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. tschawytsha* 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 24 redds constructed at six of 29 sites. We estimate a redd density of 0.4 redds/km or 192 redds in the MFJDR_IMW constructed by an estimated 769 returning adult steelhead. Collectively, we also tagged 2,646 juvenile steelhead, Chinook, and Bull trout *Salvelinus confluentus* from July to October 2008. 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.

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 also 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 smolts produced for constructed redds (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).

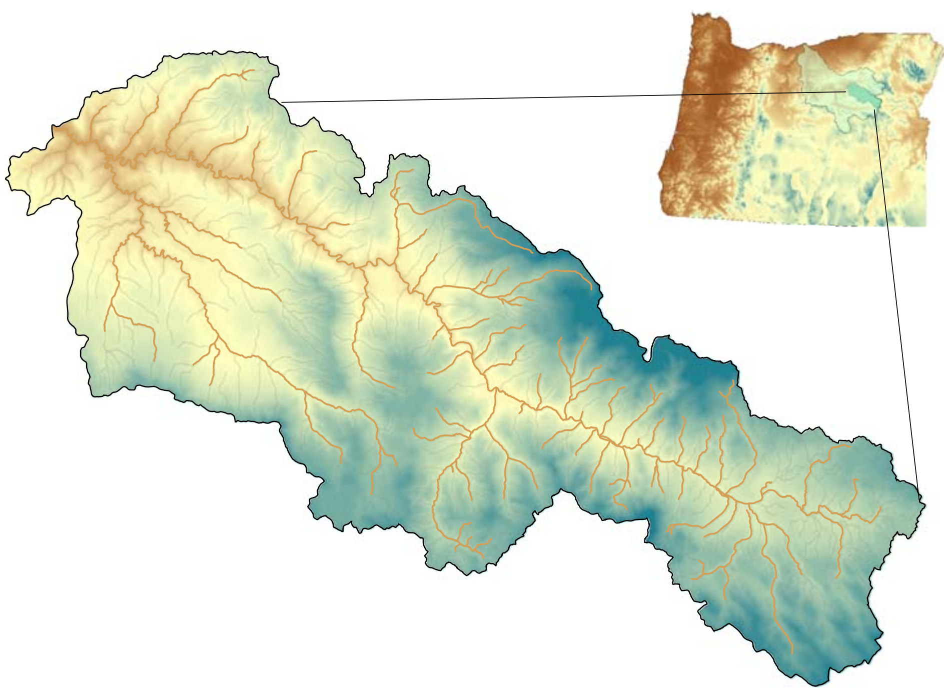

Figure 1. Map of the location of the Middle Fork John Day River and its tributaries in relation to the John Day River subbasin and the state of Oregon (Inset).

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 (March 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 efficiency. 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 or unidentified in-stream barriers.

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, to quantify the number of unique redds constructed at each site, at approximately two week intervals to account for the temporal variation in spawning activity. Survey reaches were approximately 2 km in length and encompassed the sample point derived from the EMAP sampling design. Surveyors walked upstream from the downstream end of each reach and counted all redds, live fish, and carcasses observed. New redds were flagged and the location marked with a GPS unit (UTM - NAD 27). During each visit, surveyors recorded the number of flagged redds and new redds. New redds were expected to be devoid of periphyton whereas older redds would be obscured by periphytic growth or sediment deposits.

Overall redd density (R_D) was estimated by:

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

where r_i is the number of unique redds observed at site i, d_i is the distance surveyed (km) at site i, and i is the individual sites surveyed. The total number of redds (R_T) occurring throughout the 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 (465 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 repeated 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).

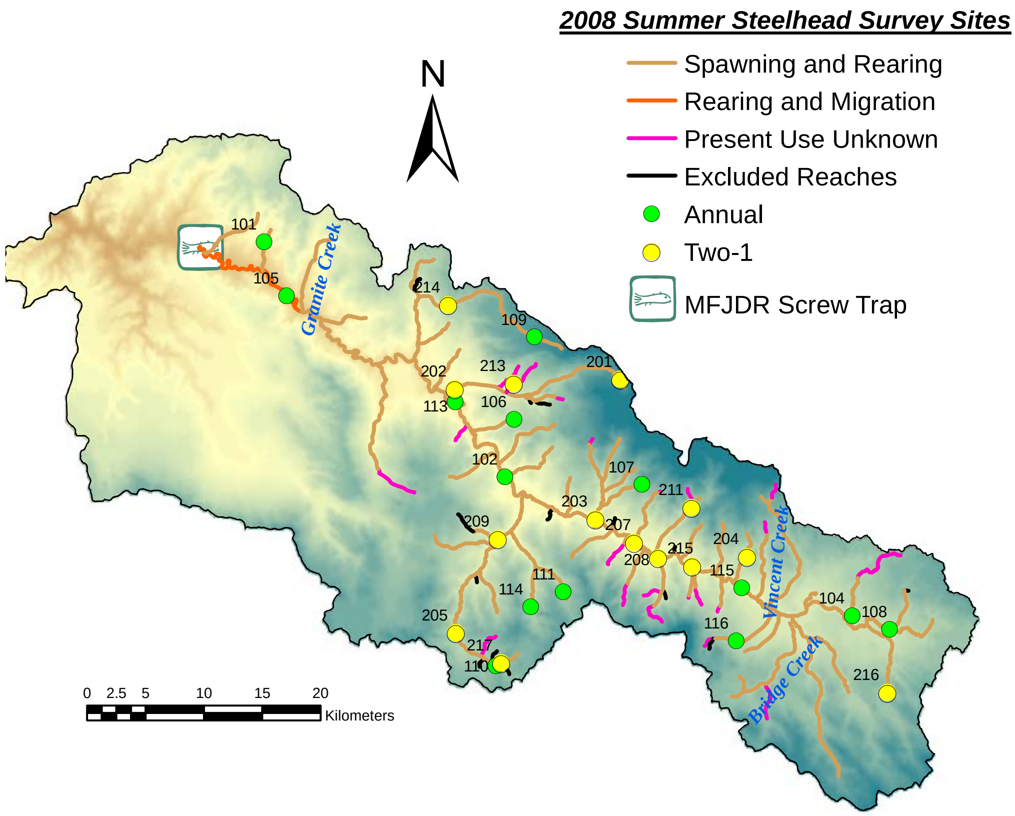

Figure 2. Map of summer steelhead distribution used for selecting steelhead spawning survey sites, with Annual and Two-1 sites sampled in 2008. The rotary screw trap (MFJDR Screw Trap) near Ritter, OR, the lower extent for sampling, is shown for reference.

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 2008. To reach our tagging goal (Table 1) we also sampled fish within the MFJDR between Camp Creek and Butte Creek, primarily targeting juvenile Chinook.

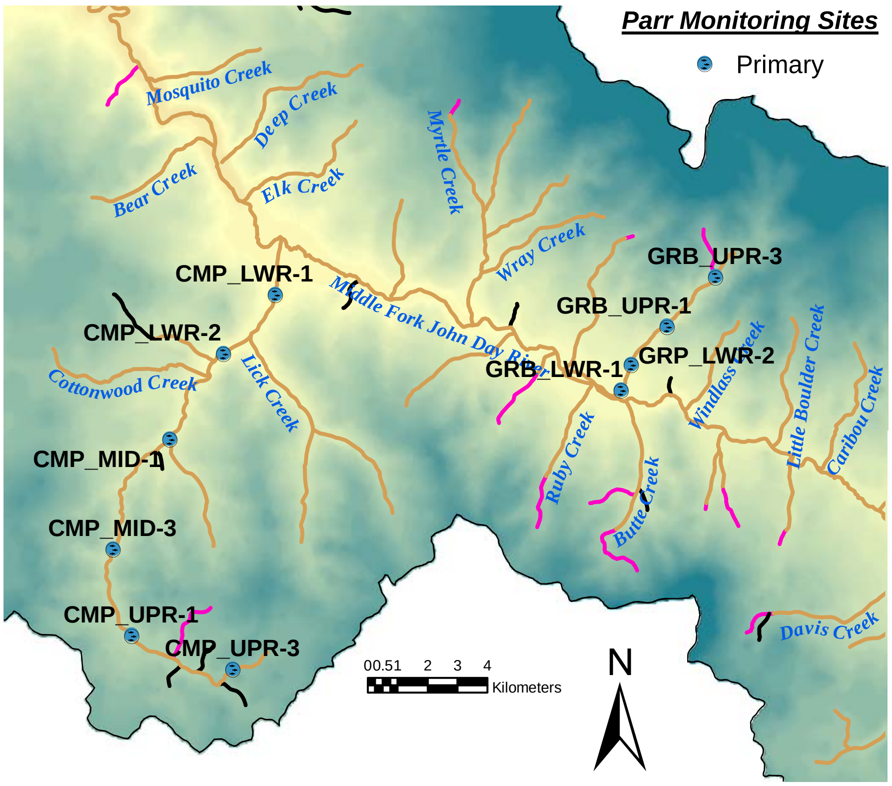

Figure 3. Parr Monitoring sites and associated site codes for Camp Creek and Granite Boulder Creek.

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

Stream	Chinook	Steelhead	Total Tags
Camp Creek	450	850	1,300
Granite Boulder Cr.	450	850	1,300
Middle Fork JDR	400		400
Total Tags	*1,300*	*1,700*	*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 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 4'x4' bag anchored at the pool tailout. 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) or fin clips, 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 five samples collected during fall sampling. All bull trout were sampled for scales. Fish smaller than 60 mm, the recommended length for PIT-tagging, were marked with a caudal clip to track recaptures, either top or bottom depending on the sampling day. No fin-clips were administered on the final sampling day. 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 and recapture probabilities as well as population abundances. 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 parsimonius 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 parameterize population abundance, which is not included in this table.

Model	Model Description	# of Parameters
p(c),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

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 Squaw Creek at the suspected upstream extent of Chinook distribution in the MFJDR_IMW (Figure 4). Sampling proceeded downstream noting the presence/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 began by sampling every fifth pool beginning at the upstream extent of juvenile Chinook distribution and proceeding downstream to the mouth. In the event that no focal fish (Chinook, steelhead, or bull trout) were observed, we proceeded to sample every third pool. If a target fish was observed in the third pool, sampling returned to an every fifth pool sampling frequency. If no focal fish were observed in the third pool, sampling frequency occurred in every pool encountered until a target fish was observed at which point we returned to sampling every fifth pool. In the mainstem MFJDR, we sampled every third pool from the confluence of Summit Creek and Squaw Creek downstream to Camp Creek. When no target fish were observed in a pool, sampling frequency was increased to every other pool until a target fish was again observed and subsequent sampling frequency returned to every third pool. In the event that no target fish were observed at the every other pool sampling frequency, we began sampling every pool encountered until a target fish was observed and sampling frequency returned to sampling every third pool. Downstream of Camp Creek within the MFJDR, we sampled every pool.

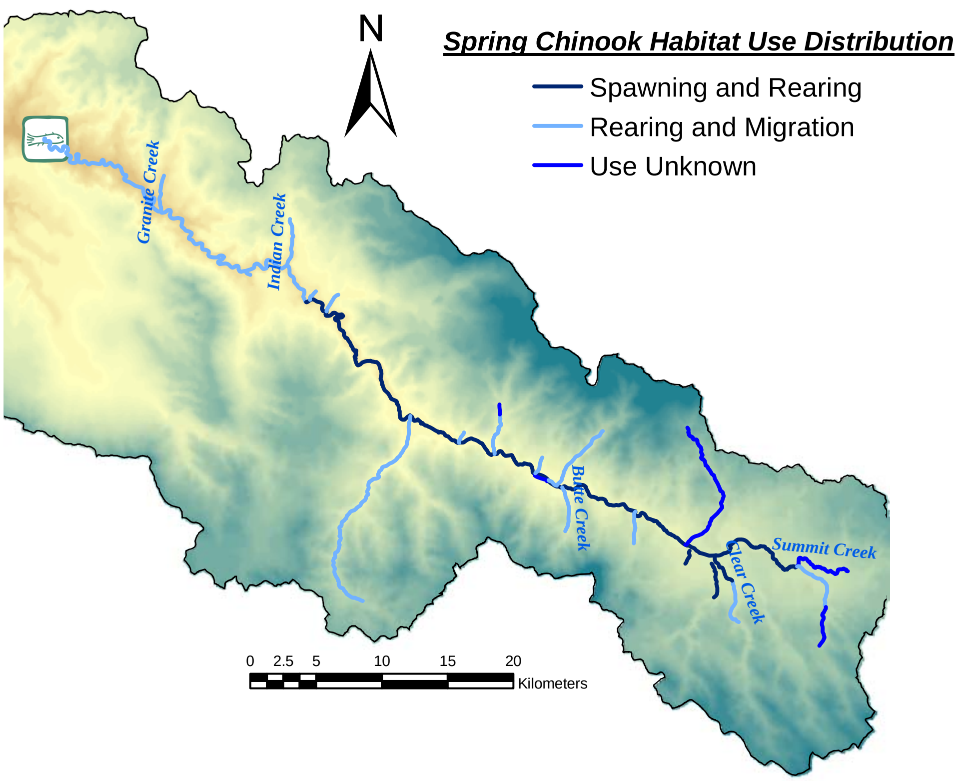

Figure 4. Spring Chinook habitat use distribution in the Middle Fork John Day River Intensively Monitored Watershed.

RESULTS

Summer Steelhead Escapement

We surveyed 29 sites for spawning adult summer steelhead in the Middle Fork John Day River from 19 March to 26 June 2008 (Table 3). We were unable to survey one site due to unsuccessful attempts to make contact with the landowner. We observed 24 total redds at only six of the 29 sites surveyed (21%). Of the six sites where redds were observed, most had one to three redds. At site 208 on Butte Creek, we observed 14 redds (Table 4). This site accounted for approximately 58% of all redds observed in the MFJDR_IMW during 2008. Corresponding redd densities at all sites ranged from zero to seven redds per kilometer (Figure 5) and averaged 0.4 redds/km for the entire MFJDR_IMW (Table 5). Given this redd density, we estimate that 192 redds were constructed in the MFJDR_IMW by 769 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 2008.

Stream	Site ID	Redds	Redd Density	Wild Steelhead	Unknown Steelhead
Rush Cr.	101	0	0.00	0	1
MFJDR	102	0	0.00	0	0
Coyote Cr.	103	0	0.00	0	0
Crawford Cr.	104	0	0.00	0	0
MFJDR	105	0	0.00	0	0
Mosquito Cr.	106	0	0.00	0	0
Wray Cr.	107	0	0.00	0	0
Summit Cr.	108	1	0.48	0	0
Indian Cr.	109	0	0.00	0	0
Camp Cr.	110	3	1.50	0	0
Lick Cr.	111	0	0.00	0	0
MFJDR	113	0	0.00	0	0
W.F. Lick Cr.	114	0	0.00	2	1
MFJDR	115	0	0.00	0	0
Davis Cr.	116	0	0.00	0	0
Big Creek	201	0	0.00	0	0
Big Creek	202	0	0.00	0	0
Big Boulder Cr.	203	0	0.00	1	2
Caribou Cr.	204	3	1.50	2	0
Camp Creek	205	0	0.00	3	0
Beaver Cr.	207	0	0.00	0	0
Butte Cr.	208	14	7.00	4	4
Camp Cr.	209	2	1.00	0	1
Granite Boulder Cr.	211	0	0.00	0	0
E.F. Big Cr.	213	0	0.00	0	0
Indian Cr.	214	0	0.00	0	0
MFJDR	215	0	0.00	0	0
Squaw Cr.	216	1	0.48	0	0
Camp Cr.	217	0	0.00	2	0

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

Stream	Site ID	UTM Zone	Start Coordinates Easting	Start Coordinates Northing	End Coordinates Easting	End Coordinates Northing	Panel	Length (Km)	Survey Date 1	2	3	4	5	6
Beaver Cr.	207	11	0367159	4945576	0368154	4947086	Two1	1.9	3/27	4/8	4/25	5/2	5/8	5/15
Big Boulder C.	203	11	0364040	4947095	0364411	4948909	Two1	2.0	3/24	4/9	4/28	5/7	6/10	6/24
Big Cr.	201	11	0364955	4960620	0366562	4959593	Two1	2.0	6/19					
Big Cr.	202	11	0352116	4959044	0353795	4959739	Two1	2.0	3/19	4/2	4/21	5/5	6/12	6/23
Butte Cr.	208	11	0369110	4944223	0369458	4942264	Two1	2.0	3/25	4/8	4/25	5/2	5/8	5/15
Camp Cr.	110	11	0353188	4936564	0354854	4935565	Annual	2.0	5/12	5/23	6/2	6/18		
Camp Cr.	205	11	0351634	4939857	0351779	4937998	Two1	2.0	4/15	5/14	5/23	6/5	6/18	
Camp Cr.	209	11	0356616	4947031	0355175	4945834	Two1	2.0	4/8	4/23	5/14	6/6	6/17	
Camp Cr.	217	11	0355134	4935559	0356735	4936469	Two1	2.0	5/12	5/23	6/4	6/18		
Caribou Cr.	204	11	0375829	4942365	0376763	4943946	Two1	2.0	4/1	4/10	4/18	4/30	5/6	5/22
Coyote Cr.	103	11	0361742	4948729	0361591	4950493	Annual	1.9	3/27					
Crawford Cr.	104	11	0385211	4937847	0385651	4939482	Annual	2.0	4/29	5/9	5/21	6/5	6/19	
Davis Cr.	116	11	0376511	4936903	0374640	4937019	Annual	2.0	4/11	5/16	5/29	6/12	6/25	
E.F. Big Cr.	213	11	0356724	4958878	0358251	4960094	Two1	2.1	3/28	5/1				
Granite Boulder Cr.	211	11	0370763	4947054	0372193	4948358	Two1	2.0	5/8	6/10	6/25			
Indian Cr.	109	11	0357867	4964889	0359348	4963560	Annual	2.1	5/28	6/20				
Indian Cr.	214	11	0350649	4967179	0352101	4966594	Two1	1.8	4/14	6/9	6/20			
Lick Cr.	111	11	0360413	4942749	0361105	4940926	Annual	2.0	5/13	6/2	6/17			
MFJDR	102	11	0355716	4953550	0356322	4951719	Annual	2.0	3/31	4/16	6/11	6/24		
MFJDR	105	11	0336913	4969033	0338333	4967912	Annual	2.0	6/12	6/23				
MFJDR	113	11	0352005	4958106	0376179	4941354	Annual	1.9	3/24	4/2	6/11	6/23		
MFJDR	115	11	0374804	4941925	0376179	4941354	Annual	1.9	4/1	4/10	6/10	6/25		
MFJDR	215	11	0373442	4942861	0372026	4943347	Two1	1.6	3/25	4/10	6/11	6/24		
Mosquito Cr.	106	11	0355384	4955875	0357311	4956573	Annual	2.1	4/7	4/23	5/1	5/15	5/22	
Rush Cr.	101	11	0336340	4970747	0336557	4972688	Annual	2.0	3/19	4/2	4/21	5/5		
Squaw Cr.	216	11	0388395	4933491	0388048	4931531	Two1	2.1	5/9	5/21	5/30	6/13	6/26	
Summitt Cr.	108	11	0387595	4937795	0389189	4937095	Annual	2.1	4/29	5/21	6/10	6/26		
W.F. Lick Cr.	114	11	0358255	4942481	0358056	4940476	Annual	2.0	4/9	5/13	6/4	6/17		
Wray Cr.	107	11	0366628	4950228	0368575	4950500	Annual	2.0	4/28					

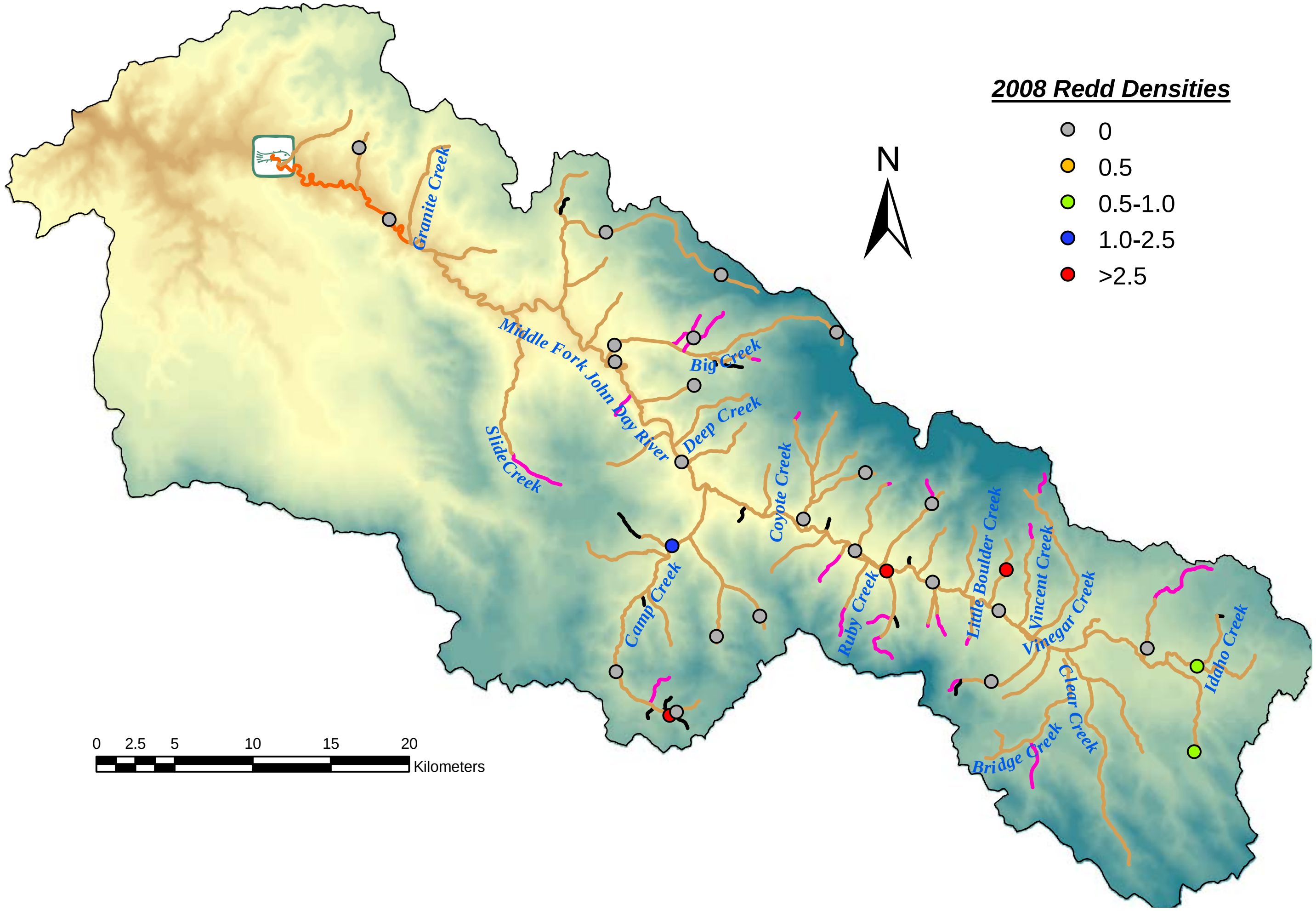

Figure 5. Redd densities at steelhead spawning sites surveyed during 2008 in the Middle Fork John Day River IMW.

Table 5. Distance surveyed, number of redds observed, estimated redd density, total estimated redds, and spawner escapement (95%CLs), during 2008 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

Parr to Smolt Survival

We collected and tagged a combined 2,646 juvenile steelhead, juvenile Chinook salmon, and Bull trout during July and October 2008 (Table 6). Nearly half (49%), 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) which were not apparent in Granite Boulder Creek (Figure 7). In fact, we observed a substantial decrease in the total number of fish tagged in Granite Boulder Creek in Fall compared to Summer while there was an increase in total number of fish captured in Camp Creek from Summer to Fall (Table 6). This relationship, however, is not entirely attributable to the apparent presence of a strong year class in Camp Creek, as the frequency of occurrence of fish in each size bin increased from Summer to Fall in Camp Creek while the reverse was apparent in Granite Boulder Creek (Figures 6 and 7, respectively).

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 2008. 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	78	5		83	188	17		205
CMP_LWR-2	52	4		56	190	15		205
CMP_MID-1	73			73	146	1		147
CMP_MID-3	31			31	73			73
CMP_UPR-1	31			31	100			100
CMP_UPR-1	36			36	57			57
Total	**301**	**9**			**754**	**33**		**787**
Granite Boulder Cr.								
GRB_LWR-1	78	58	1	137	42	35		77
GRB_LWR-2	78	1		79	32			32
GRB_UPR-1	79		1	80	37			37
GRB_UPR-3	96		7	103	19		1	20
Total	**331**	**59**	**9**	**399**	**130**	**35**	**1**	**166**
MFJDR	*34*	*950*		*984*	-	-	-	
TOTAL	**666**	**1,018**	**9**	**1,693**	**884**	**68**	**1**	**953**

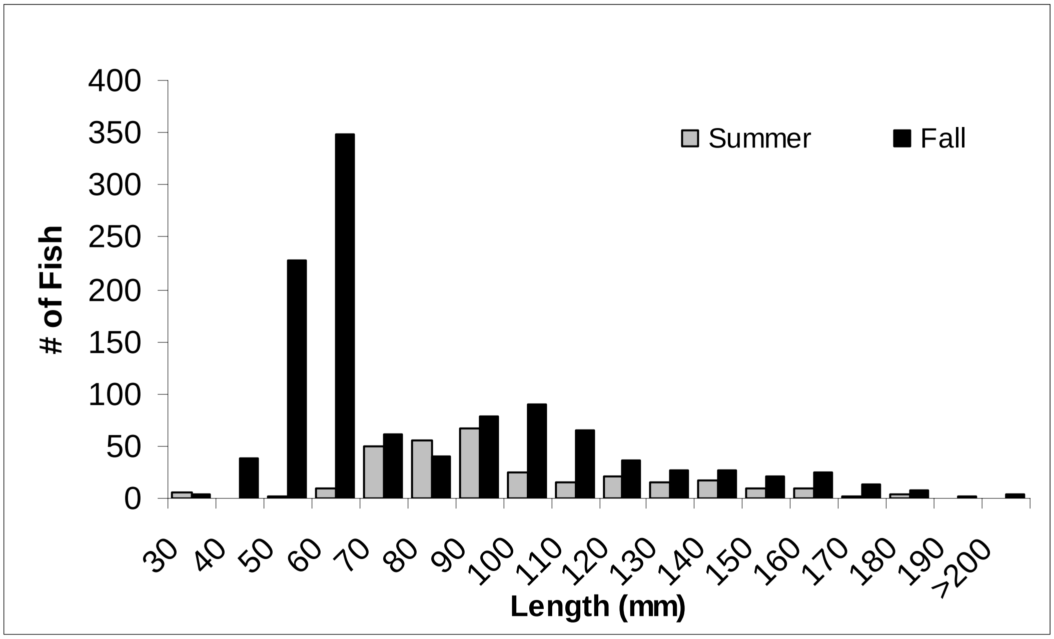

Figure 6. Number of juvenile steelhead by 10mm length increments collected in Camp Creek during Summer (July) and Fall (October) 2008. This figure includes fish which were not PIT-tagged during sampling due to small size (<60mm).

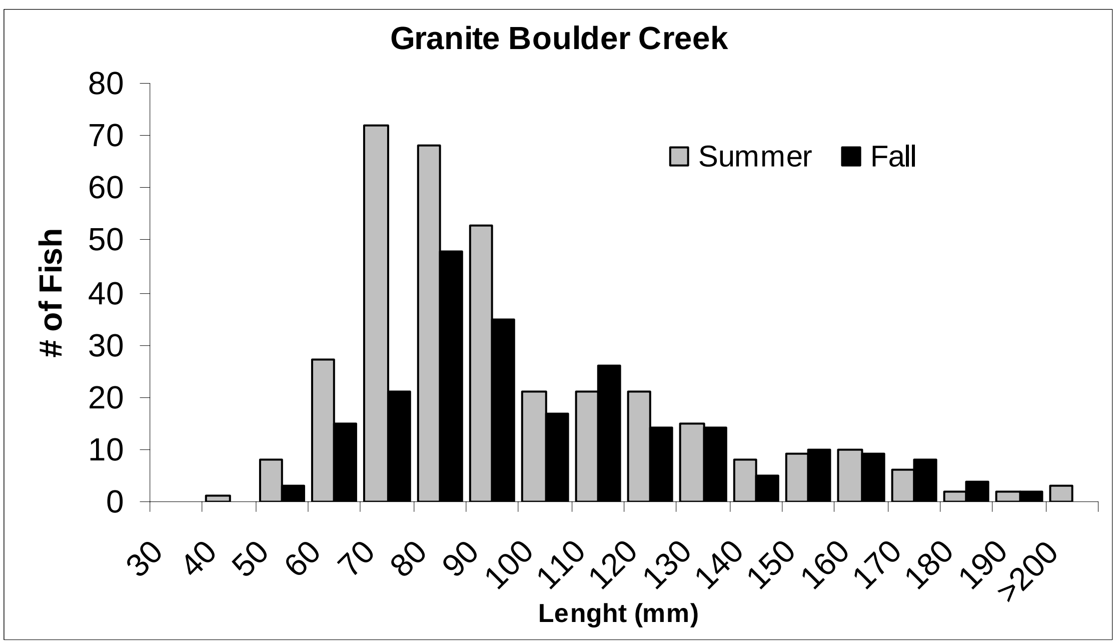

Figure 7. Number of juvenile steelhead by 10mm length increments collected in Granite Boulder Creek during sampling in Summer (July) and Fall (October) 2008. This figure includes fish which were not PIT-tagged during sampling due to small size (<60mm).

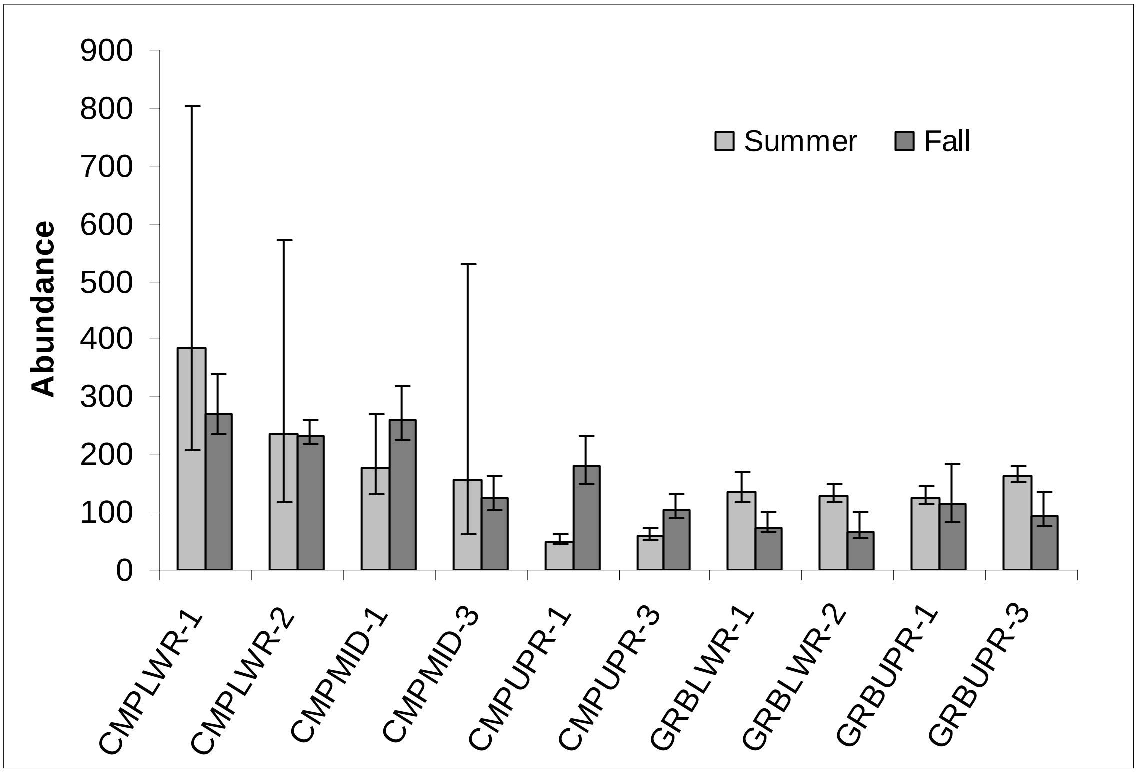

Figure 8. Abundance estimates (± 95% CI) for juvenile steelhead in Camp Creek (CMP prefix) and Granite Boulder Creek (GRB prefix) for Summer (July) and Fall (October) sampling. See Figure 3 for location site location.

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 upper Camp Creek sites (CMPUPR-1 and CMPUPR-3; Figure 8). Except for site GRBUPR-1 in Granite Boulder Creek, Fall abundance estimates were significantly less than Summer abundance estimates (Figure 8) which are consistent with the number of fish tagged in this stream (Table 6). Model parameter estimates for CMPLWR-1, CMPLWR-2, and CMPMID-3 indicate sampling efficiencies resulted in large statistical errors in the abundance estimates, especially during the summer (Table 7). Model parameter estimates for all other sites in both Camp Creek and Granite boulder creek are fairly robust resulting in greater precision of 95%CI in population estimates (Tables 7 & 8, respectively).

A total of 1,086 juvenile Chinook were collected and tagged in MFJDR_IMW during July and October, 2008 (Table 6). The majority of these individuals (91%) were sampled from the MFJDR itself between Camp Creek and Granite Boulder Creek (Table 6). The sampling that occurred in the MFJDR was not conducted as a mark-recapture event, therefore no abundance estimates are available. In addition, too few juvenile Chinook, both tagged and recaptured in both Camp Creek and Granite Boulder Creek preclude reliable population estimates in these tributaries. Average lengths of juvenile Chinook ranged from 66 mm in the Summer in Camp Creek to 81 mm in the Fall in Granite Boulder Creek (Figure 9).

Table 7. Parsimonius model selection results and associated parameter estimates of encounter histories for juvenile steelhead tagged in Camp Creek during Summer and Fall of 2008 [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	0.0754	0.0332	0.162	p(.),c(.)	p	0.381	0.279	0.495
		p	0.468	0.0197	0.107		c	0.205	0.161	0.258
		p	0.104	0.0465	0.217		N	269	237	338
		N	385	209	804					
LWR-2	p(t)=c(t)	p	0.0297	0.0094	0.0899	p(.),c(.)	p	0.522	0.431	0.611
		p	0.0892	0.0330	0.2195		c	0.164	0.126	0.210
		p	0.127	0.0478	0.298		N	232	219	260
		N	235	118	571					
MID-1	p(.)=c(.)	p	0.180	0.116	0.267	p(t)=c(t)	p	0.353	0.274	0.441
		N	178	130	270		p	0.296	0.226	0.376
							p	0.184	0.134	0.248
							N	261	225	317
MID-3	p(t)=c(t)	p	0.0254	0.0051	0.117	p(t)=c(t)	p	0.314	0.217	0.431
		p	0.114	0.0282	0.365		p	0.362	0.255	0.486
		p	0.0763	0.0186	0.265		p	0.217	0.142	0.317
		N	157	63.6	529		N	124	104	162
UPR-1	p(.)=c(.)	p	0.492	0.387	0.598	p(t)=c(t)	p	0.247	0.173	0.339
		N	50	46.1	62.3		p	0.381	0.278	0.496
							p	0.174	0.116	0.252
							N	178	149	231
UPR-3	p(.)=c(.)	p	0.454	0.354	0.558	p(.)=c(.)	p	0.354	0.274	0.443
		N	58	52.4	72.7		N	104	89.9	131

Table 8. Parsimonius model selection results and associated parameter estimates of encounter histories for juvenile steelhead tagged in Granite Boulder Creek during Summer and Fall of 2008 [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	0.334	0.263	0.413	p(.),c(.)	p	0.459	0.289	0.638
		N	136	118	168		c	0.157	0.0932	0.251
							N	72.0	64.1	100
LWR-2	p(.)=c(.)	p	0.438	0.368	0.509	p(.),c(.)	p	0.410	0.226	0.624
		N	127	117	147		c	0.147	0.810	0.252
							N	65	55.3	102
UPR-1	p(t)=c(t)	p	0.264	0.190	0.354	p(.)=c(.)	p	0.203	0.126	0.310
		p	0.6153	0.503	0.716		N	115	83.9	182
		p	0.447	0.351	0.548					
		N	125	116	144					
UPR-3	p(.)=c(.)	p	0.470	0.410	0.531	p(t)=c(t)	p	0.296	0.186	0.437
		N	162	151	181		p	0.360	0.231	0.513
							p	0.159	0.0892	0.267
							N	95	75.6	135

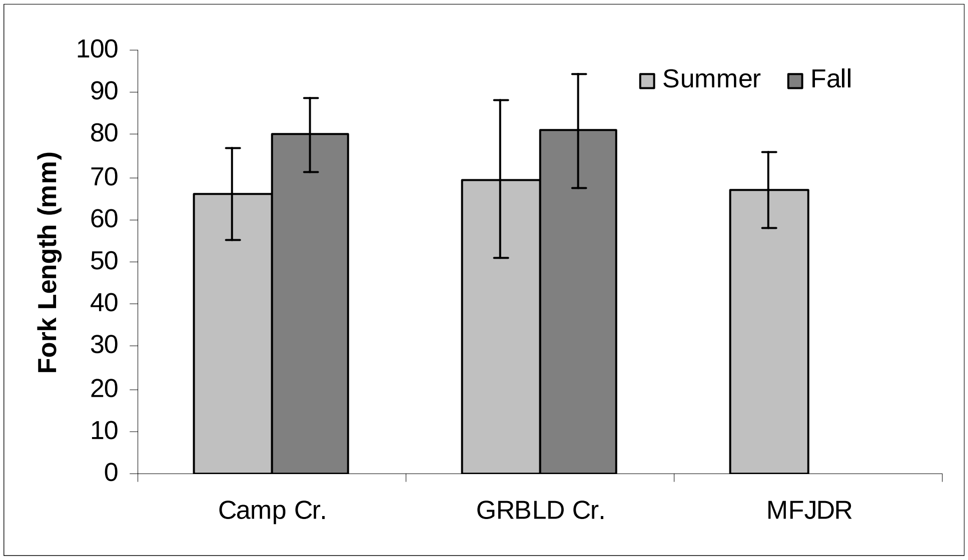

Figure 9. Average length (mm) and 95% CI of juvenile Chinook collected and tagged in Camp Creek, Granite Boulder Creek (GRBLD Cr.), and the Middle Fork John Day River (MFJDR) during Summer (July) and Fall (October) of 2008. No sampling was conducted in the MFJDR during the Fall sampling period.

Table 9. Number of juvenile steelhead and juvenile Chinook tagged during Summer and Fall sampling in Granite Boulder Creek and Camp Creek and the number and percentage of those Summer tagged fish recaptured in the Fall.

	Steelhead		Juvenile Chinook	
	Tagged	**Fall Recaptures**	**Tagged**	**Fall Recaptures**
Camp Creek	1,055			
Summer	301	91 (30.2%)	9	0 (0.0%
Fall	754		33	
Granite Boulder Creek	461			
Summer	331	99 (29.9%)	59	3 (5.0%)
Fall	130		35	
Total	1,516	190 (30.1%)	136	3 (2.2%)

During Fall, we observed similar recapture rates of juvenile steelhead previously tagged during the Summer at Camp Creek and Granite Boulder Creek sites (Table 9). The recapture rate for juvenile Chinook was only 5% for Granite Boulder Creek while no Chinook tagged during the summer were recaptured in Camp Creek during the Fall (Table 9). The lower recapture rates for juvenile Chinook compared to steelhead is due in part to their limited distribution within each stream, the small number of individuals tagged in the summer, and may not necessarily be related to poor survival.

We captured and tagged a total of 10 Bull trout in Granite Boulder Creek during sampling events there in 2008 (Table 6). Most captures occurred in the Summer (90%) while only one fish was captured in the Fall (Table 6). Lengths of captured Bull trout ranged from 75 to 188 mm (Table 9). One Bull trout (PIT-tag Code: 3D9.1C2C7F79AF) was captured on 8 October 2008 and scanned as a recapture (Table 9). However, this tag was implanted into a 74 mm steelhead on 6 August 2008 in Granite Boulder Creek, therefore this Bull trout was not included in the overall number of Bull trout tagged.

Table 10. Bull trout PIT-tag codes, tag date and site, fork length (FL; mm), mass (g), and conditional comments (RE = Recapture) captured and tagged in Granite Boulder Creek. Asterisks (*) denote recaptured fish.

PIT-tag Code	Tag Date	Tag Site	FL (mm)	Mass (g)
3D9.1C2C7F3B15	8/6/2008	GRBLDC	188	
3D9.1C2C7F3B15*	8/8/2008	GRBLDC	186	69.9
3D9.1C2C7F5929	7/28/2008	GRBLDC	166	
3D9.1C2C7F5929*	7/29/2008	GRBLDC	165	41.1
3D9.1C2C7F5929*	7/30/2008	GRBLDC	165	
3D9.1C2C7F7525	8/6/2008	GRBLDC	94	
3D9.1C2C7F79AF[a]	10/8/2008	GRBLDC	178	45.3
3D9.1C2C7F7F94	10/8/2008	GRBLDC	89	6.6
3D9.1C2C7FC45F	8/8/2008	GRBLDC	108	11
3D9.1C2C84071F	8/7/2008	GRBLDC	121	16.6
3D9.1C2C84071F*	8/8/2008	GRBLDC	121	17
3D9.1C2C8506A8	8/6/2008	GRBLDC	112	
3D9.1C2C851313	8/7/2008	GRBLDC	162	38.2
3D9.1C2C851313*	8/8/2008	GRBLDC	154	39.5
3D9.1C2C855527	8/6/2008	GRBLDC	75	
3D9.1C2C855B32	8/6/2008	GRBLDC	117	

[a] this Bull trout ingested a tag from a previously tagged steelhead (see text for further information).

Chinook Summer Rearing Distribution

We sampled 475 pools in the MFJDR_IMW to assess summer rearing distribution of juvenile Chinook salmon. Juvenile Chinook salmon were observed in 107 separate pools (22.5%). The observed summer distribution of juvenile Chinook salmon during 2008 was smaller in comparison to the purported distribution (Figure 10). Within the Middle Fork John Day River itself, juvenile Chinook distribution occurred from near its headwaters, at the confluence of Summit and Squaw Creek downstream to the mouth of Butte Creek (Figure 10). Sampling which occurred as a part of another objective in this project, from Camp Creek upstream to the mouth of Butte Creek, consistently encountered juvenile Chinook presence within that reach. We did not sample below Camp Creek in the MFJDR this summer as we ran out of time before cooler temperatures settled into the basin. If present in tributaries of the MFJDR, most juvenile Chinook occurred in the initial 1-2 kilometers upstream from the tributary mouth (Figure 10). Again, additional sampling which occurred as a separate objective for this project encountered juvenile Chinook within only the first few kilometers of both Camp Creek and Granite Boulder Creek. Multiple tracts of private land were not surveyed this year due to a lack of time to contact landowners seeking access permission.

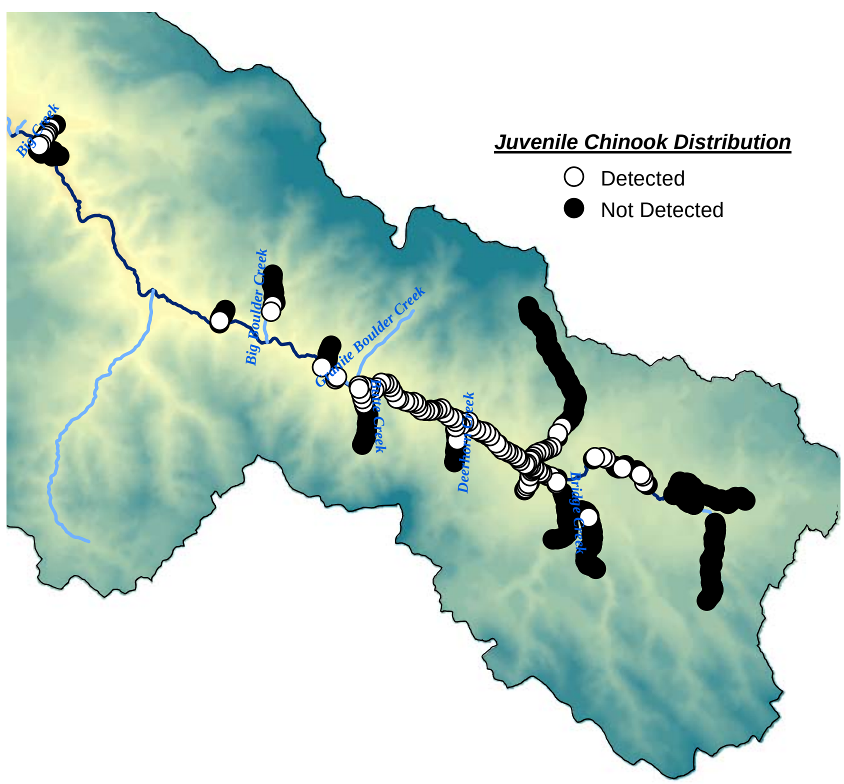

Figure 10. Presence (open circles) and absence (closed circles) of juvenile Chinook salmon in pools sampled within the MFJDR_IMW during 2008.

DISCUSSION

Weather conditions influenced our ability to conduct steelhead spawning surveys in 2008. Many sites were inaccessible until mid- to late June because of heavy snow packs, and as temperatures increased flow levels became extremely high and safety became a real concern for surveyors in many streams. Flows also influenced our ability to observe redds because of increased turbidity or by eroding visible redd characteristics. Even still, our results are consistent with other steelhead spawning data collected in the John Day River Basin in 2008 (McCormick et al. 2008, Tim Unterwegner, ODFW unpublished data). In our reference stream on the Grande Ronde River basin, Deer Creek, where a permanent weir is present, low redd visibility and short redd life resulted in a relatively high fish per redd estimate (4.07) for 2008 compared to when conditions were optimal for redd viewing (~ 1.6 fish/redd; Gee et al. 2008).

Because of the large snow-pack this winter and cool spring, spring and summer flows were above average in the MFJDR well into August and September. This increased flow likely mitigated increases in summer water temperatures, allowing rearing juveniles to occupy habitats that would not provide adequate thermal refugia during average years with lower flows and higher temperatures. Our observations suggest that temperature is not the only factor limiting juvenile Chinook distribution. A lack of flow at the mouths of Summit Creek and Squaw Creek would have prevented any upstream juvenile Chinook passage during warmer summer months. A series of multiple log jams, sufficient to limit juvenile passage, were encountered in Vinegar Creek. In Big Boulder Creek, a water fall (~4 m high) between two large boulders, prevents any upstream passage for juvenile fish. A few tributaries lacked identifiable confluences with the MFJDR (Coyote Creek and Beaver Creek). Even though Butte Creek had multiple channels flowing into the MFJDR, two of the three channels with the majority of flow, entered the MFJDR over 0.5 m high falls.

We currently do not have data to estimate parr to smolt survival. Chinook parr tagged during the summer of 2008 are expected to migrate past our rotary screw trap and PIT tag antenna array during the spring of 2009. Steelhead life history is more complex and it will be two to three years before we are able to calculate parr to smolt survival for summer steelhead.

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