AVISTA

January 24, 2012

Ms. Marcie Mangold
Washington Department of Ecology
Eastern Region Office
4601 N Monroe Street
Spokane, WA 99205-1295

Subject: **Spokane River Hydroelectric Project (FERC Project No. 2545)**
License - Appendix B, Section 5.3 D. 1
Middle Spokane River Baseline Fish Population Assessment
Annual Progress Report 2011

Dear Marcie:

I have attached the Middle Spokane River Baseline Fish Population Assessment (2011 Assessment) for your information and records. Avista contracted the Washington Department of Fish and Wildlife to complete the second year (2011) of this project for the Upper Falls Reservoir. This satisfies the activities associated with the 2011 Assessment required by our FERC License, Appendix B, Section 5.3 D. 1.

If you have any questions regarding this, you can contact me at telephone number (509) 495-8612.

Sincerely,

Tim Vore

Tim Vore
Environmental Specialist

Enclosure

cc: Yelena Goloborodko

AVISTA

January 24, 2012

Doug Robison
Washington Department of Fish and Wildlife
2315 N Discovery Place
Spokane Valley, WA 99216

Subject: **Spokane River Hydroelectric Project (FERC Project No. 2545)**
License - Appendix B, Section 5.3 D. 1
Middle Spokane River Baseline Fish Population Assessment
Annual Progress Report 2011

Dear Doug:

I have attached the Middle Spokane River Baseline Fish Population Assessment (2011 Assessment) for your information and records. Avista contracted the Washington Department of Fish and Wildlife to complete the second year (2011) of this project for the Upper Falls Reservoir. This satisfies the activities associated with the 2011 Assessment required by our FERC License, Appendix B, Section 5.3 D. 1.

If you have any questions regarding this, you can contact me at telephone number (509) 495-8612.

Sincerely,

Tim Vore

Tim Vore
Environmental Specialist

Enclosure

cc: Yelena Goloborodko

Middle Spokane River Baseline Fish Population Assessment

Annual Progress Report 2011

Prepared for:

Avista Corporation
P.O. Box 3727
Spokane, WA 99220-3727

FERC Project No. 2545-091
Contract No. R-36488

Prepared by:

Leslie C. King
and
Charles D. Lee

Washington Department of Fish and Wildlife
2315 N. Discovery Place
Spokane Valley, WA

January 2012

Abstract

The Federal Energy Regulatory Commission (FERC) issued a new license for the Spokane River Hydroelectric Project (FERC No. 2545) on June 18, 2009. This study is intended to provide a baseline assessment of the fish population between Upper Falls Dam and Upriver Dam on the Spokane River in Washington and meet the license requirements identified in Appendix B, section 5.3 D. 1. A second consecutive year of boat electrofishing surveys was conducted on the middle Spokane River as part of a three year baseline assessment of the fish community between Upper Falls and Upriver dams in September 2011. The fish assemblage observed was comprised of Cyprinidae (minnows), Catostomidae (suckers), Salmonidae (trout), Cottidae (sculpin), Centrarchidae (bass and sunfish) and Percidae (perch). Largescale suckers were the most abundant species followed by redband trout and northern pikeminnow. Redband trout were the most abundant sport fish and were represented in five year classes. Non-native sport fish collected included hatchery origin rainbow trout, brown trout, smallmouth bass and yellow perch.

Acknowledgements

We thank Tim Vore (Avista Corporation) for the administration of this project, assistance with field sampling and reviewing this document. We thank Tony Madunich (City of Spokane Parks and Recreation) and the staff at City of Spokane Upriver Dam for providing access to the river. We also thank Jeff Wilson, Marc Divens, and Randall Osborne (Washington Department of Fish and Wildlife, WDFW) for their assistance with field sampling. Lance Campbell and Lucinda Morrow (WDFW Aging Lab) conducted the scale analysis. We thank John Whalen, Chris Donley, Doug Robison (WDFW) and Marcie Mangold (Washington Department of Ecology, WDOE) for providing reviews of this document.

Funding for this project was provided by Avista Corporation. PIT tags were provided by the U.S. Department of Energy, Bonneville Power Administration (Project No. 199700400), contract no. 46284, to assist with the abundance and year class strength component of the Redband Trout Spawning and Fry Emergence Study.

Table of Contents

List of Tables

List of Figures

Introduction

The Spokane River originates at the outlet of Lake Coeur d'Alene in Idaho and flows through the city of Spokane, WA approximately 179 km westerly to the Columbia River in eastern Washington. Avista Corporation (Avista) owns five hydroelectric developments (HED) (Post Falls Dam, Upper Falls Dam, Monroe Street Dam, Nine Mile Dam, and Long Lake Dam) operated under a single license and comprise the Spokane River Project (FERC 2009; WDOE 2009). The Federal Energy Regulatory Commission (FERC) issued a new license (license) for the Spokane River Hydroelectric Project (FERC No. 2545) on 18 June 2009 (FERC 2009). Ordering Paragraph E of the FERC license incorporated the Washington Department of Ecology's (WDOE) Certification Conditions under Section 401 of the Federal Clean Water Act (WDOE 2009). These conditions can be found in Appendix B of the license. The Washington Department of Fish and Wildlife (WDFW) was contracted to assist Avista in conducting a three-year baseline assessment of the fishery between Upper Falls Dam (rkm 120.5) and Upriver Dam (rkm 129.0) to comply with condition 5.3 (D)1 described in Appendix B of the license. This report presents the results of the second year (2011) effort following the approved July 2010 – January 2013 scope of work.

Few studies have been conducted on the fishery in the middle Spokane River between Upper Falls Dam and Upriver Dam, including the Upper Falls Reservoir. The first formal fish population assessment conducted in the middle Spokane River revealed a fish assemblage comprised of native Cyprinids, Salmonids, Catostomids, and Cottids (sculpin), as well as non-native Salmonids (hatchery origin trout) and Centrarchids (bass and sunfish) (O'Connor and McLellan 2008). Recent genetic analysis in the upper (Post Falls to Upriver dams) and the lower (Monroe Street to Nine Mile dams) Spokane River indicated wild rainbow trout were the Columbia River redband subspecies *Oncorhynchus mykiss gairdneri* with limited hatchery introgression (Small et al. 2007). Current angling regulations in the middle Spokane River follow general statewide regulations and allow year-round harvest, although regulations in the upper and lower Spokane River promote conservation of redband trout through harvest restrictions and selective gear guidelines. In accordance with Article 405 of the license, Avista annually stocks 6,000 adipose fin clipped, sterile, catchable sized rainbow trout into Upper Falls Reservoir to supplement the recreational fishery.

Study Area

Avista owns and operates the Upper Falls HED as run-of-the-river, where inflow discharge equals outflow discharge. The City of Spokane owns and operates the Upriver Hydroelectric Project (Upriver Dam) just upstream on the Spokane River. The study area, hereafter referred to as the middle Spokane River, was the stretch of the Spokane River between Upper Falls (rkm 120.5) and Upriver dams (rkm 129.0) which lies within the city limits of Spokane, Washington (Figure 1).

The study area was stratified into two distinct sections identified by different physical characteristics. The upper free-flowing section downstream of the Upriver Dam (rkm 125.0-129.0) was characterized by a single, relatively narrow channel with two shallow riffles separated by medium depth (1-2 m) runs and deep pools (>3 m). Substrates in the free-flowing section were typically large with many boulders >1 m in diameter. The transition between the upper and lower sections occurred just downstream of Greene Street at the tail out of a riffle (rkm 125.0). The lower section (rkm 120.5-125.0) was wider (>35 m), slower, and typically shallower (≤1 m) than the free-flowing section. The lower half of the section included a few deep pools (>4 m). The forebay of Upper Falls Dam extended approximately 1 km upstream with depths 3-10 m. Substrates in the lower section were mostly large cobble with two areas of sand and gravel deposition (rkm 120.7 and 121.5). Old bridge abutments in the form of large timber boxes filled with a variety of cobbles and boulders were observed at three locations on both sides of the river extending to near the water surface.

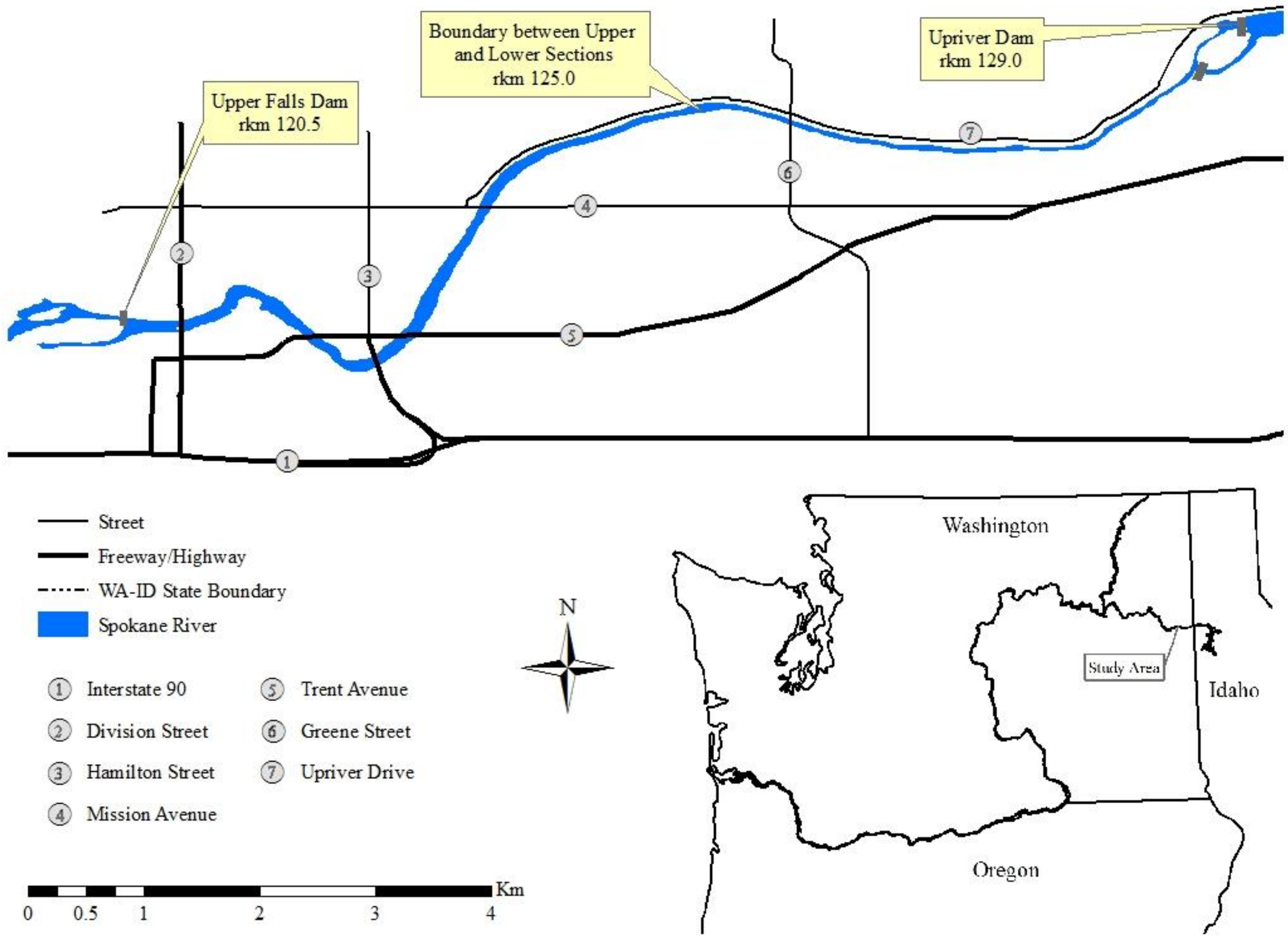

Figure 1. The middle Spokane River between Upper Falls and Upriver dams, Spokane County, Washington.

Methods

Fish were captured using boat electrofishing. A random sample strategy was employed with individual sample site locations generated using a general random tessellation stratified (GRTS) design (Stevens and Olsen 2004). The GRTS strategy supplied spatially balanced randomly chosen sample locations. Spatially balanced sampling strategies are recommended for stock assessment surveys to promote unbiased estimates of mean catch-per-unit-of-effort (*C/f*), to speed the positioning of sample gears, allow for better understanding of distribution, and to improve precision (Hilborn and Walters 1992; Bernard et al. 1993). The SPSURVEY package (version 2.1; available at: http://cran.r-project.org/web/packages/spsurvey/index.html) for the R statistical program (version 2.10.1; available at http://www.r-project.org/) and ArcGIS 10 (ESRI, Redlands, CA) were used to draw the GRTS sample locations.

A total of 12 randomly selected sites were surveyed, four in the upstream free-flowing section and eight in the lower section. Fish were captured using boat electrofishing. The electrofishing in the free-flowing section was conducted using a drift boat mounted with a Smith-Root 2.5 GPP electrofishing unit. Two Smith-Root 5.0 GPP outboard motor powered electrofishing boats were used to sample the sites in the lower section. A crew of three individuals, one rower/driver and two netters, completed the electrofishing. Sites were sampled moving in a downstream direction, beginning at the randomly selected sample location, parallel to the shoreline for a total of 600 s of electrofisher "on" time. Boat speed was maintained so that each sample section was approximately 400 m in length. All electrofishing was conducted at night, beginning at dusk and continued until all sites within that section were completed. Electrofisher settings were: voltage=low (50-100), percent varied from 40-50, pulse rate was 30 and 60 pulses per second direct current (DC), and amperage 2.0-4.0.

All fish collected were identified to species, measured for fork length (FL; mm), weighed (g), and examined for tags, marks, and physical anomalies. All data were recorded in pencil on waterproof standardized data sheets. Rainbow trout captured with an intact adipose fin were considered wild redband trout. Unmarked redband trout ≥65 mm FL were injected with a full duplex (FDX) PIT tag (Destron Fearing, TX1411SST-1, 134.2 kHz) according to the methods described in CBFWA (1999). Redband trout ≥200 mm FL were also affixed with an individually numbered Floy® FD-94 tag at the left base of the dorsal fin (Guy et al. 1996). The Floy tags were inscribed with a contact phone number to facilitate angler tag returns. Redband trout tagged for this study will facilitate evaluation of population closure for the redband trout abundance estimate downstream of Monroe Street Dam as part of the Redband Trout Spawning and Emergence Study (McLellan and Lee 2011; Lee, *in prep*).

Catch-per-unit-of-effort (*C*/*f*) index was calculated for all species as an index of population abundance. The *C/f* index was represented by the equation,

$$C/f = qN$$

where *C* was the number of fish captured, *f* was the unit of effort expended (previously defined as electrofisher "on" time), *q* was the catchability coefficient, and *N* was the total abundance of the target population (Hubert and Fabrizio 2007). Descriptive statistics of *C/f* mean and standard error were calculated using the local neighborhood methods of Stevens and Olsen (2004) and the SPSURVEY package in R.

Proportional size distribution (PSD) (Guy et al. 2006) was calculated for all sport species (trout and bass) captured. The PSD values were calculated by dividing the number of fish within a specific length category by the number of fish ≥ the minimum stock length, and multiplying by 100 (Anderson and Neumann 1996). For example, the $PSD_{S\text{-}Q}$ was calculated by dividing the number of fish ≥ the minimum quality length by the number of fish ≥ the minimum stock length, and multiplying by 100. Stock length was defined as the minimum length of fish with recreational value (20-26% of world record; rainbow trout=250 mm, smallmouth bass=180, brown trout=150) and quality length was defined as the minimum size of fish that anglers would like to catch (36-41% of world record; rainbow trout=400mm, smallmouth bass=280, brown trout=230) (Gabelhouse 1984). Preferred length was the minimum length of fish anglers would prefer to catch (45-55% of world record; rainbow trout=500 mm, smallmouth bass=350, brown trout=300). Memorable length was the minimum length of fish anglers would remember catching (59-64% of world record; rainbow trout=650 mm, smallmouth bass=430, brown trout=380). Trophy length was the minimum length of fish worthy of acknowledgement (74-80% of world record; rainbow trout=800 mm, smallmouth bass=510, brown trout=460). Total lengths (TL) of redband trout, hatchery rainbow trout, mountain whitefish, smallmouth bass, and brown trout were converted from fork length (FL) using the conversion factors (TL=1.071*FL, TL=1.071*FL, TL=1.084*FL, TL=1.04*FL, and TL=1.025*FL, respectively) from Carlander

(1969). Stock structure indices have a binomial distribution (Gustafson 1988); thus, 80% confidence intervals (CI) were calculated for the PSD values as an indication of precision, using the method for proportions (Zar 1999).

The relative weight (W_r) index was used to evaluate the condition of sport fish collected during the study. The index was calculated as,

$$W_r = \frac{W}{W_s} \times 100$$

where W was the weight (g) of an individual fish and W_s was the standard weight of a fish of the same length calculated with the standard weight (W_s) equation (Kolander et al. 1993; Milewski and Brown 1994; Simpkins and Hubert 1997). The W_s equations were obtained from Anderson and Neumann (1996). A W_r value of 100 generally indicates that a fish is in good condition (Anderson and Gutreuter 1983; Anderson and Neumann 1996).

Scale samples (up to 5 per 10 mm length class) were collected from all sport fish and sent to the WDFW Aging Lab for analysis. Fish scales were mounted on cards, pressed in acetate, and magnified to identify annuli. Ages were determined by counting annuli. Annual growth was back calculated using the direct proportional method (LeCren 1947; DeVries and Frie 1996). Annual growth was determined by the equation,

$$L_i = \frac{S_i}{S_c} L_c$$

where L_i was the back-calculated length of the fish when the ith increment was formed, L_c was the length of the fish at capture, S_c was the radius of the hard part at capture, and S_i was the radius of the hard part at the ith increment (DeVries and Frie 1996).

Results

The middle Spokane River between Upriver and Upper Falls dams was sampled on 13 and 14 September 2011. The upper free-flowing section was sampled on 13 September 2011. The lower section was sampled on 14 September 2011. A total of eleven fish species were collected via boat electrofishing in 2011 (Table 1). Largescale sucker *Catostomus macrocheilus* was the most abundant species by number and weight followed by redband trout *Oncorhynchus mykiss gairderi* across all gear types and middle Spokane River sections. Redband trout was the most abundant sport fish in the middle Spokane River.

Table 1. Species composition (%) by number (n) and weight (kg) of fish collected with all gear types in the middle Spokane River, Spokane County, WA (September 2011).

Species	Common Name	By Number		By Weight	
		n	%	kg	%
Ptychocheilus oregonensis	Northern pikeminnow	46	12.3	13.9	7.5
Richardsonius balteatus	Redside shiner	28	7.5	0.4	0.2
Catostomus macrocheilus	Largescale sucker	114	30.6	135.3	73.3
Catostomus columbianus	Bridgelip sucker	1	0.3	<0.1	<0.1
Onchorhynchus mykiss gairdneri	Redband trout	94	25.2	22.6	12.2
O. mykiss	Rainbow trout (hatchery)	11	2.9	2.3	1.2
Prosopium williamsoni	Mountain whitefish	18	4.8	7.6	4.1
Salmo trutta	Brown trout	4	1.1	1.1	0.6
Cottus spp.	Sculpin	38	10.2	0.4	0.2
Micropterus dolomieu	Smallmouth bass	18	4.8	0.9	0.5
Perca flavescens	Yellow perch	1	0.3	<0.1	<0.1
Grand Totals		373	100	184.6	100

Species richness was greater in the lower section, where all eleven species were represented. Only six species were captured in the upper free flowing section (Table 2). Redband trout was the most abundant species in drift boat electrofishing surveys conducted in the upper section, followed by largescale sucker and mountain whitefish. Whereas, largescale sucker was the most abundant in power boat electrofishing surveys in the lower section followed by redband trout and northern pikeminnow. Hatchery origin rainbow trout, northern pikeminnow, redside shiner, bridgelip sucker and yellow perch contributed to the species composition in the lower section but were absent from drift boat surveys in the upper section.

Total catch-per-unit-effort (*C/f*) was highest in power boat electrofishing surveys (Table 2). Redband trout *C/f* (64.4 fish/h) was highest in drift boat electrofishing surveys in the upper free-flowing section, although they were present in surveys of both gear types. In power boat and total electrofishing, largescale sucker *C/f* was highest, followed by redband trout.

Table 2. Number (n), relative abundance (%), and catch-per-unit-effort (*C/f*; 80% CI), by gear type, of fish collected in the middle Spokane River, Spokane County, WA (September 2011).

	Electrofishing (drift boat) effort = 0.68 h			Electrofishing (power boat) effort = 1.33 h			Total Electrofishing effort = 2.02 h		
Species	n	%	*C/f* (no./h)	n	%	*C/f* (no./h)	n	%	*C/f* (no./h)
Northern pikeminnow	0	0.0	0.0 (0.0)	46	16.3	34.5 (7.1)	46	12.3	23.0 (5.1)
Redside shiner	0	0.0	0.0 (0.0)	28	9.9	21.0 (9.3)	28	7.5	14.0 (6.2)
Largescale sucker	24	26.4	34.6 (12.3)	90	31.9	67.4 (16.0)	114	30.6	56.4 (12.2)
Bridgelip sucker	0	0.0	0.0 (0.0)	1	0.4	0.75 (0.80)	1	0.3	0.5 (0.5)
Redband trout	45	49.5	64.4 (26.0)	49	17.4	36.7 (9.3)	94	25.2	46.3 (10.7)
Rainbow trout (hatchery)	0	0.0	0.0 (0.0)	11	3.9	8.2 (4.9)	11	2.9	5.5 (3.2)
Mountain whitefish	17	18.7	25.2 (20.6)	1	0.4	0.75 (0.8)	18	4.8	8.9 (7.8)
Brown trout	3	3.3	4.3 (2.8)	1	0.4	0.75 (0.8)	4	1.1	1.9 (1.1)
Sculpin	1	1.1	4.3 (2.8)	37	13.1	27.7 (6.0)	38	10.2	18.9 (4.3)
Smallmouth bass	1	1.1	1.4 (1.5)	17	6.0	12.7 (4.3)	18	4.8	9.0 (3.3)
Yellow perch	0	0.0	0.0 (0.0)	1	0.4	0.75 (0.8)	1	0.3	0.5 (0.6)

Most of the redband trout (82%) were in the PSD_{S-Q} category, while the remaining fish were in the PSD_{Q-P} category (Table 3). The majority of brown trout *Salmo trutta* captured were in the PSD_{P-M} category, however the sample size was small (n=3). All hatchery origin rainbow trout and smallmouth bass *Micropterus dolomieu* collected were in the PSD_{S-Q} category.

Redband trout mean FL was 250 mm (SD=80) and ranged from 93 to 426 mm (Table 4). Mean weight was 240 g (SD=213) and ranged from 8 to 1,029 g. Mean relative weight W_r of redband trout was 89 (SD=7) (Figure 2). Smallmouth bass mean FL was 138 mm (SD=41) and ranged from 84 to 211 mm. Mean weight was 51 g (SD=43) and ranged from 9-145 g. Mean W_r for smallmouth bass was 102 (SD=8) (Figure 3). Additionally, mean FL for mountain whitefish was 301 mm (SD=95) and ranged from 134 to 396 mm while mean weight was 423 g (SD=246) and ranged from 27 to 732 g. Mean W_r of mountain whitefish was 98 (SD=9) (Figure 4). Hatchery origin rainbow trout mean FL was 251 mm (SD=48) and ranged from192 to 333 mm. Mean weight of hatchery rainbow trout was 209 g (SD=125) and ranged from 81 to 491 g. Brown trout mean FL was 266 mm (SD=109) and ranged from 115 to 360 mm. Mean weight was 287 g (SD=225) and ranged from 19-539 g. Mean W_r of brown trout was 97 (SD=3). Relative weight of hatchery origin rainbow trout and brown trout were not graphed due to small sample sizes.

Redband trout (n=91) were aged from 0 to 4 years (

Table 5). Mean FL of redband trout at age 0 was 112 mm and mean FL was 390 mm at age 4. Smallmouth bass (n=17) ranged in age from 1 to 4 years (Table 6). Mountain whitefish *Prosopium williamsoni* (n=17) were aged from 0 to 5 years (Table 7). The 2008 cohort (age-3 year class) of mountain whitefish and smallmouth bass were absent from the catch. The only yellow perch *Perca flavescens* collected was age-1.

Table 3. Proportional size distribution (80% CI) of trout and bass species captured in the middle Spokane River, Spokane County, WA (September 2011). The PSD length classes were stock (S), quality (Q), preferred (P), memorable (M), and trophy (T). For example, the values under S-Q indicate the proportion of stock length fish of each species that were between the stock length and the quality length. The values for the length categories of each species are provided in the methods.

Species	No. Stock Length	S-Q	Q-P	P-M	M-T	T
Redband trout	55	82 (73-88)	18 (12-27)	0	0	0
Rainbow trout (hatchery)	6	100	0	0	0	0
Brown trout	3	0	33(3-80)	67 (20-97)	0	0

Smallmouth bass	4	100	0	0	0	0

Table 4. Species, number measured and weighed (n), mean fork length (mm; ±standard deviation), range of fork length, mean weight (g), and range of weight of fish collected by electrofishing in the middle Spokane River, Spokane County, WA (September 2011).

Common Name	n	Mean FL (SD)	Range of FL	Mean Wt (SD)	Range of Wt
Northern pikeminnow	46	290 (43)	139-415	303 (153)	30-982
Redside shiner	28	97 (20)	74-151	14 (11)	4-50
Largescale sucker	114	459 (50)	163-554	1187 (289)	58-2035
Bridgelip sucker	1	137		25	
Redband trout	94	250 (80)	93-426	240 (213)	8-1029
Rainbow trout (hatchery)	11	251 (48)	192-333	209 (125)	81-491
Mountain whitefish	18	301 (95)	134-396	423 (246)	27-732
Brown trout	4	266 (109)	115-360	287 (225)	19-539
Sculpin	38	94 (12)	54-118	11 (4)	2-21
Smallmouth bass	18	138 (41)	84-211	51 (43)	9-145
Yellow perch	1	99		14	

Table 5. Mean fork length (±standard error; SE) at age of redband trout collected in the middle Spokane River, Spokane County, WA (September 2011).

Cohort	Age	n	Fork Length (SE)
2011	0	12	112 (4)
2010	1	55	231 (3)
2009	2	9	319 (8)
2008	3	11	366 (7)
2007	4	4	390 (9)

Table 6. Mean back-calculated fork length at annulus formation and mean annual growth (±SE) by cohort of smallmouth bass collected in the middle Spokane River, Spokane County, WA (September 2011).

Cohort	n	Mean Fork Length at Annulus Formation			
		1	2	3	4
2010	5	50 (2)			
2009	9	54 (6)	113 (9)		
2008	0				
2007	3	45 (8)	86 (9)	125 (9)	164 (10)
Grand Means	17	51 (3)	113 (7)	125 (9)	164 (10)
Mean annual growth		51 (3)	54 (5)	39 (3)	38 (3)

Table 7. Mean back-calculated fork length at annulus formation and mean annual growth (±SE) by cohort of mountain whitefish collected in the middle Spokane River, Spokane County, WA (September 2011).

Cohort	n	Mean Fork Length at Annulus Formation				
		1	2	3	4	5
2010	2	177 (2)				
2009	1	176	272			
2008	0					
2007	5	179 (11)	297 (9)	332 (8)	353 (7)	
2006	5	158 (16)	252 (28)	306 (5)	332 (4)	349 (3)
Grand Means	13	171 (7)	274 (13)	319 (6)	343 (4)	349 (2)
Mean annual growth		171 (7)	105 (7)	44 (11)	24 (2)	17 (3)

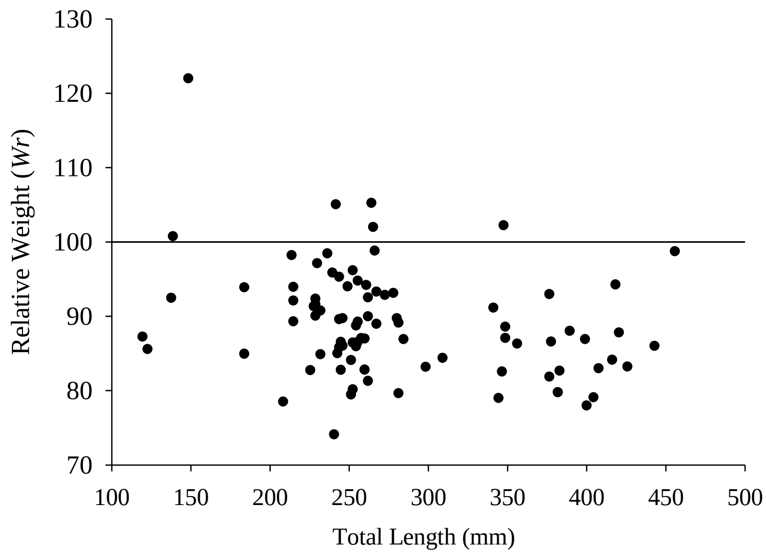

Figure 2. Relative weight (*Wr*) of redband trout (n=87) captured in the middle Spokane River, Spokane County, WA (September 2011).

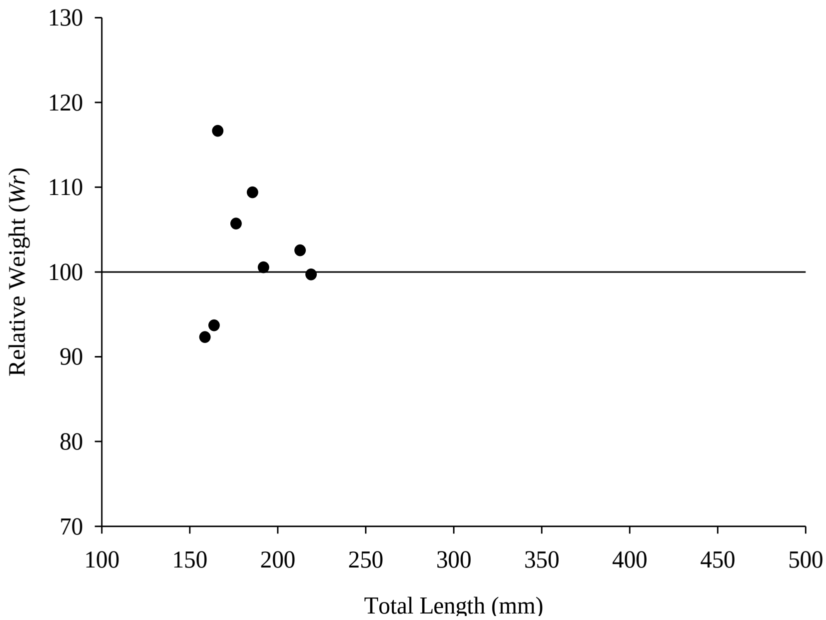

Figure 3. Relative weight (*Wr*) of smallmouth bass (n=8) captured in the middle Spokane River, Spokane County, WA (September 2011).

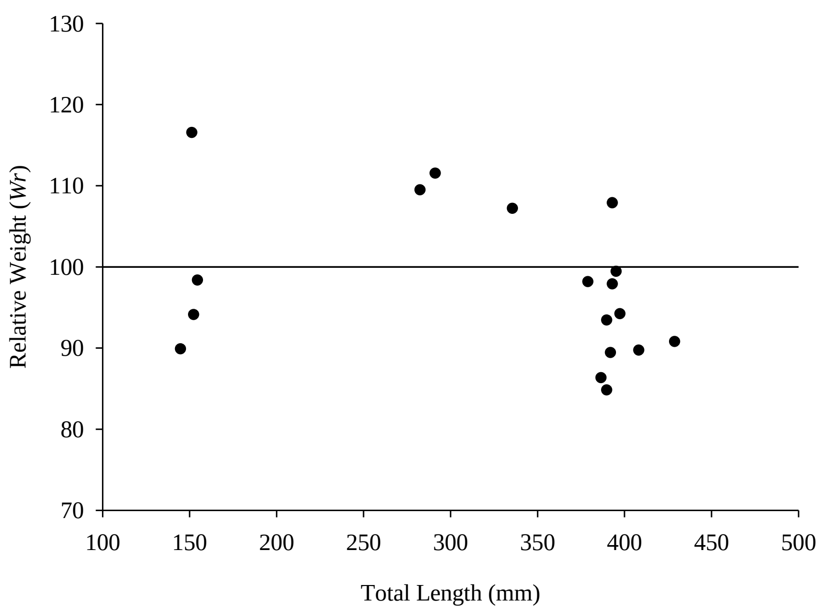

Figure 4. Relative weight (*Wr*) of mountain whitefish (n=18) captured in the middle Spokane River, Spokane County, WA (September 2011).

Discussion

In 2011, we observed a similar fish assemblage to that reported the previous year by Lee and McLellan (2011). Largescale sucker was the most abundant species in both 2010 and the present study. Redband trout exhibited a substantial increase in relative abundance since 2007 (O'Connor and McLellan 2008) and was the second most abundant species in the present survey. Although northern pikeminnow was the third most abundant species, a large decline in relative abundance was observed in 2011 from the previous year (Table 8). We collected a single bridgelip sucker, which have been absent in recent surveys, but were reported by Peden (1987) and Johnson (1994, 1997) in earlier investigations in the upper Spokane River. Largemouth bass were absent from the present survey, although a single specimen was collected in the middle Spokane River by Lee and McLellan (2010).

Redband trout *C/f* nearly tripled from 2007 and exhibited a moderate increase from 2010. The increases were observed in both the upper free flowing section and the lower section of the middle Spokane River. Mountain whitefish *C/f* more than doubled, however most (n=14) of the fish were collected at one site. Although largescale sucker was the most abundant species in the present study, *C/f* declined to nearly half of the values reported in 2010 for both drift boat and power boat electrofishing.

Notable differences between the two most recent surveys (Lee and McLellan 2011; present survey 2011) and the survey conducted by O'Connor and McLellan (2008) included survey timing, river discharge, water temperature and the random selection of sites. The 2007 survey was conducted in August with surface water temperature reported as 20 °C, whereas the 2010 and 2011 surveys were conducted in September when water temperatures ranged from 13-15 °C. Additionally, mean discharge measured at Post Falls (USGS gage no. 12419000) during the 2007 survey ranged from 9.0-9.2 m^3/s, while discharge in 2010 (35.1-35.7 m^3/s) and 2011 (32.3 m^3/s) was substantially greater (Available at: http://waterdata.usgs.gov/, accessed 12/13/2011). Although flow conditions were similar during the most recent surveys, during the 212 day period that encompassed the spring freshet (January-July), there were 34 days in 2010 with a discharge greater than 250 m^3/s (mean daily discharge = 166 m^3/s) compared to 136 days in 2011 (mean daily discharge = 421 m^3/s). The differences in the magnitude and duration of high discharge could account for variation in distribution and *C/f* of individual fish species between 2010 and 2011 surveys. Due to random site selection, four sites were electrofished with a drift boat in the free flowing section above Greene Street and eight below with a power boat in the 2010 and 2011 surveys, whereas O'Connor and McLellan (2008) surveyed five sites with a drift boat and six below with a power boat. In both the 2010 and 2011 surveys, power boat electrofishing *C/f* was greater than previously observed in the lower section for all species except redband trout and mountain whitefish. The higher catch rates of redband trout could be a result of a strong 2010 cohort. Additionally, sampling efficiency was likely greater in the upper section in 2010 and 2011 compared to the 2007 survey due to the increased discharge. The increase in mountain whitefish *C/f* from the 2010 to 2011 surveys may be a result of random site selection and fish distribution related to habitat preference at the time of the surveys. A single site in the upper free flowing section resulted in 78% of the whitefish collected in 2011 and represented all of the year classes captured.

In the present survey, redband trout were aged from 0 to 4, whereas Lee and McLellan (2011) reported redband from 0 to 6 years and O'Connor and McLellan (2008) identified redband trout ranging from 0 to 5 years. A strong 2010 year class was identified by Lee and McLellan (2011), where age-0 fish accounted for 41% of the redband trout collected. The 2010 cohort accounted for 60% (n=55) of the redband collected in 2011, thus validating the year class strength.

An additional survey planned for 2012 will provide additional information to describe the current fish assemblage in the middle Spokane River.

Table 8. Comparison of the total number of fish collected by all gear types (n), relative abundance (%), total electrofishing effort, and *C/f* for fish species collected in the middle Spokane River by O'Connor and McLellan (2008), Lee and McLellan (2011) and in the current survey (September 2011).

	2007[a]			2010[b]			2011		
	11 Sites (1.83h)			12 Sites (1.97 h)			12 Sites = 2.02 h		
Species	n	%	*C/f* (no./h)	n	%	*C/f* (no./h)	n	%	*C/f* (no./h)
Northern pikeminnow	128	30.8	33.3 (16.1)	119	22.2	52.4 (6.1)	46	12.3	23.0 (5.1)
Redside shiner	12	2.9	5.5 (5.2)	35	6.5	17.5 (13.0)	28	7.5	14.0 (6.2)
Largescale sucker	194	46.8	69.8 (15.9)	233	43.5	111.8 (14.4)	114	30.6	56.4 (12.2)
Bridgelip sucker	0	0.0	0.0 (0.0)	0	0.0	0.0 (0.0)	1	0.3	0.5 (0.5)
Redband trout	29	7	15.8 (8.5)	79	14.7	39.5 (7.8)	94	25.2	46.3 (10.7)
Rainbow trout (hatchery)	7	1.7	3.3 (2.5)	8	1.5	4.0 (1.7)	11	2.9	5.5 (3.2)
Mountain whitefish	18	4.3	9.8 (6.4)	8	1.5	4.2 (2.3)	18	4.8	8.9 (7.8)
Brown trout	2	0.5	1.1 (1.0)	1	0.2	0.5 (0.5)	4	1.1	1.9 (1.1)
Sculpin	15	3.6	8.2 (3.7)	27	5.0	13.1 (3.9)	38	10.2	18.9 (4.3)
Smallmouth bass	10	2.4	5.5 (2.8)	24	4.5	12.0 (3.9)	18	4.8	9.0 (3.3)
Largemouth bass	0	0.0	0.0 (0.0)	1	0.2	0.5 (0.5)	0	0.0	0.0 (0.0)
Yellow perch	0	0.0	0.0 (0.0)	1	0.2	0.5 (0.6)	1	0.3	0.5 (0.6)

[a]O'Connor and McLellan (2008)

[b]Lee and McLellan (2011)

Literature Cited

Anderson, R. O., and R. M. Neumann. 1996. Length, weight, and associated structural indices. Pages 447-482 in B.R. Murphy and D.W. Willis, editors. Fisheries techniques, 2nd edition. American Fisheries Society, Bethesda, Maryland. Anderson, R. O. and S. J. Gutreuter. 1983. Length, weight, and associated structural indices. Pages 283-300 *in* L. A. Nielsen and D. L. Johnson, editors. Fisheries techniques. American Fisheries Society, Bethesda, Maryland.

Anderson, R. O., and S. J. Gutreuter. 1983. Length, weight, and associated structural indices. Pages 283-300 *in* L. A. Nielsen and D. L. Johnson, editors. Fisheries techniques. American Fisheries Society, Bethesda, Maryland.

Bernard, D. R., J. F. Parker, and R. Lafferty. 1993. Stock assessment of burbot populations in small and moderate-size lakes. North American Journal of Fisheries Management 13:657-675.

Bonar, S. A., B. D. Bolding, and M. Divens. 2000. Standard fish sampling guidelines for Washington State ponds and lakes. Report # FPT 00-28. Washington Department of Fish and Wildlife, Olympia, Washington.

Carlander, K. D. 1969. Handbook of freshwater fishery biology, volume 1. The Iowa State University Press, Ames, Iowa.

CBFWA (Columbia Basin Fish and Wildlife Authority). 1999. Pit tagging procedures manual, version 2.0. Portland, Oregon. Available at: http://www.ptagis.org/ptagis/frame.jsp?menu=3&main=main.jsp?menu=3. Accessed 03/12/2010.

DeVries, D. R., and R. V. Frie. 1996. Determination of age and growth. Pages 483-512 *in* B. R. Murphy and D. W. Willis, editors. Fisheries techniques, 2nd edition. American Fisheries Society, Bethesda, Maryland.

FERC. 2009. Order Issuing New License and Approving Annual Charges for Use of Reservation Lands. FERC Project Nos. 2454-091 and 12606-000. FERC DC.

Gabelhouse, D. W., Jr. 1984. A length-categorization system to assess fish stocks. North American Journal of Fisheries Management 4:273-285.

Gustafson, K. A. 1988. Approximating confidence intervals for indices of fish population size structure. North American Journal of Fisheries Management 8:139-141.

Guy, C. S., H. L. Blankenship, and L. A. Nielsen. 1996. Tagging and marking. Pages 353-383 *in* B.R. Murphy and D. W. Willis, editors. Fisheries techniques, 2nd edition.American Fisheries Society, Bethesda, Maryland.

Guy, C. S., R. M. Neumann, and D. W. Willis. 2006. New terminology for proportional stock density (PSD) and relative stock density (RSD): proportional size structure (PSS). Fisheries 31:86-87.

Hilborn, R., and C. J. Walters. 1992. Quantitative fisheries stock assessment: choice, dynamics, and uncertainty. Chapman and Hall, New York.

Hubert, W. A., and M. C. Fabrizio. 2007. Relative abundance and catch per unit effort. Pages 279-325 *in* C. S. Guy and M. L. Brown, editors. Analysis and Interpretation of Freshwater Fisheries Data. American Fisheries Society, Bethesda, Maryland.

Johnson, E. 1994. Scientific collectors permit report 1994. Prepared by Washington Water Power Company, Spokane, Washington. Prepared for Washington Department of Fish and Wildlife, Olympia, Washington. 7 pp.

Johnson, E. 1997. Scientific collectors permit report 1997. Prepared by Washington Water Power Company, Spokane, Washington. Prepared for Washington Department of Fish and Wildlife, Olympia, Washington. 11 pp.

Kolander, T. D., D. W. Willis, and B. R. Murphy. 1993. Proposed revision of the standard weight (*Ws*) equation for smallmouth bass. North American Journal of Fisheries Management 13:398-400.

LeCren, E. D. 1947. The determination of the age and growth of the perch (*Perca fluviatilis*) from the opercular bone. Journal of Animal Ecology 16:188-204.

Lee, C. D. *in prep*. Redband trout spawning and fry emergence study: abundance and year class strength component, annual progress report 2011. Draft report prepared for Avista Corporation, Spokane, Washington.

Lee, C. D., and J. G. McLellan. 2011. Middle Spokane River baseline fish population assessment, annual progress report 2010. Report prepared for Avista Corporation, Spokane, Washington.

McLellan, J. G., and C. D. Lee. 2011. Redband trout spawning and fry emergence study: abundance and year class strength component, annual progress report 2010. Draft report prepared for Avista Corporation, Spokane, Washington.

Milewski, C. L., and M. L. Brown. 1994. Proposed standard weight (WS) equation and length category standards for stream-dwelling brown trout. Journal of Freshwater Ecology 9:111-116.

O'Connor, R. R., and J. G. McLellan. 2008. Baseline fish community assessment for the middle Spokane River, Washington. Annual Progress Report to Bonneville Power Administration, Portland, Oregon. Project No. 199700400. BPA Document No.P106617.

Peden, A.E. 1987. Report of fish collected in Washington State in 1986 under Washington Department of Game permit No. 031. Prepared for Washington Department of Game, Olympia, Washington., Prepared by British Columbia Provincial Museum, Victoria, British Columbia.

Small, M. P., J. G. McLellan, J. Loxterman, J. Von Bargen, A. Frye, and C. Bowman. 2007. Fine-scale population structure of rainbow trout in the Spokane River drainage in relation to hatchery stocking and barriers. Transactions of the American Fisheries Society 136:301-317.

Simpkins, D. G., and W. A. Hubert. 1996. Proposed revision of the standard-weight equation for rainbow trout. Journal of Freshwater Ecology 11:319-325.

Stevens, D. L. Jr., and A. R. Olsen. 2004. Spatially balanced sampling of natural resources. Journal of the American Statistical Association 99:262-278.

WDOE (Washington Department of Ecology). 2009. 401 Certification-Order. Spokane River Hydroelectric Project Certification, Amended Order No. 6702, FERC License No, 2545, May 8, 2009.

Zar, J.H. 1999. Biostatistical analysis, fourth edition. Prentice Hall, NJ.