

Bull Trout Population and Habitat Surveys in the Middle Fork Willamette and McKenzie Rivers

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Bull Trout *Salvelinus confluentus* Population and Habitat Surveys in the McKenzie and Middle
Fork Willamette Basins, 2001.

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INTRODUCTION

Prior to 1978, bull trout were commonly known as dolly varden (*Salvelinus malma*) and were classified into an anadromous and interior form. Cavender (1978) described the interior form as a distinct species, classifying it as *Salvelinus confluentus*, the bull trout. Bull trout are large char weighing up to 18 kg and growing to over one meter in length (Goetz 1994). They are distinguished by a broad flat head, large downward curving maxillaries that extend beyond the eye, a fleshy knob and a notch in the lower terminus of the snout, and light colored spots normally smaller than the pupil of the eye (Cavender 1978).

Bull trout are found throughout northwestern North America from latitude 41°N to 60°N. In Oregon, bull trout were once distributed throughout 12 basins in the Klamath and Columbia River systems including the Clackamas, Santiam, McKenzie and Middle Fork Willamette sub-basins west of the Cascades (Buchanan et al. 1997). However, it is likely that bull trout have been extirpated from west of the Cascades with the exception of the McKenzie sub-basin.

McKenzie River bull trout were a contiguous population from the mouth to Tamolitch Falls prior to 1963. Three populations were isolated following the construction of Cougar and Trail Bridge Reservoirs which include the mainstem McKenzie and tributaries from the mouth to Trail Bridge Reservoir, mainstem McKenzie and tributaries above Trail Bridge Reservoir to Tamolitch Falls, and the South Fork McKenzie and tributaries above Cougar Reservoir. On June 10, 1998 the U.S. Fish and Wildlife Service (USFWS) listed the Columbia River bull trout population segment as Threatened under the federal Endangered Species Act and Buchanan et al. (1997) listed the bull trout population in the mainstem McKenzie as “of special concern”, the South Fork McKenzie population as “high risk of extinction,” and the population above Trail Bridge Reservoir as “high risk of extinction.” Bull trout in the Middle Fork Willamette were listed as “probably extinct.”

Our study area includes the three McKenzie populations, and a reintroduced population in the Middle Fork Willamette and tributaries above Hills Creek Reservoir. We monitored bull trout populations in the McKenzie and Middle Fork Willamette basins using a combination of sampling techniques that include spawning surveys, juvenile trapping, electronic fish counters, and night snorkeling. We continued to reintroduce bull trout fry from Anderson Creek (McKenzie Basin) to the Middle Fork Willamette above Hills Creek Reservoir in an attempt to rehabilitate the bull trout population in the Middle Fork Willamette Basin. By monitoring population trends and determining life history characteristics of bull trout in McKenzie and Middle Fork Willamette basins, we can make informed management decisions that will help maintain long term and sustainable bull trout populations in the upper Willamette Basin.

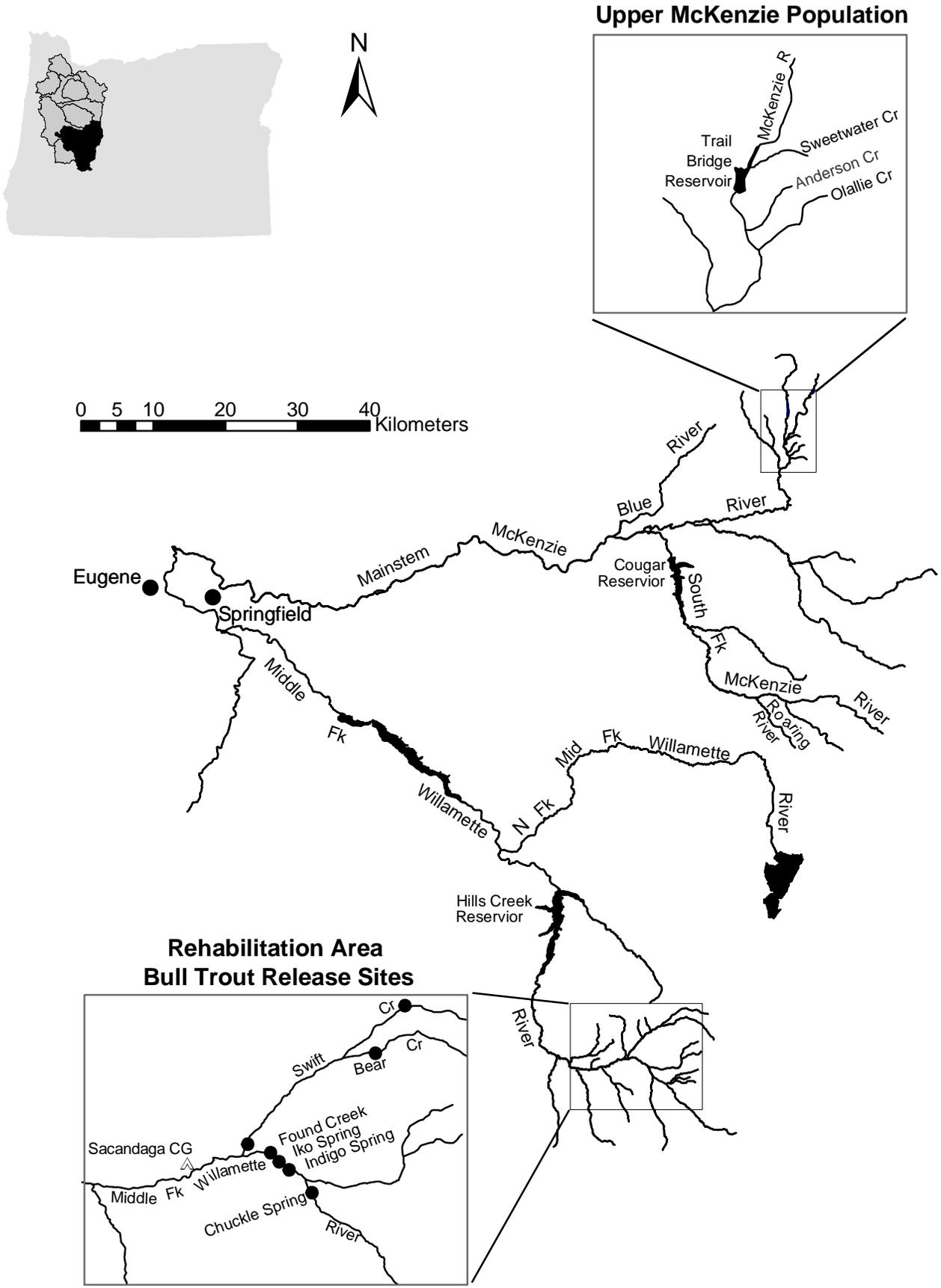


Figure 1. Map of the McKenzie and Middle Fork Willamette Rivers. Boxes denote key study areas.

METHODS

Spawning Surveys

We conducted bull trout spawning surveys in Roaring River (South Fork McKenzie), Anderson, Sweetwater, and Olallie Creeks (McKenzie Basin) during September and October 2001. Surveys occurred bi-weekly to ensure maximum redd visibility and began at the mouth of each stream and continued upstream to natural barriers for migrating adult bull trout. A team of two conducted each survey with one person walking each side of the stream. Surveyors marked each new redd observed with flagging and recorded the date, redd number, and the number and size estimate of bull trout if present.

The fish per redd estimate in Anderson Creek is a result of the number of bull trout estimated to pass through the Vaki Fishcounter and the number of redds enumerated.

Vaki Riverwatcher Fishcounter

A Vaki Riverwatcher Fishcounter was installed in Anderson Creek and Roaring River to estimate the number and size of spawning adult bull trout migrating into each stream. The Vaki is an electronic counter that emits infrared light beams that are interrupted when a fish swims through the counter and produces a silhouette of the fish. The unit records the date, time, water temperature, direction, length, and body depth of each fish passing upstream or downstream. Weirs were constructed in both streams to direct fish passage through the counter. Migration was monitored from 15 August to 8 October in Roaring River and in Anderson Creek from 8 August-31 October 2001. Routine maintenance performed on the counter included removing debris from the weir, changing batteries, and uploading data weekly.

In 2001 we used a length to depth ratio of 4.6/1 to estimate the approximate length distribution of bull trout passing through the Vaki Riverwatcher. The general default ratio suggested by Vaki was 6/1, however after measuring 2 display specimens we estimated that the ratio of 4.6/1 would more accurately represent bull trout.

Juvenile Trapping in Anderson Creek and Fry Transfer to Middle Fork Willamette

U.S. Forest Service (USFS) personnel trapped juvenile and young-of-the-year bull trout migrating down Anderson Creek using a 5 ft. rotary screw trap. This trap was located downstream of the U.S. 126 culvert approximately 0.4 river kilometers (rkm) upstream from the mainstem McKenzie. The trap was operated four days each week from 19 February to 03 May 2001 and trap checkers recorded the number and length of all juvenile bull trout and measured a proportion of the fry captured.

After capture, bull trout fry were transferred from Anderson Creek and released into the Middle Fork Willamette. Release sites were chosen in relation to historical accounts and areas that appear to contain suitable spawning and rearing habitat for bull trout (ODFW et. al 1998). Additionally, no more than 25% of the estimated bull trout fry escaping from Anderson Creek were to be transferred to the Middle Fork (ODFW et. al 1998).

Juvenile Distribution and Microhabitat Use in the Mainstem McKenzie

To estimate juvenile bull trout distribution and characterize microhabitat in the mainstem McKenzie River, night snorkelers surveyed margins of the river downstream of previously known juvenile bull trout distribution from 11 July to 25 July 2001. Using Bruckart Bridge (rkm 100) as a starting location, a 200 m reach on the north bank of the mainstem was night snorkeled. Divers observed no bull trout at the initial site therefore sites were selected as surveyors moved upstream to estimate the current extent of distribution for juvenile bull trout in the mainstem McKenzie.

Juvenile bull trout rearing habitat was categorized in the mainstem using eight quantitative measurements. After divers observed juvenile bull trout, locations were marked using a floating marker anchored to a three-ounce weight. The diver observed fish and classified activity as resting, feeding, swimming, or holding (Goetz 1994), while also estimating focal point elevation and the length of each fish. Surveyors returned during the day to record water depth, focal point velocity, temperature, substrate (organic debris, silt, mud, sand, gravel, cobble, boulder, or bedrock), habitat type (Bisson et al. 1982), cover type (substrate, undercut bank, vegetation, turbulence, fine woody debris (<10 cm diameter), coarse woody debris (10-50 cm diameter), and large woody debris (>50 cm diameter), and distance to cover for each juvenile bull trout observed.

Distribution and Abundance of Bull Trout in the Middle Fork Willamette above Hills Creek Reservoir

Snorkel surveys were conducted at night from 30 July to 8 August to examine distribution and abundance of bull trout in the Middle Fork Willamette River above Hills Creek Reservoir. Four divers snorkeled six study reaches that totaled 2.1 river kilometers. Surveyors divided each observation reach into two sections. One pair of divers snorkeled upstream from the bottom of the reach to the midpoint and the other pair snorkeled upstream from the midpoint to the top of the survey section. Divers enumerated and estimated the size of bull trout observed.

The minimum density estimate is based on the number of bull trout observed by surveyors in an estimated 2.1 river kilometers sampled.

RESULTS

Mainstem McKenzie

Spawning Surveys

Surveyors conducted three spawning surveys and observed 72 redds in Anderson Creek from 13 September to 31 October 2001 (Table 1). Densities in Anderson Creek were 28 redds/km with an estimated 1.6 fish / redd. No redds were observed in surveys conducted above the barrier falls.

We conducted spawning surveys of Olallie Creek on 12 September and 26 October 2001. Surveyors observed a total of 6 redds (Table 1) including 4 above the U.S. 126 culvert.

ODFW personnel observed 2 redds in Sweetwater Creek on 9 October 2001.

Table 1. The number of bull trout redds enumerated in Anderson, Olallie, and Sweetwater Creeks, 1989-2001.

	Number of Redds Observed				
	Anderson		Olallie	Sweetwater	Total
	Index Area RKM 1.3	Total RKM 2.6			
Year					
1989	7				
1990	9				
1991	7				
1992	13				
1993	15				
1994	22	30			
1995	30	77	10		87
1996	26	82	8		90
1997	18	85	9		94
1998	29	79	7		86
1999	47	77	6		83
2000	44	83	9	2 ^a	94
2001	23	72	6	2	80

^a Spawning survey conducted by USFS personnel

Juvenile Trapping

We captured 3,245 fry and 81 juvenile bull trout in Anderson Creek in 2001 (Table 2). The number of fry captured in 2001 was 46% of the mean capture of 6,986 fry from 1997 to 2000.

Table 2. The number of bull trout fry and juveniles (1+ and older) captured in the downstream migrant screwtrap in Anderson Creek from 1994 to 2001.

Date	Number of fry		Number of Age 1 and Older	
	Captured	Estimated migrants ^a	Captured	Estimated migrants ^a
Feb. 15-May 26, 1994	1,808	5,308	129	403
Feb. 15-May 31, 1995	1,877	5,995	261	785
Feb. 19-May 31, 1996	1,995	5,700	179	550
Feb. 11-May 31, 1997	6,540	21,592	64	215
Feb. 10-June 11, 1998	7,902	23,153	151	453
Feb. 23-June 03, 1999	7,406	21,693	100	263
Feb. 21-May 25, 2000	6,097	17,713	190	553
Feb. 19-May 3, 2001	3,245	9,733	81	235

^a Assumes trapping seven days per week and a 60% trap efficiency

Vaki Riverwatcher Counts / Anderson Creek

We recorded 107 bull trout passing upstream and 113 downstream in Anderson Creek. Peak upstream and downstream migration appears to occur during the first three weeks of September (Figure 2). Many of the bull trout migrated upstream and downstream during daylight hours with peak migration occurring between 13:00-18:00 hours (Figure 3).

Analysis of the Vaki body depth measurements resulted in bull trout ranging in size from 140-690 mm. Size structure of bull trout in Anderson Creek during 2001 shifted to a population of predominantly smaller fish when compared to previous years (Figure 4).

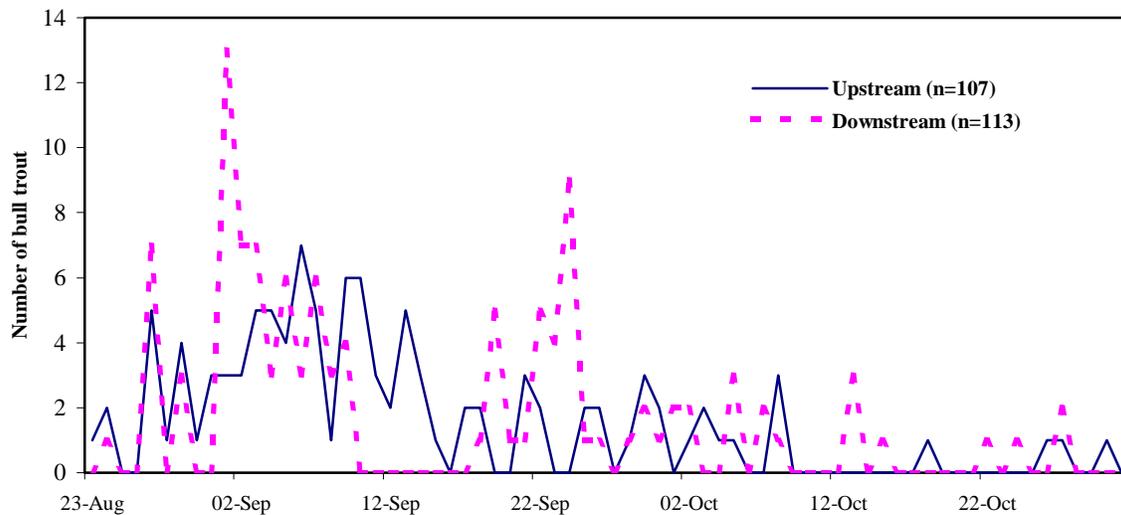


Figure 2. Migration over time of bull trout through the Vaki Riverwatcher in Anderson Creek from 8 August to 31 October 2001. No fish were recorded passing through the Vaki until 23 August.

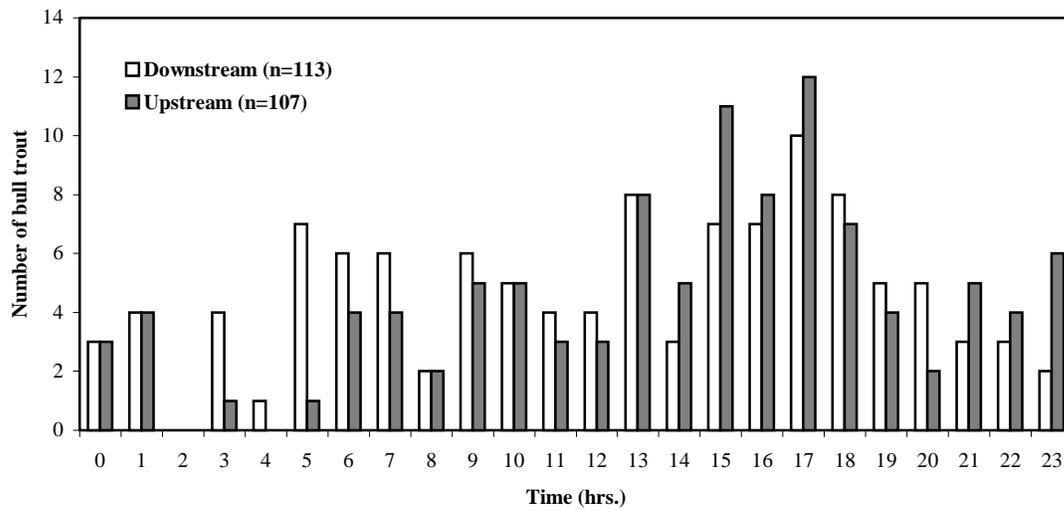


Figure 3. Daily time periods in which bull trout passed through the Vaki Riverwatcher in Anderson Creek during the 2001 migration period. Time is represented from 00:00 hours to 24:00 hours from 8 August to 31 October.

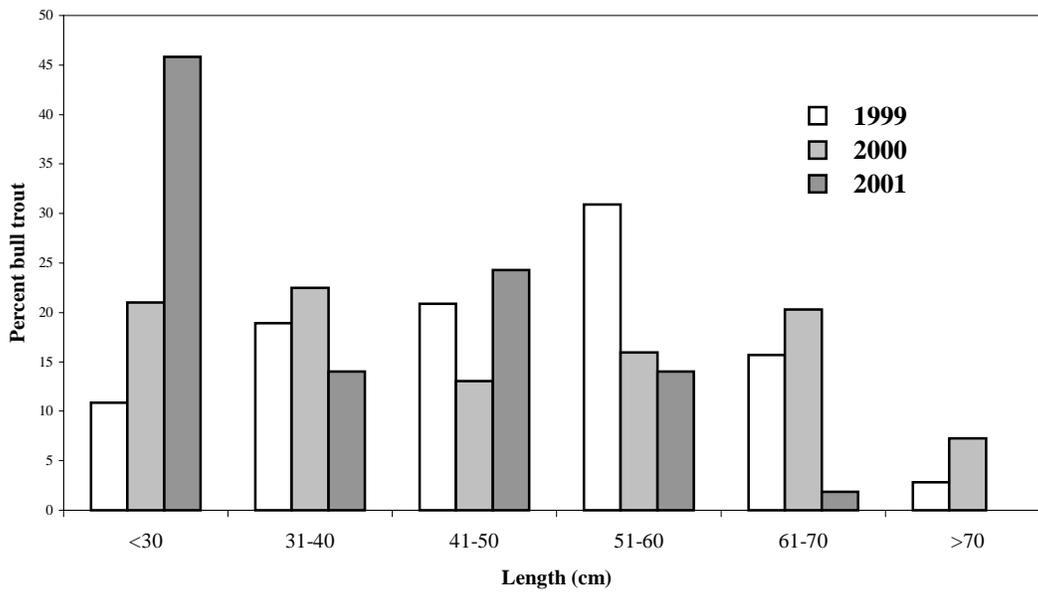


Figure 4. Length frequency histogram of bull trout passing upstream through Vaki Riverwatcher in Anderson Creek from 1999 to 2001. Individual bars represent the percentage of total bull trout sampled that were represented in each length class for 1999, 2000, and 2001.

Juvenile Distribution and Microhabitat Use

Juvenile bull trout distribution surveys did not extend the known distribution of juvenile bull trout in the mainstem McKenzie River. Surveyors during 2001 initially located juvenile bull trout at the third study reach just below the mouth of Frissell Creek (rkm 124) whereas previous surveys have documented downstream distribution at Belknap Hot Springs at river kilometer 118. The number of bull trout observed increased as the study reaches moved upstream and the highest densities of juvenile bull trout began just above the Olallie boat launch (rkm 128).

Observations were made on 36 juvenile bull trout. Divers noted 94% of the juvenile bull trout within 5 cm of the bottom and estimated size ranges from 90-180 millimeters resulting in a mean length of 130 mm ± 10 with a mean focal point elevation estimated at 38.1 mm ± 15.2. The bull trout observed occupied primarily low velocity habitat with a mean of 0.08 ft/sec. ± 0.05, water depths from 0.12 – 0.94 meters with a mean total depth of 0.4 m ± 0.06, and a mean water temperature of 8° C. The most common substrate identified was cobble (29%) followed by sand (21%), organic debris (18%), and boulders (18%) (Figure 5).

We observed 91 % of the juvenile bull trout in micro-backwater pools associated with boulders and 9% of the bull trout in small lateral scour pools associated with boulders. The predominant cover type available to bull trout was substrate, being either cobble or boulders (Figure 6), and surveyors observed 82% of the juvenile bull trout within 46 cm of cover with a mean distance to cover 0.27 m ± 0.03.

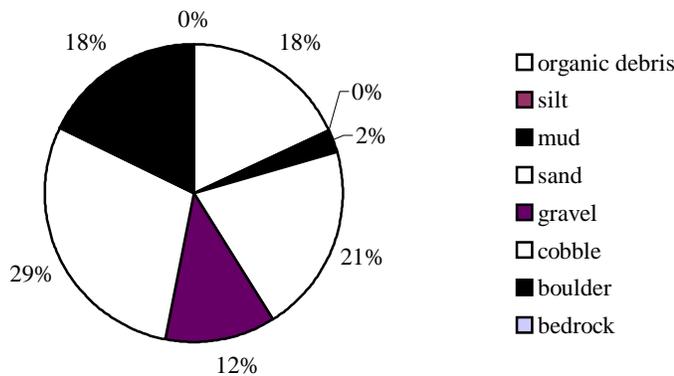


Figure 5. Substrate composition for juvenile bull trout located in the mainstem McKenzie River, July 2001.

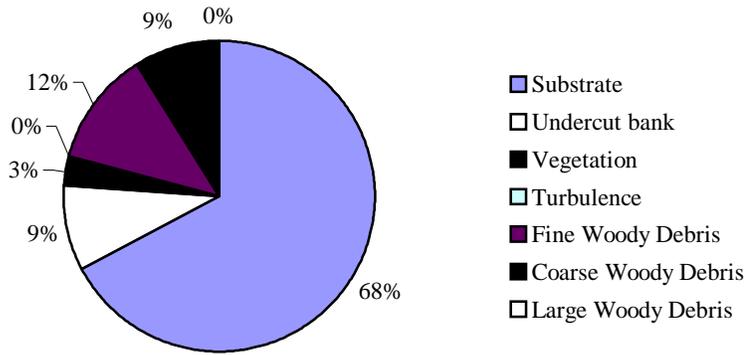


Figure 6. Preferred cover type that was located the shortest distance from juvenile bull trout observations in the mainstem McKenzie, July 2001.

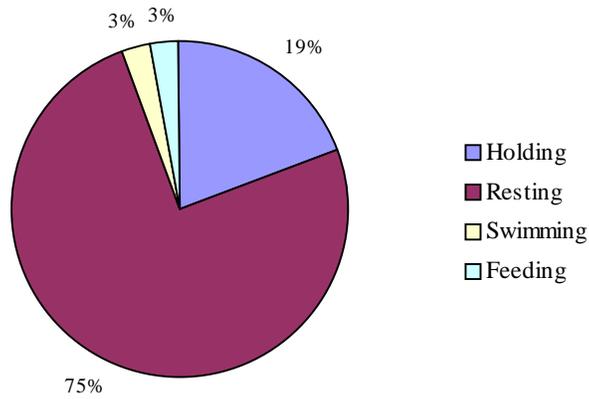


Figure 7. Activity of 36 juvenile bull trout observed by divers in the mainstem McKenzie River, July 2001.

Middle Fork Willamette

Juvenile Transfer

ODFW and USFS personnel transferred 1,456 fry (26-31mm) from 2 March to 5 April 2001 (Table 3) from Anderson Creek to four release sites in the Middle Fork Willamette Basin.

Table 3. Location and number of bull trout fry transferred from Anderson Creek to release sites in the Middle Fork Willamette above Hills Creek Reservoir from 1997 to 2001.

<u>Year</u>	Location								<u>Total</u>
	Springs				Creeks				
	Chuckle	Iko	Indigo	Shadow	Bear	Found	Skunk	Swift	
1997	96		26				56		178
1998	411	938		150					1,499
1999	302	1,000		148				526	1,976
2000	349	1,075	204	53		285		822	2,788
2001	269	418			673			96	1,456
Total	1,427	3,431	230	351	673	285	56	1,444	7,897

Distribution and Abundance of Bull Trout in the Middle Fork Willamette above Hills Creek Reservoir

Surveyors estimated bull trout distribution extends at least 8.8 kilometers in the Middle Fork Willamette from approximately Chuckle Springs downstream to Sacandaga Campground (Figure 1). Divers observed 28 bull trout ranging in size from 100-350 mm. Surveyors estimated sampling approximately 25% (2.1 km) of the available habitat within the survey area. A minimum density of 13.3 bull trout/km were observed by surveyors.

South Fork McKenzie

Spawning Surveys

We observed a total of 34 redds, the highest redd count recorded for Roaring River (Table 4). Surveyors identified 25 redds above Rd. 19 crossing Roaring River and below a partial barrier 1.1 river kilometers upstream and observed nine redds above the partial barrier. This was the first documentation of spawning above the partial barrier.

Table 4. The number of bull trout redds enumerated in Roaring River by ODFW and USFS personnel from 1993 to 2001.

Year	Redds Observed
1993	1
1994	1
1995	2
1996	0
1997	0
1998	6
1999	13
2000	25
2001	34

Vaki Riverwatcher Fishcounter

ODFW recorded 67 bull trout passing upstream and 69 downstream with peak upstream migration occurring during the last week of August and the first week of September and downstream migration peaking the second and third weeks of September (Figure 8). It appears much of the upstream and downstream migration occurred during daylight hours with peak migration occurring at 14:00 - 19:00 hours (Figure 9).

Bull trout ranged in size from 22-81 cm in 2001 and appear to show a trend in Roaring River of a size increase since 1999 (Figure 10).

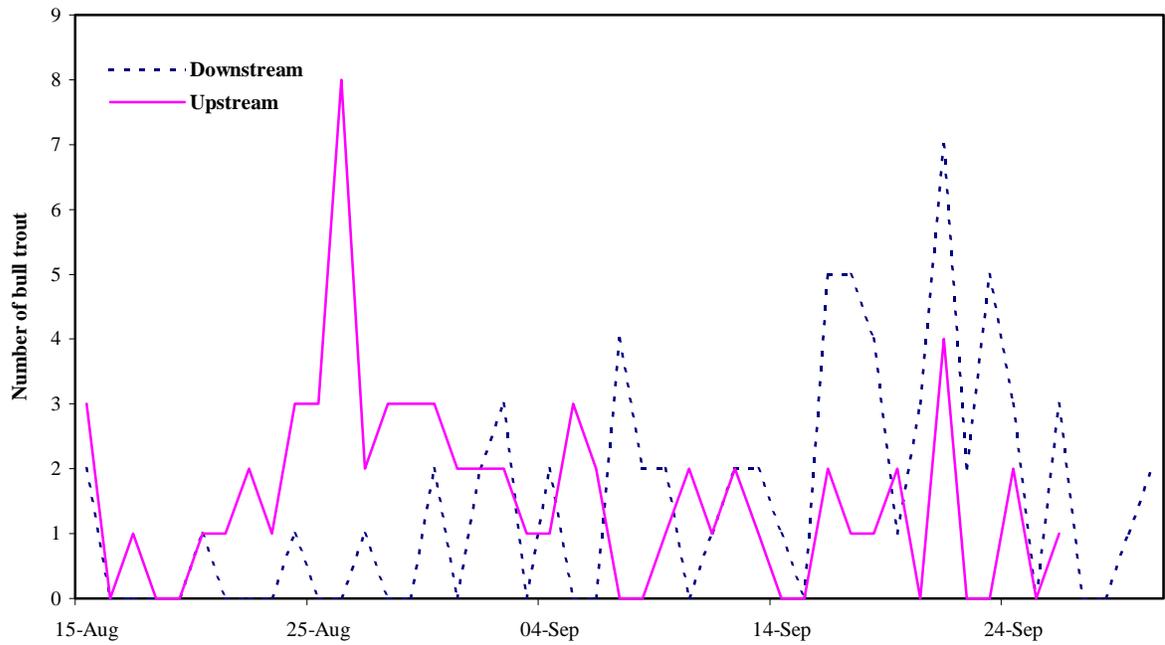


Figure 8. Migration over time of bull trout through the Vaki Riverwatcher in Roaring River from 15 August to 8 October 2001.

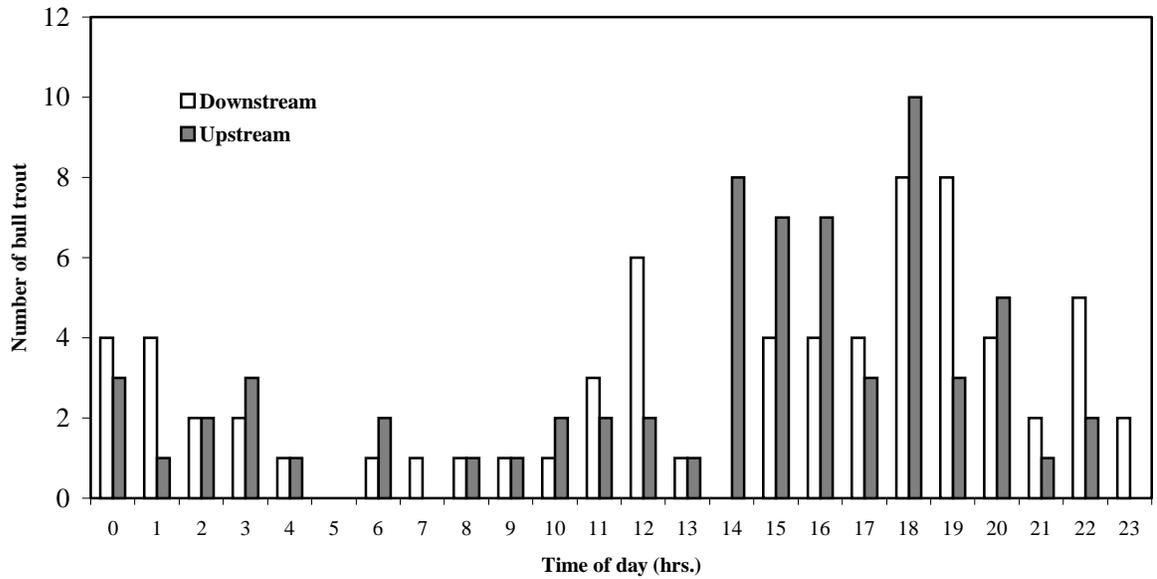


Figure 9. Daily time periods in which bull trout passed through the Vaki Riverwatcher in Roaring River during the 2001 migration period. Time is represented from 00:00 hours to 24:00 hours from 15 August to 8 October.

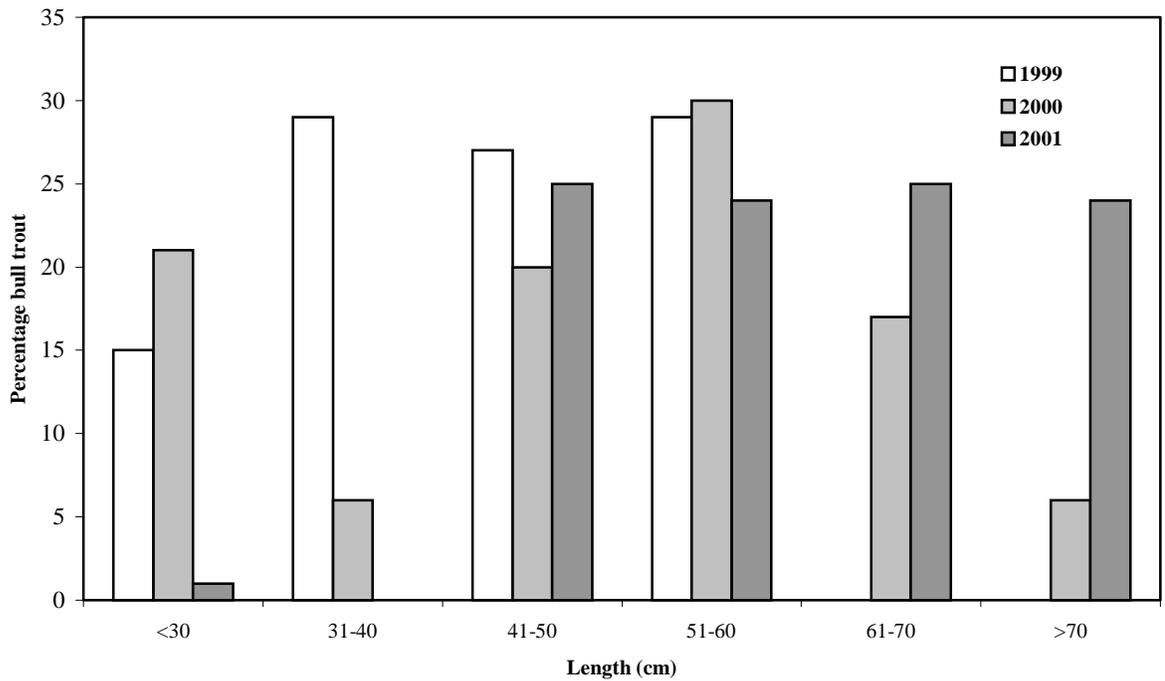


Figure 10. Length frequency histogram of bull trout passing upstream through Vaki Riverwatcher in Roaring River from 1999 to 2001. Individual bars represent the percentage of total bull trout sampled that were represented in each length class for 1999, 2000, and 2001.

DISCUSSION AND CONCLUSIONS

Mainstem McKenzie

Spawning surveys conducted in tributaries of the mainstem McKenzie River (Anderson and Olallie Creek) have shown consistent redd counts since more than doubling in 1995 (Table 1). This trend contrasts with the decline in the number of spawners we have observed entering Anderson Creek using the Vaki Fishcounter. In 1999, we calculated a ratio of 3.7 bull trout per redd in Anderson Creek, which is similar to those reported for streams in the Metolius basin (Ratliff et al. 1996). However, in 2000 and 2001, we determined the fish to redd ratio in Anderson Creek to be 2.0 and 1.6 respectively. It is uncertain if we overestimated the number of adult spawners in 1999, underestimated the number of adult spawners in 2000 and 2001, or if this represents a shift in the fish to redd ratio in Anderson Creek.

We observed 2 redds for the second consecutive year in Sweetwater Creek. We assume the spawning fish are the result of fry transfers that began in 1993 from Anderson Creek. The age of the bull trout spawning in Sweetwater Creek is unknown. Leary et al. (1993) reported that migratory bull trout begin spawning at Age 5+ to Age 6+. Pratt (1991) determined that most adult bull trout in the Metolius River begin spawning at Age 5.

The number of emergent bull trout fry captured in Anderson Creek decreased approximately 54% from the mean capture of 1997 to 2000 even though redd counts have been consistent. This could be a result of a shift in the size structure of the population, which may have reduced the number of eggs deposited in the redds. In 2000 and 2001 we commonly observed smaller redds than in 1998 and 1999. Vaki data indicated a shift towards smaller fish in Anderson Creek that could produce a further decline in the number of emergent fry captured in Anderson Creek in 2002.

In 2001, the Vaki Riverwatcher recorded a total of 107 bull trout passing upstream and 113 downstream. The counter recorded 31 fewer bull trout moving upstream than in 2000 and 142 fewer than in 1999 but run timing and migration timing were consistent. The decrease of adult spawners through the Vaki are inconsistent with the redd count data collected, so we are unable to determine whether this represents a true shift in run size, an error with the Vaki counter, a change in migration behavior of the fish (more or less double counting of fish), or a change in the spawning behavior of the fish (similar number of redds produced by fewer fish).

Juvenile bull trout distribution surveys did not extend the known distribution of juvenile bull trout in the mainstem McKenzie River. However, high densities of juvenile bull trout in the mainstem McKenzie were observed approximately 1 mile below Anderson and Olallie Creeks identifying this as a primary rearing area. We observed bull trout below this area, but densities were low. It is our opinion that rearing is confined in the mainstem from Trailbridge Dam downstream to approximately Belknap Springs.

In the analysis of rearing habitat in the mainstem McKenzie, we observed juvenile bull trout in shallow, low velocity marginal habitat. These habitats were associated almost exclusively with large boulders where bull trout remained on or just above the substrate and close (within 46 cm) to cover. Surveys to determine the feasibility of reintroducing bull trout in other locations in the Upper Willamette Basin should quantify the amount of juvenile rearing habitat available using the range of physical habitat features identified.

Middle Fork Willamette

We continued to implement the Rehabilitation Plan (ODFW et al. 1998) for bull trout in the Middle Fork Willamette Basin in 2001. We transferred 1,456 bull trout fry from Anderson Creek to four release sites in the Middle Fork Willamette Basin above Hills Creek Reservoir. This number was well below the 3,000 fry we intended to transfer. Future releases depend on the availability of fry from Anderson Creek, but we believe the 2002 release will be similar to the 2001 release and fall short of the goal of 3000 fry. Fewer fish available for release reduces the number of release sites that we can transfer fish into and increases the risk of failure for that year class.

Monitoring efforts this year were focused on determining the distribution and abundance of bull trout in the Middle Fork Willamette. During our sampling period bull trout occupied at least 8.8 kilometers of the Middle Fork with minimum densities low, but encouraging. We observed fish up to 350 mm and expect that spawning is still two years away with it possible that some fish could spawn in 2002. It is also likely that bull trout are occupying Hills Creek Reservoir during the winter. Even though this has not been confirmed, USFS personnel captured a 250 mm bull trout in a screwtrap approximately 1.5 kilometers above the head of the reservoir in October, 2001. This could indicate bull trout are present in the reservoir and that some of the bull trout present will have an adfluvial life history pattern.

South Fork McKenzie

We continue to see the number of bull trout redds increasing in the South Fork where surveyors observed 34 redds. This increase in redd counts is similar to the increase observed in Anderson Creek between 1994-95 and we believe that changes in angling regulations (catch and release for bull trout) and hatchery trout releases were primary reasons for the increase in redds observed in Anderson Creek. In 1992, we implemented more restrictive angling regulations that allowed only adipose fin marked trout to be taken in the South Fork McKenzie River. In 1997, we discontinued stocking rainbow trout in the South Fork McKenzie. We believe these restrictive angling regulations will continue to increase redd counts in the South Fork McKenzie.

The Vaki Fishcounter recorded 67 bull trout passing upstream and 69 downstream that resulted in about 10 fish fewer than in 2000 with run timing and migration timing consistent with 1999 and 2000. Peak migration and spawning was about two weeks earlier in Roaring River than in Anderson Creek. In contrast to Anderson Creek, the size structure of the Roaring River bull trout population is increasing. We are unsure as to why the size structure of bull trout in the South Fork is increasing and decreasing in Anderson Creek.

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