FISH POPULATION MONITORING IN THE MIDDLE FORK JOHN DAY RIVER INTENSIVELY MONITORED WATERSHED

ANNUAL TECHNICAL REPORT

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EXECUTIVE SUMMARY

Recovery efforts for listed mid-Columbia steelhead *Oncorhynchus mykiss* populations and spring Chinook salmon *O. tshawytscha* rely on habitat restoration efforts as a major approach to recovery. However, most effectiveness monitoring efforts accompanying restoration actions are not adequate to determine if the actions have benefited the target populations. Therefore, a series of Intensively Monitored Watersheds, including one in the Middle Fork John Day River, have been developed to understand the interaction of fish and their habitat as well as the impact restoration actions play in that interaction. We conducted summer steelhead and spring Chinook salmon monitoring within the Middle Fork John Day River Intensively Monitored Watershed. Here, we report on fish monitoring efforts funded through this IMW effort. Detailed information regarding spring Chinook salmon escapement and steelhead and Chinook smolt emigration from this watershed will be reported elsewhere. During steelhead spawning surveys, we observed 76 redds constructed at 15 of 29 survey sites. We estimate a redd density of 1.3 redds/km or 556 redds in the MFJDR_IMW constructed by an estimated 2,114 returning adult steelhead. Collectively, we also tagged 3,297 juvenile steelhead, Chinook, and Bull trout *Salvelinus confluentus* from July to October 2009. Abundance estimates varied among survey sites and between seasons. Surveys to determine summer rearing distribution of juvenile Chinook salmon indicated their presence in most Mainstem Middle Fork pools above Butte Creek, but limited to the lower 1–2 kilometers in tributary habitats. Three additional tributaries (Wray Creek, Lick Creek, and Little Boulder Creek) were identified to provide an additional 1.5 km of rearing habitat for juvenile Chinook salmon.

INTRODUCTION

The John Day River, located in northeastern Oregon, is unique in that it supports one of the last remaining wild populations of summer steelhead *Oncorhynchus mykiss* and spring Chinook salmon *O. tschawytsha* in the Columbia River basin with no intentional hatchery supplementation. However, these populations remain depressed relative to historic levels. In 1999, the National Marine Fisheries Service (NMFS) listed the Middle Columbia River summer steelhead distinct population segment (DPS), which includes John Day River summer steelhead, as threatened under the Endangered Species Act (ESA). Both the 2000 and 2004 Biological Opinions that outline the recovery strategy for steelhead and salmon within the Columbia Basin rely on stream restoration as a major approach to recovery. However, past restoration efforts have rarely included effectiveness monitoring programs to determine if projects have provided a benefit to the target population (Roni et al. 2002; Roni et al. 2005), including restoration efforts within the John Day River basin intended to improve steelhead and other salmonid freshwater production and survival (James et al. 2007). As a result, watershed scale coordinated restoration efforts, with the associated effectiveness monitoring programs, have been initiated in the Pacific Northwest, including the Middle Fork John Day River, to evaluate population level responses to restoration actions. These programs are programmatically referred to as Intensively Monitored Watershed (IMW) studies (PNAMP 2005). The goal of the IMW is to improve our understanding of the relationships between fish and their habitat (PNAMP 2005).

Within the Middle Fork John Day River IMW (MFJDR_IMW), several habitat factors have been identified as limiting for the recovery of summer steelhead. Degraded floodplain and channel structure, altered sediment routing, altered hydrology, and water quality (temperature) are cited as limiting factors in the Draft Mid-Columbia Steelhead Recovery Plan (Carmichael 2008). Current and proposed restoration efforts for the MFJDR_IMW are anticipated to address these key limiting factors. In order to assess restoration effectiveness on focal fish species, monitoring and analyses must emphasize population level spatial scales. Fish population monitoring for the MFDJR_IMW includes evaluating summer steelhead and spring Chinook population productivity, survival, and abundance. While abundance is an important metric for population assessments, survival and production will be key indicators of population responses to planned restoration activities. Freshwater survival is assessed from the parr to smolt life stages (parr to smolt survival) and ocean or out-of-basin survival is estimated as a smolt to adult return ratio (SAR). Freshwater productivity is assessed as the number of smolts produced for each constructed redd (smolts/redd).

Project Objectives

1. Estimate spawner escapement of summer steelhead and spring Chinook to the MFJDR.
2. Estimate freshwater productivity (smolts/redd) of spring Chinook and summer steelhead.
3. Estimate parr-to-smolt survival for summer steelhead and spring Chinook.
4. Delineate seasonal parr rearing habitat.

METHODS

Study Area

The Middle Fork John Day River originates in the Blue Mountains of the Malheur National Forest, flows westerly for 75 miles, and merges with the North Fork John Day River about 18 miles above the town of Monument (Figure 1). The Middle Fork John Day is a fourth field watershed (USGS cataloging unit 17070203) that drains 806 mi^2 with a perimeter of 158 miles. Watershed elevations range from 2,200 feet near the mouth to over 8,200 feet in the headwater areas. The watershed receives approximately 15-25 inches of precipitation each year. The fish metrics reported here refer to the portion of this watershed upstream of the town of Ritter at river mile 15 (Figure 2).

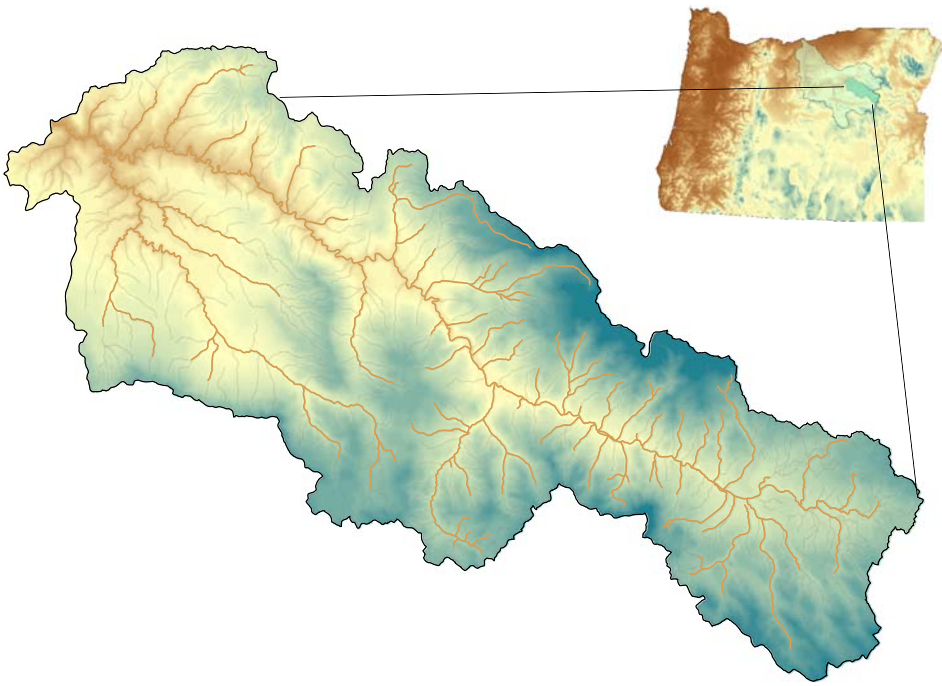

Figure 1. Map of the location of the Middle Fork John Day River and its tributaries in relation to the John Day River subbasin and the state of Oregon (Inset).

Steelhead Escapement Estimate

Steelhead redd surveys, based on standard ODFW methods (Susac and Jacobs 1999; Jacobs et al. 2000; Jacobs et al. 2001), were conducted during the spring (April to June) coinciding with steelhead spawn timing in the MFJDR. Survey sites were selected using a generalized random tessellation stratification (GRTS) design which randomly selects sites based on the spatial structure of the stream network of interest. Sites were then assigned to one of three different panels using the Environmental Monitoring and Assessment Protocol (EMAP): sites visited every year (Annual Sites), sites visited every other year beginning with year-1 (Two-1), or sites visited every other year beginning in year-2 (Two-2). Although assigning sites to a panel is usually performed in a random fashion, we were able to incorporate sites utilized by another steelhead monitoring project in the John Day River

Basin into our site selection to utilize their previously collected data and increase personnel and resource efficiencies. Thirty sites were selected to be surveyed each year and were equally distributed between Annual (n=15) and Two-year sites (n=15 for each panel). Additional sites were selected within each panel as replacement sites in the event that a site had to be removed due to access restrictions, unidentified in-stream barriers, or unsuitable habitat conditions.

We used a 1:100,000 EPA river reach file of summer steelhead distribution in the MFJDR subbasin for site selection (Figure 2). This spatial dataset is based on best professional knowledge provided by ODFW managers as well as other local agency biologists. The actual dataset utilized for site selection was modified to meet the objectives of this project. Specifically, stream segments downstream of a rotary screw trap (RST) operated by ODFW at river kilometer (Rkm) 24 (River mile 15) were excluded since this area was outside of the target IMW area.

Sites were surveyed multiple times, at approximately two week intervals, to quantify the number of unique redds constructed at each site, and to account for the temporal variation in spawning activity. Survey reaches were approximately 2 km in length and encompassed the sample point derived from the EMAP sampling design. Surveyors walked upstream from the downstream end of each reach and counted all redds, live fish, and carcasses observed. New redds were flagged and the location marked with a GPS unit (dd.dd – WGS84). During each visit, surveyors recorded the number of previously flagged and newly observed redds.

Overall redd density (R_D) was estimated by:

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

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

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

where d_u is the total kilometers available to steelhead for spawning and rearing (428 km). Steelhead escapement (E_S) was then estimated by:

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

where C is an annual fish per redd constant developed from repeat spawner surveys in the Grande Ronde River basin (Flesher et al. 2005; Lance Clarke, Jim Ruzycki, ODFW, unpublished data). A locally weighted neighborhood variance estimator (Stevens 2004), which incorporates the pair-wise dependency of all points and the spatially constrained nature of the design, was utilized to estimate 95% confidence intervals of the escapement estimate using R statistical software (R Development Core Team 2005).

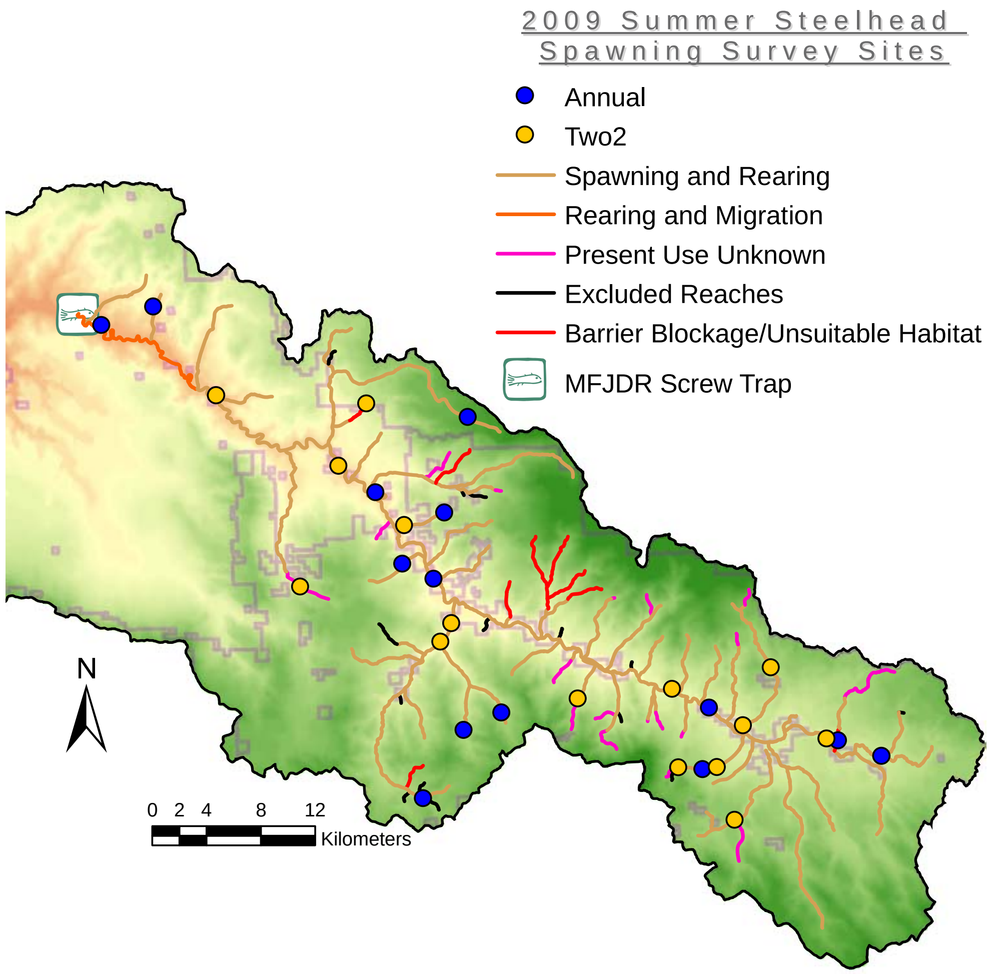

Figure 2. Map of summer steelhead distribution used for selecting steelhead spawning survey sites, with Annual and Two-2 sites sampled in 2009. The rotary screw trap (MFJDR Screw Trap) near Ritter, OR, the lower extent for sampling, is shown for reference.

Parr to Smolt Survival

Granite Boulder Creek and Camp Creek were selected for parr to smolt survival monitoring because of the differences in temperatures recorded during the summer rearing season. Camp Creek is generally warmer than Granite Boulder Creek during summer months. Each stream was divided into reaches based on the current summer steelhead distribution and topographical features from 1:24,000 quad topographic maps. Although both summer steelhead and spring Chinook were targeted in this sampling, summer steelhead distribution was utilized for both species because steelhead distribution encompasses the entire known distribution of spring Chinook. Within each reach, three sites were selected for monitoring (Figure 3). Sites were determined by utilizing the GIS layer developed by EMAP for steelhead spawning surveys in the MF_IMW. Specifically, the first point encountered in each reach proceeding in an upstream direction was selected as a sampling site. Depending on whether that point was in the first third, middle third, or latter third of the reach, all other site locations in the reach were located a distance equal to 1/3 of the reach distance from the other sampling points within that reach, resulting in one sampling site occurring in each third of the reach. Coordinates were extracted for each site from ArcGIS to locate sites in the field. Because of logistical and time constraints not all sites were sampled during the current year and only sites labeled as 'Primary' were sampled during 2009. To reach our tagging goal (Table 1) we also sampled fish within the MFJDR between Camp Creek and Butte Creek, primarily targeting juvenile Chinook.

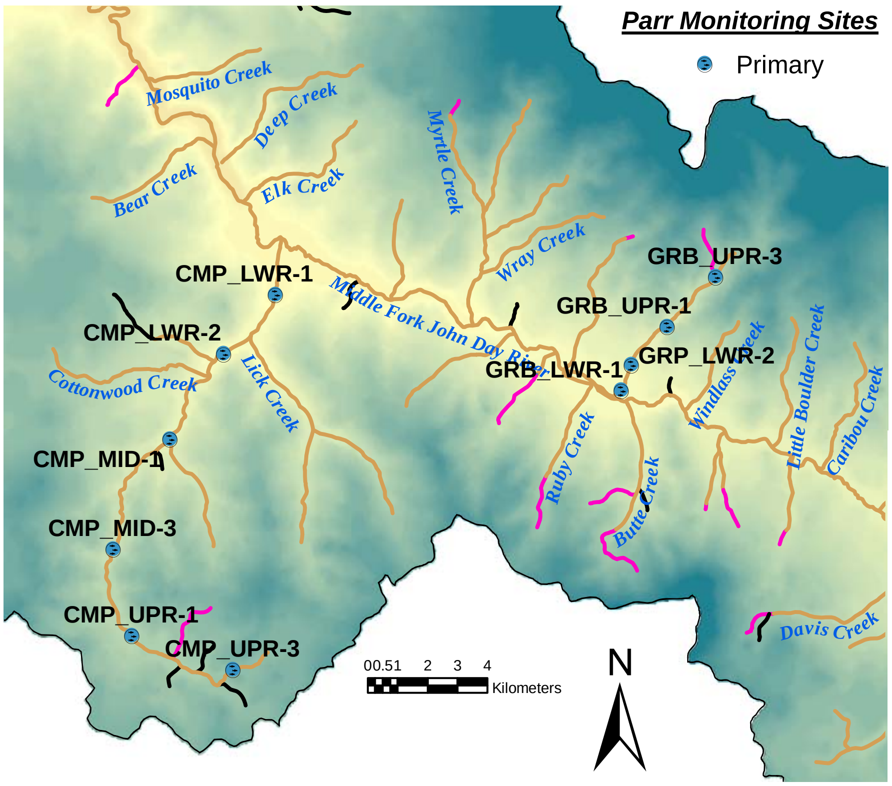

Figure 3. Parr Monitoring sites and associated site codes for Camp Creek and Granite Boulder Creek.

Table 1. PIT-tagging goals by stream and species for 2009.

Stream	Chinook	Steelhead	Total Tags
Camp Creek	100	600	700
Granite Boulder Cr.	200	600	800
Middle Fork JDR	1,500		1,500
Total Tags	**1,800**	**1,200**	**3,000**

Site lengths were 20 times the average ACW measured at five locations near the site point. The site point was considered the mid-point of the sampling section, however in some instances the section was moved upstream or downstream to avoid constraints from secondary channels or tributaries where possible. Block nets were employed at the upstream and downstream extents of each sample section to eliminate fish movement during sampling. Sites were sampled once a day for three consecutive days. Block nets remained in place until sampling was completed on the third day at each site.

Three different fish sampling techniques were employed, depending on the habitat condition encountered. At sites where habitat conditions were highly variable, more than one technique was employed to ensure the most efficient sampling of the site. In habitats with deep pools, fish were collected by snerding, in which a snorkeler would enter at the head of a pool and attempt to herd fish downstream into a 12' wide by 4' high seine with a 2'x2' bag anchored at the pool tail crest. In deeper swift water, fish were similarly collected by E-herding in which a crew member used an electrical current produced by a backpack electrofisher (Smith-Root LR24) to force fish downstream into an anchored seine. In shallower swift water, traditional spot electrofishing techniques were employed. During fall sampling, habitat conditions encountered at basal flows permitted all sampling to occur via spot electrofishing.

Once collected, fish were placed into an aerated bucket and transferred to instream live boxes where they were held until the entire site was sampled and tagging operations commenced. Captured juvenile spring Chinook, steelhead, and Bull trout *Salvelinus confluentus* were anesthetized with tricane methane sulfonate (MS-222), interrogated for passive integrated transponder tags (PIT tags), weighed to the nearest 0.1 g, and fork length (FL) measured to the nearest millimeter (mm). Scales were taken from a subsample of steelhead collected that were larger than 60 mm. Subsamples were grouped into 10 mm bins and 15 samples were collected in each bin during summer sampling and 10 samples collected during fall sampling. All bull trout were sampled for scales. All anesthetized fish were allowed to recover in an aerated bucket until they regained equilibrium (~5-10 min). Once recovered, fish were released in small groups throughout the site and allowed to distribute themselves naturally within the sampling reach.

Encounter histories were developed for each steelhead tagged to estimate population abundance. A closed capture model (Otis et al. 1978) was used to analyze the encounter histories by site in Program MARK (White and Burnham 1999). This analysis utilizes a log maximum likelihood probability to estimate both capture (p) and recapture (c) probabilities as well as population abundances (N). Model variables for capture and recapture estimates can vary temporally or can be constant, either together or separately. For each site, three potential models were fit to the data (Table 2). The most parsimonious model was selected based on the lowest Akaike Information Criteria (AICc) value. When AICc values of two or more potential models differed by less than two, the model with the fewest parameters was selected.

Table 2. Models fit to encounter history data, description of the model used, and the number of parameters in the associated model. All models also parameterized population abundance, which is not included in this table.

Model	Model Description	# of Parameters
p(.),c(.)	Capture and recapture are constant but not equal	2
p(.)=c(.)	Capture and recapture are constant and equal	1
p(t)=c(t)	Capture and recapture vary temporally but equal during sampling events	3

Smolt Abundance

Juvenile spring Chinook and steelhead migrants were captured using a 1.52 m rotary screw trap (RST) operated on the Middle Fork John Day River near Ritter (see Figure 2). Trap operation typically begins during early October and continues into June of the following year to encompass a migration year. The trap was either removed or stopped during times of ice formation, high discharge, and during warm summer months after fish ceased migrating.

The RST is typically fished four days/week by lowering cones on Mondays and raising cones on Fridays and is checked daily during these weekly fishing periods. We assumed that all fish captured were migrants. Non-target fish species were identified, enumerated, and returned to the stream. Captured juvenile spring Chinook and steelhead migrants were anesthetized with tricane methane sulfonate (MS-222), interrogated for passive integrated transponder tags (PIT tags) or pan jet paint marks, enumerated, weighed to the nearest 0.1 g, and measured (fork length, FL; mm). A subsample of fish was released above the trap to estimate migrant abundance using mark-recapture techniques. Further details of our RST operation are available (Wilson et al. 2007).

Summer Rearing Distribution

Summer rearing distribution of juvenile Chinook salmon within the MFJDR_IMW was assessed by snorkeling or electro-fishing pools. We began surveying in Big Creek at the downstream extent of Chinook distribution in the MFJDR_IMW (Figure 4). Sampling proceeded upstream noting the presence or absence of juvenile Chinook, steelhead, or Bull trout. Locations of all pools sampled were determined with a handheld GPS along with focal fish presence/absence. Within tributary streams, we sampled every fifth pool beginning at the first pool upstream of the tributary confluence. In the event that no juvenile Chinook were observed in a sampled pool, we proceeded to sample every pool encountered, until a juvenile Chinook was encountered at which point we returned to sampling every fifth pool. If no juvenile Chinook were encountered after sampling five consecutive pools, sampling ceased in that tributary. In the mainstem MFJDR, we sampled every third pool upstream of Camp Creek to the confluence of Summit Creek and Squaw Creek. When no target fish were observed in a pool, sampling frequency was increased to every pool until a target fish was again observed and subsequent sampling frequency returned to every third pool. Every pool in the Middle Fork John Day River from Big Creek to Camp Creek was snorkeled regardless of observed fish species.

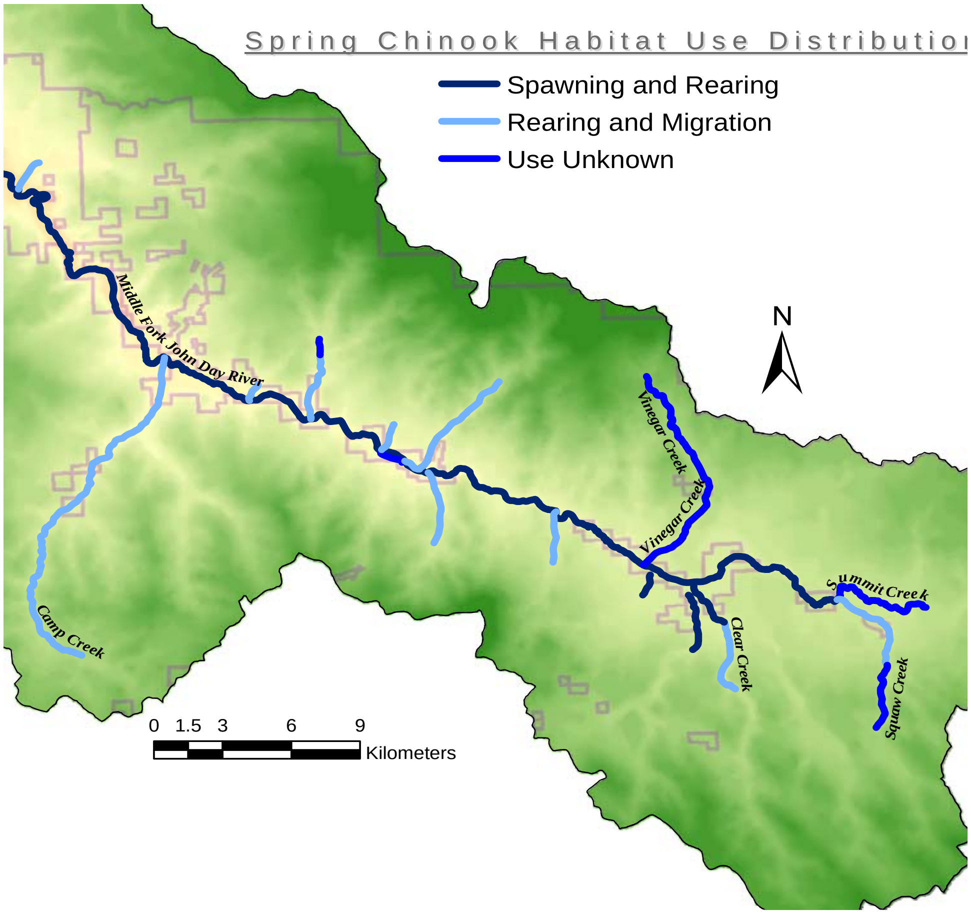

Figure 4. Spring Chinook habitat use distribution in the Middle Fork John Day River Intensively Monitored Watershed upstream and including Big Creek.

RESULTS

Summer Steelhead Escapement

We surveyed 29 sites for spawning adult summer steelhead in the Middle Fork John Day River from 2 April to 12 June 2009 (Table 3). We were unable to survey one site due to unsuccessful attempts to make contact with the landowner. We observed 76 total redds at only 15 of the 29 sites surveyed (52%). Corresponding redd densities at all sites ranged from zero to 4.5 redds per kilometer (Figure 5) and averaged 1.3 redds/km for the entire MFJDR_IMW (Table 5). Given this redd density, we estimate that 556 redds were constructed in the MFJDR_IMW by 2,114 returning adults (Table 5).

Table 3. Total redds, redd density and number of wild, hatchery, and unknown origin steelhead observed at spawning ground survey sites in the MFJDR_IMW during 2009.

Stream	Site ID	Redds	Redd Density	Wild Steelhead	Unknown Steelhead
Rush Cr.	101	1	0.50	0	1
MFJDR	102	1	0.50	0	0
Crawford Cr.	104	0	0.00	0	0
MFJDR	105	Not Surveyed			
Mosquito Cr.	106	0	0.00	0	0
Summit Cr.	108	3	2.10	0	0
Indian Cr.	109	0	0.00	0	0
Camp Cr.	110	8	4.00	9	0
Lick Cr.	111	0	0.00	0	0
MFJDR	113	0	0.00	0	0
W.F. Lick Cr.	114	4	2.00	0	0
MFJDR	115	0	0.00	0	0
Davis Cr.	116	5	2.50	0	0
MFJDR	117	0	0.00	0	0
Bear Creek	118	1	0.50	0	0
Davis Creek	301	8	3.80	4	4
Vinegar Creek	302	8	4.00	5	3
Camp Creek	304	0	0.00	0	1
MFJDR	305	0	0.00	0	0
Vinegar Creek	306	5	2.50	2	5
Camp Creek	307	3	1.76	0	1
MFJDR	308	0	0.00	0	0
Ruby Creek	309	9	4.50	0	0
MFJDR	310	2	1.00	0	0
Mosquito Creek	311	0	0.00	0	0
MFJDR	312	0	0.00	0	0
Bridge Creek	313	9	4.50	1	3
Slide Creek	315	9	4.50	4	1
Cougar Creek	316	0	0.00	0	0
Davis Creek	317	0	0.00	0	0

Table 4. Stream name, site identification number, site coordinates (DD.DD, WGS-84), panel type, reach length, and survey dates for steelhead spawning ground surveys conducted during 2008 in the Middle Fork John Day River IMW.

		Start Coordinates		End Coordinates		Panel	Distance	Survey Date				
Stream	Site ID	Latitude	Longitude	Latitude	Longitude	Type	(km)	1	2	3	4	5
Bear Creek	118	44.72279	-118.83202	44.71159	-118.85023	Annual	2.0	5/4	5/19			
Bridge Creek	313	44.54829	-118.85995	44.53901	-118.54863	Two2	2.0	4/29	5/15	5/29		
Camp Creek	110	44.56925	-118.84995	44.56060	-118.82869	Annual	2.0	4/28	5/14	5/26	6/5	
Camp Creek	304	44.69325	-118.79578	44.67659	-118.79918	Two2	1.9	4/6	5/20			
Camp Creek	307	44.67659	-118.79918	44.66412	-118.44189	Two2	1.7	4/7	5/20	6/2		
Crawford Creek	104	44.58661	-118.44708	44.60140	-118.44189	Annual	2.0	4/17	5/15			
Davis Creek	116	44.57668	-118.55641	44.57740	-118.58000	Annual	2.0	5/7	5/21	6/3		
Davis Creek	301	44.58896	-118.53550	44.87698	-118.55567	Two2	2.1	4/20	5/1	5/7	5/21	6/3
Davis Creek	317	44.57740	-118.58000	44.57191	-118.60369	Two2	2.2	6/12				
Indian Creek	109	44.82456	-118.80019	44.81340	-118.77983	Annual	2.1	5/27	6/11			
Lick Creek	111	44.62634	-118.76067	44.61007	-118.75147	Annual	2.0	5/11	5/26			
MFJDR	102	44.72260	-118.82289	44.70625	-118.81474	Annual	2.0	6/8				
MFJDR	113	44.76283	-118.87105	44.75979	-118.86572	Annual	1.9	6/10				
MFJDR	115	44.62157	-118.57913	44.61668	-118.56166	Annual	1.9	5/29				
MFJDR	117	44.88145	-119.12366	44.87015	-119.11325	Annual	2.1	6/12				
MFJDR	305	44.62962	-118.59648	44.62157	-118.57913	Two2	1.9	5/29				
MFJDR	308	44.79021	-118.90682	44.77608	-118.89608	Two2	2.0	6/10				
MFJDR	310	44.89599	-118.46317	44.58688	-118.44796	Two2	2.0	5/22	6/1			
MFJDR	312	44.83447	-119.02231	44.82432	-119.00959	Two2	2.0	6/10				
Mosquito Cr.	106	44.74345	-118.82775	44.75012	-118.80361	Annual	2.1	4/30	5/12			
Mosquito Creek	311	44.74191	-118.85120	44.74345	-118.82775	Two2	1.9	4/2	4/15	4/30		
Ruby Creek	309	44.63789	-118.67580	44.62154	-118.68518	Two2	2.0	4/16	5/6	5/20	6/2	
Rush Creek	101	44.87314	-119.07295	44.89066	-119.07083	Annual	2.0	4/2	4/14	4/27		
Slide Creek	315	44.71352	-118.95212	44.70138	-118.93543	Two2	2.0	4/8	5/14	5/26	6/8	
Summit Creek	108	44.58652	-118.41705	44.58047	-118.39681	Annual	2.1	4/20	5/15	6/1		
Unnamed Tributary	316	44.81329	-118.89054	44.82481	-118.87283	Two2	2.0	4/6	4/14	4/27		
Vinegar Creek	302	44.63473	-118.49835	44.65018	-118.50961	Two2	2.0	5/13	5/28	6/9		
Vinegar Creek	306	44.60123	-118.53569	44.61079	-118.51521	Two2	2.0	4/16	5/1	5/13	5/28	6/9
W.F. Lick Cr.	114	44.62350	-118.78779	44.60543	-118.78974	Annual	2.0	5/11	5/26	6/5		

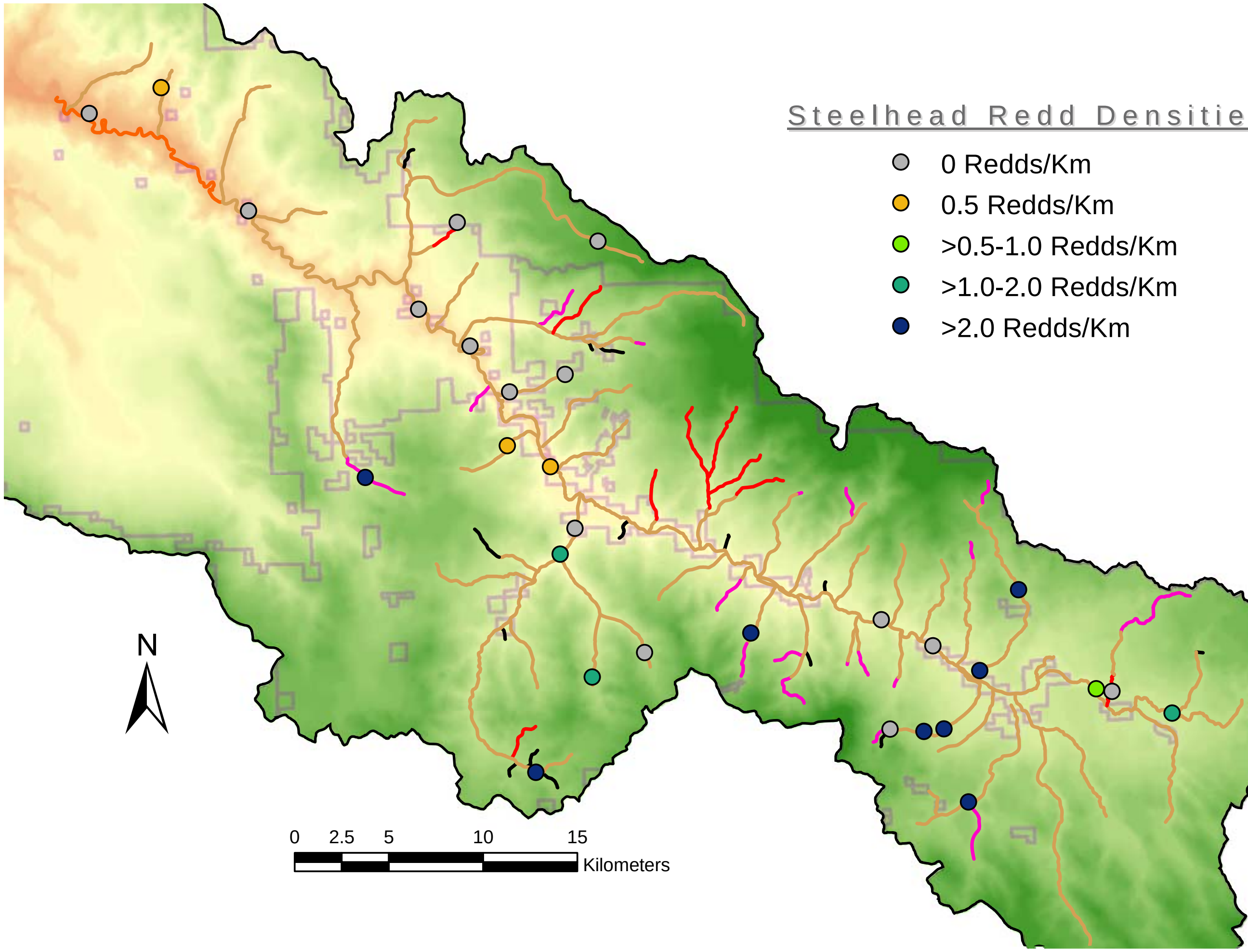

Figure 5. Redd densities at steelhead spawning sites surveyed during 2009 in the Middle Fork John Day River IMW.

Table 5. Distance surveyed, number of redds observed, estimated redd density, total estimated redds, and spawner escapement (95%CLs), during 2008 and 2009 summer steelhead spawning surveys in the MFJDR_IMW.

Year	Kilometers Surveyed	Unique Redds	Redd/Km	Total Redds	Escapement	95% LCI	95% UCI
2008	57.5	24	0.41	192	769	-135	1,675
2009	57.9	76	1.30	556	2,114	1,326	2,901

Initiation of redd construction in the Middle Fork John Day River IMW coincided with the descending limb of the 2009 hydrograph (Figure 6). After flows peaked at approximately 1,700 cfs in late April and continued to decline to the end of May, greater than 90% of redds were constructed during this time period.

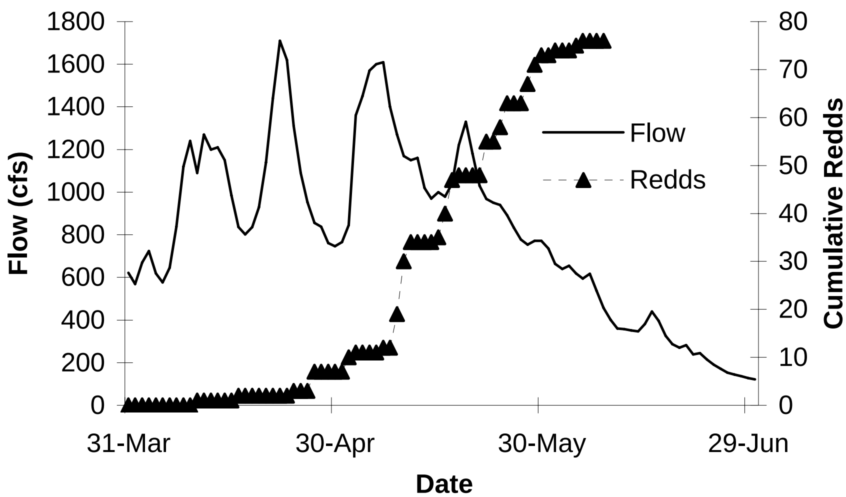

Figure 6. Cumulative redd construction in the Middle Fork John Day River IMW and mean daily discharge measured at the USGS gauging station near Ritter, OR from 31-Mar-2009 to 30-June-2009.

Parr to Smolt Survival

We collected and tagged a combined 3,297 juvenile steelhead, juvenile Chinook salmon, and Bull trout during July and October 2009 (Table 6). Nearly half (40%), of the juvenile steelhead tagged were captured and tagged during the fall in Camp Creek (Table 6). This disproportionate sampling appears to be partially the result of a very strong year class of age-0 steelhead present in Camp Creek during October (Figure 6). While there appears to be a strong age-0 year class present in Granite Boulder Creek (Figure 7) there was still an overall decrease in the total number of fish tagged from Summer to Fall mostly as a result of fewer juvenile Chinook (Table 6).

Table 6. PIT-tagging results for parr to smolt monitoring of juvenile steelhead, Chinook, and Bull trout in the MFJDR_IMW during Summer (July) and Fall (October) of 2009. No sampling was conducted in the MFJDR during the Fall period.

	Summer				Fall			
	Steelhead	Chinook	Bull Trout	Total	Steelhead	Chinook	Bull Trout	Total
Camp Cr.								
CMP_LWR-1	170	46		216	160	45		205
CMP_LWR-2	37	21		58	135	174		309
CMP_MID-1	66	3		69	93	3		96
CMP_MID-3	61			61	45			45
CMP_UPR-1	20			20	86			86
CMP_UPR-1	34			34	57			57
Total	**388**	**70**		**458**	**576**	**222**		**798**
Granite Boulder Cr.								
GRB_LWR-1	68	178		246	48	57		105
GRB_LWR-2	45	4		49	46	14		60
GRB_UPR-1	45			45	38	1	1	40
GRB_UPR-3	21		15	36	46		18	64
Total	**179**	**182**	**15**	**376**	**178**	**72**	**19**	**269**
MFJDR	*111*	*1,285*		*1,396*	-	-	-	
TOTAL	**678**	**1,537**	**15**	**2,230**	**754**	**294**	**19**	**1,067**

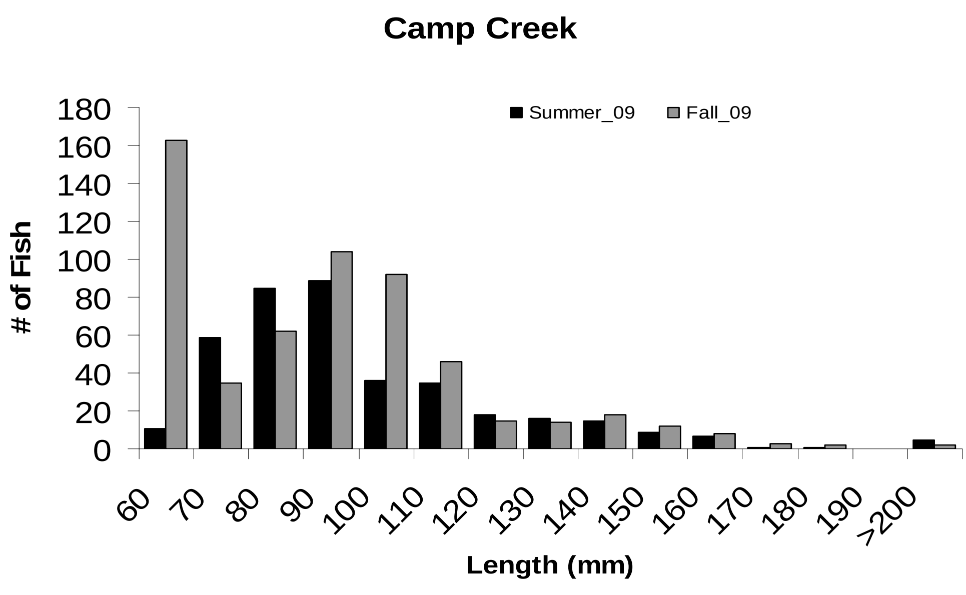

Figure 7. Number of juvenile steelhead by 10mm length increments collected in Camp Creek during Summer (July) and Fall (October) 2009.

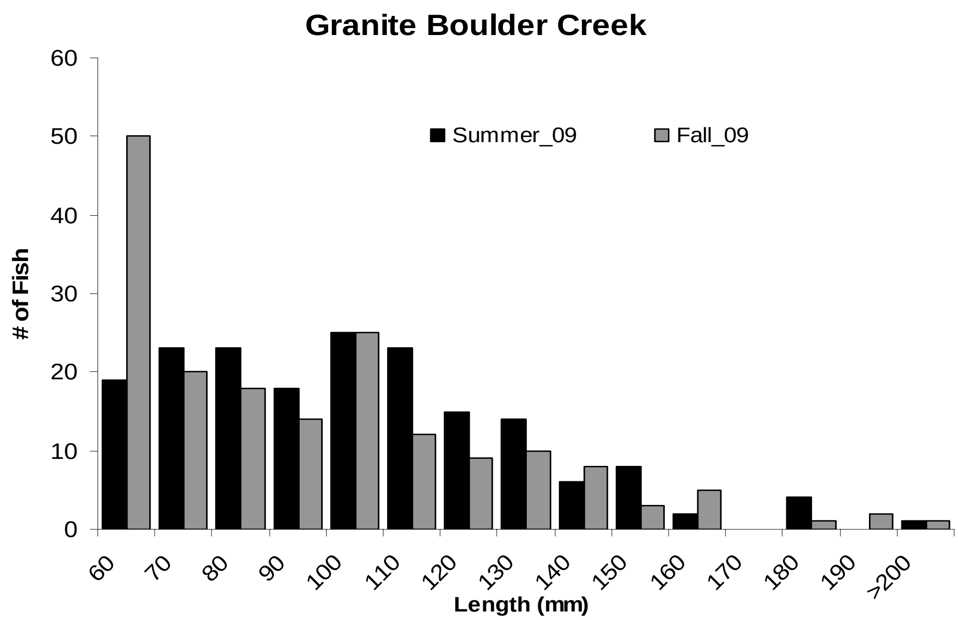

Figure 8. Number of juvenile steelhead by 10mm length increments collected in Granite Boulder Creek during sampling in Summer (July) and Fall (October) 2009.

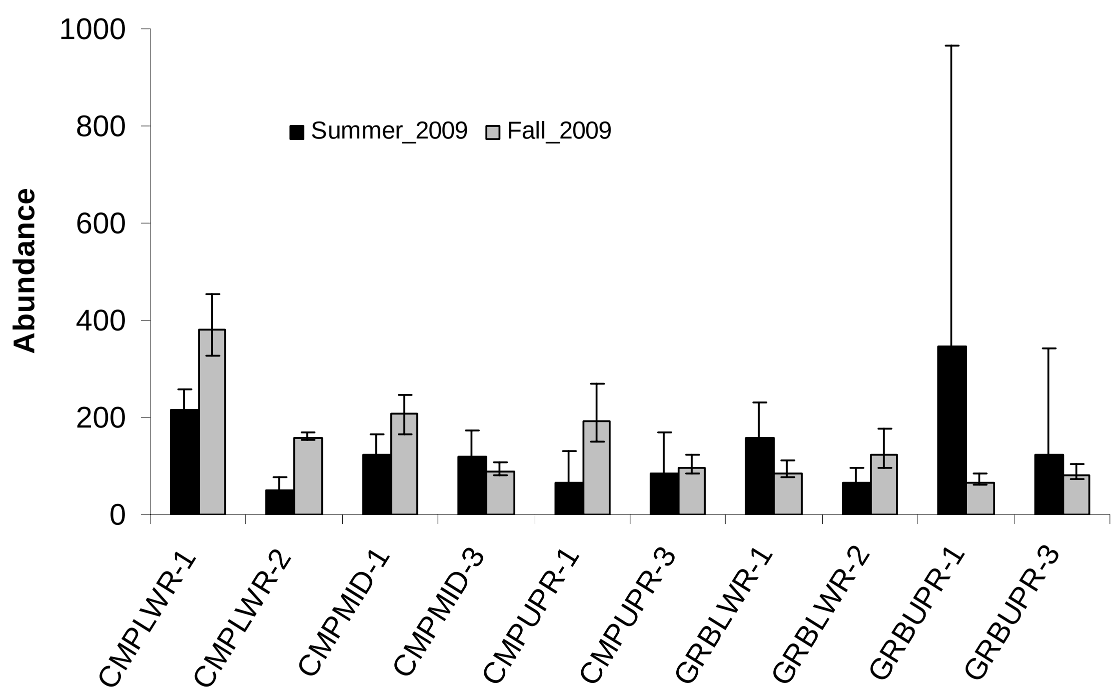

Figure 9. Abundance estimates (± 95% CI) for juvenile steelhead in Camp Creek (CMP prefix) and Granite Boulder Creek (GRB prefix) for Summer (July) and Fall (October) sampling during 2009. See Figure 3 for location site location.

Population modeling for abundance estimates of juvenile steelhead yielded varying results among both streams and sites (Figure 8). Although we tagged a greater number of fish in Camp Creek in the Fall compared to Summer, we did not observe a statistically larger population estimate for most sites, except at the lower Camp Creek sites (CMPLWR-1 and CMPLWR-3; Figure 8). Granite Boulder Creek abundance estimates were similar during fall and summer except in GRBUPR-1 (Figure 8) despite tagging nearly equal numbers of fish (Table 6) and is most likely attributable to block net failures during the summer sampling periods.

A total of 1,831 juvenile Chinook were collected and tagged in MFJDR_IMW during July and October, 2009 (Table 6). The majority of these individuals (70%) were sampled from the MFJDR itself between Camp Creek and Bridge Creek (Table 6). The sampling that occurred in the MFJDR was not conducted as a mark-recapture event, therefore no abundance estimates are available. Average lengths of juvenile Chinook ranged from 67mm in the Summer in Camp Creek to 78mm in the Fall in Granite Boulder Creek (Figure 10).

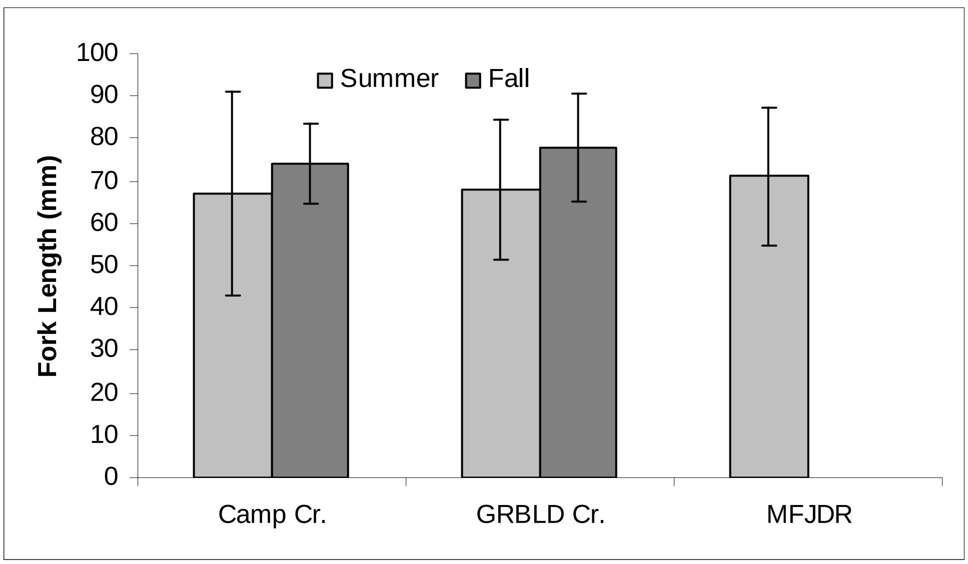

Figure 10. Average length (mm) and 95% CI of juvenile Chinook collected and tagged in Camp Creek, Granite Boulder Creek (GRBLD Cr.), and the Middle Fork John Day River (MFJDR) during Summer (July) and Fall (October) of 2008. No sampling was conducted in the MFJDR during the Fall sampling period.

We captured and tagged a total of 34 Bull trout in Granite Boulder Creek during sampling events in 2009 (Table 6). Lengths of captured Bull trout ranged from 71 to 153 mm (Table 9). No Bull trout were captured in Camp Creek or the Middle Fork John Day River.

Table 7. Parsimonious model selection results and associated parameter estimates of encounter histories for juvenile steelhead tagged in Camp Creek during Summer and Fall of 2009 [p = probability of capture, c = probability of recapture, N = abundance estimate, (.) = constant parameter, (t) = parameter varies temporally].

	Summer					Fall				
Site	**Model**	**Parameter**	**Estimate**	**LCI**	**UCI**	**Model**	**Parameter**	**Estimate**	**LCI**	**UCI**
LWR-1	p(t)=c(t)	p	0.438	0.332	0.549	p(.),c(.)	p	0.252	0.207	0.304
		c	0.142	0.103	0.191		N	379	328	454
		N	215	194	259					
LWR-2	p(t)=c(t)	p	0.437	0.232	0.665	p(.),c(.)	p	0.636	0.543	0.720
		c	0.113	0.0517	0.230		c	0.177	0.134	0.231
		N	48	42	77		N	158	153	172
MID-1	p(.)=c(.)	p	0.267	0.192	0.358	p(t)=c(t)	p	0.454	0.373	0.538
		N	124	101	170		p	0.220	0.149	0.314
							p	0.0863	0.0508	0.143
							N	208	166	284
MID-3	p(t)=c(t)	p	0.142	0.0810	0.238	p(t)=c(t)	p	0.454	0.373	0.538
		p	0.318	0.203	0.460		N	90	82	107
		p	0.260	0.162	0.388					
		N	119	93	172					
UPR-1	p(.)=c(.)	p	0.184	0.0896	0.342	p(t)=c(t)	p	0.275	0.183	0.392
		N	65	42	130		p	0.161	0.102	0.246
							p	0.182	0.116	0.273
							N	192	149	271
UPR-3	p(.)=c(.)	p	0.0938	0.0367	0.219	p(.)=c(.)	p	0.488	0.358	0.620
		p	0.270	0.122	0.494		p	0.214	0.137	0.317
		p	0.141	0.0599	0.296		p	0.376	0.267	0.500
		N	85	54	171		N	98	86	124

Table 8. Parsimonious model selection results and associated parameter estimates of encounter histories for juvenile steelhead tagged in Granite Boulder Creek during Summer and Fall of 2009 [p = probability of capture, c = probability of recapture, N = abundance estimate, (.) = constant parameter, (t) = parameter varies temporally].

	Summer					Fall				
Site	**Model**	**Parameter**	**Estimate**	**UCI**	**LCI**	**Model**	**Parameter**	**Estimate**	**UCI**	**LCI**
LWR-1	p(.)=c(.)	p	0.357	0.200	0.551	p(.),c(.)	p	0.478	0.322	0.636
		p	0.180	0.116	0.268		c	0.188	0.123	0.276
		N	107	88	168		N	85	76	111
LWR-2	p(.)=c(.)	p	0.435	0.255	0.634	p(.),c(.)	p	0.242	0.168	0.337
		c	0.194	0.119	0.302		N	125	98	178
		N	63	57	97					
UPR-1	p(t)=c(t)	p	0.0550	0.0182	0.154	p(.)=c(.)	p	0.536	0.374	0.691
		N	345	147	966		c	0.250	0.171	0.351
							N	67	63	85
UPR-3	p(.)=c(.)	p	0.0884	0.0271	0.252	p(t)=c(t)	p	0.501	0.347	0.655
		p	0.145	0.0459	0.372		c	0.220	.0149	0.312
		p	0.0562	0.0161	0.178		N	81	74	103
		N	124	60	341					

Table 9. Bull trout PIT-tag codes, tag date and site, fork length (FL; mm), mass (g), and weight (g) captured and tagged in Granite Boulder Creek.

PIT Code	Tag Date	Fork Length (mm)	Weight (g)
3D9.1C2D56CFE4	13-Jul-09	74	4.3
3D9.1C2D57F819	13-Jul-09	80	4.9
3D9.1C2D58676D	13-Jul-09	85	5.8
3D9.1C2D5838BA	14-Jul-09	74	3.7
3D9.1C2D58A786	14-Jul-09	77	4.3
3D9.1C2D5838FB	14-Jul-09	79	4.7
3D9.1C2D56CE7E	14-Jul-09	79	4.5
3D9.1C2D57E62B	14-Jul-09	81	4.7
3D9.1C2D57F989	14-Jul-09	83	5.6
3D9.1C2D5823BE	15-Jul-09	71	3.3
3D9.1C2D57DB5F	15-Jul-09	75	4.3
3D9.1C2D57E7E4	15-Jul-09	77	4.5
3D9.1C2D5775DC	15-Jul-09	86	6.4
3D9.1C2D59201F	15-Jul-09	91	7.1
3D9.1C2D57B059	15-Jul-09	116	15.3
3D9.1C2D58887B	28-Sep-09	86	6
3D9.1C2D57DC99	28-Sep-09	86	5.3
3D9.1C2D58A344	28-Sep-09	88	6.6
3D9.1C2D57FCA6	28-Sep-09	90	7
3D9.1C2D57F11F	28-Sep-09	95	7.4
3D9.1C2D57FC93	28-Sep-09	99	10.4
3D9.1C2D57D672	28-Sep-09	104	10.2
3D9.1C2D58A731	29-Sep-09	153	33.6
3D9.1C2D56DB85	29-Sep-09	83	
3D9.1C2D58A778	29-Sep-09	87	
3D9.1C2D57EAC6	29-Sep-09	90	
3D9.1C2D580038	29-Sep-09	96	
3D9.1C2D57F24E	30-Sep-09	83	
3D9.1C2D57DC46	30-Sep-09	85	
3D9.1C2D57D745	30-Sep-09	89	
3D9.1C2D57DCA5	30-Sep-09	91	
3D9.1C2D58B936	30-Sep-09	97	
3D9.1C2D57FECE	30-Sep-09	99	
3D9.1C2D583BA0	30-Sep-09	102	

Smolt Abundance

We captured 3,646 juvenile Chinook salmon and 478 juvenile steelhead at our RST near Ritter. Trap operation was initiated on 1 October 2008 and continued through 19 June 2009. Using mark recapture, we estimate that 38,519 juvenile Chinook and 14,522 juvenile steelhead migrated out of the Middle Fork watershed during this period. Each of these estimates is more than twice as great as those estimated for the previous migration year. More detailed results will be published elsewhere in our annual report to the Bonneville Power Administration as part of BPA project 199801600.

PIT-Tag Detection History

Of the 1,087 juvenile Chinook tagged during 2008, 46 were recaptured during trapping operations at the RST near Ritter, OR and another 133 were detected at detection facilities in the Columbia River hydropower system. Of the 1,550 juvenile steelhead tagged in 2008, 132 were recaptured during sampling in Camp Creek or Granite Boulder Creek during 2009, 49 were detected at the in-stream PIT-tag antenna array in the Middle Fork John Day River, three were recaptured during tagging operations at the RST near Ritter, OR and 42 were detected at detection facilities in the Columbia River hydropower system.

Table 10. Juvenile Chinook and steelhead PIT-tagged during 2008 and detected during 2009 at the MFJDR, PIT-tag antenna array. * No juvenile Chinook were anticipated to be recaptured in the MFJDR during 2009 sampling efforts.

Species	'08 Tag Total	'09 Recaps	MF Array Detections	RST Detections	CRHP Detections
Chinook	1,087	0* (0%)	0 (0%)	46 (4.2%)	133 (12.2%)
Steelhead	1,550	132 (8.5%)	49 (3.2%)	3 (0.2%)	42 (2.7%)

A total of 34 returning adults, both steelhead and Chinook, were detected at our instream PIT-tag antenna array during 2009. Of the 27 adult Chinook detected, two were age 5, 23 were age 4, and two were age 3. One presumably precocious male, tagged as a smolt on 16 April 2009, was detected moving upstream on 06 July 2009. Of the six adult steelhead detected, five were 1-ocean fish and one was a 2-ocean fish. Because the in-stream antenna array was not installed until mid-April, we likely missed some proportion of the upstream migrating steelhead during 2009.

Table 11. Adult PIT-tag detections at the MFJDR in-stream PIT-tag antenna array during 2009.

Species	Juvenile MY	Ocean Residence	# Detected
Chinook	2006	3 yr	2
	2007	2 yr	23
	2008	1 yr	2
	2009	Precocious	1
Steelhead	2006	2 yr	1
	2007	1 yr	5

Chinook Summer Rearing Distribution

We sampled 388 pools in the MFJDR_IMW to assess summer rearing distribution of juvenile Chinook salmon. The observed summer distribution during 2009 (Figure 10) was similar to that observed during 2008. Within the Middle Fork John Day River itself, juvenile Chinook distribution was consistent from near its headwaters downstream to the mouth of Granite Boulder Creek (Figure 10). Below Granite Boulder Creek, presence of juvenile Chinook was patchy. If present in tributaries of the MFJDR, most juvenile Chinook occurred in the initial 1-2 kilometers upstream from the tributary mouth (Figure 10). Additional sampling in tributaries not originally identified as supporting juvenile Chinook rearing, identified three additional streams (Lick Creek, Wray Creek, and Little Boulder Creek) where juvenile Chinook were rearing. Additional rearing area from these streams only increases the available habitat by less than 1.5 km. Additional surveys were also conducted in Windlass Creek, however no juvenile Chinook were detected. Multiple tracts of private land were not surveyed due to a lack of time to seek access.

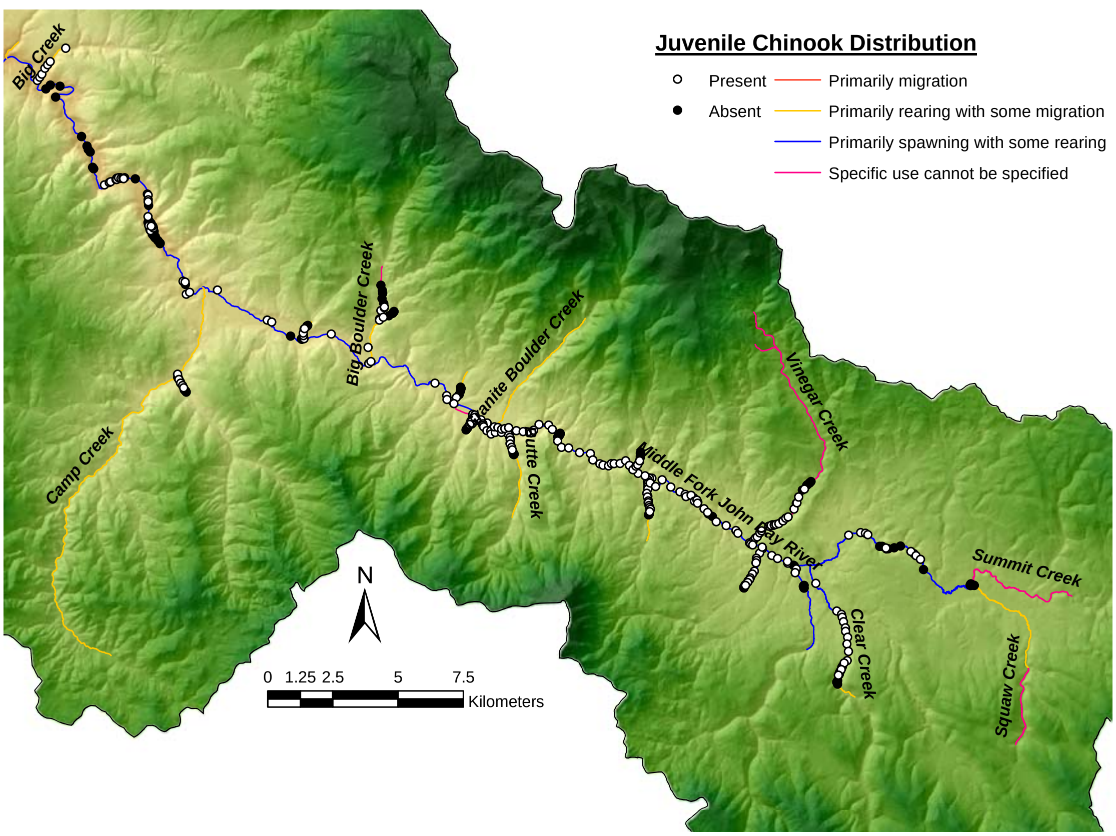

Figure 11. Presence (open circles) and absence (closed circles) of juvenile Chinook salmon in pools sampled within the MFJDR_IMW during 2009.

DISCUSSION

The number of juvenile Chinook salmon and steelhead migrating out of the watershed more than doubled from 2008 to 2009. These results are encouraging and much of this increase is likely due to the lethal summer temperatures experienced by salmon and steelhead parr during 2007 (Schricker et al. 2008). Overall, water temperatures were cooler in the watershed during the summer of 2008 when many of the smolts that emigrated during the most recent migration were rearing as parr in the watershed. We still need one additional year of monitoring both juvenile steelhead and redd abundance before we can provide a smolt/redd estimate for steelhead in the watershed. Smolt/redd estimates for Chinook salmon in the Middle Fork John Day River were very low, 37 smolts/redd, for the 2006 brood year. This is the brood composed of parr rearing during the warm 2007 summer. During Fall 2007, 85 Chinook redds were observed in the watershed and during 2008-09, 38,519 estimated smolts emigrated from the watershed. These estimates result in an astounding 453 smolts/redd for the 2007 brood year. The previous high estimate during the past six years was 95 smolts/redd for the 2005 brood year. This high productivity estimate for the 2007 brood year suggests a great deal of resilience and potential for significant positive benefits to salmon and steelhead resulting from habitat restoration actions in the watershed.

Summer steelhead redd counts were substantially higher in 2009 compared with 2008. In addition, survey conditions were more conducive this year aiding our ability to identify redds and increasing redd longevity. Despite a nearly three fold increase in observed redds, however, there was no statistical difference in escapement estimates for adult steelhead. A substantial factor contributing to the lack of significance is the large variance encompassing the escapement estimate in 2008. The standard error was 60% of the estimated escapement level in 2008. In 2009 the standard error was 19% of the estimated escapement level. The large standard error in 2008 resulted from more than 80% of the sites surveyed having no observed redds and one site contributing more than 50% of the observed redds to the annual count. While last years spawning survey conditions were less than optimal due to prolonged periods of high flows (Appendix A), in 2009 we still had no redds constructed at approximately 50% of the sites surveyed. This is typical other projects attempting to estimate steelhead escapement in interior basins where adult densities are low (McCormick 2009; Ruzycki 2009). Although the MFJDR_IMW monitoring project has only been active for two years, low densities of adult steelhead will likely limit our ability to assess population level responses to restoration activities unless a more robust statistical method is developed to estimate variance at low abundances.

We PIT tagged nearly 1,000 more juvenile salmonids in the Middle Fork John Day River in 2009 compared to 2008 (3,297 and 2,646, respectively). With the increased tagging effort, there should be an increased level of detection of downstream migrating fish improving our ability to estimate parr to smolt survival estimates. Since our instream PIT-tag antenna array was not functional until after 1 April 2009, we likely missed a large portion of the downstream migrating smolts and upstream migrating adult steelhead. We anticipate improved detection levels during future migration seasons. Additional improvements in parr to smolt survival estimates could be attained by increasing detections of tagged fish. Typically, the RST is only operated when discharge is below 1,000 cfs. However, flows often exceeded this discharge during the past two Springs. Hopefully, data from the instream antenna array can provide additional information when fish are moving downstream and fishing effort can be increased to sample the portion of the run even if flows exceed 1,000 cfs as long as safe operation of equipment and personnel are practiced.

Capturing over 200 juvenile Chinook salmon in Camp Creek during the Fall sampling events helped exceed our tagging goal of 3,000 fish. This unexpected capture level may be due in part to the removal of several log weirs in the lower reaches of Camp Creek by the Forest Service during the summer of 2009. Most juvenile Chinook captured this fall were captured in the vicinity of another series of three log weirs in the Lower Camp Creek near the FS36 Road bridge—suggesting that artificially placed log weirs may be inhibiting juvenile Chinook passage. Additional log weirs are anticipated to be removed over the next couple of years, potentially improving upstream distribution of juvenile salmonids. Our juvenile Chinook distribution surveys also indicate that both natural and artificial obstructions are limiting juvenile Chinook distribution. Small log jams and/or weirs, less than 3 ft. in height, appear to limit juvenile Chinook passage, especially in Deerhorn, Vinegar, and Davis creeks. Although *O. mykiss* are found throughout the Middle Fork John Day watershed, even above these apparent juvenile Chinook barriers, it is possible that obstructions also limit upstream passage of juvenile *O. mykiss* seeking thermal refugia. As such, it may be beneficial to prioritize removal of artificial log weirs in tributaries when evidence suggests they pose a barrier to juvenile fish.

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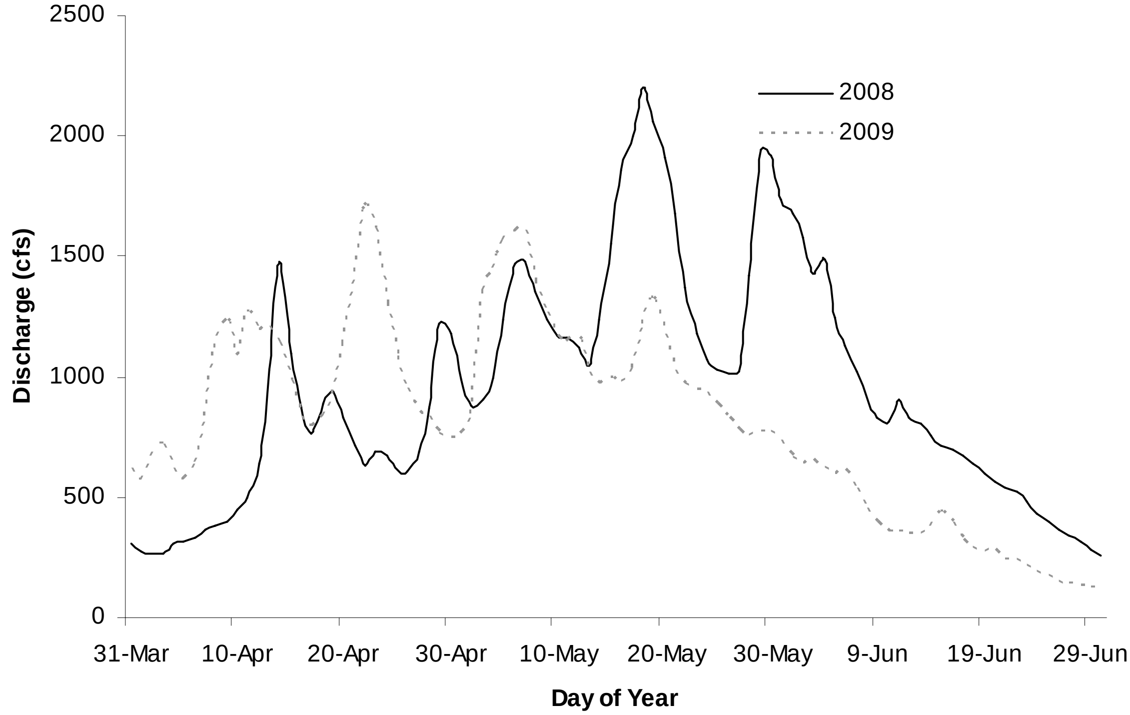
APPENDICES



Appendix A. Discharge, in cubic feet per second, recorded from 31-March to 30-June at the USGS gauging station on the Middle Fork John Day River near Ritter, OR.