.7	15.9	1808	1341
% of Total	25%															
NFJDR	18.1															
Average		14.1	2.7	12.8	22.9	2.0	11.5	30.6	49.1	5.8	4.8	13.0	0.2	9.2	525	55
Min		2.4	0.3	4.0	0.0	0.0	0.1	5.9	5.2	0.0	0.0	0.0	0.0	0.0	0	0
Max		60.9	8.4	22.0	43.2	6.0	32.6	61.5	79.1	22.6	19.5	50.8	0.8	34.5	2032	224
% of Total	35%															
MFJDR	8.6															
Average		3.8	4.3	12.4	17.1	0.6	21.1	37.5	63.2	4.0	5.2	18.0	0.3	14.0	695	197
Min		1.4	2.1	8.5	6.3	0.0	9.3	21.0	30.9	0.0	0.0	2.5	0.0	1.0	61	0
Max		7.2	7.8	17.0	45.3	1.9	45.7	53.2	79.8	11.8	10.9	51.3	1.0	40.7	2113	650
% of Total	17%															
SFJDR	0.6															
Average		4.3	1.8	7.0	47.5	0.4	17.2	34.2	52.6	5.4	6.6	5.7	0.2	3.6	305	427
Min		4.3	1.8	7.0	47.5	0.4	17.2	34.2	52.6	5.4	6.6	5.7	0.2	3.6	305	427
Max		4.3	1.8	7.0	47.5	0.4	17.2	34.2	52.6	5.4	6.6	5.7	0.2	3.6	305	427
% of Total	1%															
Basin Total	52.3															

DISCUSSION

We accomplished our goal of surveying 50 EMAP sites for steelhead spawning, juvenile salmonid distribution, and habitat and riparian conditions during the second year of our project, in 2005. Although we surveyed only a small percentage of the total sampling universe, the random site selection process allowed us to produce a much needed estimate of steelhead escapement to the John Day River basin, and provide baseline data for juvenile salmonids and habitat conditions throughout the basin. In addition, we evaluated trends in abundance and distribution of steelhead redds, juvenile salmonids, and habitat conditions within the basin by comparing our results from 2004 to 2005.

Steelhead Escapement

Our escapement estimate for 2005 (3,291 spawners) was much lower than our estimate for 2004 (6,011 spawners), because significantly fewer redds were observed in 2005 (39 redds; 0.62 redds/mile) than in 2004 (66 redds; 1.12 redds/mile). The decrease in the number of redds observed may partially be explained by a decrease in the number of steelhead that returned to the basin to spawn. Data from adult fish ladders on the John Day Dam suggest approximately 20% fewer steelhead (hatchery and wild) were passed over the dam in 2004 compared to 2003 (FPC 2006). Index survey redd counts show a fairly strong relationship between redd abundance in the John Day River basin and passage of adult steelhead (hatchery and wild) over John Day Dam since 1996 (Figure 17).

Within the basin, the decline in the number of redds was most evident at three annual sites in the Lower Mainstem, two on Rock Creek and one on Service Creek. In 2004, 28 redds and 33 steelhead were observed at these three sites, compared to 3 redds and no steelhead observed in 2005. One plausible reason for the decline in redds and steelhead observed in the Lower Mainstem in 2005, other than less spawners returning to the basin, is low water flows that occurred in early spring. Because steelhead tend to spawn earlier in Lower Mainstem tributaries (Tim Unterwegner, personal communication) than in other areas of the basin due to lower elevations and quickly warming water temperatures in the spring, low water flows likely restricted access to potential spawning sites. For example, Service Creek is a small tributary with numerous beaver dams that steelhead must negotiate to reach suitable spawning habitat. In 2004, steelhead were able to negotiate these beaver dams due to sufficient water flows but, in 2005 the lack of flows until late in the spawning season probably resulted in physical migration barriers. Steelhead that possibly would have spawned in Service Creek and other Lower Mainstem tributaries may have spawned in areas with more optimal water conditions. This may help to explain the shift in redd distribution observed at EMAP sites throughout the basin. For example, from 2004 to 2005, the percentage of redds observed in the Lower Mainstem decreased 37%, while the percentage of redds in the Upper Mainstem increased 49%. This shift might be attributed to low spring flows in 2005, which may have caused steelhead to pass Lower Mainstem tributaries and spawn higher in the basin. Larger streams, such as the John Day River (Site ID 38) in the Upper Mainstem, were likely more significant for steelhead spawning in 2005 because of less than optimal water conditions in smaller tributaries. Low flows also may have been a factor in the lack of redd observations in the Middle Fork and South Fork in 2005. Because 72% of sites surveyed in 2005 were new and may have differed in spawning habitat quality compared to sites surveyed in 2004, the shift observed in redd distribution in the basin may partially be attributed to new survey sites.

We observed significantly fewer redds per mile during our EMAP surveys in 2005 (0.62 redds/mile) than the mean number of redds per mile found at index sites surveyed by ODFW biologists from 1959 to 2005 (5.8 redds/mile) and the number observed at index sites during 2005 (1.8 redds/mile; Figure 17). In fact, the number of redds per mile we observed in 2005 was lower than in any one year of index surveys (Figure 17). Overall, our EMAP redds per mile estimate in 2004 and 2005 was 36% and 34% of the estimate calculated from index surveys conducted in each respective year.

Several factors in the implementation of the EMAP sampling design potentially created bias that likely contributed to the difference in redd density observed between EMAP and index surveys in 2004 and 2005. First, our sampling universe is based upon the approximate distribution of steelhead spawning and rearing habitat in the John Day River basin. Although, this distribution is based on the knowledge of District Biologists and other professionals and was acquired over a number of years, the large size of the basin has precluded complete verification of steelhead life history use. We encountered this problem during our spawning surveys when we visited sites that were located upstream of passage barriers, or were dry in the spring. Although these sites are not accessible to steelhead for spawning or rearing they were still listed within our sampling universe. After each survey year, we now refine the EMAP sampling universe based on field observations of previously unknown barriers, the removal of barriers (e.g. road culverts), and other restrictions (e.g. dry streams) that limit fish migration. Second, our estimate of spawning density in 2004 and 2005 may be low because a large number of our random EMAP sites in both years were located on small, headwater streams in the upper distribution of what is considered steelhead spawning habitat. The bias of our sites towards headwater streams occurs when permission is denied by private landowners and replacement sites are located on public land, which tends to be at the upper distribution of our sampling universe. In 2005, 48% of EMAP sites were private and 52% were public, despite the fact that the John Day basin is approximately 59% private land (OGDC, 2004). Overall, we were denied permission to 32% of privately owned sites in 2005. Third, it is possible that our surveys may not have encompassed the full duration of steelhead spawning activity. We attempted to address this problem in 2005 by initiating surveys early in the spawning season and conducting as many site visits as logistically possible until all spawning activity ceased. We believe this increased effort is important because of the inherent difficulty in accurately timing steelhead spawning surveys to encompass the full duration of spawning due to annual differences in weather and precipitation events. Fourth, some of our surveys were affected by high water events that likely impaired our ability to see and detect redds. For instance, in Rock Creek (Site ID 42; Figure 3) we observed a pair of steelhead spawning on our first site visit but were unable to survey this site again for one month due to heavy precipitation that made access difficult and water too murky to conduct a second survey within two weeks. Similarly, in the John Day River (Site ID 38; Figure 4) we observed seven steelhead redds on our first site visit under ideal water conditions, but after high, murky water for the next month, none of these previously observed redds could be detected. It is difficult to estimate if, or how many, redds were missed or undetected at these two sites (or other sites) due to high water events late in the spring. Finally, despite reaching our goal of 50 sites surveyed annually, we only surveyed a very small percentage (2%) of what is considered to be steelhead habitat in the basin. Future years of sampling using the EMAP protocol will give us better coverage and a much more accurate assessment of the status and distribution of steelhead spawning within the basin.

Although index surveys have been a good indicator of the trend in steelhead abundance since 1959, these surveys have their own biases. Index sites are not randomly selected, have generally been selected based on personnel time and ease of access, and were surveyed because of the presence of spawning steelhead (Wilson et al. 2004). Additionally, until 1993, the number and distance of streams surveyed was also inconsistent between years and subbasins (Wilson et al. 2004). Further, index sites are surveyed only once during each season. Single visits may bias index redd counts when flow conditions obscure redds by sedimentation, scour, and poor water clarity. Because index surveys are likely biased to streams frequently used by steelhead for spawning, it is probable that using these surveys will overestimate redd densities and spawner escapement within the basin. We believe our EMAP spawning escapement estimate is more accurate for status than index counts, but index surveys provide supplementary trend information. Despite the differences between EMAP and Index surveys they both show a similar decline in redd densities over the last two years (45% & 42%, respectively).

Hatchery:Wild Ratios

Historically, the John Day River basin has been managed exclusively for wild steelhead and low hatchery stray rates have been reported (4% - 8%; ODFW 1990). In recent years, however, with the addition of the John Day Basin Spring Chinook Salmon Escapement and Productivity Monitoring project in 1999 and this project, data indicates that there may be a stronger hatchery influence in the basin than once reported. During spawning surveys at one EMAP site in 2004 (Service Creek, rkm 245), we observed 15 hatchery steelhead of 26 steelhead adults (live and carcasses) that we could identify for origin. In 2005, despite observing significantly fewer live steelhead, our hatchery stray rate (29%) was very similar to 2004 (38%). This includes observations of hatchery steelhead further upstream in the basin (Rock Creek; rkm 320) than 2004. Over the duration of our project our hatchery stray rate is 37% basinwide, leading us to believe hatchery steelhead have a much greater influence in the basin than previously assumed. Additionally, the high percentage of hatchery steelhead near redds and, several observations of hatchery fish spawning with wild fish, suggests hatchery fish are actively spawning with wild steelhead in the John Day River basin. We do not know if they are contributing to natural production or possibly disrupting natural productivity of the wild fish populations.

Data from the Chinook salmon monitoring project also shows a high prevalence of hatchery steelhead strays in the basin (Appendix Table A-1). For example, Wilson et al. (2002) observed 10 hatchery steelhead of 28 steelhead adults captured while seining for smolts in the mainstem John Day River between Kimberly (rkm 298) and Spray (rkm 274). Claire and Gray (1992) also found a high number of hatchery steelhead in the 1992 steelhead fishery upstream of Kimberly, where a 29% hatchery stray rate was reported from fisherman in the lower North Fork. Index surveys conducted by ODFW biologists since 2000 have increasingly focused on identifying the origin of spawning steelhead and results indicate a significantly lower hatchery steelhead stray rate than reported for the surveys above (Appendix Table A-1). However, index surveys are designed to be conducted once after all steelhead spawning is completed, which could potentially bias observations towards wild steelhead because hatchery steelhead tend to arrive on and leave spawning grounds earlier in the spawning season (Mackey et al. 2001).

Hatchery steelhead coded wire tag (CWT) recoveries in the basin from 1986 to 2003 (394 recoveries; Wilson et al. 2004; PSMFC 2006; John Day Field Office archives) identify 17 separate hatcheries as the source of these strays. The majority of CWT recoveries were located downstream of Tumwater Falls (Figure 8) in the John Day Arm (rkm 16; 323 recoveries; Appendix Table A-2) and may not represent fish that strayed and spawned within the John Day River basin. Data indicates Dworshak National Hatchery as the predominate source of hatchery steelhead strays in this portion of the basin (98 CWT recoveries; 30%). Between Tumwater Falls and Cottonwood Bridge (rkm 64; Figure 8) 62 hatchery CWT recoveries have been reported with many recoveries (30 CWT recoveries; 48%) in this area identifying Irrigon Hatchery (fish released in the Grande Ronde or Imnaha River basins) as the source of hatchery steelhead strays (Appendix Table A-3). Limited information is available upstream of Cottonwood Bridge with only 9 hatchery CWT recoveries reported (Appendix Table A-4). Irrigon hatchery was the source of three hatchery steelhead strays in this area (33%). We did not recover any coded wire tags from hatchery steelhead in our sampling in 2005. However, we believe it is likely that future surveys will result in more hatchery steelhead CWT recoveries and, consequently, more information to the source of hatchery strays in the John Day River basin.

Juvenile Salmonid Surveys

O. mykiss were the most abundant salmonid found during juvenile surveys in 2005, occurring at the majority of sites (44 sites; 88%). Although *O. mykiss* were absent at two sites (Rock Creeks; Site ID 6 & 9; Figure 9) in the Lower Mainstem where they were abundant in 2004, these absences were consistent with a significant decrease in redds observed at these two sites during spawning surveys in 2005. In addition, *O. mykiss* were absent from four other sites in the basin. Two of these absences were at sites on small, headwater streams that had no fish species present (Cougar Creek; Site ID 112 & Steers Canyon; Site ID 521; Figure 9). The other absences were in the Upper Mainstem at Rail Creek (Site ID 13; Figure 13) which was dominated by westslope cutthroat trout and bull trout and in the North Fork John Day River (Site ID 526; Figure 12) where high temperatures were likely a limiting factor during our survey. Spring Chinook were the next most abundant salmonid, but occurred infrequently during sampling (7 sites; 14%). Occurrences of spring Chinook were generally at larger EMAP sites (e.g. John Day River, Granite Creek) that were within or close to known Chinook spawning areas. These waters are generally uncharacteristic of most EMAP sites. Westslope cutthroat trout, bull trout, and brook trout were observed at a small number of sites and their distributions were generally restricted and localized.

O. mykiss were present at most EMAP sites in the basin, however, the species was absent in approximately 25% of pools surveyed at sites where the species was present. Four possible reasons exist for these absences. First, some pool absences of *O. mykiss* are likely the result of natural occurrences, such as, high water temperatures, low water flow, and low pool complexity. For example, salmonids were observed in 42.9% of pools in Caribou Creek (Site ID 34; Figure 12) in the Middle Fork. The predominance of shallow pools with little cover and water temperatures that exceeded 18˚C (75˚F) in the afternoon, likely contributed to many pool absences of *O. mykiss* at this site. Second, some pool absences of *O. mykiss* may be attributed to gear limitations or surveyor error. This includes the use of one electrofisher to sample pools that could not be completely covered or were difficult to shock (e.g. deep pools, complex habitat) or difficulty detecting species during snorkel surveys where a species was rare. Third, some pool absences are most likely the result of anthropogenic effects. For example, *O. mykiss* were only present in 50% of pools surveyed in Ingle Creek (Site ID 114; Figure 13) in the Upper Mainstem. This site has excessive siltation and limited riparian production from heavy cattle grazing. Similarly, *O. mykiss* were absent in nearly 35% of pools surveyed at Bear Wallow Creek (Site ID

48; Figure 12) in the North Fork. The upper part of this site is heavily grazed which has resulted in siltation, unstable banks, and limited riparian cover. And fourth, introduction of non-native salmonids into the John Day River basin may also be affecting *O. mykiss* distribution and abundance. We observed brook trout in nearly every pool (91%) at Crawfish Creek (Site ID 41; Figure 12) in the North Fork, but only observed two large adult *O. mykiss* in one pool (9%) at this site. The occurrence of brook trout in Crawfish Creek is likely a result of stocking the species upstream in Crawfish Lake. Despite the absence of *O. mykiss* in pools at a number of sites because of anthropogenic impacts, *O. mykiss* appear to be able to persist at many sites despite severe human impacts. For instance, in Parrish Creek (Site ID 525; Figure 9) we observed *O. mykiss* in nearly every pool (89%) despite extremely high water temperatures (24° C) during our habitat survey and obvious impacts from cattle grazing and other land use activities.

Spring Chinook were found in all pools surveyed at sites where they were expected to be abundant. However, Chinook were only present in 54% of the pools at sites where they were observed. This is a result of only a few Chinook occurrences in pools at Rock Creek (Site ID 42; Figure 9) in the Lower Mainstem, Pine Creek (Site ID 520; Figure 12) in the North Fork, and Canyon Creek (Site ID 109; Figure 13) in the Upper Mainstem. Other than Canyon Creek, where juvenile Chinook have been found in previous surveys (Jeff Neal, personal communication), there is no previous information to compare to our finding of Chinook at Rock and Pine Creeks. Juvenile Chinook distribution is expected to encompass most mainstem rivers and tributaries within or near Chinook spawning areas that contain suitable rearing habitat (Jeff Neal, personal communication). This description is charateristic of both Rock and Pine Creeks. EMAP surveys suggest westslope cutthroat trout, bull trout, and brook trout have restricted and localized distributions in the basin. Westslope cutthroat trout and bull trout were difficult to electrofish and capture in Rail Creek in the Upper Mainstem and are likely more abundant in pools at this site than data suggest. However, other than the presence of westslope cutthroat trout in all pools surveyed in Vance Creek (Site ID 15; Figure 13), neither species was abundant in pools at any site where the respective species was encountered. Disturbingly, brook trout were more abundant in pools in the basin in 2005 than bull trout. Hybridization between the two species is known to occur in the basin (Tim Unterwegner, personal communication) although no hybrids were identified during EMAP surveys.

O. mykiss densities at three sites in the Lower Mainstem declined significantly from 2004 to 2005. Two of these sites, both on Rock Creek (Site IDs 6 & 9; Figure 9), had no *O. mykiss* present in 2005. The other site, located on Service Creek (Site ID 11; Figure 9), contained *O. mykiss* but exhibited a substantial decline over the two years and had significantly fewer *O. mykiss* fry. The decline in steelhead redd abundance at these sites from 2004 to 2005 spawning surveys is a plausible reason for the significant reduction in *O. mykiss* densities observed during juvenile salmonid surveys over the two years. One site in the Middle Fork (West Fork Lick Creek; Site ID 17; Figure 12) also had a significant decline in *O. mykiss* density that could partly be attributable to a decline in redd abundance observed at this site over the two years. However, despite declines at these four sites, the majority of sites exhibited an increase in *O. mykiss* densities from 2004 to 2005. Spring Chinook densities remained relatively consistent at the three annual sites where this species was encountered.

With only two years of EMAP status and trend data currently available in the basin, it is difficult to evaluate current *O. mykiss* and other salmonid distribution and abundance. In addition, minimal historical data exists to compare with EMAP results. Future years of EMAP surveys will allow for a more comprehensive evaluation to be made regarding the status and trend in *O. mykiss* and other salmonid distribution and abundance over a variety of habitat and biological conditions throughout the basin. Future analysis of habitat data will also allow for a quantitative assessment to be made regarding the factors that influence salmonid distribution and abundance.

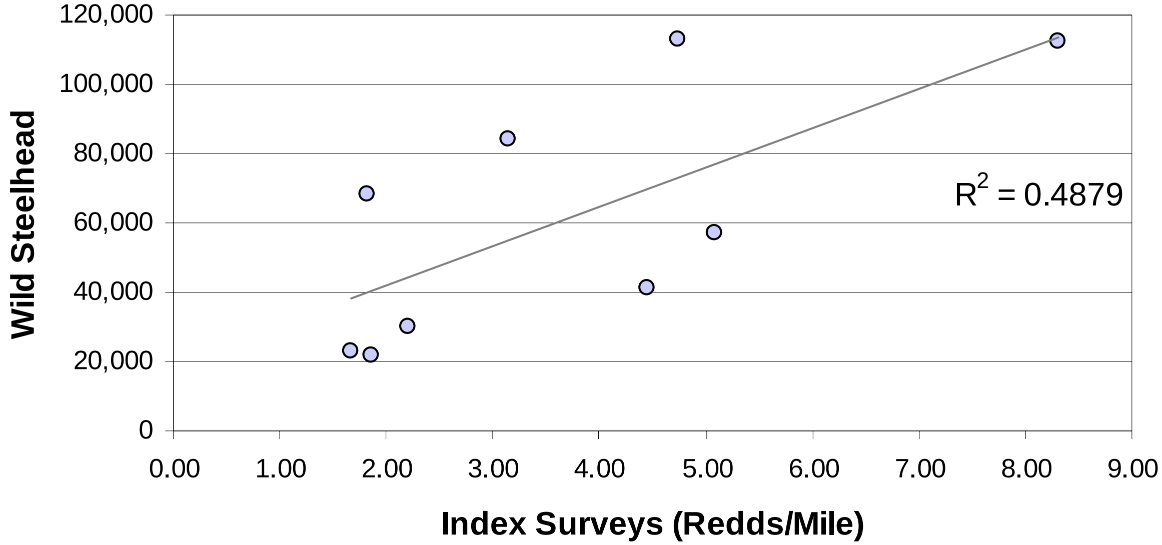
Habitat and Riparian Surveys

Several important observations were made from habitat and riparian surveys in 2004 and 2005. First, a large percentage of EMAP sites in both years had grazing as a dominant land use. Future analysis of habitat data should allow for a more comprehensive evaluation to be made regarding the impact of grazing on habitat and salmonids throughout the basin. The majority of sites in both years had channels that were constrained by terraces, hillslopes, and land use. Constrained channels have a lower connectivity between the terrestrial and aquatic environment than unconstrained channels which permit water to interact with the riparian zone. Constrained channels can result in increased bank erosion, increased water flow in the stream channel during high water events, and reduced exchange of nutrients and organic matter between the riparian zone and stream channel. Some of our small, headwater sites were naturally constrained by hillslopes. However, some of our other sites (e.g. Rock Creek; Site ID; Figure 9) had constrained channels that were likely due to anthropogenic activities resulting in downcutting of the stream channel and subsequent loss of connectivity with the floodplain.

Data analysis to test for statistical significance of various habitat parameters among John Day subbasins yielded few patterns. However, small sample sizes generally reduced the power of these tests and may have resulted in fewer detected differences among subbasin habitat than were present in the data. Only bank erosion (%) and residual pool depth (m) were different between subbasins in both years. The Lower Mainstem had significantly more bank erosion than the North Fork in both years and the North Fork had a significantly higher residual pool depth than the Upper Mainstem in 2004 and Middle Fork in 2005. Sites in the North Fork in both years were typically found at high elevations and located on National Forest land where fewer human impacts occur. Conversely, Lower Mainstem sites were generally found on or amongst private land at lower elevations where human impacts such as grazing and agriculture are predominant. This likely contributed to differences in the percentage of bank erosion observed at sites in the two subbasins. Similarly, in 2005, the number of wood pieces in the Lower Mainstem was significantly lower than in the Middle Fork and the volume of wood pieces in the Lower Mainstem was significantly lower than in the Middle Fork and North Fork. This is expected due to the predominance of National Forest sites in the Middle Fork and North Fork and high percentage of private land in the Lower Mainstem and elevational changes in riparian vegetation types.

In order to more comprehensively evaluate habitat conditions in the John Day River basin in the future, analysis of QAQC sites will allow for a determination to be made regarding the variance among surveyors in estimating and quantifying habitat at EMAP sites. This analysis will help determine true “signals” in the data compared to “noise” resulting from estimator error and inconsistencies. Also, future evaluation of habitat at annual sites with the same start and end point will be beneficial in determining the variability of habitat from year to year.

a.)



b.)

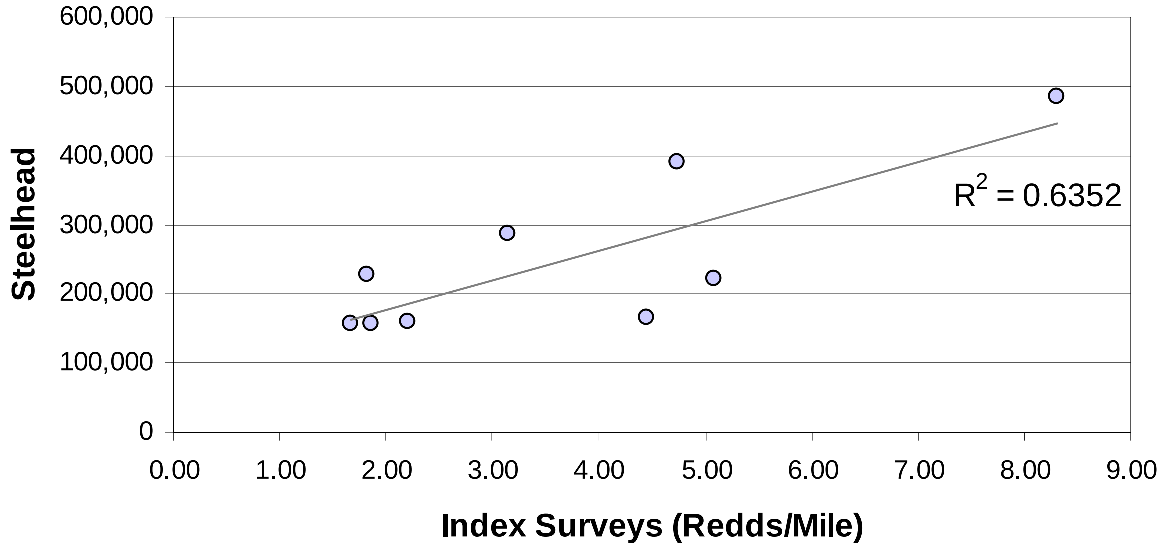


Figure 17. Relationship between passage of wild steelhead (a) and all steelhead (b) at John Day Dam and index steelhead redd counts conducted by ODFW personnel in the John Day River basin from 1996 to 2005.

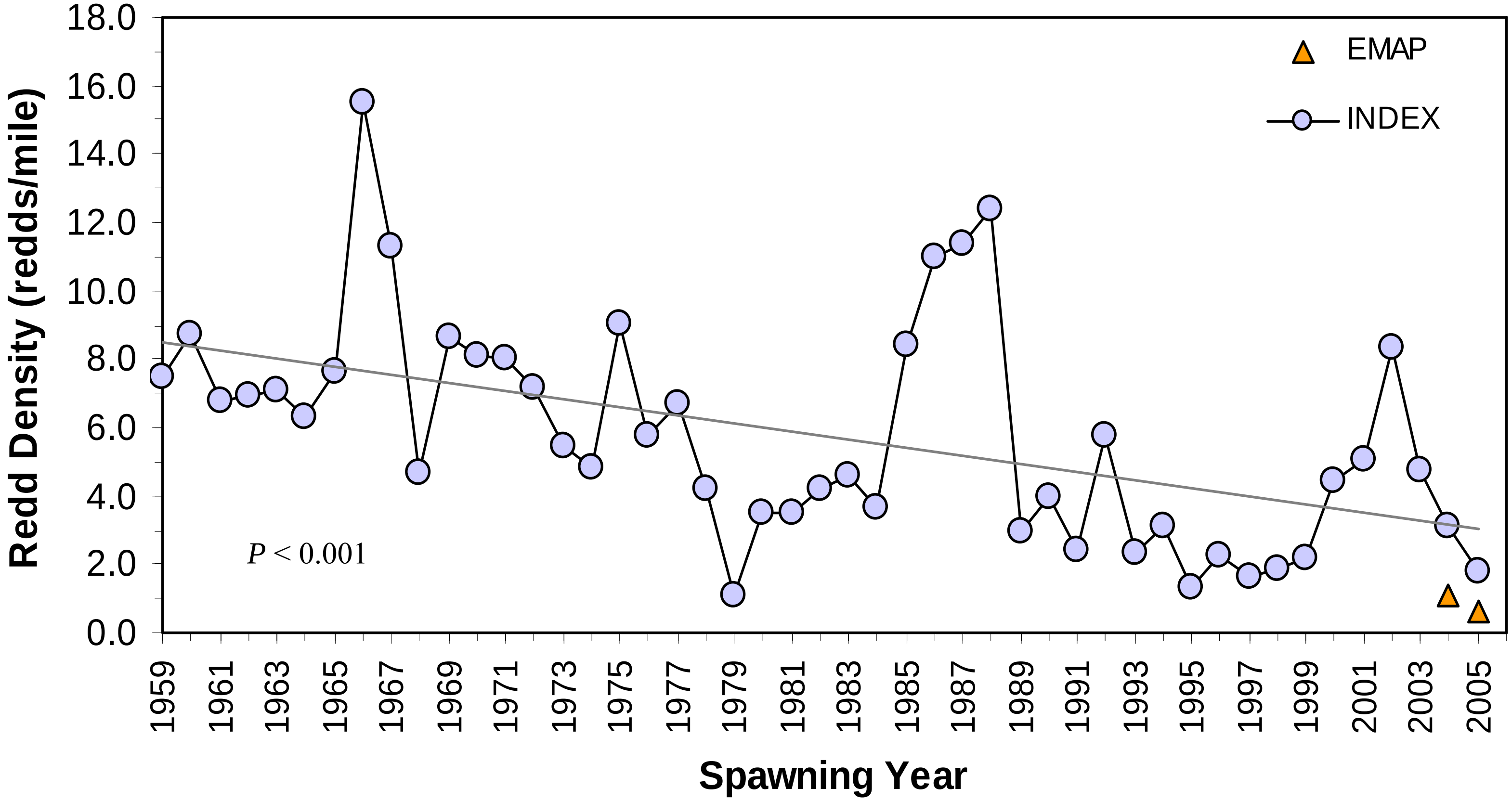


Figure 18. Decline ($P < 0.001$) in summer steelhead redd density (redds/mile) observed at index survey sites sampled by ODFW personnel in the John Day River basin from 1959 to 2005. Redd density observed at EMAP sites is shown for comparison.

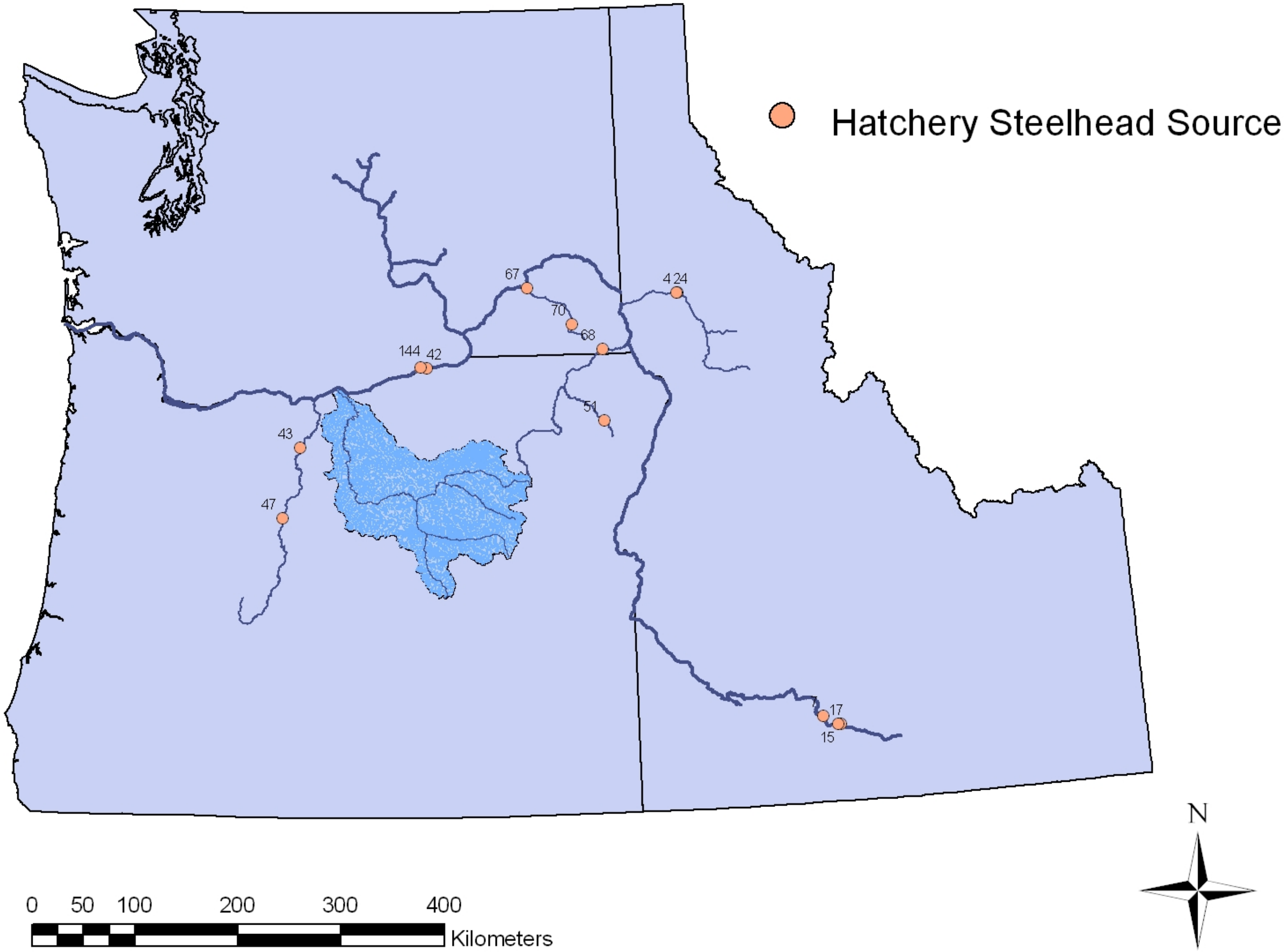


Figure 19. Location of hatcheries known to produce steelhead strays in the John Day River basin. Data were compiled from coded-wire tag recoveries from ODFW personnel and the Regional Mark Information System (PSMFC 2006). Numbers next to each hatchery are for reference to Appendix Tables 2, 3, and 4. Hatchery locations do not necessarily correspond to release locations.

CONCLUSION

Initiation of the Environmental Monitoring and Assessment Program (EMAP) protocol in the John Day River basin in 2004, and continuation of the project in 2005, has begun to provide much needed information for determining the status and trends in steelhead redd abundance and escapement, status and trends in juvenile salmonid abundance and distribution, and status and trends in stream habitat and riparian conditions. The first two years of the project have yielded a number of important findings and efforts. We observed a significantly lower number of steelhead redds at our random EMAP sites than those observed during index surveys conducted by ODFW biologists since 1959. This suggests that index surveys may be biased towards frequently used spawning habitats and are not likely to provide an accurate population estimate of steelhead returning to the basin because they do not incorporate random site selection. However, index surveys may provide better trend information for steelhead especially during low escapement years. Overall, the decline in redd abundance observed at EMAP surveys over the past two years is consistent with the decline observed at index surveys. We believe comparison of EMAP results with that of index surveys will yield a more complete picture of the status and trends in steelhead redd abundance and escapement within the basin. In addition, removing sites from our sampling universe that are inaccessible to steelhead will also allow us to develop a more accurate assessment of the status and distribution of steelhead spawning and rearing within the basin. We have observed a significant number of hatchery steelhead on the spawning surveys and made several observations of hatchery steelhead spawning with wild steelhead. Our findings are contrary to previous monitoring efforts and suggest a more significant hatchery steelhead influence in the basin. Finally, we have completed two years of baseline data collection on juvenile salmonids and habitat and riparian conditions. We are now beginning to have a better understanding of the distribution and abundance of native and non-native salmonids and condition of habitat in the basin.

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Appendix Table A-1. Recovery year, number of wild steelhead, number of hatchery steelhead, and % hatchery steelhead observed during index steelhead spawning surveys in the John Day River basin (Tim Unterwegner, personal communication), 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).

Recovery	Index			Spring Chinook Monitoring Project		
Year	# of Wild Steelhead	# of Hatchery Steelhead	% Hatchery Steelhead	# of Wild Steelhead	# of Hatchery Steelhead	% Hatchery Steelhead
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	77	0	0.0	8	2	20.0
2000	24	0	0.0	11	1	8.3
TOTAL	328	20	5.7	74	28	27.5

Appendix Table A-2. Hatchery source, hatchery identification number (ID), stock, number recovered, recovery period, and release agency for hatchery steelhead with coded wire tags in the John Day River Arm (mouth to Tumwater Falls) from 1992 - 2003. Data were compiled from the Pacific States Marine Fishery Commission Regional Mark Information System (PSMFC 2006).

Hatchery Source	ID	Stock	Number Recovered	Recovery Period	Release Agency
Dworshak National	4	Dworshak 'B' run	98	10/10 - 12/28	FWS
Irrigon	42	Wallowa R., Imnaha R. & Tributaries	52	10/03 - 12/31	ODFW
Magic Valley	15	Sawtooth Hatchery 'A' run, Pahsimeroi R. 'A' run, Dworshak 'B' run, Hells Canyon 'A' run, EF Salmon R. 'B' run	43	10/03 - 01/28	IDFG
Clearwater	24	Dworshak 'B' run	41	10/17 - 12/22	IDFG
Hagerman National	7	Sawtooth Hatchery 'A' run, Pahsimeroi R. 'A' run, Dworshak'B' run	26	10/13 - 12/20	FWS
Niagara Springs	17	Pahsimeroi R. 'A' run, Hells Canyon 'A' run	19	10/23 - 12/30	IDFG
Cottonwood Creek Pond	68	Wallowa R.	13	10/12 - 12/28	WDFW
Unknown		Snake River below rkm 97 at the Palouse R.	12	10/31 - 12/21	NMFS
Lyons Ferry	67	Lyons Ferry Hatchery, Snake R. between Lower Monumental Dam & Little Goose Dam	11	10/13 - 12/27	WDFW
Umatilla	144	Umatilla R.	4	11/05 - 12/13	ODFW
Curl Lake Imprint Pond	70	Lyons Ferry Hatchery, Snake R. between Lower Monumental Dam & Little Goose Dam	3	10/24 - 11/15	WDFW
Oak Springs	43	Umatilla R.	1	11/28	ODFW

Appendix Table A-3. Hatchery source, hatchery identification number (ID), stock, number recovered, recovery period, and release agency for hatchery steelhead with coded wire tags in the John Day River Above Arm (Tumwater Falls upstream to Cottonwood Bridge) from 1986 - 2003. Data were compiled from the Pacific States Marine Fishery Commission Regional Mark Information System (PSMFC 2006) and archives in the John Day Field Office.

Hatchery Source	ID	Stock	Number Recovered	Recovery Period	Release Agency
Irrigon	42	Wallowa R., Imnaha R. & Tributaries	30	10/10 - 05/07	ODFW
Cottonwood Creek Pond	68	Wallowa R.	10	10/11 - 05/23	WDFW
Magic Valley	15	Pahsimeroi R. 'A' run, Dworshak 'B' run, EF Salmon R. 'B' run	8	10/24 - 02/13	IDFG
Niagara Springs	17	Pahsimeroi R. 'A' run, Hells Canyon 'A' run	6	10/20 - 01/29	IDFG
Clearwater	24	Dworshak 'B' run	2	01/09 - 02/10	IDFG
Dworshak National	4	Dworshak 'B' run	2	10/17 - 02/09	FWS
Umatilla	144	Umatilla R.	2	10/09 - 11/11	ODFW
Round Butte	47	Unknown	1	Unknown	ODFW
Unknown Idaho Hatchery		Unknown	1	Unknown	IDFG

Appendix Table A-4. Hatchery source, hatchery identification number (ID), stock, number recovered, recovery period, and release agency for hatchery steelhead with coded wire tags in the John Day River upstream of Cottonwood Bridge (rkm 64) from 1988 - 2003. Data were compiled from archives in the John Day Field Office and Wilson et al. (2004).

Hatchery Source	ID	Stock	Number Recovered	Recovery Period	Release Agency
Irrigon	42	Wallowa R.	3	04/16 - 05/07	ODFW
Cottonwood Creek Pond	68	Wallowa R.	1	04/16	WDFW
Magic Valley	15	Pahsimeroi R. 'A' run	1	02/02	IDFG
Niagara Springs	17	Pahsimeroi R. 'A' run	1	02/09	IDFG
Unknown Washington Hatchery		Unknown	1	04/16	WDFW
Upper Columbia		Unknown	1	Unknown	Unknown
Wallowa	51	Unknown	1	Unknown	ODFW

Appendix A-5. 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 A-6. 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 A-7. 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 A-8. 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.