# PROGRESS REPORTS

## 2010

## FISH DIVISION

## Oregon Department of Fish and Wildlife

Odell Lake Bull Trout

ANNUAL PROGRESS REPORT

FISH RESEARCH PROJECT

OREGON

PROJECT TITLE: **Odell Lake Bull Trout**

CONTRACT NUMBERS: E-2-53

PROJECT PERIOD: 12/01/2009-3/15/2011

Shannon E. Richardson and Steve Jacobs
Native Fish Investigations Project
Oregon Department of Fish and Wildlife
28655 Highway 34
Corvallis, Oregon 97333

This project was financed with Endangered Species Act Section 6 Cooperative Agreement funds administered by the U.S. Fish and Wildlife Service, Contract E-2-53

## CONTENTS

# INTRODUCTION

Odell Lake is inhabited by the only remaining natural adfluvial population of bull trout (*Salvelinus confluentus*) in Oregon. The only known breeding population in the Odell Lake watershed is restricted to the lower 1.3 km of Trapper Creek (Figure 1). This population is geographically isolated from other bull trout populations and its abundance is extremely low, with a spawning population of 10-30 adult fish annually (Higgins et al. 2005).

Recent studies have shown that juvenile bull trout require extended stream rearing prior to using lake habitats (Downs et al. 2006). Starting in the mid-1930's, channelization and habitat simplification of Trapper Creek through the adjacent campground led to greatly reduced in-stream fish habitat (Powers 2006). Between 2002 and 2008, efforts to increase habitat complexity and habitat availability for spawning and rearing occurred in the lower 1.3 km of Trapper Creek. Despite these improvements in habitat capacity and the small size of the Trapper Creek population, juvenile rearing habitat likely limits recruitment into Odell lake. Other tributaries in the Odell Lake watershed may offer the potential for bull trout rearing and the viability of Odell Lake bull trout would be improved if additional breeding populations were established. Fry transfers have shown some success in establishing new breeding populations of bull trout in the Middle Fork Willamette River (Tranquilli 2007).

The presence of brook trout (*Salvelinus fontinalis*) in Odell Lake watershed tributaries may jeopardize the potential for establishing breeding populations of bull trout via transfer due to hybridization and competition. Although several removal efforts have occurred, attempts at eradication have been opportunistic in nature and as a result, the current abundance and distribution of brook trout is unclear. Additionally, it is unclear whether prior brook trout stocking into Yoran Lake has resulted in a source population for Trapper Creek.

Our primary objective in 2010 was to evaluate the magnitude of fry emigration from Trapper Creek to determine whether sufficient numbers of fry would be available for possible transfers. This was the first year that such an evaluation had been attempted for Trapper Creek. Our second objective was to obtain a population estimate of juvenile bull trout in Trapper Creek repeating the study first conducted in 2005 (Moore 2005). These estimates have utility in calibrating multi-year snorkel surveys to monitor abundance of juvenile bull trout in Trapper Creek.

# METHODS

## Fry Emigration from Trapper Creek

We installed a motorized inclined plane trap just upstream of the Trapper Creek Campground foot bridge, approximately 200 m from the mouth of Trapper Creek (Figure 1). The trap configuration consists of a 1 m wide screen suspended between two pontoons, the pitch of which can be changed by means of a cable winch on the suspension crossbar; the screen is constructed of hardware cloth and has L-shaped cups affixed to it at 60 cm intervals (Figure 2). Downstream-migrating fish are swept onto the screen by stream current, carried to the back of the trap and are deposited into a livewell attached to the rear (downstream end) of the trap to be enumerated later. The livewell is fitted with a removable false bottom made of 1.3 cm diamond screening, which allows smaller fish to be held with larger fish while reducing the risk of predation by larger fish. A 12-volt DC motor powered by 2 or 3 deep cell batteries turns the screen.

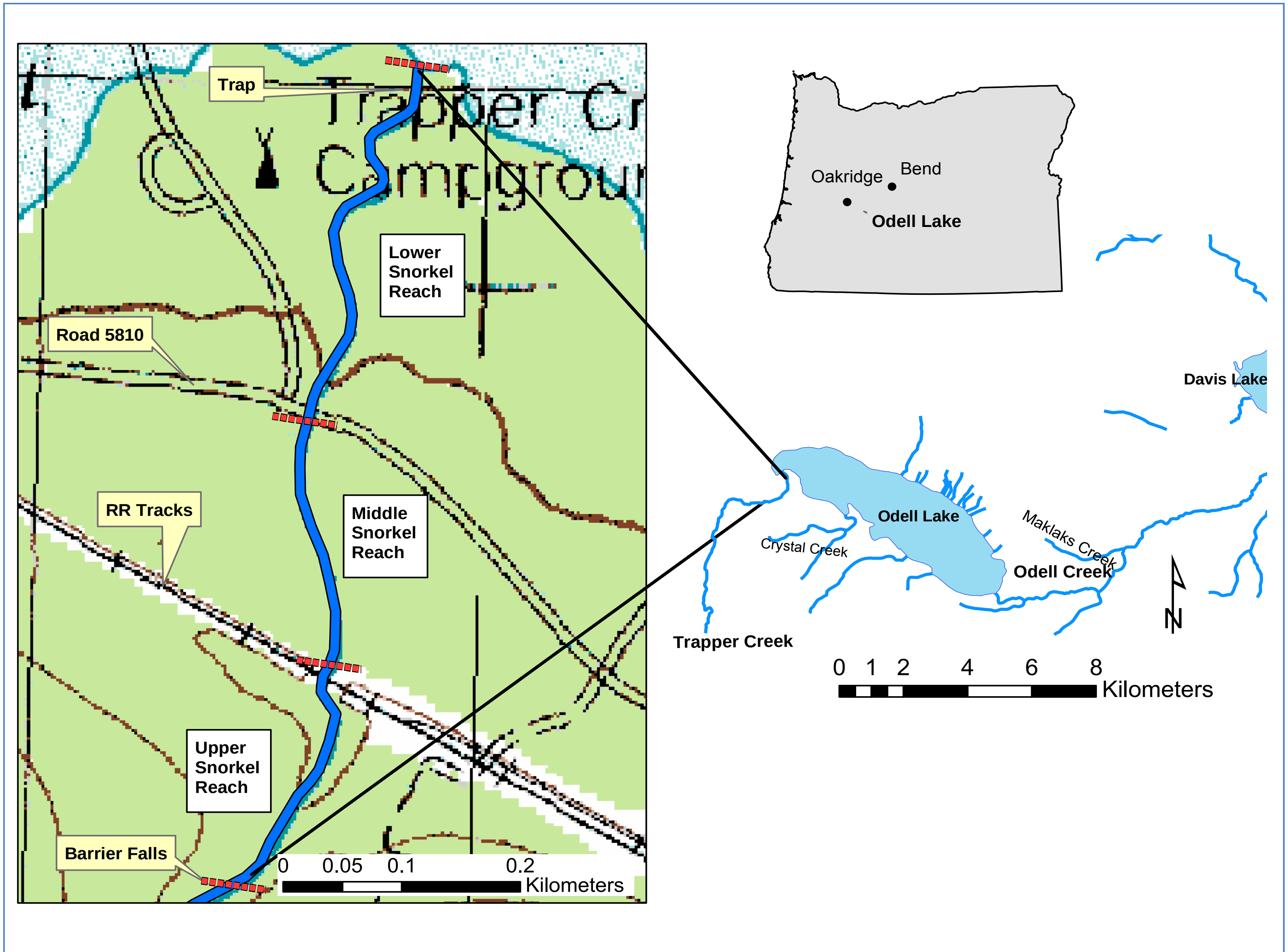


**Figure 1.** Study area of Trapper Creek in the Odell Lake Watershed. Map on left shows locations of the incline plane trap and the three snorkel reaches.

We transported the trap to the survey location in November 2009, prior to a seasonal accumulation of snow, which would have made trap assembly and installation more challenging. After assembly, the trap was tethered to the foot bridge in a non-fishing position until its deployment in mid-March. We operated the trap from 15 March to 17 July. During this period, snow and cold temperatures occasionally caused the trap to freeze over and stop fishing. Additionally, a high water event from 2-7 June forced the trap from its fishing location and resulted in a one-week period of no fishing. Field personnel reinstalled the trap slightly upstream of its initial location for the remainder of the sampling season. Weir boards were installed to divert flow toward the trap.

**A** **B**

**Figure 2.** Photos of trap locations. Photo A shows initial location directly under footbridge. Photo B shows second location upstream with weir boards in place. The footbridge is visible in the upper left corner.

To minimize impact to outmigrating fry, we operated the trap for a maximum of four nights per week. In general, we checked the trap every 24 hours during the morning hours; on three occasions, the trap was allowed to fish for 36-48 hours. When field personnel checked the trap, they detached the batteries from the motor and moved the screen into a non-fishing position before opening the livewell. They first removed, identified, enumerated and measured the fork length (mm) of all fish excluded by the livewell's false bottom. They then removed the false bottom and repeated those procedures, releasing all fish downstream of the trap after sampling. When all fish were sampled, the false bottom was replaced in the livewell and the screen was returned to a fishing position. In addition to the fish surveys, water depth at the trap, water temperature, weather, screen revolutions per minute and total time fished were recorded. Field personnel then replaced the spent batteries with charged batteries, reattached the motor, and ensured that the trap was fishing properly before leaving.

We obtained continuous water temperature data for the period of trap operation from U.S. Forest Service. Their temperature logger was deployed under the Trapper Creek Campground footbridge, just downstream of the trap location. The logger passed field audits using a National Institute of Standards and Technology (NIST) thermometer at Oregon Department of Environmental Quality's A-level, meaning that a ≤ 1.5°C difference was observed between the logger and the NIST thermometer readings (A. Reischauer, USFS, personal correspondence). We calculated daily averages of water temperature for the period of 15 March-18 July 2010, which coincides with the dates of trap operation. Daily average water temperatures from 2005 were used for comparison, as 2005 was the only other year where water temperatures in Trapper Creek were recorded during this time period.

We used air temperatures for Chemult, OR as a proxy for air temperatures at Trapper Creek to compare relative temperature trends during the period between spawning and fry emergence. This is the closest gauge with continuous long-term data available (40 km from Odell Lake). We then converted the temperatures from Fahrenheit to Celsius and calculated monthly averages.

## Mark-Resight Population Estimate for Trapper Creek

The mark-release phase of the mark-recapture survey occurred on 19 July 2010 and the recsight component occurred on 26 July 2010. The entire 1.3 km of Trapper Creek currently considered accessible to bull trout was split into three sections and sampled by snorkel survey. The sections were: Lower (mouth to road bridge), Middle (road bridge to railroad crossing), and Upper (railroad crossing to falls). Snorkelers sampled the three sections simultaneously and all sampling occurred at night. Night snorkeling has been shown to be effective for observing bull trout (Thurow et al. 2006) with minimal biological impact.

*Marking Methods*

Teams of two (Middle and Upper reaches) or three (Lower reach) snorkelers with dive lights proceeded upstream, capturing bull trout ≥ 80 mm fork length (FL) by hand nets. When bull trout were captured, they were relayed to data recording teams of two persons on shore. We briefly anesthetized fish in a MS-222 solution buffered with sodium bicarbonate, identified, measured fork length, and marked each by clipping the upper lobe of the caudal fin. Fish were then transferred to a recovery bucket and allowed to revive prior to being released downstream of the snorkel teams.

*Resight Methods*

Teams of two (Middle and Upper reaches) or three (Lower reach) snorkelers with dive lights proceeded upstream and searched for bull trout ≥ 80 mm fork length. Snorkelers noted the number of marked, unmarked and fish with unknown mark status observed. Bull trout were divided into three size classes (80-120 mm FL, 121-160 mm FL and >160 mm FL) and every bull trout observed was counted. Any other species observed were also noted. Data teams recorded counts of fish by size categories and mark status. The resight survey also served as the annual snorkel count.

*Population Estimate*

All formulas were obtained from Krebs (1999). Because the recapture method introduced the potential for a single fish to be observed more than once, the population estimate was calculated using the Peterson method for sampling with replacement as follows: $\hat{N}$ = [$M$ ($C$ + 1)/ $R$ + 1], where $M$ = the number of fish marked in the first sample, $C$ = the number captured in the second sample and $R$ = the number of marked fish recaptured.

A bootstrap method was used to estimate confidence intervals of the population estimate (Buckland and Garthwaite 1991, Mooney and Duval 1993). The fate of bull trout present in the survey portion of Trapper Creek was divided into several capture histories to form an empirical probability distribution as follows:

1. marked and recaptured on the spawning grounds (*R*)
2. marked and never seen again (*M*-*R*)
3. unmarked and sighted during the second snorkel pass (*C*-*R*)
4. unmarked and never seen ($\hat{N}$-*M*-*C*+*R*)

A random sample of size ($\hat{N}$) was drawn with replacement from the empirical probability distribution (capture histories 1-4). Values for the statistics *M, R, C* were then calculated and a new population size was estimated from these statistics. This process was repeated 1,000 times to derive 1,000 population estimates. The percentile method was used to calculate the 95% confidence interval from the 1,000 bootstrap samples. The interval lies between the 25$^{th}$ lowest and 25$^{th}$ highest values of the bootstrap population estimates.

# RESULTS

## Fry Emigration from Trapper Creek

We operated the trap a total of 61 trap nights from 15 March to 17 July for an average of three nights per week. A total of 33 fish were captured in the trap, resulting in a catch per unit effort (CPUE) of 0.54. Fish captured ranged from 25 to 176 mm FL and species captured were bull trout, kokanee *Oncorhynchus nerka*, and redband trout *Oncorhynchus mykiss ssp.* (Table 1). In addition to operating the inclined screen trap, field personnel conducted day time snorkel surveys from the rail road crossing down to the trap once a week for the first three weeks of June; no fish were observed during these surveys.

**Table 1.** Total catch from inclined screen trap on Trapper Creek.

| Species | Fork length range (mm) | Number captured |
|---|---|---|
| Bull trout | 25-30 | 4 |
| Bull trout | 80-138 | 7 |
| Kokanee | 25-64 | 20 |
| Kokanee | - | 1 |
| Redband | 176 | 1 |
| Total | | 33 |

Water temperatures in Trapper Creek were markedly colder during the latter portion of the incubation period of 2010 compared to 2005. Average daily water temperatures during the trapping season 2010 were fairly similar with 2005 temperatures through mid-May, at which point, 2010 water temperatures remained up to 5°C lower than in 2005. Lower temperatures persisted until late June 2010, when water temperatures were again comparable to or higher than 2005 temperatures (Figure 3).

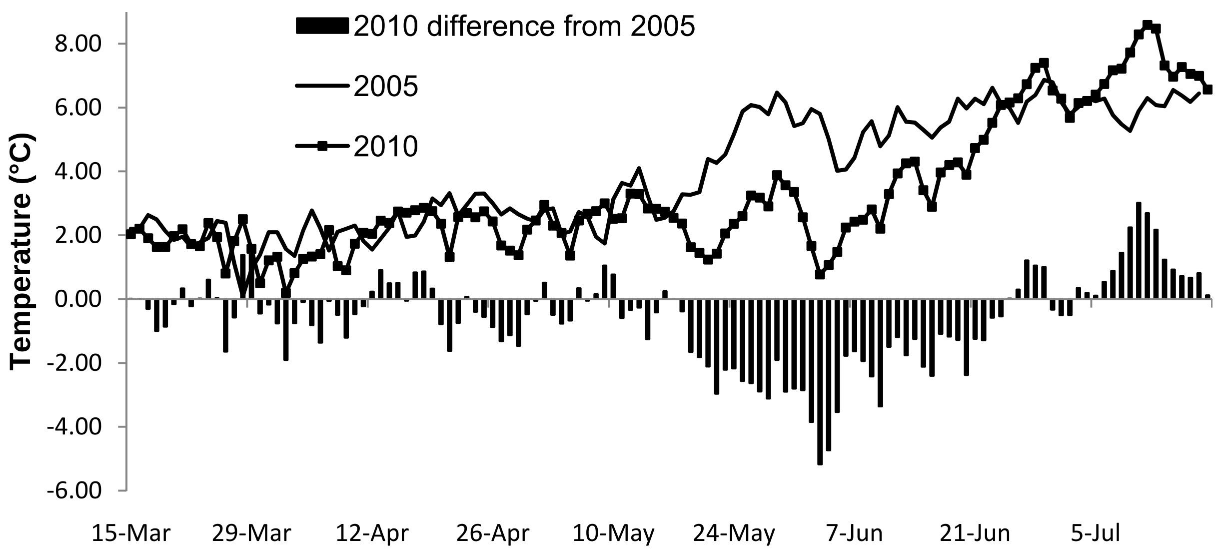


**Figure 3.** Average daily water temperatures for 2010 trapping season compared to the same period of 2004.

We reviewed long term air temperature data during the egg incubation and alevin development period for bull trout and compared monthly average temperatures to those of the 2004-05 and 2009-10 season. This comparison shows 2009-10 to be colder than average, whereas 2004-05 was near average (Figure 4). Further, we found that air temperatures at this location were highly correlated to water temperatures we had available for Trapper Creek ($R^2$ =0.82, p<0.01). This analysis suggests that water temperatures during the 2009-10 incubation period were exceptionally cold in Trapper Creek.

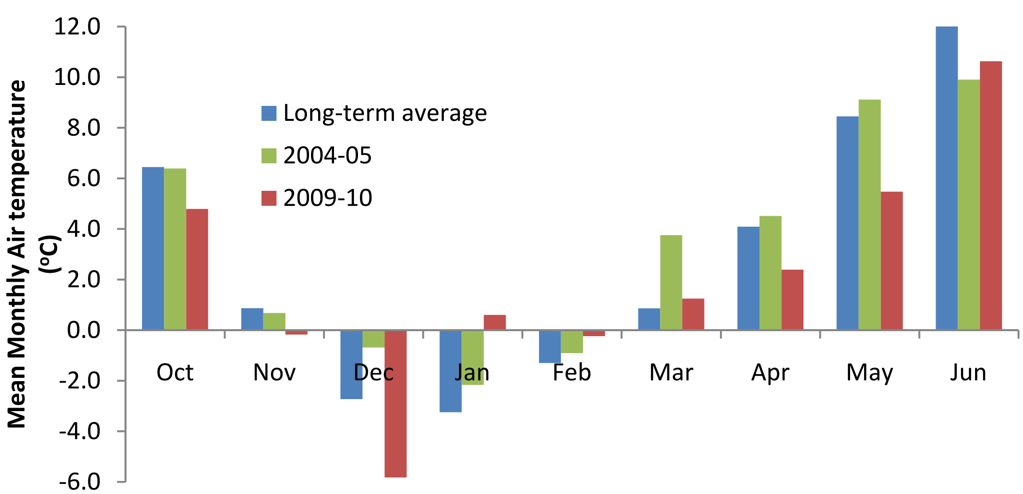


Figure 4. Monthly mean air temperature at Chemult, Oregon during the egg and alevin incubation period for Odell bull trout for the 2004-05 and 2009-10 brood years and also for a long-term average of brood years. The long-term average spans from 1937-2010 and has a minimum of 54 observations per monthly mean. Data obtained from the Western Regional Climate Center (http://www.wrcc.dri.edu/cgi-bin/cliMAIN.pl?or1546).

In 2010, we observed fish larger than 80 mm FL in the trap throughout the operation period, but observed neither bull trout nor kokanee fry until late June, when water temperatures had been steadily increasing for nearly a month (Figure 5).

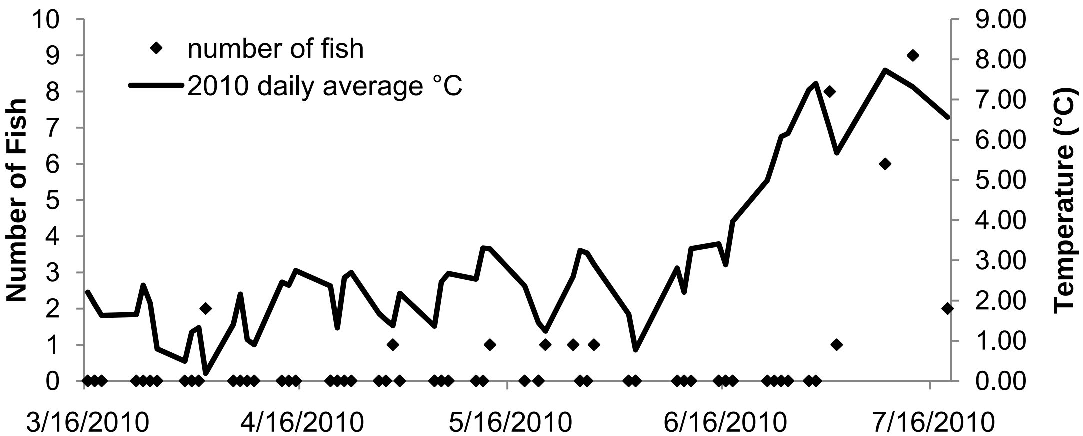


**Figure 5.** Number of fish captured in trap compared to 2010 daily average temperatures. Emergent fry (≤ 30 mm) were only observed in the final two weeks of sampling.

## Mark-Resight Population Estimate for Trapper Creek

A total of 121 bull trout ≥ 80 mm FL were counted during the resight snorkel survey. All but one of these fish could be verified as being marked or unmarked. The majority of fish were observed in the lower reach, between the mouth and the road bridge, shown in Figure 6. A total of 64 bull trout < 80 mm were also observed in the Lower reach only (not shown). Other species observed during the survey include 18 redband trout, 1 kokanee, 1 hybridized brook/bull trout and 3 brook trout.

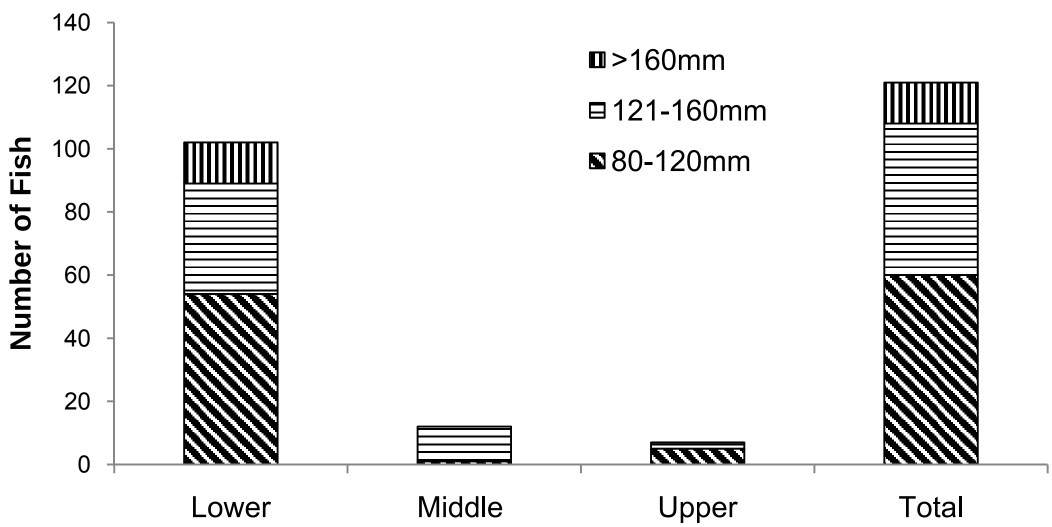


**Figure 6.** Bull trout ≥ 80 mm FL counted by reach during the resight phase of sampling.

Numbers of bull trout marked, observed and resighted to obtain the population estimate for 2010 are shown in Table 2. The size of bull trout captured and marked in 2010 was generally similar to those marked in 2005 (Figure 7). The 2010 population of juvenile bull trout ≥ 80 mm FL in Trapper Creek was estimated to be 253 (95% CI: 192-350). The snorkel observation efficiency for 2010, calculated by dividing the total number observed by the population estimate, was 47%. This snorkel efficiency was not significantly different from the observation efficiency obtained in 2005 (52%; $X^2$ contingency analysis, p=0.48).

Table 2. Numbers of bull trout marked (M), counted (C) and resighted (R) to obtain the population estimate for 2010 in Trapper Creek.

| Reach | M | C | R |
|---|---|---|---|
| Lower | 36 | 101 | 15 |
| Middle | 6 | 12 | 6 |
| Upper | 4 | 7 | 0 |

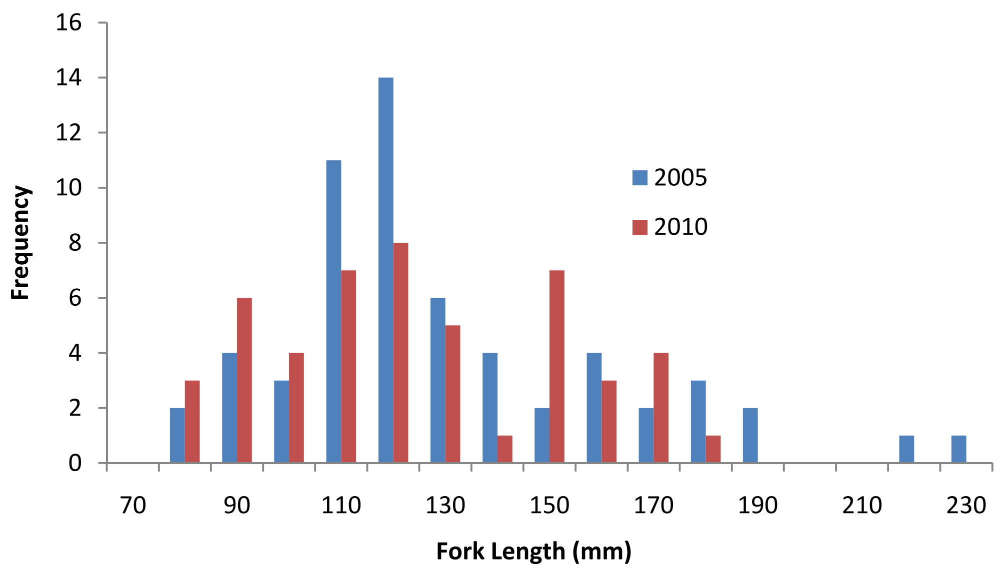


Figure 7. Length frequency of bull trout captured and marked in the lower 1.3 km of Trapper Creek in 2005 and 2010.

## DISCUSSION

Redd surveys indicate that Bull trout spawning generally occurs in late summer to early fall in Trapper Creek, with the majority of spawning complete by late September (Higgins et al. 2005, ODFW unpublished redd survey data). While literature surveys indicate that newly-emerged bull trout fry have been observed in the first week of April throughout their range (Pratt, 1992), we did not see bull trout fry in the inclined screen trap until late June. During the period of March to July 2010, uncommonly late cold water temperatures resulted in 81 fewer Celsius Temperature Units (CTUs), which likely delayed the emergence of bull trout fry and possibly reduced their survival to emergence. We did not see kokanee fry, which have similar CTU requirements, until late June as well. Snorkelers did not observe any fry during the presence-absence snorkel surveys conducted prior to capturing any fry in the trap, making us reasonably sure that fry did not bypass the trap in great numbers. We were unable to operate the trap past mid-July, at which point, we were seeing fry in the trap. It is possible that, had we been able to continue trapping, we would have captured more bull trout fry however only 64 bull trout fry were observed during snorkeling.

Because the timing of our trapping efforts was mismatched with fry emergence timing, we are unsure of the magnitude of fry emigration. We recommend repeating the fry trapping effort in 2011 with an adjusted time frame. Temperature data from years prior to 2010 indicate that lower water temperatures in Trapper Creek may delay emergence until late May or early June; installation and operation of the trap might therefore occur on a limited sample schedule (e.g. 2 days/week) beginning in mid-April until emergence is noted. Sampling might then occur 4-5 days/week through peak emergence. If it is determined that there is sufficient fry emigration to support transfers, the suitability of other tributaries within the Odell Lake watershed should be evaluated prior to fry transfer initiation; it is particularly important to confirm the absence of any self-sustaining bull trout populations to protect against unintended genetic consequences.

Hybridization and competition with brook trout and superimposition of redds by kokanee have been discussed as factors limiting the Odell Lake watershed bull trout population, persistence and potential expansion. Weeber et al (2010) found that kokanee did not dig deep enough redds to disturb bull trout redds and caused no net loss in bull trout egg-to-fry survival rates. Suspected bull/brook trout hybrids were found in both the 2005 and 2010 surveys. An evaluation of the extent of brook trout in the Odell Lake watershed tributaries should be undertaken prior to any potential fry transfers, as brook trout exhibit a tendency to out-compete bull trout in resource-limited situations (Gunckel et al. 2002).

The only other mark-recapture estimate of juvenile bull trout in Trapper Creek was obtained in late June, 2005 (Moore 2005). Using similar methods the 2005 estimate totaled 162 (bootstrap 95% CI: 132-202) fish with 52% snorkel observation efficiency. While the point estimate for 2010 is 64% higher, the confidence interval for the two estimates slightly overlap indicating no statistical difference between the two populations. Additionally, we found no difference between snorkel efficiencies for the two years. Although limited by the precision of the population estimates, this finding suggests that annual snorkel surveys provide a consistent index of juvenile bull trout abundance in Trapper Creek and that snorkel observation efficiency wasn't substantially affected by the complexity added to the stream as a result of habitat projects conducted by the U. S. Forest Service in 2007 and 2008. We recommend continuing the annual snorkel surveys to monitor juvenile bull trout abundance and repeating the mark-resight population estimate at five-year intervals to further evaluate the reliability of snorkeling. .

## ACKNOWLEDGEMENTS

We appreciate the tireless efforts of Dave Elverud, who monitored the inclined screen trap. Thanks to Richard Biederbeck for assistance in trap set-up and maintenance. We acknowledge the continued support of ODFW Upper Deschutes District, USFWS, and USFS personnel, and appreciate their many contributions to the 2010 season. Thanks to the Deschutes Chapter #552 of Trout Unlimited for their assistance with snorkel surveys. We are grateful to the owners of the Shelter Cove Resort for allowing us to store equipment at their facilities.

# REFERENCES


Buckland, S.T. and P.H. Garthwaite. 1991. Quantifying precision of mark-recapture estimates u using bootstrap and related methods. Biometrics 47:255-268.

Downs, C. C., D. Horan, E. Morgan-Harris, R. Jakubowski 2006. Spawning demographics and juvenile dispersal of an adfluvial bull trout population in Trestle Creek, Idaho. North American Journal of Fisheries Management 26(1): 190-200.

Gould, W. R. 1987. Features in early development of bull trout *Salvelinus confluentus*. Northwest Science 61(4): 264-268.

Gunckel, S.L., A.R. Hemmingsen, and J.L. Li 2002. Effect of bull trout and brook trout interactions on foraging habitat, feeding behavior, and growth. Transactions of the American Fisheries Society 131: 1119-1130.

Higgins, A., T.G Wise and S. Jacobs. 2005. Timing and location of bull trout in the Odell Lake watershed and Heising Spring of the Metolius River watershed, 2003-2004. Oregon Department of Fish and Wildlife, Information Report 2005-04, Corvallis.

Krebs, Charles J. 1999. *Ecological Methodology*, 2nd ed., Addison-Welsey Educational Publishers, Inc., Menlo Park, CA. 620 pp.

Mooney, C.V. and R. D. Duvall. 1993. Bootstrapping: A Non Parametric Approach To Statistical Inference. Sage Publications, Newbury Park, CA, 73 p.

Moore,T. 2005. Trapper Creek PIT tagging and mark-recapture population estimate, June 2005. Oregon Department of Fish and Wildlife Interim Report, Corvallis.

Pratt, K. L. 1992. A review of bull trout life history.. Proceedings of Gearhart Mountain Bull Trout Workshop, Oregon Chapter of the American Fisheries Society.

Powers, P. 2006. Trapper Creek restoration. Monitoring Report. U. S. Forest Service,Dechuttes National Forest, Crescent, OR.

Thurow, R. F., J. T. Peterson and J. W. Guzevich 2006. Utility and validation of day and night snorkel counts for estimating bull trout abundance in first to third-order streams. North American Journal of Fisheries Management 26:217-232.

Tranquilli, V. 2007. Middle Fork Willamette Basin bull trout rehabilitation and monitoring p roject. Oregon Department of Fish and Wildlife, Annual Progress Report, Springfield, OR. 38 p.

Weeber, M.A., G.R. Giannico, and S.E. Jacobs. 2010. Effects of redd superimposition by introduced kokanee on the spawning success of native bull trout. North American Journal of Fisheries Management 30:47-54.

OREGON

Fish & Wildlife