RECLAMATION

Managing Water in the West

2010 Annual Report

Bureau of Reclamation
Report on Monitoring and Implementation Activities
Associated with the USFWS 2005 Biological Opinion

For

Operation and Maintenance of the Bureau of Reclamation
Projects in the Snake River Basin above Brownlee Reservoir

U.S. Department of the Interior
Bureau of Reclamation
Pacific Northwest Region
Snake River Area Office, Boise, Idaho

March 2011

U.S. DEPARTMENT OF THE INTERIOR

PROTECTING AMERICA'S GREAT OUTDOORS AND POWERING OUR FUTURE

THE U.S. DEPARTMENT OF THE INTERIOR PROTECTS AMERICA'S NATURAL RESOURCES AND HERITAGE, HONORS OUR CULTURES AND TRIBAL COMMUNITIES, AND SUPPLIES THE ENERGY TO POWER OUR FUTURE.

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THE MISSION OF THE BUREAU OF RECLAMATION IS TO MANAGE, DEVELOP, AND PROTECT WATER AND RELATED RESOURCES IN AN ENVIRONMENTALLY AND ECONOMICALLY SOUND MANNER IN THE INTEREST OF THE AMERICAN PUBLIC.

Front photograph: Anderson Ranch Reservoir, Idaho.

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1.0 INTRODUCTION

The Bureau of Reclamation (Reclamation) consulted with the U.S. Fish and Wildlife Service (USFWS) on 12 proposed actions involving the effects of future operations and routine maintenance at 12 Federal projects in the upper Snake River basin. The USFWS completed a non-jeopardy Biological Opinion (Opinion) in March 2005 for Reclamation operations and maintenance activities in the Snake River basin above Brownlee Reservoir. The Opinion contains a 30-year incidental take statement (ITS) and corresponding reasonable and prudent measures that outline nondiscretionary actions to minimize take for Utah valvata (*Valvata utahensis*) and bull trout (*Salvelinus confluentus*) (USFWS 2005).

Section 9 of the Endangered Species Act (ESA) defines take as any action that can harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or to attempt to engage in such conduct toward an ESA-listed species. Under the terms of Section 7(b)(4) and Section 7(o)(2), take that is incidental to and not intended as part of the agency action is not considered to be a prohibited take under the ESA, provided that such take is in compliance with the terms and conditions of the ITS. The ITS has two main components: (1) a monitoring component to ensure the action agency does not exceed the amount or extent of incidental take described in the ITS, and (2) reasonable and prudent measures (RPMs) to minimize the amount or extent of take without altering the basic design, location, scope, duration, or timing of the action. The Opinion requires that Reclamation provide an annual report to the USFWS reporting incidental take monitoring efforts and implementation status of all RPMs and terms and conditions. The annual report is due by March 31 of each year. The submittal date was changed from December 31 to March 31 after USFWS agreed to a request by Reclamation for a permanent change (letter dated November 13, 2007).

This document is submitted as Reclamation's annual report for Water Year 2010 (October 1, 2009, to September 30, 2010). This is an appropriate reporting period, but presents a challenge because annual minimum reservoir contents occur near the end of the reporting period. For 2010, the minimum contents of many reservoirs occurred in the first few days of the reporting period in October 2009 and are the result of 2009 operations that were reported last year. Generally, the relevant 2010 minima are reported in this report and their relationship to the initial conditions is described when needed to enhance clarity.

Also referenced in this report is an Opinion from the National Oceanic Atmospheric Administration (NOAA) Fisheries Service, dated May 2008, for the continued operation and maintenance of Reclamation projects in the Snake River basin above Brownlee Reservoir (NOAA Fisheries Service 2008). The ITS included RPMs and associated terms and conditions to minimize incidental take to 13 ESA-listed salmon and steelhead evolutionarily significant units (ESUs) or adversely modify or destroy critical habitat that is designated for three of the ESUs. The annual progress report for the NOAA Fisheries Service Opinion is reported under a different cover (Reclamation 2010a).

2.0 SUMMARY OF 2009 OPERATIONS

2.1 Idaho

November carryover storage from 2009 was average in the Payette River basin (100 percent) and in the Boise River basin (104 percent), and above average in the upper Snake River basin above Milner (116 percent). Despite a wet October, the rest of the 2010 winter had well below average snowfall and by April 1, snow packs in these three basins were 64 percent, 70 percent, and 55 percent of average, respectively, with similarly low runoff forecasts. However, a cool spring and a very wet June (over 200 percent of average in the middle and upper Snake River basins) helped offset snowpack deficiencies and added substantially to the runoff. Observed unregulated runoff for the April through July period was 89 percent for the Payette River at Horseshoe Bend, 80 percent for the Boise River near Boise, and 73 percent of average for the Snake River at Heise. It is notable that these observed runoff volumes fell near or outside of the 95 percent confidence interval for the runoff forecasts, indicating how unexpected these results were.

The Payette reservoir system refilled completely in 2010, with record releases from Cascade Reservoir in June following back-to-back rain events. The Boise River reservoir system had sufficient water to refill completely as well, but was deliberately held at about 19,600 acre-feet from full in order to move the flow augmentation release to an earlier timeframe as outlined in the 2008 Biological Opinion (NOAA Fisheries Service 2008). The upper Snake River reservoir system (above Milner) physically refilled to within 32,000 acre-feet of full. Sufficient water was available in 2010 to provide 487,000 acre-feet for Reclamation's flow augmentation program for salmonid species below Brownlee Reservoir. This amount is the upper limit of flow augmentation to be provided in any given year. Contributions to the flow augmentation included 198,966 acre-feet from the upper Snake River above Milner Dam, 160,415 acre-feet from the Payette River basin, 42,632 acre-feet from the Boise River basin, and 84,987 acre-feet of natural flows.

2.2 Oregon

Carryover storage was very low for the Malheur River basin, and in particular Beulah Reservoir, in Water Year 2010. The watershed above Beulah Reservoir represents approximately 20 percent of the Malheur River basin. At the beginning of the 2010 Water Year, carryover storage in Beulah Reservoir was about 680 acre-feet, or 11 percent, of the 2000 to 2009 average due to drought conditions in recent years. Unregulated runoff for the April through July period was 97 percent of the 1971 to 2000 average for Beulah Reservoir, thanks primarily to a cool and wet spring. Beulah Reservoir filled to about 88 percent (52,509

acre-feet) of physical capacity in 2010 and was drafted to 12 percent of reservoir capacity (7,164 acre-feet) on September 30, 2010. The Malheur River basin does not contribute to Reclamation's flow augmentation program.

Flow information for the 2010 Water Year (October 1, 2009 to September 30, 2010) can be found at Reclamation's Hydromet website[1] (Reclamation 2011a). Reservoir water operations including daily average reservoir elevations, acre-feet contents, storage, and outflow for the following sites are discussed in detail later in this report:

- American Falls Reservoir and Lake Walcott
- Anderson Ranch Reservoir
- Arrowrock Reservoir
- Deadwood Reservoir
- Beulah Reservoir

[1] http://www.usbr.gov/pn/Hydromet/

3.0 UTAH VALVATA

3.1 Introduction and Background

The USFWS 2005 Opinion found that operations associated with the proposed operations of American Falls and Minidoka dams would result in incidental take of Utah valvata (*Valvata utahensis*).

The known distribution area of Utah valvata ranges from the Henrys Fork River at the Idaho Highway 33 Bridge (Henrys Fork river mile [RM] 9) near Rexburg, downstream to Brownlee Reservoir (Figure 1).

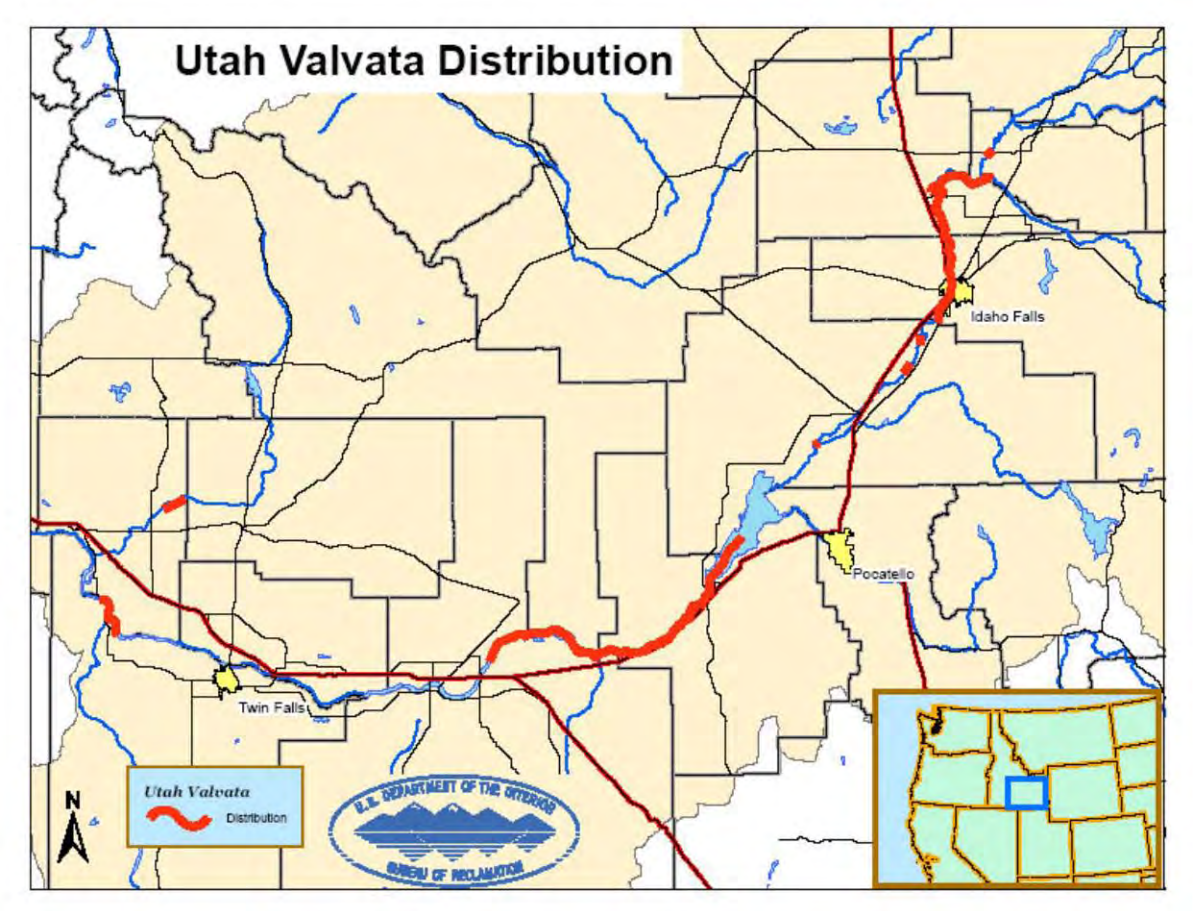

Figure 1. Known distribution of Utah valvata populations in the upper Snake River basin.

The USFWS included terms and conditions in its Opinion to minimize incidental take of Utah valvata. The Opinion contains the ITS and corresponding RPMs that outline nondiscretionary actions for Utah valvata. The RPM requires Reclamation to minimize incidental take of Utah valvata related to Reclamation's operations of two facilities: American Falls Dam and Reservoir and Minidoka Dam and Lake Walcott. Reclamation must comply with the RPMs to receive Section 9 coverage under the ESA, 16 U.S.C. 1531 et seq. In addition, the Opinion requires Reclamation to develop monitoring plans to ensure that Reclamation's operations do not exceed the defined extent or amount of incidental take.

The operation of Reclamation projects in the upper Snake River basin directly affects aquatic species and physical habitat by limiting their dispersal and migration, altering habitat and water quality, decreasing bedload movement, and altering the transport of fine sediment. The primary effects to water quality include increased suspended sediment, nutrient loading, and changes in the thermal regimes of the riverine and reservoir environments. For Reclamation to implement the RPMs issued by USFWS in its Opinion (USFWS 2005), the two agencies implemented a cooperative research and monitoring plan for the Utah valvata in the Snake River from the confluence of the Henrys Fork and the Snake River, downstream to Lake Walcott. In this chapter, the field monitoring activities conducted by Reclamation during Water Year 2010 are summarized. Operational thresholds and the respective effects, frequency, and timing for 2010 are summarized in Table 1.

Table 1. Summary of amount or extent of anticipated take of Utah valvata associated with Reclamation facility operations.

Facility	Anticipated Take	Operational Indicators	Critical Season	Frequency	2010 operation (October 2009 to September 2010)	Quick reference: Times threshold was exceeded
American Falls Dam and Reservoir	Up to 85 percent of Utah valvata in the reservoir are affected by stranding and desiccation when the reservoir is drafted to its lowest levels.	Reservoir storage volume falls to 0 percent of capacity (475 acres of wetted habitat), corresponding to a reservoir surface elevation of 4295.6 feet.	summer and early fall (August to October)	2 of 30 years	In Water Year 2010 the lowest reservoir storage volume, after storage season, was 402,047 acre-feet on September 30, 2010 (Figure 8).	0 of 2 years 2006: 0 2007: 0 2008: 0 2009: 0 2010: 0
	Between 40 and 85 percent of Utah valvata in the reservoir are affected by stranding and desiccation when the reservoir is drafted to low levels.	Reservoir storage volume is between 475 and 22,351 AF (surface elevation ranges between 4,295.6 and 4,303.4 feet)	summer and early fall (August to October)	2 of 30 years	In Water Year 2010 the lowest reservoir storage volume was 402,047 acre-feet on September 30, 2010 (Figure 8).	1 of 2 years 2006: 0 2007: 4 days 2008: 0 2009: 0 2010: 0
	Between 5 and 40 percent of Utah valvata in the reservoir are affected by stranding and desiccation when the reservoir is drafted as part of normal operations.	Water stored in and released from American Falls Reservoir.	Year-round	30 of 30 years	Figure 8 depicts American Falls content in acre feet for Water Year 2010. Storage began in early October and continued thru April and then releases began.	4 of 30 years 2006: all year 2007: all year 2008: all year 2009: all year 2010: all year
Neely Reach	Up to 54 percent of Utah valvata in the Snake River, Neeley Reach, are affected by stranding and desiccation when river flows are at their lowest levels.	Minimum winter flows at the Snake River at Neeley gage reach 350 cfs.	winter	9 of 30 years	In Water Year 2010, the lowest winter flows at Neeley were 1,200 cfs (Figure 9).	1 of 9 years 2006: 5 days 2007: 0 2008: 0 2009: 0 2010: 0

In July 2007, Reclamation received a recovery permit from the USFWS as authorized under Section 10(a)(1)(A) of the ESA for the purpose of monitoring Utah valvata and Snake River physa (*Physa natricina*) at specific locations in the Snake River in southern Idaho.[2] The permit expires August 6, 2012.

Under the authority of the Endangered Species Act of 1973, as amended, the USFWS removed the Utah valvata from the Federal List of Endangered and Threatened Wildlife (List). Based on a thorough review of the best available scientific and commercial data, the USFWS determined that the Utah valvata is more widespread and occurs in a greater variety of habitats in the Snake River than known at the time of listing in 1992. It is now understood that the Utah valvata is not limited to areas of cold-water springs or spring outflows; rather, it persists in a variety of aquatic habitats, including cold-water springs, spring creeks and tributaries, the mainstem Snake River and associated tributary stream habitats, and reservoirs influenced by dam operations. The USFWS determined that the species did not meet the definition of an endangered or threatened species under the Act. Therefore, the Utah valvata was removed from the List, thereby removing all protections, and subsequent monitoring and reporting requirements, provided by the Act (75 FR 52272). Accordingly 2010 is the last year Reclamation will monitor the Utah valvata and all terms and condition identified to minimize take and reporting are considered discretionary in the future.

3.2 Implementation of the Reasonable and Prudent Measures and Associated Terms and Conditions for Utah Valvata

The USFWS identified one RPM and two terms and conditions for American Falls Dam and downstream reaches to reduce the take associated with the operation of the project (Table 2). The RPMs state that Reclamation shall implement measures to minimize the amount and the effect of take of Utah valvata from stranding, exposure, and desiccation within American Falls Reservoir and downstream reaches associated with operation of American Falls Dam and Reservoir. American Falls Reservoir did not draft below 50,000 acre-feet in Water Year 2010.

[2] Permit # TE056557-4

Table 2. Terms and Conditions under the BiOp

T&C Number	Terms and Conditions
1.a.	*Within the range of operations defined in the proposed action, minimize the frequency, extent, and duration of drawdown of American Falls Reservoir to levels below 50,000 acre-feet for the period of the proposed action.*
1.b.	*When Reclamation drafts American Falls Reservoir to less than 50,000 acre-feet, Reclamation shall report to the Service when the operation occurred, the duration and the conditions leading to such operation.*

3.3 Monitoring Area

The monitoring area is located in southeast and south-central Idaho and includes the Snake River from the confluence of the Henrys Fork downstream to Minidoka Dam (Figure 1). The elevation ranges from 1326 meters to 1294 meters (4805 feet to 4245 feet). Near the upstream end of the monitoring area, the Snake River basin has a drainage area of 35,224 square kilometers (13,600 square miles) with water diversions supporting nearly 3,238 square kilometers (800,000 acres) of irrigated agricultural lands. The area is high desert with sage brush (*Artemisia sp.*) vegetation.

The hydrology of the monitoring area is primarily influenced by winter snowfall and springtime runoff from the mountainous areas in the basin. Reclamation maintains two dams in the monitoring area (Minidoka and American Falls dams) and manages the river for water storage and hydroelectric generation. The maximum river flow in the Snake River near Neeley Reach measured prior to regulation (period of record is 1907 to 1926) was 48,400 cfs in 1918 and the minimum flow measured was 2,180 cfs in 1924. The maximum river discharge measured since regulation was 46,100 cfs in 1997, and the minimum discharge was 50 cfs in 1941, 1961, and 1970.[3] Many tributaries have irrigation diversions, and at times, these diversions remove all the surface flow that would enter the Snake River (Gianotto 1995). Currently, the monitoring area is listed under Section 303(d) of the Clean Water Act for the water quality parameters of dissolved oxygen, nutrients, oil and grease, and sediment (IDEQ 1998).

The usual range of parameters for water conductivity was from 430 to 470 micromhos per centimeter; for pH, from 8.4 to 8.7; and for alkalinity, from 140 to 200 milligrams per liter of calcium carbonate ($CaCO_3$). The monitoring area contains several endemic mollusk species thought to be a relict from the Pliocene epoch, such as the California floater (*Anodonta californiensis*) and the Utah valvata (Taylor 1982). Historically, this portion of the Snake River was not accessible to anadromous fish, and today primarily supports populations of

[3] http://id.waterdata.usgs.gov

stocked, non-native rainbow trout (*Oncorhynchus mykiss*) and smallmouth bass (*Micropterous dolomieui*) to provide a sport fishery. Several species of macrophytes are commonly found in reservoir and other lower velocity habitats throughout the monitoring area.

3.4 Methods

3.4.1 Sample Locations

Four long-term monitoring sites were selected at locations in regulated river or reservoir habitat where Utah valvata were detected during previous distribution surveys. Listed from downstream to upstream, the four sites are:

- Lake Walcott, RM 680 to 702
- Snake River at Vista (Neeley Reach), RM 710 to 713
- American Falls Reservoir, RM 714 to 720
- Upper Snake River (Snake River above American Falls Reservoir), RM 746 to 901.6

Beginning in Water Year 2006, Reclamation discontinued annual monitoring surveys for each site and initiated monitoring surveys on an alternate year schedule. Utah valvata monitoring surveys occurred in Lake Walcott and the Neeley reach of the Snake River in the summer and fall of 2009. In Water Year 2010, Utah valvata monitoring surveys were conducted throughout American Falls Reservoir and the upper Snake River (Sunnyside Bridge near Idaho Falls, Snake River near Roberts, and the confluence of the Henrys Fork and South Fork of the Snake River).

The upper Snake River is characterized by a free-flowing riverine channel with bedrock, boulder, gravel, and fine sediments. Adjacent backwater and oxbow habitat and large woody debris are common in this reach. American Falls Reservoir has deeper (greater than 10 meters depth) reservoir habitat where the channel was originally located. The reservoir has a broader, uniform bottom characterized by fine sediments.

Consistent with previous years sampling protocols, Reclamation continued presence/absence surveys for Utah valvata monitoring based on Fore and Clark (2005). The presence/absence surveys were conducted at each site in 2010. Reclamation typically uses Geographic Information System (GIS) to create a 100-meter grid layer over the respective survey area and assigns a random numeric value to each quadrat. A random number generator is then utilized to randomly select 100 numeric values. The corresponding quadrats are then selected as

potential sample locations. Using Geographic Positioning System (GPS), Reclamation personnel then navigate to each quadrat and collect samples inside the 100-meter square for each of the selected quadrats. Reclamation selected a different set of quadrats for each sampling period (i.e., June and August) in 2010, but was unable to utilize the selected points due to an unknown error in product software. As a result, Water Year 2010 sites were simply randomly selected by Reclamation personnel on site and recorded using GPS.

3.4.2 Snail Collection

Presence/absence surveys for Utah valvata were conducted by Reclamation in American Falls Reservoir and the upper Snake River in June and August 2010. A total of 186 samples were collected in Water Year 2010; no Utah valvata were knowingly killed as a result of collection and handling during this period. All Utah valvata were returned to the monitoring site collection points immediately following species verification.

All plots were sampled with a Venturi suction dredge operated by a SCUBA diver. A 0.25-square-meter plot was excavated approximately 2.5 centimeters deep by the vacuum dredge. The sample was transported through flexible tubing, and collected in a 1,000-micrometer sieve. Samples were immediately searched for live Utah valvata. When the first live Utah valvata was encountered, the presence of Utah valvata was noted for that plot and the sample was returned to the collection point. It was assumed that all live Utah valvata encountered with broken shells were the result of the sampling, however, none were encountered in 2010. No dewatered sites were sampled.

3.4.3 Habitat Measurements

Water depth, temperature, and dissolved oxygen were measured with a water quality meter made by Yellow Springs Instruments, Inc. Macrophyte presence was recorded for all plots. Dominant substrate types were visually determined and recorded.

3.5 Results and Discussion

In June and August of 2010, surveys were conducted in American Falls Reservoir (Figure 2 and Figure 3). Fifty-six samples were collected from American Falls Reservoir in June, with live Utah valvata occurring in one sample. Clear shells, suggesting recent (possibly less than one year) mortality, were encountered at one site (Figure 2). Forty-nine samples were collected from American Falls Reservoir in August, with live Utah valvata occurring in one sample. Clear shells were found in three samples (Figure 3).

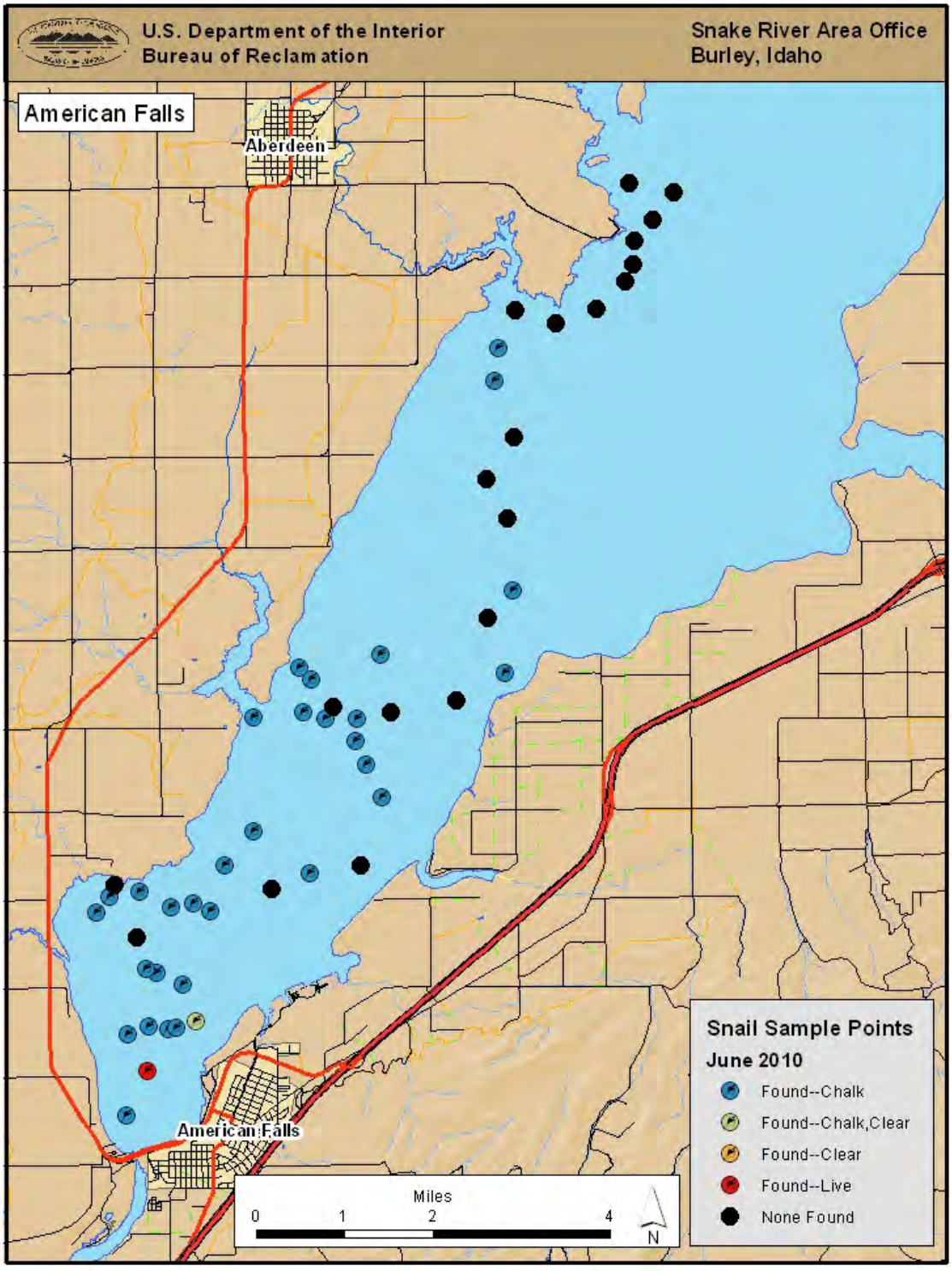

Figure 2. Locations of randomly selected survey sites American Falls Reservoir in June 2010, for Utah valvata annual monitoring activities.

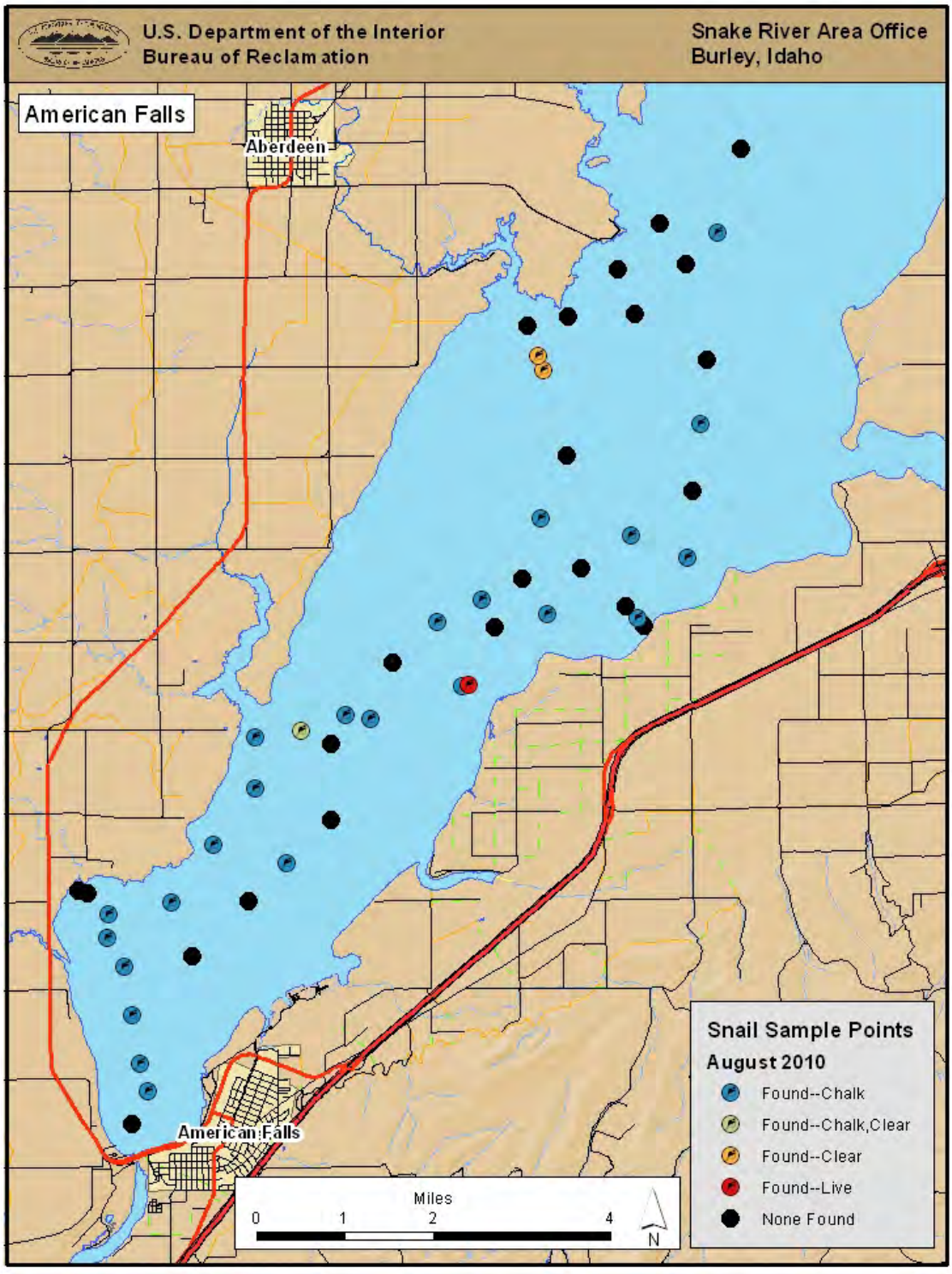

Figure 3. Locations of randomly selected survey sites on Lake Walcott in August 2009 for Utah valvata annual monitoring activities.

Fewer live Utah valvata were collected in American Falls Reservoir in 2010 than previous sampling periods. This is likely due to a number of compounding factors. The spring of 2010 was a late spring with mean ambient and water temperatures below average through much of April, May, and June, resulting in a later onset of spring flows. Utah valvata emergence and respective reproduction timing was likely delayed accordingly, thereby reducing the likelihood of encountering emerging adults in June and juveniles in late August. In addition, the number of samples collected from the reservoir was lower than in previous years due to windy conditions during sampling. Sampling was postponed multiple times due to significant winds. Wind in excess of 15 miles per hour on American Falls Reservoir creates considerable wave action, which in turn slows sample collection. Finally, Reclamation's inability to utilize GIS-generated collection quadrats, as previously discussed, resulted in a non-random sampling pattern. The clustered sampling pattern exhibited on Figures 2 and 3 illustrate this. A purely random sampling scheme may likely have resulted in an increased rate of occurrence of live Utah valvata in the samples.

In August 2010, 81 samples were collected from the upper Snake River, with live Utah valvata occurring in 31 samples (Figure 4 through Figure 7). There were three survey areas in the upper Snake River: Sunnyside Bridge area (near Idaho Falls, Idaho), the Snake River near Roberts, Idaho, and the confluence of the Henrys Fork and the South Fork of the Snake River. No samples were collected from the Snake River near Roberts or the Henrys Fork confluence in June due to high flows and very unsafe sampling conditions. High flows in June did not allow passage under bridges or access to the boat ramps. In addition, the large amount of woody debris floating in the river made passage and diving unsafe. Sampling was, however, conducted below the Sunnyside Bridge near Idaho Falls in June.

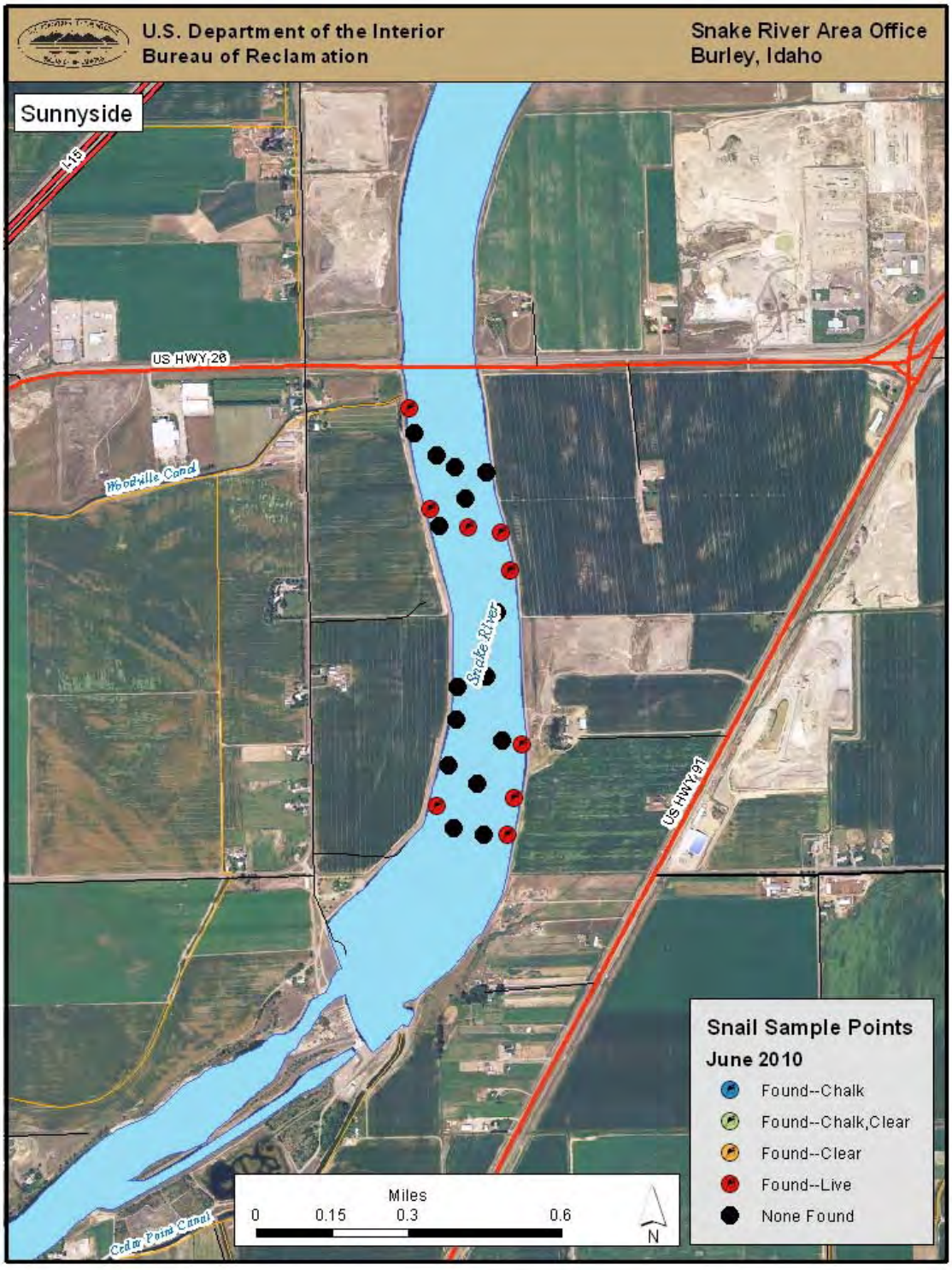

Figure 4. Locations of selected survey sites on the upper Snake River below Sunnyside Bridge in June 2010 for Utah valvata annual monitoring activities.

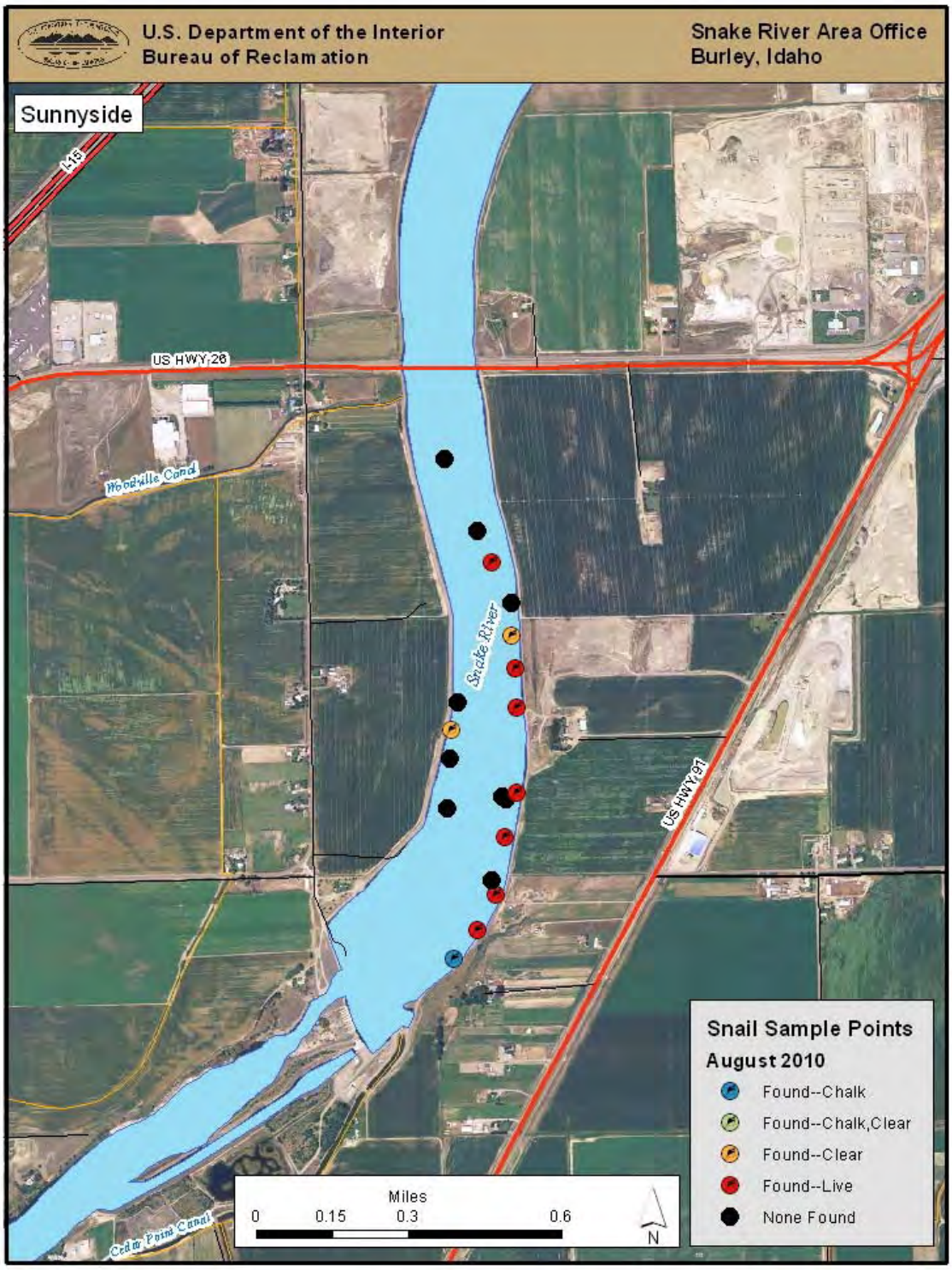

Figure 5. Locations of selected survey sites on the upper Snake River below Sunnyside Bridge in August 2010 for Utah valvata annual monitoring activities.

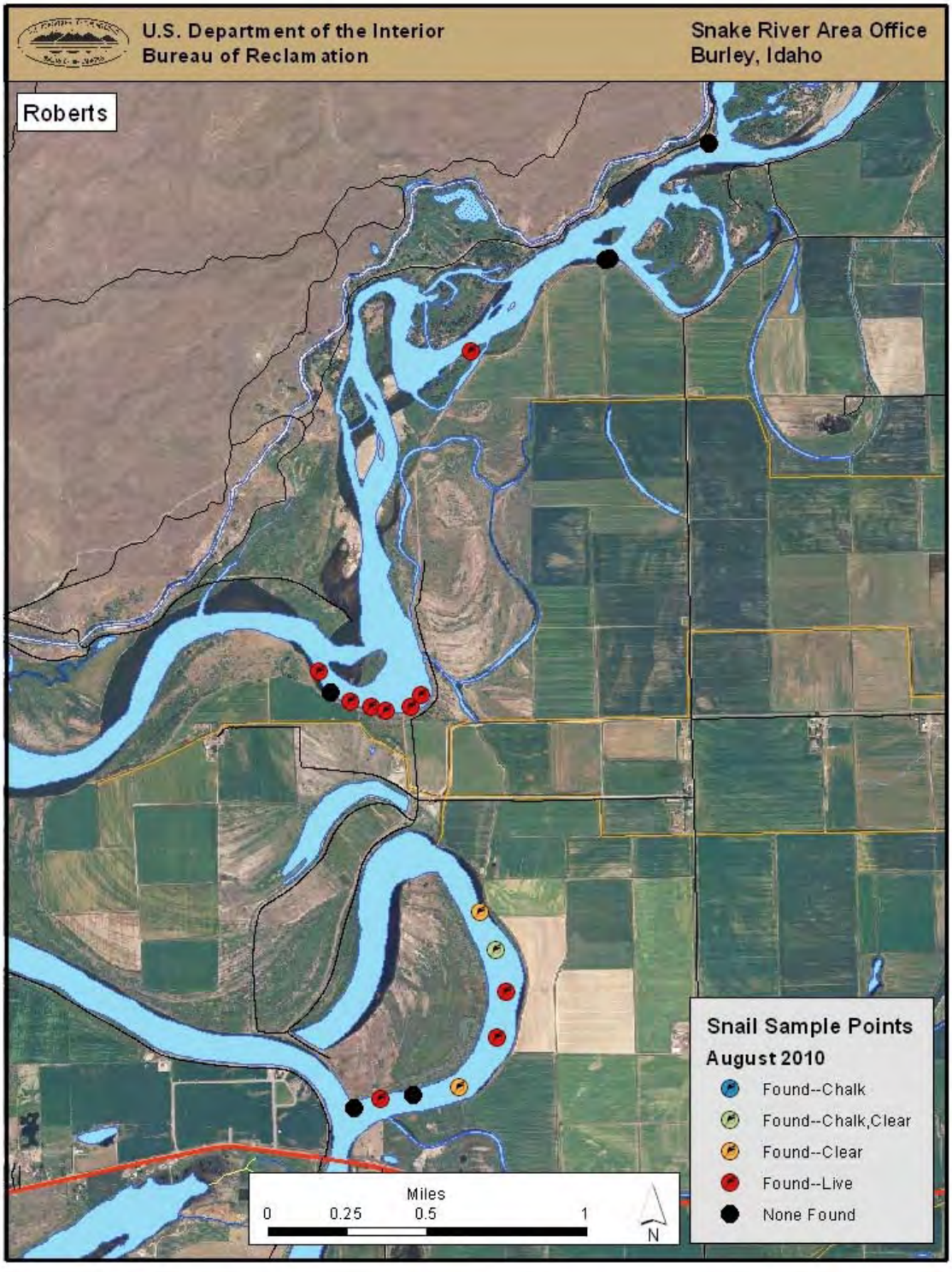

Figure 6. Locations of selected survey sites on the upper Snake River near Roberts in August 2010 for Utah valvata annual monitoring activities.

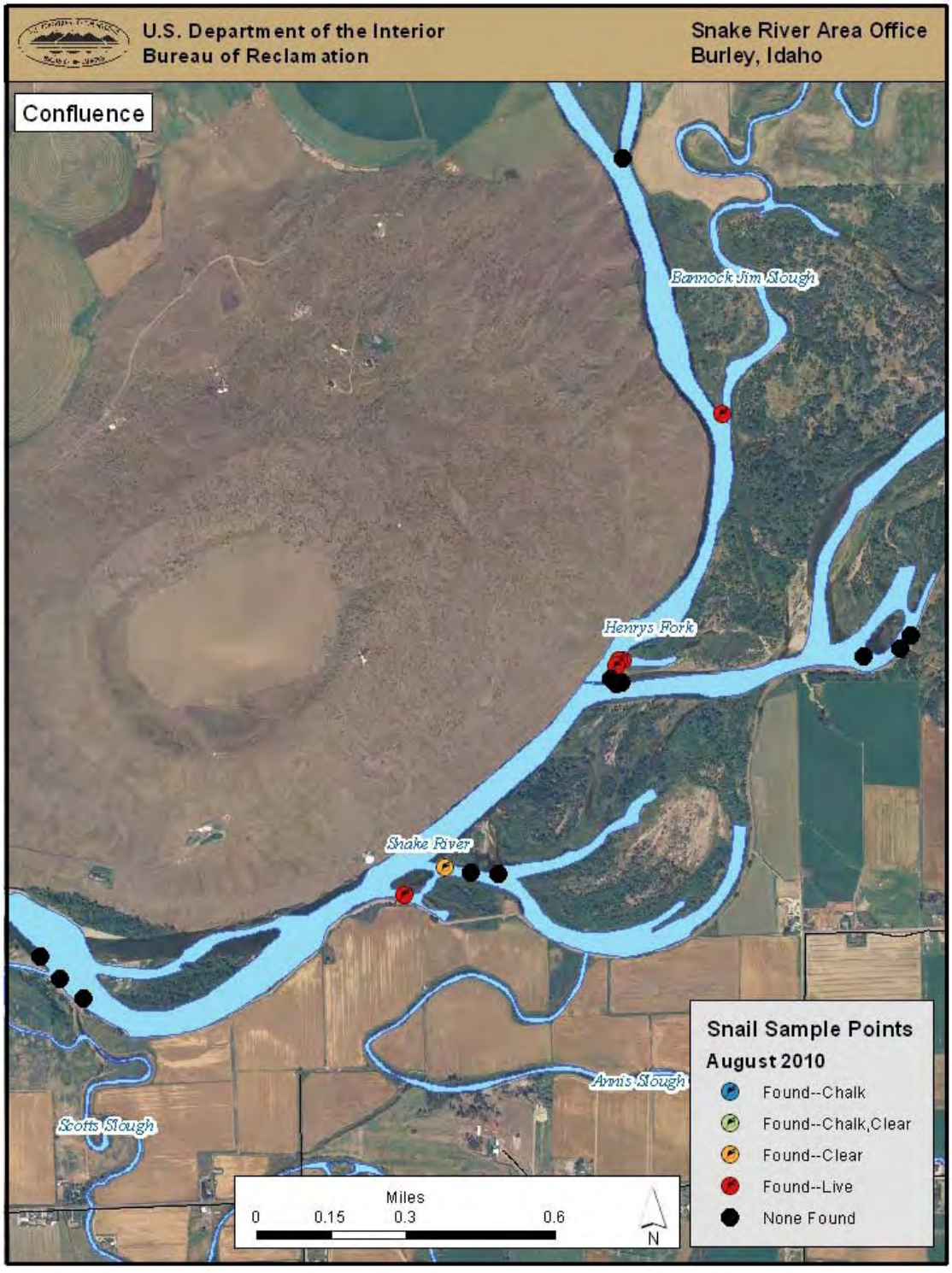

Figure 7. Locations of selected survey sites on the upper Snake River at the confluence of the Henrys Fork and South Fork in August 2010 for Utah valvata annual monitoring activities.

As encountered in previous years, Utah valvata habitat was characterized as dominated with fines. Although Utah valvata were encountered in sand, small gravel, medium gravel, and some cobbles, the substrate types still consisted of fines occupying the interstitial space associated with the small and medium gravel with intermittent cobble. The Utah valvata appear to occupy this space, where velocities are near zero and fines are deposited. No Utah valvata were found in sand-only substrates. All plots containing live Utah valvata contained silt. Although Utah valvata were occasionally encountered in sites with macrophytes present, the snails do not appear to be dependent upon them. Utah valvata and macrophytes are each associated with fines and subsequent low water velocities, with little to no dependence on each other.

Water quality data collected in Water Year 2010 was consistent with measurements from previous years. The water quality data summary for the Water Year 2010 field season is listed in Table 3.

Table 3. Summary water quality data for June and August 2010 including temperature (°C), dissolved oxygen (DO) measured in parts per million (ppm), and depth (feet).

Site	Date	DO (ppm)		Temperature (^{o}C)		Depth	
		Range	Mean	Range	Mean	Range	Mean
American Falls Reservoir	June	2.8 - 10.15	9.35	13.10 - 15.60	14.33	20.00 - 63.30	48.28
Upper Snake - Sunnyside	June	8.20 - 11.11	10.29	11.09 - 12.40	12.11	1.00 - 25.20	13.47
American Falls Reservoir	August	3.20 - 9.98	7.93	21.40 - 22.50	22.27	16.00 - 51.30	34.76
Upper Snake - Sunnyside	August	8.12 - 10.40	8.77	18.20 - 19.10	18.68	4.80 - 23.00	11.76
Upper Snake - Roberts	August	na	na	na	na	2.00 - 11.90	6.04
Upper Snake - Confluence	August	4.03 - 10.60	8.77	13.50 - 21.00	16.58	1.60 - 12.00	4.49

3.5.1 American Falls Dam and Reservoir Operations

Initial reservoir content for American Falls Reservoir in Water Year 2010 was 567,400 acre-feet on October 1, 2009, much above the 50,000 acre-foot threshold (Figure 8). This reservoir carry-over content resulted from an average water supply, irrigation demands reduced by spring precipitation, and fulfillment of Reclamation's downstream flow augmentation obligations under the NOAA Fisheries Opinion (NOAA Fisheries Service 2008) and the Nez Perce Settlement of 2007.

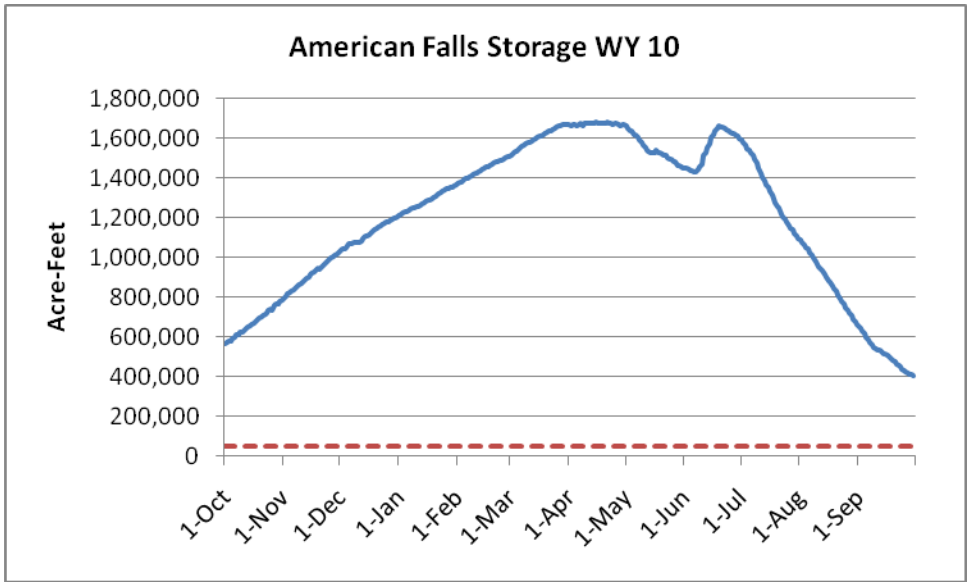

Figure 8. American Falls Reservoir storage volumes (acre-feet) for Water Year 2010 (WY10). The dotted line represents Reclamation's operational threshold storage of 50,000 acre-feet.

System carry-over from 2009 was much above average and American Falls minimum content was 566,406 acre-feet on September 29, 2009. Discharge below American Falls Dam was decreased to 1,500 cfs after the irrigation season ended in October 2009 (Figure 9). System storage and American Falls storage were adequate to avoid a low winter discharge.

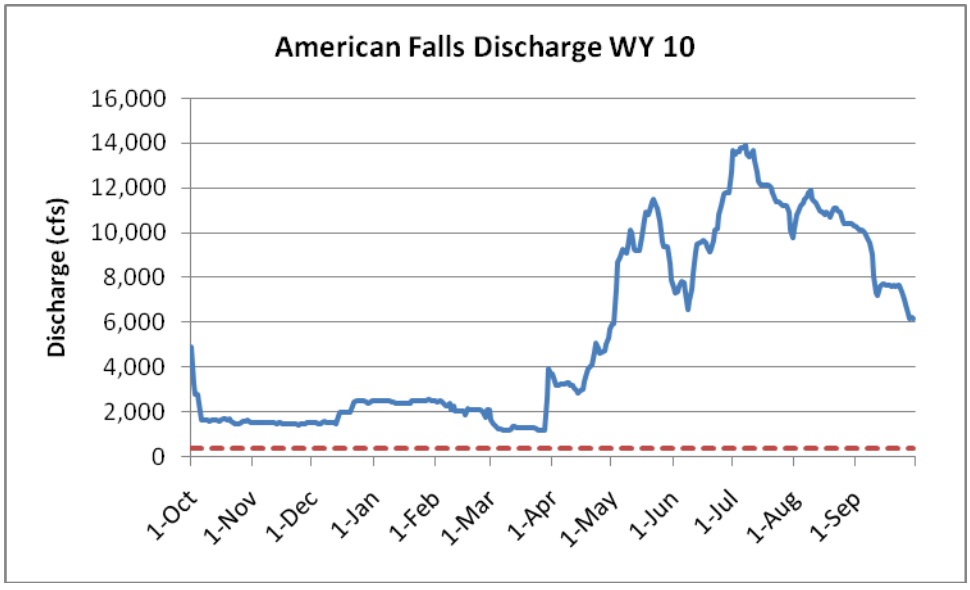

Figure 9. Discharge from American Falls Reservoir (Neeley Reach) for Water Year 2010 (WY10). The dotted line represents Reclamation's operational threshold discharge flow of 350 cubic feet per second (cfs).

Winter precipitation was well below average through the snow accumulation season. The storage system was expected to fill only because of the generous carryover from 2009. Cool weather in April and May was followed by wet weather mid-May through early June. Peak inflows from snowmelt were enhanced by rain and the widespread rain fulfilled crop needs. The storage system reached its maximum content much later in the irrigation season than expected and the shortened season of storage use resulted in good carryover, but not less than in the previous year. Delivery of augmentation water began much earlier than in recent years. Cold weather in April and May resulted in slow snowmelt and low flows in the lower Snake and Columbia rivers. Since migrating fish were observed in the river, the TMT requested the water. Once upper Snake reservoirs reached their maximum content, additional water was secured by Reclamation and delivered mid-June through early July.

At the beginning of Water Year 2010, flow below American Falls Dam was ramped down to 1,500 cfs. Flows near 1,500 cfs persisted until mid-December when flow increased through February. In March, flows were reduced to increase the rate of storage, but remained at 1,200 cfs or higher.

The total storage capacity of American Falls Reservoir is 1,672,600 acre-feet. American Falls Reservoir was near full through the month of April, was drafted about 200,000 acre-feet during May, and approached full again in the third week of June. The maximum content of 1,677,787 acre-feet occurred on April 21. Minimum American Falls Reservoir content of 24 percent (402,047 acre-feet) was observed on September 30.

3.5.2 Minidoka Dam and Lake Walcott Operations

At the beginning of Water Year 2010, Lake Walcott was drafted to the winter elevation of 4240.0 feet (Figure 10) by October 19. The water was delivered to meet downstream irrigation demand. During the winter, only normal variations in water surface elevation were observed. The intent of the operation is to limit the formation of ice on the spillway structure and to keep the ice cover below the piers' contacts with the ogee crest. To achieve this intent, the reservoir is operated at approximately elevation 4239.8 feet and abrupt corrections are avoided while the reservoir remains between elevations 4239.5 feet and 4240.0 feet. The winter low elevation of 4239.34 feet occurred on October 26, 2009, during a period of high winds.

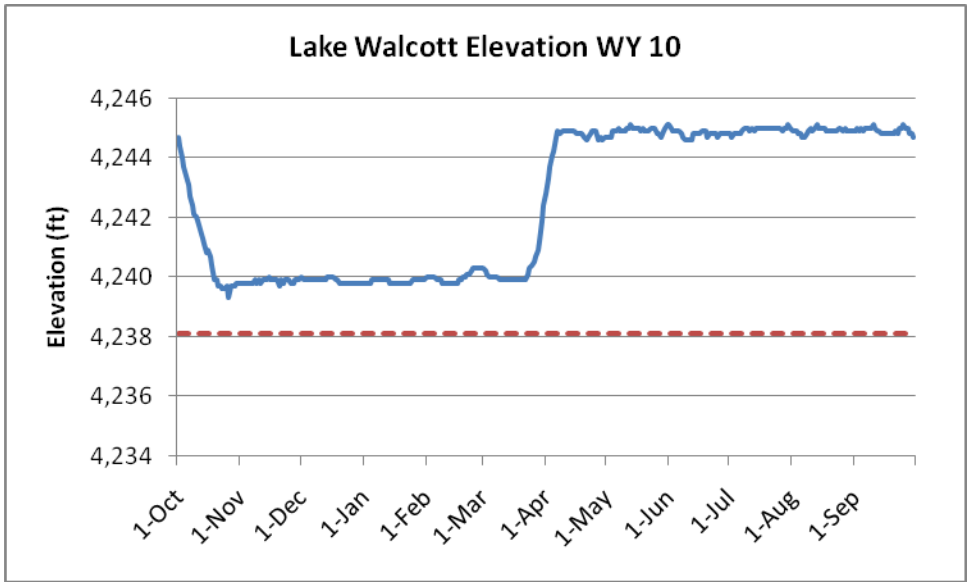

Figure 10. Reservoir elevation at Lake Walcott for Water Year 2010 (WY10). The dotted line represents Reclamation's summer and early fall threshold elevation of 4238.11 feet.

Discharge below Minidoka Dam followed American Falls discharge plus reach gains from the end of the irrigation season through the third week of March when the flow was reduced to fill Lake Walcott. Flows were maintained to meet downstream irrigation demand, Idaho Power Company's flow requirements below Milner Dam, and Reclamation's augmentation flows through the summer (Figure 11).

The winter draft of Lake Walcott began on September 30 and reached the over-winter elevation of 4240 feet on October 11.

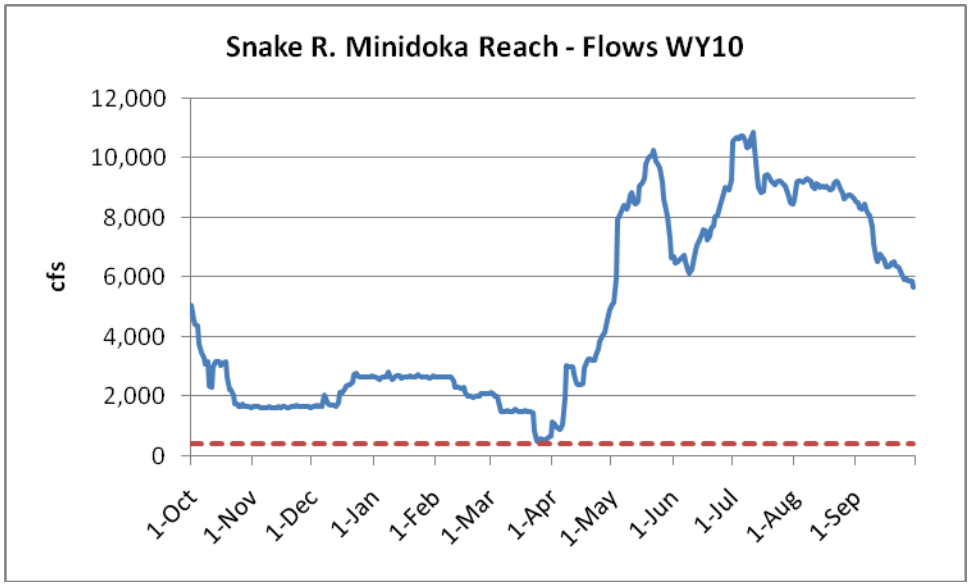

Figure 11. Snake River Minidoka Reach river flows cubic feet per second (cfs) for Water Year 2010 (WY10). The dotted line represents Reclamation's operational threshold discharge flow of 400 cfs.

4.0 BULL TROUT

4.1 Introduction and Background

Bull trout are present in four of Reclamation's facilities in the upper Snake River basin (Figure 12). Summary of the bull trout ITS including monitoring efforts and RPMs during Water Year 2010 are described in this chapter. Operational thresholds, population monitoring, and other relevant bull trout work not managed by Reclamation is described in Section 4.2 of this report. Work associated with research projects that address specific RPMs is described in Section 4.3 of this report.

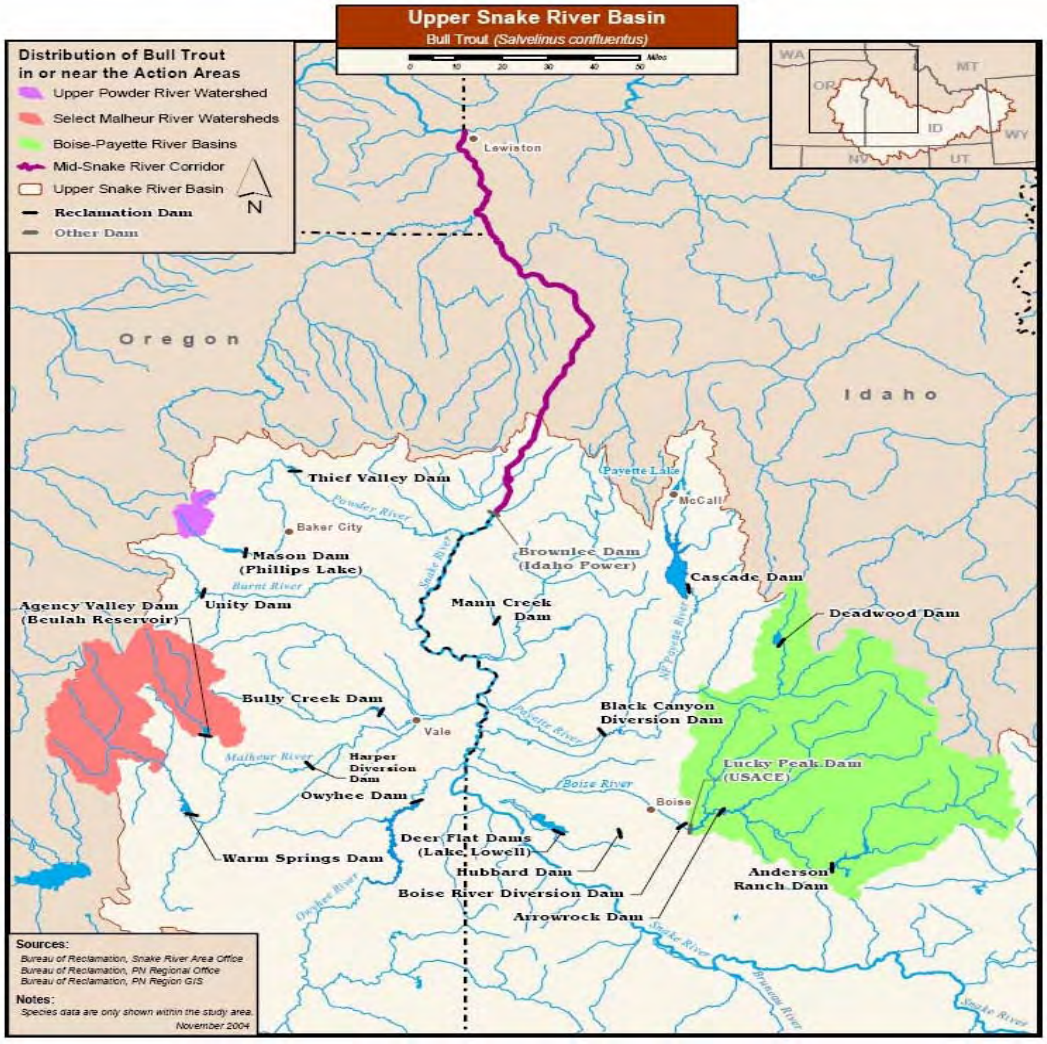

Figure 12. Known distribution of bull trout populations associated with Reclamation facilities in the upper Snake River basin (Reclamation 2004).

The USFWS determined incidental take by correlating frequencies and magnitudes of streamflow and reservoir conditions at specific facilities with an estimate of population effects during critical seasonal time periods in the bull trout's life history. The USFWS then described the amount or extent of incidental take at each facility based on operational thresholds (USFWS 2005). Operational thresholds and the respective effects, frequency, and timing for 2010 are summarized in Table 5.

Table 4 . Summary of amount or extent of anticipated take of bull trout associated with Reclamation facility operations during the 2009 reporting period.

Facility	Anticipated Take	Operational Indicators	Critical Season	Frequency	2010 Operations (October 2009 to September 2010)	Quick reference: Times threshold was exceeded
Arrowrock Dam and Reservoir	Up to 50 percent of the Middle and North Fork populations are affected by low reservoir productivity and decreased prey.	Reservoir volume of less than 200,000 acre-feet by the end of June.	June 30	3 of 30 years	Reservoir volume was not drafted below 200,000 acre-feet during June 2010.	2 of 3 years 2007: yes 2008: 0 2009: 0 2010: yes
	Up to 8 percent of bull trout in the reservoir are entrained into Lucky Peak Reservoir, as averaged over any consecutive 5-year period.	Water is discharged over the spillway.	March through June	15 of 30 years	Spillway use did not occur during the reporting period.	1 of 15 years 2007: 0 2008: 0 2009: 0 2010: 0
	Up to 2 percent of bull trout in the reservoir are entrained into Lucky Peak Reservoir.	Discharge exceeds 695 cfs while the reservoir water surface elevation is less than 3,111 feet.	July through September	30 of 30 years	Reservoir surface elevation did not drop below 3,111 feet during Water Year 2010 (Figure 13).	4 of 30 years 2007: 48 days 2008: 1 day 2009: 3 days 2010: 0
	Up to 20 percent of bull trout in the reservoir, as averaged over any 5 consecutive years, experience habitat degradation and predation.	Mean daily reservoir elevation falls below 3,100 feet.	September 15 through October 31	18 of 30 years	Reservoir surface elevation did not drop below 3,111 feet during Water Year 2010 (Figure 13).	0 of 18 years 2007: 0 2008: 0 2009: 0 2010: 0
	Up to 5 percent of bull trout in the reservoir are entrained into Lucky Peak Reservoir, as averaged over any consecutive 5-year period.	Discharge exceeds 695 cfs while the reservoir water surface elevation is less than 3,111 feet.	winter	20 of 30 years	Reservoir elevations did not go below 3,111 feet in the winter months of 2008 (Figure 14).	0 of 20 years 2007: 0 2008: 0 2009: 0 2010: 0

Table 4 cont. Summary of amount or extent of anticipated take of bull trout associated with Reclamation facility operations during the 2009 reporting period.

Facility	Anticipated Take	Operational Indicators	Critical Season	Frequency	2010 Operations (October 2009 to September 2010)	Quick reference: Times threshold was exceeded
Anderson Ranch Dam	Up to 50 percent of the North and Middle Fork Boise Rivers' spawning population are affected by spillway discharges that disrupt timing of migration and spawning and that alter metabolic rates and up to 10 percent of bull trout in the reservoir are entrained into the SF Boise River.	Water is discharged over the spillway.	spring	6 of 30 years	Spillway use did not occur during the reporting period.	1 of 6 years 2007: 0 2008: 0 2009: 0 2010: 0
	Up to 50 percent of the North and Middle Fork Boise Rivers' spawning population are affected by the altered flow and temperature regime that disrupts migration and spawning and that increases metabolic rates.	Water is stored and released at Anderson Ranch Dam.	spring through fall	30 of 30 years	Anderson Ranch Reservoir elevations for Water Year 2010 are shown in Arrowrock Dam and Reservoir (Figure 15).	5 of 30 years 2007:spring/fall 2008: spring/fall 2009: spring/fall 2010: spring/fall
	Up to 4 percent of bull trout in reservoir experience degraded water quality.	Reservoir storage volume falls below 62,000 acre-feet.	summer	2 of 30 years	Reservoir storage volume was maintained above 62,000 acre-feet (Figure 16).	0 of 2 years 2007: 0 2008: 0 2009: 0 2010: 0

Table 4 cont. Summary of amount or extent of anticipated take of bull trout associated with Reclamation facility operations during the 2009 reporting period.

Facility	Anticipated Take	Operational Indicators	Critical Season	Frequency	2010 Operations (October 2009 to September 2010)	Quick reference: Times threshold was exceeded
Deadwood Dam	Up to 2 to 4 percent of bull trout in Deadwood Reservoir are entrained into the Deadwood River below the dam.	Water discharged over the spillway.	spring	11 of 30 years	Water was discharged over the spillway for 15 days during Water Year 2010 (June 7-21, 2010).	4 of 11 years 2007: 33 days 2008: 33 days 2009: 0 days 2010: 15 days
	Up to 2 to 4 percent of bull trout in Deadwood Reservoir are affected by degraded water quality.	Reservoir storage volume falls below 50,000 acre-feet.	August through October	2 of 30 years	Reservoir storage volumes were maintained between 87,007 and 155,833 acre-feet during Water Year 2010 (Figure 17).	0 of 2 years 2007: 0 2008: 0 2009: 0 2010:0
	All bull trout in the Deadwood River downstream from the dam are affected by spillway discharges that disrupt timing of migration and spawning and that alter metabolic rates.	Water is discharged over the spillway.	May through July	11 of 30 years	Water was discharged over the spillway for 15 days during Water Year 2010 (June 7-21, 2010).	4 of 11 years 2007: 33 days 2008: 33 days 2009: 0 days 2010: 15 days
	All bull trout in the Deadwood River downstream from the dam are affected by low winter stream flows and temperatures that affect bull trout movement and growth and reproduction of bull trout and the prey base.	Deep water releases at Deadwood Dam and low flows below the dam.	Spring - temperature increases and flow decreases. Summer - temperature decreases and flow increases. Fall - temperature increases and flow reductions. Winter - temperature increases and flow reductions.	30 of 30 years	All releases are deep water releases except for water discharged over the spillway.	5 of 30 years 2007: all year 2008: all year 2009: all year 2010: all year

Table 4 cont. Summary of amount or extent of anticipated take of bull trout associated with Reclamation facility operations during the 2009 reporting period.

Facility	Anticipated Take	Operational Indicators	Critical Season	Frequency	2010 Operations (October 2009 to September 2010)	Quick reference: Times threshold was exceeded
Beulah Dam	Up to 10 percent of bull trout in Beulah Reservoir are entrained into the NF Malheur River below the dam.	Water is discharged over the spillway.	May through June	3 of 30 years	Spillway was not used during this reporting period.	1 of 3 years 2007: 0 2008: 0 2009: 0 2010: 0
	All bull trout that return to Beulah Reservoir to over winter are affected by a reduced prey base.	Reservoir storage volume falls below 2,000 acre-feet.	August through October	10 of 30 years	Reservoir storage volume fell below 2,000 acre-feet from Oct. 01 to Oct. 28, 20089 (Figure 18).	4 of 10 years 2007: 60 days 2008: 34 days 2009: 53 days 2010: 28 days

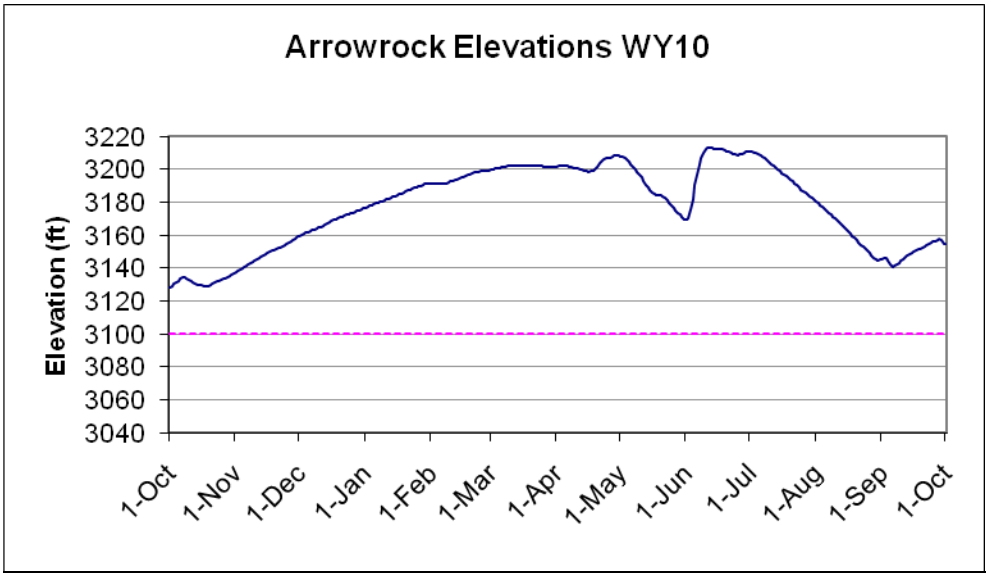

Figure 13. Arrowrock Reservoir elevation (feet above sea level) for Water Year 2010 (WY10). Bottom dotted line represents Reclamation's fall minimum threshold of 3100 feet elevation.

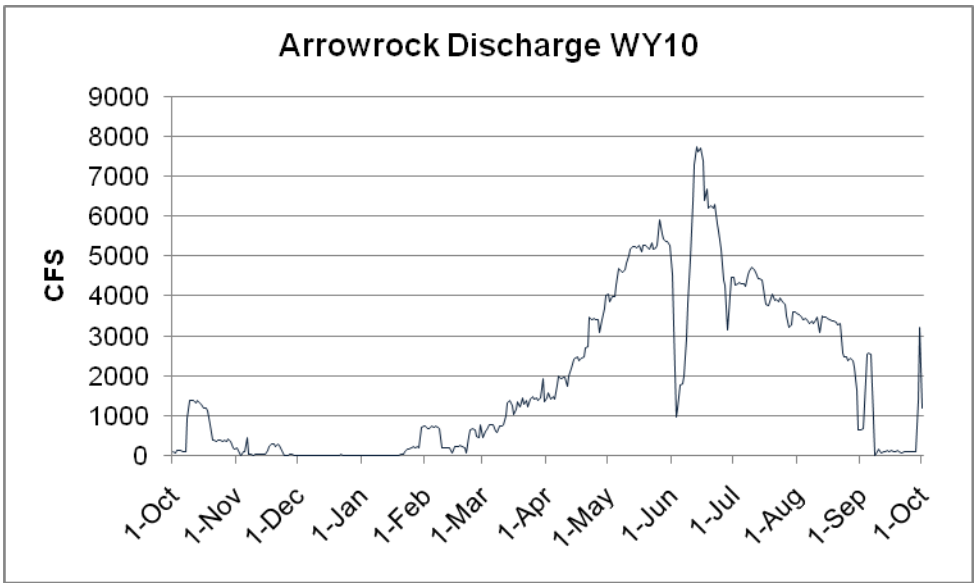

Figure 14. Arrowrock Reservoir discharge cubic feet per second (cfs) for Water Year 2010 (WY10).

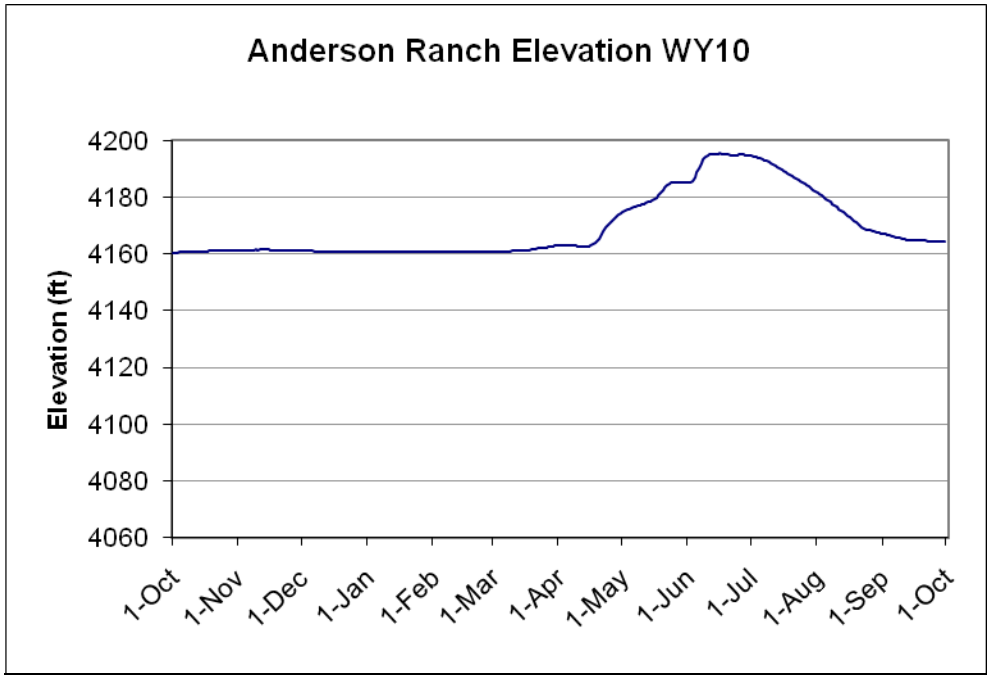

Figure 15. Anderson Ranch Reservoir elevations (feet above sea level) for Water Year 2010 (WY10).

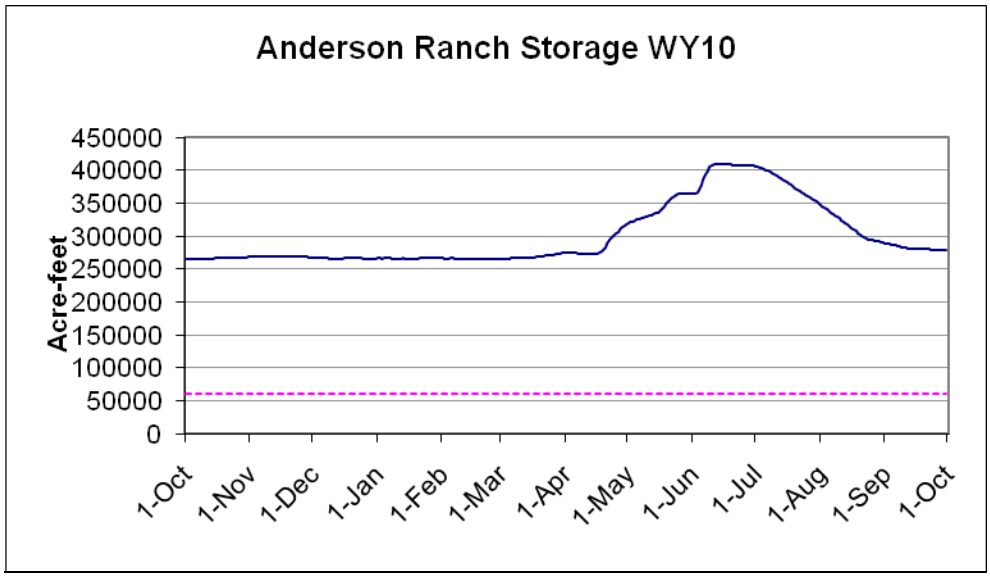

Figure 16. Anderson Ranch Reservoir storage volumes (acre-feet) for Water Year 2010 (WY10). The bottom dotted line represents Reclamation's minimum threshold of 62,000 acre-feet of storage.

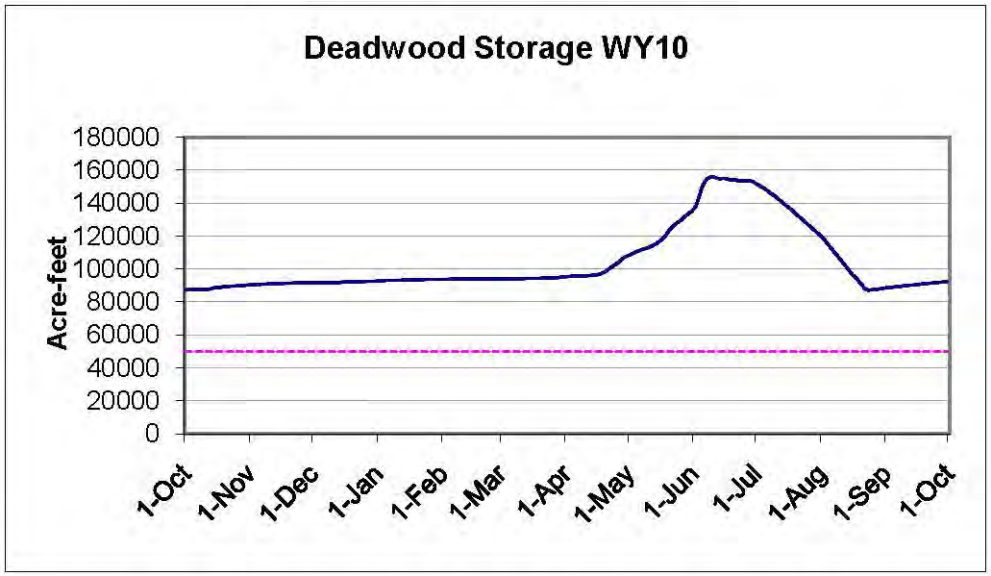

Figure 17. Deadwood Reservoir storage volumes (acre-feet) for Water Year 2010 (WY10). The bottom dotted line represents Reclamation's minimum threshold of 50,000 acre-feet of storage.

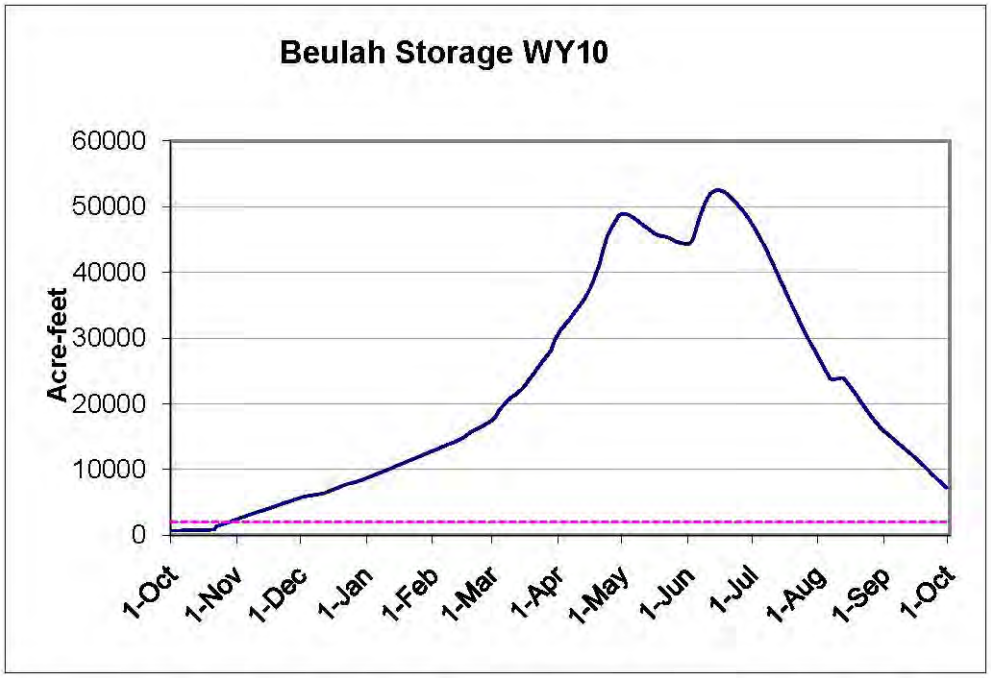

Figure 18. Beulah Reservoir storage volumes (acre-feet) for Water Year 2010 (WY10). The bottom dotted line represents Reclamation's minimum threshold of 2,000 acre-feet of storage.

4.2 Bull Trout Monitoring

The Implementation and Monitoring Plan identifies how Reclamation will monitor bull trout throughout the duration of the 2005 Opinion (Reclamation 2006). Monitoring elements include evaluating operational indicators, tracking population trends, and estimating the proportion of annual take. To monitor compliance with the operational thresholds defined in the ITS, operations for Water Year 2010 were monitored, evaluated, and summarized using Reclamation's Hydromet system (Reclamation 2011a). Operational thresholds affecting the amount or extent of anticipated take are described in Table 5. Monitoring population trends may not occur annually at each of the four facilities.

4.2.1 Boise River Basin Operational Indicators

One operational indicator was exceeded during the 2010 reporting period in the Boise River basin. Water was stored and released at Anderson Ranch Dam (Figure 15 and Figure 16). Reclamation has an exemption for this action 30 of the 30 years in the Opinion.

Boise River basin bull trout population trend monitoring activities did not occur during Water Year 2010.

4.2.2 Payette River Basin Operational Indicators

One operational indicator was exceeded during the 2010 reporting period in the Payette River basin. Deep water releases occurred throughout the year at Deadwood Dam (Figure 17). Reclamation has an exemption for this action 30 of the 30 years.

Payette River basin bull trout population trend monitoring activities did not occur during the Water Year 2010.

4.2.3 Malheur River Basin Operational Indicators

One operational indicator was exceeded during the 2010 reporting period in the Malheur River basin. Beulah Reservoir pool fell below 2,000 acre-feet from October 1 through October 28, 2009 (Figure 18). Reclamation has an exemption for this action for 10 of the 30 years in the Opinion.

Malheur River basin bull trout population trend monitoring activities included bull trout redd counts in the North Fork Malheur River with interagency cooperation as planned by the Oregon Department of Fish and Wildlife (ODFW).

In 2010, North Fork Malheur River basin bull trout redd counts totaled 55; however, the survey area was reduced in size from previous surveys completed before 2008 (Perkins 2009).

Assuming 2.68 bull trout per redd (Al-Chokhachy et al. 2005), an estimated 147 adfluvial adult bull trout were present in 2010. Figure 19 depicts the number of redds observed in the North Fork Malheur River basin and carryover of reservoir storage in Beulah Reservoir. Carryover storage in Beulah Reservoir has been shown to affect the bull trout prey base (Rose and Mesa 2009); however, a direct link between carryover pool elevations and bull trout redd counts remains speculative.

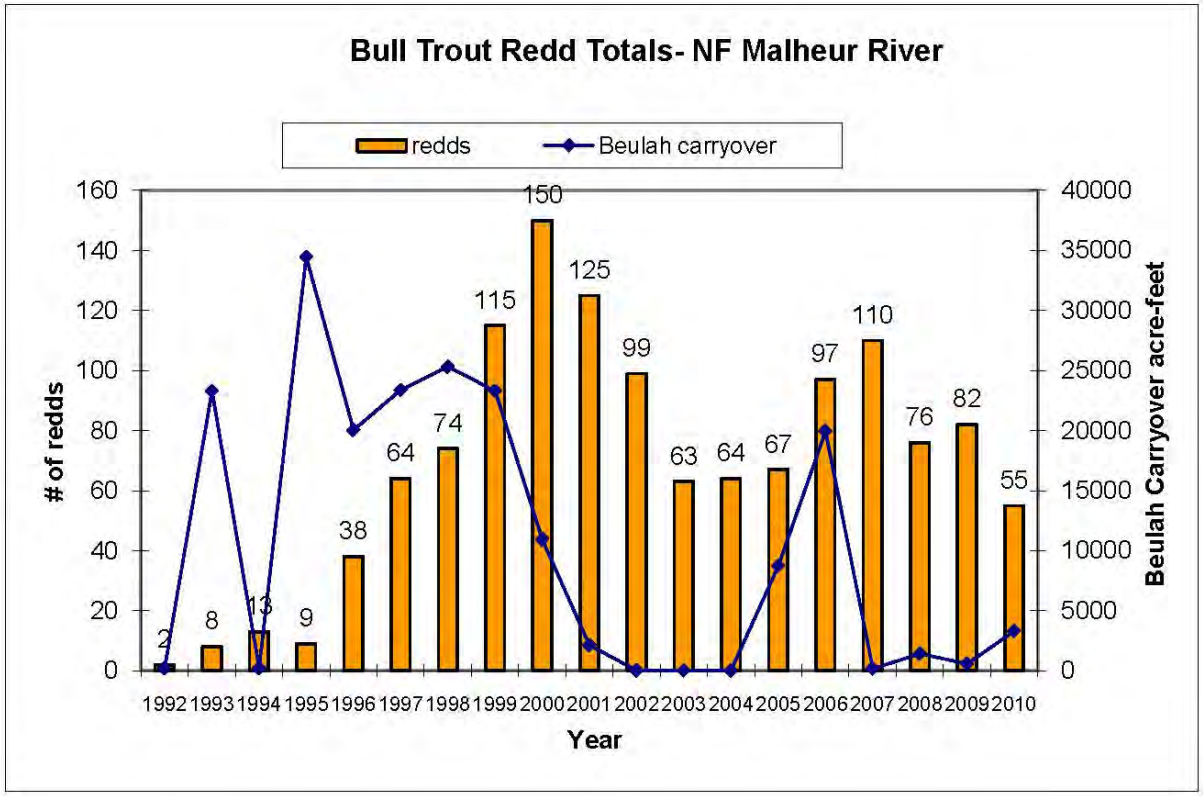

Figure 19. Bull trout redds observed in the North Fork Malheur River watershed (NF Malheur River) between 1992-2010 and carryover storage in Beulah Reservoir. Note: The number of redds observed in 2008 was adjusted to reflect a reduction in survey area, actual number equaled 75 redds.

4.3 Implementation of Reasonable and Prudent Measures and Associated Terms and Conditions for Bull Trout

The ITS includes four RPMs and associated terms and conditions to minimize incidental take of bull trout related to operations at Reclamation's facilities within the identified action area where bull trout are present: Arrowrock, Anderson Ranch, Deadwood, and Agency Valley dams and associated reservoirs. In 2010, Reclamation focused monitoring and implementation activities at Deadwood Reservoir. The sequence of activities presented in this document reflects the priorities identified by the USFWS in the ITS and has been further documented in Reclamation's Monitoring and Implementation Plan (Reclamation 2006). This document presents the activities for each location.

4.4 Boise River Basin

Bull trout work associated with the 2005 Opinion (USFWS 2005) included a trap-and-haul effort to relocate bull trout from Lucky Peak Reservoir to Arrowrock Reservoir. A trap-and-haul effort is required every 2 years. A trap-and-haul effort was conducted during the spring of 2010.

Trap-and-haul methods were similar to those used in previous years to capture bull trout in the tailrace of Arrowrock Dam (Lucky Peak Reservoir) and are described in Salow (2005). Methods consisted of using experimental mesh gill nets set perpendicular to the shoreline with soak times not exceeding 60 minutes. Sampling was performed between April and June, a period when bull trout have been documented to migrate into the tailrace of Arrowrock Dam (Flatter 2000). Sampling periods in 2010 included April 12 to 15, May 3 to 6, and June 7 to 8. A total of 244 fish were sampled during this effort representing nine species and included two bull trout (Table 5).

One of the two captured bull trout had expired when the nets were retrieved; the other was relocated to Arrowrock Reservoir and released at the High Water boat launch. Captured bull trout measured 405 and 520 mm total length. The 2010 bull trout catch per unit effort (0.01 fish per hour) was within the range (0.01 to 0.08 fish per hour), but below the average (0.04 bull trout per hour) of previous sampling efforts (years 2000 through 2008).

Table 5. Catch data for trap-and-haul effort on Lucky Peak Reservoir, 2010. Catch per unit effort (CPUE) is measured in fish captured per hour.

	CPUE (mean)	1.12
	Total Fish	244
	Total Hours	218
Species	**Number of fish Caught**	**CPUE (fish/hr)**
Largescale sucker (*Catostomus macrocheilus*)	99	0.45
Bridgelip sucker (*Catostomus columbianus*)	33	0.15
Kokanee (*Oncorhynchus nerka kennerlyi*)	8	0.04
Northern Pikeminnow (*Ptychocheilus oregonensis*)	49	0.22
Rainbow trout (*Oncorhynchus mykiss*)	35	0.16
Mountain whitefish (*Prosopium williamsoni*)	11	0.05
Bull trout (*Salvelinus confluentus*)	2	0.01
Chiselmouth chub (*Acrockeilus alutaceus*)	1	0.00
Smallmouth bass (*Micropterus dolomieue*)	3	0.01
Rainbow trout/cutthroat trout hybrid	1	0.00

4.4.1 Boise River Basin Discussion

The Arrowrock Dam Hydroelectric Project, originally proposed in the 1980s but never constructed, was reauthorized in 2008 by the Federal Energy Regulatory Commission (FERC) with amendments from the original design and operations. The Hydroelectric Project was completed in the spring of 2010 and includes:

- Two 58-inch diameter steel penstocks
- A 50-foot-wide, 80-foot-long, 70-foot-high powerhouse
- Two 7.5 MW Francis turbines
- A 55-foot-wide, 125-foot-long tailrace discharging into Lucky Peak Reservoir
- Electrical transmission lines connecting the project to the Idaho Power system

The Licensees consist of a group of local irrigation districts; however, operations are coordinated with Reclamation. Water management for both Arrowrock and Lucky Peak reservoirs will not change as a result of the Hydroelectric Project.

Requirements of the FERC license and an agreement with the Arrowrock Fish Technical Group resulted in the Licensee conducting several environmental studies/monitoring efforts including an Entrainment Survival Study, fish salvage and monitoring, and dissolved oxygen

monitoring. The details of these studies are described in the Fish Injury and Mortality Monitoring Plan (Environmental Planning Group 2010) and the Dissolved Oxygen Monitoring Plan (Sorenson Engineering 2009). Live rainbow trout were used as a surrogate for bull trout in all study groups to calculate entrainment survival. Additionally, a smaller number of electronic sensor fish were used in each release group to record locations of injury through entrainment. Results of the Entrainment Survival Study are described in detail in the completion reports prepared by the Licensee of the Hydroelectric Project and summarized in this report.

Entrainment survival and the location and severity of injury were recorded for each study group of fish. Survival of the test fish was compared between study groups using live study fish and Balloon Tag technology (Normandeau 2011). Forty-eight-hour survival varied between study groups:

- Hydroelectric Project turbines and tailrace (6.0 percent)
- Hydroelectric Project tailrace only (53.1 percent)
- Clamshell valve (21.7 percent)
- Control group (100 percent)

Sources and severity of injury were recorded with sensor fish technology (Duncan 2011). The clamshell valve, Hydroelectric Project, and tailrace release paths demonstrated the potential for severe injury with a total of two, three, and one severe significant event respectively.

A trap-and-haul effort to relocate bull trout from Lucky Peak Reservoir to Arrowrock Reservoir has occurred 10 times since 1997. Sampling for bull trout has always been most successful in the area immediately downstream from the tailrace except in 2010. Catch rates for all fishes were lower in this area during the 2010 sampling effort. Discharge from the Hydroelectric Project has changed the water currents in the tailrace area, dissipating the defined thalweg in the traditional sampling area. It is possible that the change in currents redistribute fish in that immediate area. It is unknown if this phenomena influenced catch rates for the 2010 trap-and-haul efforts; however, the catch per unit effort was within the long-term average (see section 4.4). The two bull trout captured in 2010 were near Lucky Peak Dam.

4.5 Payette River Basin – Deadwood River System

The USFWS 2005 Opinion identifies five terms and conditions for Reclamation to address in order to minimize the effect and/or amount of take associated with the operation of Deadwood Dam.

Each of the terms and conditions address a different aspect of the effects of operations on bull trout. However, addressing each aspect individually limits the ability to understand how much flexibility Reclamation has in operation of the system as a whole, and the systemic impacts of individual changes in operations. By addressing the terms and conditions jointly and looking at the system in its entirety, Reclamation can evaluate operational flexibility to minimize biological impacts. The Deadwood Reservoir Flexibility Study was initiated in 2006 to collectively address all five terms and conditions and their relative tradeoffs and balances when looking for system flexibility in minimizing impact.

The terms and conditions of the Opinion made several assumptions regarding the reservoir operation effects on bull trout. Therefore, before an evaluation of the operational flexibility to minimize impacts to bull trout can be done, there needs to be an understanding of what those impacts are and to what degree they can be quantified. The Deadwood Reservoir Flexibility Study proposal outlines the terms and conditions, hypotheses, assumptions, and assessments as well as identifying the data needed to test the hypotheses (Reclamation 2008).

The year 2010 was the fifth year of an intensive 6-year data collection process to establish a comprehensive understanding of physical and biological factors limiting bull trout productivity as well as understanding bull trout movement in the reservoir and in the river below the dam. Physical and water quality data collection instruments were monitored in Deadwood Reservoir and the Deadwood River above and below the dam to gather hydrology and water quality data such as temperature, river channel morphology, inflow and outflow quantities, water quality, and reservoir profile characteristics. The information collected within the reservoir is key to providing the resulting habitat conditions entering the reach below the dam under varying operational conditions.

Evaluating the flexibility of the operational effects of Deadwood Dam on aquatic fauna requires an understanding of the potential overall ecosystem response to an operational change over time. Using modeling and physical and biological parameters measured over the course of this project will allow for an ecosystem analysis of the terms and conditions for Deadwood Reservoir operations and its influence on bull trout populations.

Data collection and data processing as part of the Deadwood Reservoir Operations Flexibility Study began in 2006 and continued during 2010. Study objectives are described in the Deadwood Reservoir Flexibility Study Proposal and encompass both the Deadwood Reservoir and the Deadwood River reach located below the dam and extending to the confluence with the South Fork of the Payette River (Reclamation 2008).

A detailed description of the methods can be found in the Deadwood Reservoir Flexibility Study Proposal (Reclamation 2008). Detailed fish sampling results can be found in Reclamation's 2010 fish sampling report to Idaho Department of Fish and Game (IDFG) (Reclamation 2011b).

4.6 Deadwood River System – Reservoir and Tributaries Data Collection

In the Deadwood River system above Deadwood Dam, three methods of fish sampling were used in 2010: fyke netting in Deadwood Reservoir, a picket weir in the Deadwood River, and backpack electrofishing in tributaries to the reservoir. All fishes, including bull trout, were released at the point of capture. Most captured bull trout that were of proper size were surgically fitted with radio transmitters before being released. In addition to sampling bull trout, physical, hydrology, and water quality data were also collected in the river, reservoir, and selected tributaries as outlined in the Deadwood Reservoir Flexibility Study Proposal (Reclamation 2008).

4.6.1 Fish Sampling/Radio Tracking

A total of 823 fish, including 51 bull trout, were sampled in Deadwood Reservoir and tributaries to Deadwood Reservoir between June and August in 2010 (Table 6; Reclamation 2011b). The most abundant fish sampled was Westslope cutthrout trout (*Oncorhynchus clarki lewisi*) accounting for 68.8 percent of the total catch. Sculpin (*Cottus spps*) were the next most abundant (10.7 percent) followed by bull trout (6.2 percent), Dace (*Rhinichthys spps*; 5.6 percent), and rainbow trout (*Oncorhynchus mykiss*; 5.3 percent). Mountain whitefish (*Prosopium williamsoni*) were the least abundant of the sampled species only accounting for 3.4 percent of the total catch. No kokanee (*Oncorhynchus nerka kennerlyi*) or redside shiners (*Richardsonius balteatus*) were captured in 2010 (Reclamation 20011a).

Table 6. Total catch summary for 2010 including numbers of each species captured (total catch) and percent (%) of total catch. Includes catches from fyke nets in the reservoir and backpack electroshocking in the tributaries to the reservoir.

2010 Deadwood Reservoir and tributaries total catch summary		
Species	**Total Catch**	**Percent**
Bull Trout (*Salvelinus confluentus*)	51	6.2
Westslope Cutthroat Trout (*Oncorhynchus clarki lewisi*)	566	68.8
Kokanee (*Oncorhynchus nerka kennerlyi*)	0	0
Rainbow Trout (*Oncorhynchus mykiss*)	44	5.3
Redside Shiner (*Richardsonius balteatus*)	0	0
Sculpin (*Cottus spps*.)	88	10.7
Dace (*Rhinichthys spps*.)	46	5.6
Mountain Whitefish (*Prosopium williamsoni*)	28	3.4
Total	**823**	**100**

Biological samples collected from bull trout included fin clips (n=42), muscle plugs (n=4), scales (n=38), and gut samples (n=9). Fin clips were sent to the USFWS Genetics Lab in Abernathy, Washington. Genetic analysis may be used for population assignment within the South Fork Payette River basin (DeHann and Ardren 2008). The muscle plugs are being used in an associated isotope study (Reclamation 2008). Bull trout scales are being analyzed by Reclamation staff to determine general age and growth patterns in the population. The collection of fin clips, scales, and gut samples occurred while bull trout were anesthetized. Muscle plugs were taken before anesthetic was administered so the samples would not be contaminated. None of the methods for taking these biological samples were lethal to the fish. Bioenergetic modeling, scheduled to occur after field studies are complete, will utilize data from age, growth, and diet analyses.

Bull trout collections, tagging, and radio tracking efforts will continue through 2011 in the Deadwood River basin.

Fyke Netting

A total of 58 fish, including 4 previously unmarked bull trout, were sampled using fyke nets in Deadwood Reservoir from June 21 to June 24, 2010, for a total of 118 hours (Table 7; Reclamation 2011b). Species composition was similar to previous accounts for littoral fish assemblages in the reservoir. Mountain whitefish and dace were the most abundant fish

sampled (cumulatively 77.6 percent of the total catch) while bull trout represented 7.0 percent of the total catch. Other fishes sampled included rainbow trout (7.0 percent), westslope cutthroat trout (5.2 percent), and sculpin spps (3.4 percent). The total catch per unit (hours) of effort (CPUE) was 0.49 fish per hour.

Table 7. Bull trout fyke net sampling summary for Deadwood Reservoir in 2010, including date and location of capture, total length, and weight.

	2010 Deadwood Reservoir bull trout summary			
Date	**Location**	**Total length (mm)**	**Weight (g)**	**Notes**
6/23/2010	Trail Creek Mouth	585	2190	Recapture
6/24/2010	Trail Creek Mouth	339	388	
6/24/2010	Trail Creek Mouth	374	516	
6/24/2010	Trail Creek Mouth	387	504	

Bull trout, captured by fyke net (Table 7), were surgically implanted with radio transmitters and fitted with a Passive Integrated Transponder (PIT) tags from Biomark Incorporated, Boise, Idaho. In addition, scale, genetic, isotope, and gut samples were collected and other biological data recorded. Three of the four radio-tagged bull trout (originally captured in the reservoir) were tracked through the end of the reporting period; the remaining bull trout died as a result of sampling. Behavior of radio-tagged bull trout has varied since the radio telemetry work started in 2006 and will be summarized upon completion of this project. In general, tributary inflow (timing and extent of spring runoff) as well as reservoir and tributary water temperatures appear to influence the behavior and migration timing of bull trout in the reservoir.

Fyke netting also occurred below Deadwood Dam in the stilling basin during Reclamation's salvage effort during bridge repair work (see sections 4.7.4 and 4.7.5 for details on the bridge repair work and corresponding salvage efforts). Eleven bull trout were captured in the stilling basin between August 24 and September 23, 2010. Ten of the bull trout received a radio and PIT tag and one bull trout, too small to radio tag, received only a PIT tag. All bull trout captured in the stilling basin were transplanted into the reservoir or its tributaries (Table 15) in accordance with a decision made by Reclamation, IDFG, and USFWS. This decision was based on the results of genetic samples collected from bull trout caught below the dam between 2007 and 2010 which showed that all bull trout caught below the dam, thus far, have come from reservoir populations. Of the ten bull trout caught in the stilling basin that received radio tags, Reclamation has recovered two tags: one on the shore of Trail Creek about 1.5 miles upstream from the reservoir and the other on an island in the reservoir. Two of the bull trout have not been located, but the remaining six continue to be tracked by helicopter and two remote stations on the reservoir.

Picket Weirs

One picket weir was operated by IDFG at the mainstem inflow of the Deadwood River into the Deadwood Reservoir between August 17 and September 11, 2010. No bull trout were caught in the weir during this effort (Alsager et. al 2010).

Backpack Electroshocking

From early July through mid-August in 2010, five tributaries above Deadwood Dam were sampled with Smith-Root backpack electroshockers. Those tributaries included Deer Creek which flows into the mainstem Deadwood River above the reservoir and Wildbuck, Beaver, South Fork Beaver, and Trail creeks which all flow directly into the reservoir. There were two goals in using this technique: to collect bull trout for genetic samples to determine natal origin and to sample bull trout to radio tags for monitoring migration habits.

In the five tributaries sampled above Deadwood Dam, 765 fish were collected representing five species (Table 8: Reclamation 2011b). The most abundant fish sampled were cutthroat trout, which accounted for 73.6 percent of total catch, followed by sculpin (11.2 percent), bull trout (6.1 percent), rainbow trout (5.2 percent), and dace (3.8 percent).

Table 8. Numbers of each species captured (total catch) and percent (%) of total catch for all 2010 electrofishing sampling efforts above Deadwood Dam.

Species	Beaver Creek	Deer Creek	South Fork Beaver Creek	Trail Creek	Wildbuck	Total	Percent
Bull Trout (*Salvelinus confluentus*)	2	2	11	31	1	47	6.1
Cutthroat Trout (*Oncorhynchus clarki lewisi*)	52	0	188	84	239	563	73.6
Dace (*Rhinichthys spps)*.	5	0	13	11	0	29	3.8
Rainbow Trout (*Oncorhynchus mykiss*)	0	12	9	12	7	40	5.2
Sculpin (*Cottus spps*.)	20	0	9	18	39	86	11.2
Total	**79**	**14**	**230**	**156**	**286**	**765**	100

All captured fish were identified to species and enumerated. Total length was recorded for all game species. When a bull trout was captured, it was anesthetized using Tricaine Methane Sulfanate or MS222, measured (total length and fork length, fin length, in millimeters [mm]), weighed (grams), and, after it was scanned for PIT tags, scale samples, fin clips, and stomach content (on some) were taken. All previously untagged and healthy looking bull trout over 53 grams were implanted with radio transmitters (Lotek Wireless, Ontario, Canada) and PIT tags.

All previously untagged bull trout under 53 grams, but over 100 mm were implanted with PIT tags only. A digital image of each scale sample was created and multiple readers will assign ages to each fish by identifying growth annuli. Aging techniques and backcalculating length at age measurements for scales are described by Devries and Frie (1996). Scale samples are being housed at Reclamation's Snake River Area Office in Boise, Idaho. Fin clips have been sent to the USFWS Abernathy Fish Technology Center in Abernathy, Washington for genetic analysis allowing assignment to natal streams within the drainage. The collection of fin clips, scale samples, and muscle plugs from bull trout were non-lethal.

Of the 47 bull trout captured while electrofishing in tributaries above Deadwood Dam, 19 were PIT tagged and ranged in length from 105 mm to 243 mm (total length). Out of the 19 PIT tagged bull trout, 2 also received radio tags. Their measurements were 206 and 243 mm total length and 72 and 138 grams in weight, respectively. Both of these bull trout continue to be tracked by helicopter and by two remote stations located on and above the dam in Trail Creek.

4.6.2 Hydrology and Water Chemistry

Reservoir and tributary samples were collected about monthly during 2010, with sampling beginning in early June and ending in early November. Similar to the 2009 protocols, eight water quality parameters were measured in the field and another eleven processed in the lab; all parameters are listed in Table 9. Hydrology and water chemistry samples were collected at eight locations on the reservoir as well as Trail Creek, Deadwood River inflow, and Deadwood River outflow (Table 10, Figure 20, and Figure 21). Additional tributary sites were sampled in 2010 for laboratory water quality parameters.

Table 9. Water quality parameters measured in the field and laboratory processed for Deadwood River and Reservoir, 2010.

Field Measured	Laboratory Processed
Water Temperature	Nitrate + Nitrite, dissolved
Dissolved Oxygen concentration	Orthophosphate, dissolved
pH	Total phosphorus
Conductivity	Ammonia, dissolved
Turbidity	Total Kjeldahl nitrogen
Florescence (reservoir only)	Total Organic Carbon
Barometric Pressure	Dissolved Organic Carbon
Secchi depth (reservoir only)	Turbidity
	Chlorophyll-a
	Pheophytin-a
	Silica, dissolved

Table 10. Reservoir sampling locations and frequency of sampling for Deadwood River and Reservoir, 2007-2010.

Sampling Site	2007 Sampling Duration	2007 Sampling Frequency	2008 Sampling Duration	2008 Sampling Frequency	2009 Sampling Duration	2009 Sampling Frequency	2010 Sampling Duration	2010 Sampling Frequency
DEA004	5/23-10/9	weekly	6/16-10/6	biweekly	6/29-9/28	monthly	06/3-11/4	monthly
DEA006	5/23-10/9	weekly	6/16-10/6	biweekly	6/29-9/28	monthly	06/3-11/4	monthly
DEA008	4/30-10/9	weekly	---	---	---	---		---
DEA010	4/30-10/9	weekly	6/5-10/6	biweekly	6/29-9/28	monthly	06/3-11/4	Weekly (mid-June to late-July) monthly (all other times)
DEA012	5/29-9/10	biweekly	---	---	---	---		---
DEA014	5/29-9/10	biweekly	6/30-10/6	biweekly	6/29-9/28	monthly	06/3-11/4	monthly
DEA016	5/29-9/10	biweekly	6/16-10/6	biweekly	6/29-9/28	monthly	06/3-11/4	monthly
DEA101	4/26-10/9	weekly	6/5-10/6	biweekly	6/29-9/28	monthly	06/3-11/4	monthly
DEA102	4/26-10/9	weekly	6/5-10/6	biweekly	6/29-9/28	monthly	06/3-11/4	monthly
DEA104	5/10-10/9	weekly	6/5-10/6	biweekly	6/29-9/28	monthly	06/3-11/4	monthly

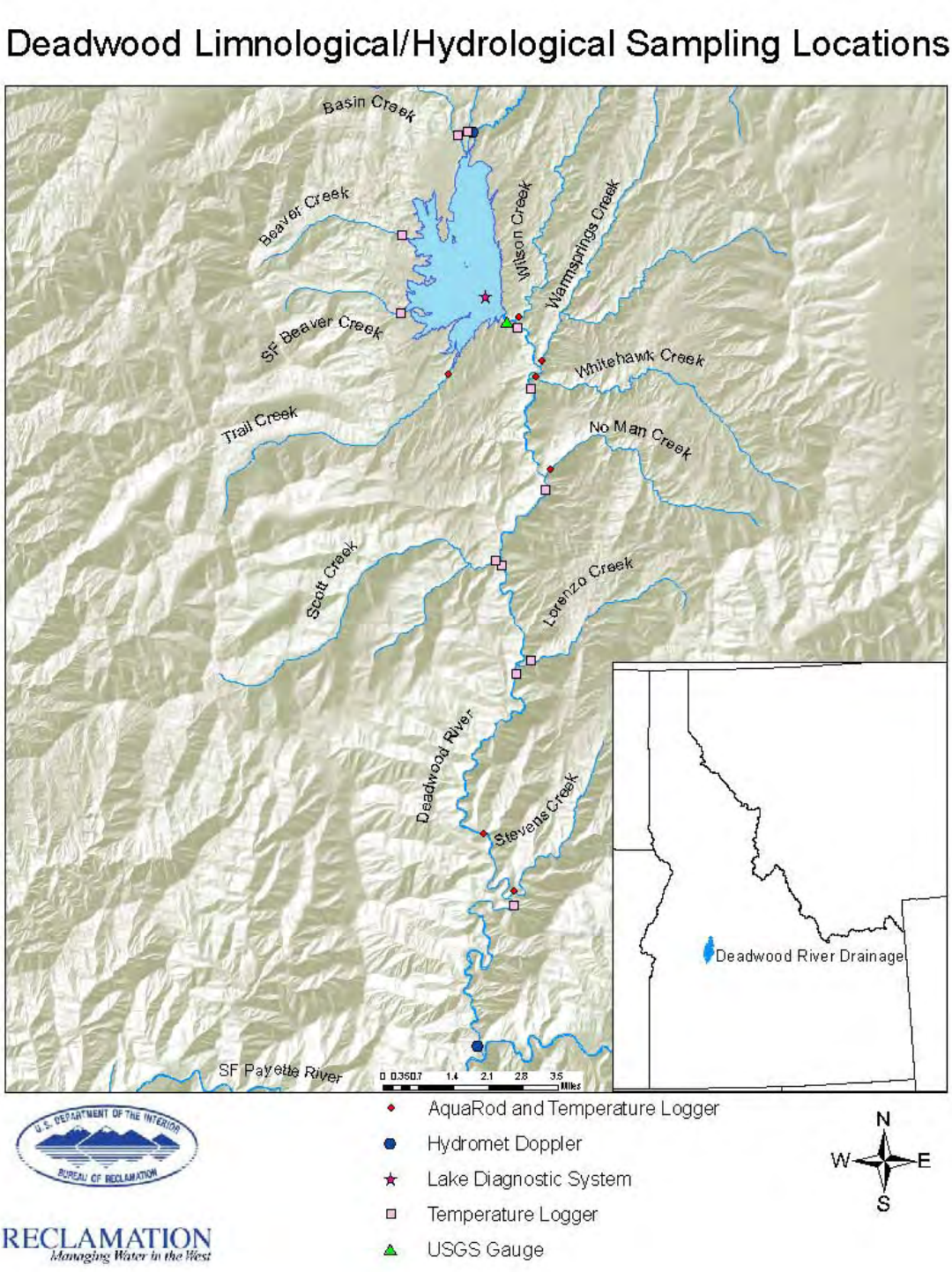

Figure 20. Limnologic and hydrologic sampling locations in the Deadwood study area, Idaho 2010. Equipment used to record data varied between locations and included AquaRods and temperature loggers, a lake diagnostic system, Hydromet doppler, and a U.S. Geological Survey water gage (USGS gage).

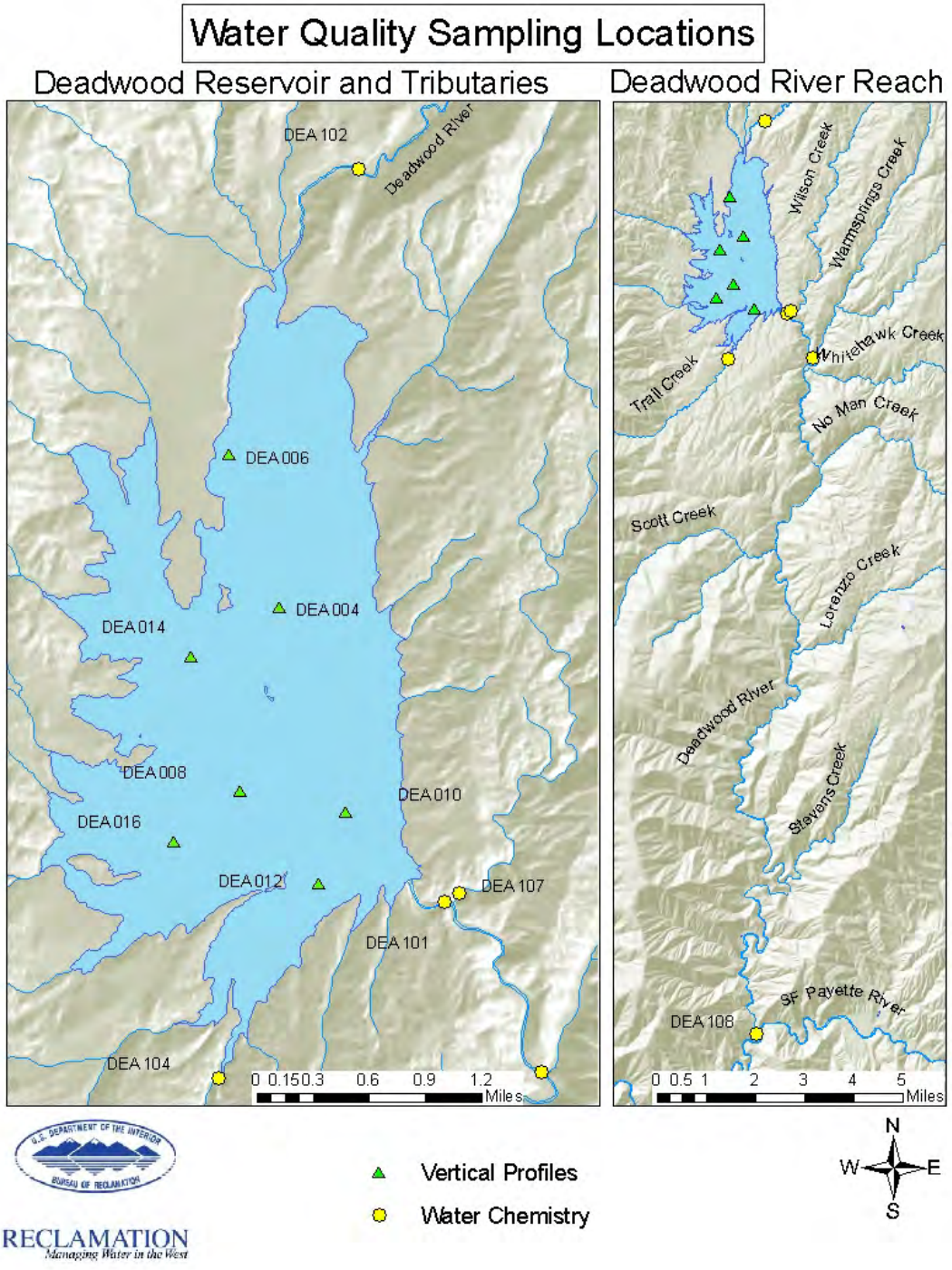

Figure 21. Water quality sampling locations in the Deadwood Reservoir (DEA) and tributaries and the Deadwood River Reach study sections. Vertical profiles and water chemistry samples were collected in both reaches. Sample locations DEA 004, 006, 010, 014, 016, 101, 102, and 104 were sampled monthly from June through November 2010. Sample locations DEA 008 and 012 were not sampled during 2010.

The lake diagnostic system (LDS) meteorological sensors were moved onshore during the winter months to protect the frame structure from damage by the winter ice cover on the lake. The LDS meteorological sensors were moved from the winter location to the open water location on August 5, 2010. On September 1, 2010, they were moved back on shore to the winter location. The LDS temperature and oxygen chain remains in the reservoir year-round. It became inoperable June 20, 2010, and was re-deployed on the lake August 5, 2010, after minor repairs. On August 14, 2010, the chain stopped transmitting data and was redeployed on September 1, 2010, after evaluation that the chain was properly working. Data obtained by the LDS were transmitted via satellite communication to Boise, Idaho and subsequent uploaded onto the Online Lake and Reservoir Information System (OLARIS) website on a daily basis. These data can be viewed on the Centre for Water Research, University of Western Australia's website (OLARIS; CWR 2010).

Water temperatures continued to be collected in five tributaries to the reservoir using Onset TidbiT temperature thermographs, in the Deadwood River inflow with Sontek Acoustic Doppler Current Meter (ADCM), and in the reservoir using the LDS (Figure 20). Thermographs recorded hourly water temperature data and were manually downloaded a minimum of two times per year. The ADCM collected water temperatures at 15-minute intervals. Data from the ADCM was transmitted via satellite to Reclamation's Hydromet website (Reclamation 2011a: DRII) until July 7, 2010. Manual downloading of the ADCM, due to interference during satellite transmission, started on July 7, 2010, and continued until September 20, 2010. Manual downloads will continue through 2011. The LDS temperature and oxygen chain recorded data every minute, at 1-meter intervals, while it was deployed.

Flow stage was collected at the Deadwood River inflow using a Sontek ADCM and in Trail Creek using an AquaRod Water Level gauge. In addition to flow stage and water temperature, the ADCM recorded water velocity. Data from the ADCM was transmitted via satellite to Reclamation's Hydromet website (Reclamation 2011a: DRII) until July 7, 2010, when manual downloads began. The AquaRod recorded flow stage every 30 minutes from June through October and hourly during the rest of the year. Data was downloaded monthly from the AquaRod during the field season. On several occasions, manual flow measurements were made at the same location as the AquaRod for the purposes of developing stage/discharge relationships to quantify flow and water quality constituent concentrations entering the reservoir. All temperature, flow and stage data is stored on Reclamation's Hydromet database and is being used for the biological and hydrology modeling (Reclamation 2011a).

Hydrology and water quality data will continue to be sampled through the 2011 field season. Incorporation of these data into the modeling efforts as well as additional study background information is described in the Deadwood Reservoir Flexibility Study proposal (Reclamation 2008).

4.6.3 Deadwood River System - Reservoir and Tributaries Discussion

Evaluation of the 2007 hydrology and water chemistry data indicated a need for some modifications to the sampling program. Analyses of silica concentrations and low-level detection analyses for nitrogen and phosphorus were initiated in 2008 and continued in 2010. The trichromatic spectrophotometric method used in 2007 for chlorophyll-a analyses was changed in 2008 through 2010 to an acid-corrected spectrophotometric one that yields values for both chlorophyll-a and pheophytin-a. Chlorophyll sampling from 2008 through 2010 was modified to collect samples at the 1-meter depth as well as at the depth of the fluorescence maxima at most of the reservoir stations.

Sampling frequency and locations were similar to the 2009 field season. Within-reservoir sampling locations included the same seven sites and the same frequency as 2009. The frequency was reduced from bi-weekly in 2008 to monthly in 2009 and 2010, due to funding reductions and the evaluation of the 2008 data which lead to refined data needs for the last two years.

IDFG operated a picket weir on the mainstem of the Deadwood River just above the reservoir; however, there was no catch of bull trout either moving upstream or downstream of the weir. Trawling and hydroacoustic surveys were conducted on July 12 to provide estimates of kokanee recruitment. The IDFG also stocked 7,282 catchable (6 inches or greater) Chinook salmon and 5,020 catchable (6 inches or greater) Triploid Troutlodge Kamloop rainbow trout into Deadwood Reservoir as a measure to control kokanee salmon and provide a sport fishery. All work performed by the IDFG is summarized in IDFG Region 3 Fish Management Report (Kozfkay et al. 2011 in press).

Annual mortality of radio tagged bull trout above the dam (two in Trail Creek and two in the reservoir near the mouth of Trail Creek) was lower in 2010 than the previous three years. One of the six bull trout that was radio tagged in 2010, died in 2010 (17 percent), compared to 38 percent in 2006, 78 percent in 2007, 34 percent in 2008, and 20 percent in 2009. This mortality was directly related to the surgery process.

4.7 Deadwood River System – Deadwood River Reach: Downstream of Deadwood Dam to the confluence with the South Fork Payette River Data Collection

Between June 22 and October 6, 2010, bull trout sampling occurred in the Deadwood River system below Deadwood Dam using fyke nets, hook and line sampling, minnow traps, seines, and backpack electroshockers. Bull trout caught in the stilling basin during salvage efforts were transported to locations above the dam (Reclamation 2010b). Most were implanted with radio transmitters. Fishes, other than bull trout, caught in the stilling basin were relocated downstream into main channel pool habitat and distributed between pools to minimize resource competition. All fishes, including bull trout, caught in the tributaries during backpack electroshocking efforts were released in close proximity to their capture location. In addition to sampling bull trout, physical, hydrologic, and water chemistry data were also collected. A detailed description of these activities occurring within the Deadwood River reach and tributaries below the dam is presented in this section.

A total of 1,599 fish, including 162 bull trout, were sampled in the Deadwood River system below Deadwood Dam, including tributaries to the river (Reclamation 2011b). The most abundant fish sampled was rainbow trout accounting for 37.5 percent of the total catch (Table 11). Dace were the next most abundant (34.5 percent) followed by sculpin and bull trout (both around 10 percent) and mountain whitefish and kokanee salmon (both around 3 percent). Cutthroat trout, cutthroat/rainbow hybrids and redside shiners all accounted for less than 1 percent of the total catch (Reclamation 2011b).

Table 11. Total catch summary for 2010 including numbers of each species captured (total catch) and percent (%) of total catch. Includes all fish captured in the Deadwood River system below Deadwood Dam.

Species	Total Catch	Percent
Bull Trout *(Salvelinus confluentus)*	162	10.1
Westslope Cutthroat Trout *(Oncorhynchus clarki lewisi)*	3	0.2
Cutthroat/Rainbow trout hybrid	2	0.1
Rainbow Trout *(Oncorhynchus mykiss)*	600	37.5
Redside Shiner *(Richardsonius balteatus)*	13	0.8
Sculpin (*Cottus spps).*	173	10.8
Dace (*Rhinichthys spps)*.	551	34.5
Mountain Whitefish *(Prosopium williamsoni)*	49	3.1
Kokanee salmon (*Oncorhynchus nerka kennerlyi*)	46	2.9
Total	**1,599**	**100.0**

4.7.1 Fish Sampling/Radio Tracking

From June 22 to August 11, 2010, presalvage sampling efforts included using a fyke net in the stilling basin and a backpack electroshocker in two of the tributaries below Deadwood Dam. A total of 306 fish were captured, including 151 bull trout (Table 12: Reclamation 2011b). Bull trout were the most abundant fish captured during these efforts accounting for 49.3 percent of the total catch. Dace represented 32.7 percent and rainbow trout, 18 percent of the total catch.

Table 12. Total of each species captured (total catch) and percent (%) of total catch for presalvage fish sampling efforts below Deadwood Dam in 2010.

Species	Total Catch	Percent
Bull Trout (*Salvelinus confluentus*)	151	49.3
Rainbow Trout (*Oncorhynchus mykiss*)	55	18.0
Dace (*Rhinichthys spps)*.	100	32.7
Total	**306**	**100**

Captured fish were identified to species, enumerated and measured for total length (game species only). When a bull trout was captured, it was anesthetized using MS-222, measured (total length and fin length in mm), weighed (grams), and scanned for PIT tags. All previously untagged and healthy looking bull trout over 53 grams were implanted with radio transmitters (Lotek Wireless, Ontario, Canada) and PIT tags. All previously untagged and

healthy looking bull trout under 53 grams, but over 100 mm were implanted with PIT tags only. Biological samples collected from bull trout included fin clips (n=101), scales (n=69), and gut samples (n=15) when possible. Fin clips were sent to the USFWS Genetics Lab in Abernathy, Washington. Genetic analysis may be used for population assignment to a natal stream in the South Fork Payette drainage (DeHann and Ardren 2008). Muscle plugs are being used in an associated isotope study (Reclamation 2008). Bull trout scales are being analyzed by Reclamation staff and being used to determine general age and growth patterns in the population. The collection of fin clips, scales, and gut samples occurred while bull trout were anesthetized. The muscle plugs were taken before anesthetic was administered so the samples were not contaminated. None of the methods for taking these biological samples were lethal to the fish. Bioenergetic modeling, scheduled to occur after field studies are complete, will utilize data from age and growth and diet analyses.

Fyke Netting

Prior to construction activities, a total of 141 fish were captured in the stilling basin from June 22 to July 7, 2010, using a fyke net (Reclamation 2011b). No bull trout were captured and all fish were released back into the stilling basin after being measured for total length. Dace represented 71 percent of these sampled fish; the remainder were rainbow trout. Total sampling effort was 36.67 hours and Total CPUE was 3.8 fish per hour.

Backpack Electroshocking

Three tributaries that drain into the river below the dam were sampled with Smith-Root backpack electroshockers from early July through mid-August in 2010. The tributaries chosen included Scott and South Fork Scott creeks as well as Warmsprings Creek. There were two goals while using this technique: to collect bull trout for genetic samples to determine natal origin and to insert radio and PIT tags for telemetry purposes.

Of the three tributaries sampled below Deadwood Dam, there were 165 fish collected representing two species. The most abundant were bull trout, accounting for 91.5 percent of total catch, followed by 8.5 percent rainbow trout (Reclamation 2011b).

Of the 151 bull trout captured while electrofishing in tributaries below Deadwood Dam, 120 were PIT tagged and ranged in total length from 101 mm to 234 mm. Out of the 120 PIT tagged bull trout, 18 also received radio tags. Their measurements ranged from 180 mm and 234 mm in total length and 54 grams and 124 grams in weight, respectively. Of the bull trout that received radio tags, 17 continue to be tracked by helicopter. One of these fish has a tag which is on a frequency that is untrackable by helicopter due to interference. There is a remote station at the Deadwood River confluence with the South Fork Payette River that will record fish that move into that area. Tracking activities are planned to continue through 2011.

4.7.2 Hydrology and Water Chemistry

Water quality data were collected during the 2010 reporting period for the purpose of riverine and habitat modeling efforts (Reclamation 2008). Eight water quality parameters were measured in the field and another eleven processed in the lab (Table 9). Water quality sampling sites included two locations on the Deadwood River (one below the dam and one near the confluence with the South Fork Payette River) and one in Wilson Creek, a tributary to the river below Deadwood Dam. Sampling locations for hydrology and water quality data are depicted in Figure 20 and Figure 21. Sample locations and frequencies are listed in Table 10.

Water temperatures continued to be collected downstream of Deadwood Dam in the mainstem Deadwood River and seven tributaries to the Deadwood River: Wilson, Whitehawk, No-Man, Scott, Lorenzo, Julie, and Stevens creeks. Thermographs recorded water temperature hourly throughout the year and were manually downloaded a minimum of once per year. Locations of all temperature thermographs in the Deadwood River basin are illustrated in Figure 20.

A Sontek ADCM located near the confluence of the Deadwood River with the South Fork Payette River was maintained and continued to record data during 2010 until late fall when it was replaced by USGS with a pressure transducer. The ADCM recorded water temperature, water velocity, and water depth. Data from this location are transmitted via satellite to Reclamation's Hydromet website (Reclamation 2011a: DRMI).

AquaRod water level and temperature loggers were maintained in Wilson, Warmsprings, Whitehawk, No-Man, and Stevens creeks and in the Deadwood River near Julie Creek. The AquaRod loggers recorded flow stage every 30 minutes from June through October and hourly during the rest of the year. Data were downloaded monthly during the field season. On several occasions, manual flow measurements were made at these locations for the purpose of developing stage/discharge relationships in order to quantify flow and water quality constituent concentrations entering the river.

In 2010, flows were measured twice to assist in developing stage-discharge relationships at the gages and to verify discharge measurements from the automated sensors. Flows were first recorded on August 16 at Trail, Wilson, Warmsprings, Whitehawk, No Man, and Stevens creeks, as well as the Deadwood River inflow. September 30 through October 1, 2010, flows were recorded in Nine Mile, Lorenzo, Scott, Wilson, Warmsprings, Whitehawk, No Man, Stevens, Pine, Nellys Basin, Josie, Deadwood Jim, Slim, Slaughterhouse, and an unnamed creek, as well as the mainstem Deadwood River at Julie Creek Bridge and the ADCM (DRMI) near the confluence with the South Fork Payette River.

Two additional data collection efforts are underway within the Deadwood River system in order to further understand two noteworthy observations. First, in the Deadwood River at the mouth of Warmsprings Creek, a network of tidbit temperature loggers has been placed to track the thermal "plume" or "regime" of Warmsprings Creek. The goal is to characterize the thermal signature and come to a conclusion about whether it provides a thermal refuge for bull trout, and/or how a different operation of the dam might affect the warm water entering the river from Warmspring Creek.

The second data collection involves the investigation of icing and snow in the Trail Creek drainage. In past winters, very large spikes in Trail Creek's stage have been observed. These spikes were discovered to coincide with large snow events tracked at Deadwood Summit. In order to identify what is happening at Trail Creek, three game cameras were placed at the instrument location at Trail Creek that take time lapse photos of the site. If photos of significant snow or ice events are captured, they may provide insight into winter habitat for bull trout.

Hydrology and water quality data will continue to be sampled through the 2011 field season. All temperature, flow, and stage data is stored on Reclamation's Hydromet database and is being used for the biological and hydrologic modeling. Results will be available in the final report upon completion of the project following the outline described in the Deadwood Reservoir Flexibility Study Proposal (Reclamation 2008).

4.7.3 Deadwood River Productivity

The 2005 Opinion (USFWS 2005) describes factors that potentially limit bull trout in the Deadwood River below Deadwood Dam, including low winter flow and low water temperatures that limit invertebrate production. Aquatic macroinvertebrates make up an important part of the prey base for bull trout—both directly for bull trout and indirectly as food for fish that bull trout prey upon. The objective of this portion of the Deadwood Reservoir Flexibility Study Proposal (Reclamation 2008) was to determine if macroinvertebrate abundance and biovolume below a bottom-release dam on the Deadwood River is adequate to provide a sufficient prey base for bull trout and their forage. Another goal was to describe effects of dam regulation on periphyton abundance and macroinvertebrate communities in the Deadwood River. Aquatic macroinvertebrate communities in the regulated portion of the Deadwood River, in unregulated sections of the Deadwood River, and in similar nearby rivers (e.g., Clear Creek, Middle Fork Payette River) were described. The unregulated sites serve as references to describe background conditions without dam influence. A comparison of macroinvertebrate communities using community-level metrics (density, community composition) and population-level metrics (productivity, phenology) for select indicator taxa was developed.

Two study sites were located upstream of Deadwood Dam, four were located downstream of the dam, two sites were in unregulated Clear Creek, and two sites were in the upper South Fork Payette River (Figure 22). Study sites were selected as those which were accessible and most likely to support maximum benthic macroinvertebrate densities. Riffles dominated by cobble are commonly the richest-targeted habitat in streams for macroinvertebrates (Buffagni and Comin 2000, Moulton et al. 2002) and so were selected as the target habitat to sample in this study.

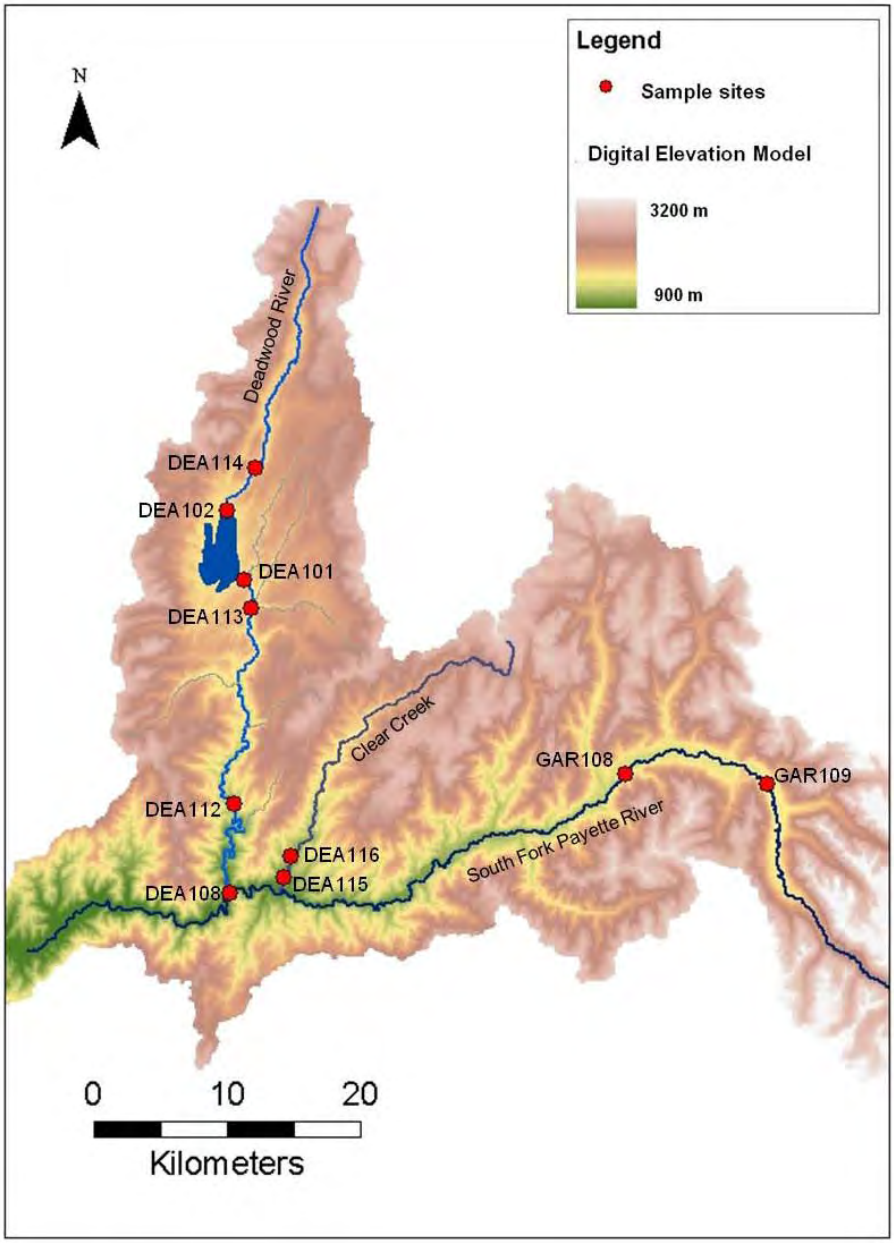

Figure 22. Sample sites on the Deadwood and South Fork Payette rivers and Clear Creek for prey base portion of Deadwood Reservoir Flexibility Study Proposal (Reclamation 2008).

Field data were collected from June through October in 2010. Temperature data were collected hourly using Onset temperature monitors and discharge data were collected at varying intervals, depending on the method used. Water quality, periphyton, macroinvertebrate data, and some physical habitat data were collected monthly at each site. Other physical habitat data were collected once during low water. At each site, a 100-meter sample reach was established along a cobble-dominated riffle. During each sampling date, three transects were selected randomly (without replacement) within the reach. Benthic macroinvertebrate samples were collected at two depths on each transect. Detailed methodology of this study is described in the Deadwood Reservoir Flexibility Study Proposal (Reclamation 2008). Results will be provided at the completion of the project.

4.7.4 Construction

Routine inspections at Deadwood Dam found that erosion was occurring around and below the concrete access bridge located 197 feet downstream from the dam and repairs to the east bridge abutment were required. Repair work was performed during the fall of 2010 and involved partially dewatering the tailrace in order to repair the east bridge abutment. The flows were reduced and the tailrace was pumped out until the construction site was completely dewatered. The USFWS issued Reclamation a Biological Opinion to perform the work (USFWS 2010). On the evenings of August 23 and 24, 2010, Deadwood Dam flows were reduced from irrigation flows of 509 cfs to hydroelectric generator flows of 2.25 to 2.30 cfs.

From August 24 to September 12, 2010, measured flows at the USGS gage below Deadwood Dam were approximately 3.0 cfs (USGS data; DRMI; Reclamation 2011a). The 3.0 cfs flow was comprised of hydroelectric generation flow (2.25 to 2.30 cfs), dam seepage, water draining from the tailrace, and groundwater. Hydroelectric generation flows were measured with an Accusonic Model 787, Portable Clamp-on Transit-time Flowmeter, applied directly to the 10-inch penstock feeding the hydroelectric generator. Reclamation attempted to measure seepage from the dam by constructing a temporary weir, but flows going over the weir were too low to measure. Reclamation estimated seepage flows to be less than 1cfs.

On the evening of September 12, the hydroelectric generator was shut down. The remaining flows in the 0.3-mile stretch below the dam to the first tributary entering the mainstem were from dam seepage, groundwater flows, and initial tailrace pumping. The lowest recorded flows at the USGS gage were 0.51cfs from September 25 to October 3, 2010 (USGS data; DRMI; Reclamation 2011a). On October 8, 2010, the repair work on the bridge was completed and flows were released from the dam at 50 cfs (normal winter flows).

While flows were reduced from the dam, Reclamation crews collected additional biological information that would otherwise not have been collected due to safety reasons associated

with flows below the dam. These biological data collection efforts followed the Deadwood Flexibility Study Proposal and allowed Reclamation to conduct more comprehensive studies to better address the terms and conditions of the 2005 Opinion. Results from additional field efforts during the fall of 2010 are summarized in this report.

4.7.5 Fish Sampling/Radio Tracking (Salvage)

Two fish salvage efforts occurred immediately following the reduction of flows from Deadwood Dam to 2.3 cfs on August 24, 2010. The first effort took place in the stilling basin to capture fishes that did not migrate out of the stilling basin as flows were reduced (August 24 to September 22, 2010). The second effort salvaged fishes in stranding pools downstream of the dam, (August 24 to September 3, 2010). Additional salvage efforts also occurred at randomly selected sampling locations throughout the 24 miles of the Deadwood River to the South Fork Payette River during other scheduled fish and habitat sampling throughout the drawdown (Reclamation 2010b).

Between August 24 and September 22, 2010, a total of 1,258 fish were captured in the Deadwood River system below Deadwood Dam, including 11 bull trout (Table 13; Reclamation 2011b). Rainbow trout and dace were the most abundant species captured during these efforts (cumulatively 76.4 percent of the total catch). Sculpin were the next most abundant representing 13.8 percent of total catch followed by mountain whitefish and kokanee salmon (both around 4 percent). Redside shiner, cutthroat trout, and cutthroat-rainbow trout hybrids all represented 1 percent or less of the total catch.

Table 13. Total of each species captured (total catch) and percent (%) of total catch during all salvage efforts below Deadwood Dam, 2010.

Species	Total Catch	Percent
Bull Trout *(Salvelinus confluentus)*	11	0.9
Cutthroat Trout *(Oncorhynchus clarki lewisi)*	3	0.2
Cutthroat/Rainbow Trout hybrid	2	0.2
Rainbow Trout *(Oncorhynchus mykiss)*	510	40.5
Redside Shiner *(Richardsonius balteatus)*	13	1.0
Sculpin (*Cottus spps).*	173	13.8
Dace (*Rhinichthys spps*.)	451	35.9
Mountain Whitefish *(Prosopium williamsoni)*	49	3.9
Kokanee salmon (*Oncorhynchus nerka kennerlyi*)	46	3.7
Total	**1258**	**100.0**

Biological samples collected from bull trout included fin clips (n=11), muscle plugs (n=3), scales (n=11), and gut samples (n=3).

First Salvage Effort (Stilling Basin)

Multiple sampling gears were used to remove fish that did not migrate downstream as flows were reduced from the stilling basin. A total of 918 fish were removed from the stilling basin, including 11 bull trout (Table 14; Reclamation 2011b) using fyke and gill nets as well as a boat electroshocker. The total sampling time was 222.7 hours and the CPUE was 4.12 fish per hour. Several attempts to salvage fish using a seine net, minnow traps, and hook-and-line sampling resulted in zero fish caught; therefore, these methods were not continued.

Table 14. Total numbers of each species captured (total catch), Catch Per Unit Effort (CPUE hrs) and percent (%) of total catch for all 2010 salvage efforts within the stilling basin below Deadwood Dam.

Total sampling effort during salvage in the stilling basin			**222.7 hours**
Species	**Total Catch**	**CPUE**	**Percent**
Bull Trout *(Salvelinus confluentus)*	11	0.05	1.2
Cutthroat Trout *(Oncorhynchus clarki lewisi)*	3	0.01	0.3
Cutthroat/Rainbow Trout hybrid	2	0.01	0.2
Rainbow Trout *(Oncorhynchus mykiss)*	415	1.86	45.2
Redside Shiner *(Richardsonius balteatus)*	13	0.06	1.4
Sculpin *Cottus spps.*	2	0.01	0.2
Dace *Rhinichthys spps*.	433	1.94	47.2
Mountain Whitefish *(Prosopium williamsoni)*	39	0.18	4.2
Total	**918**	**4.12**	**100**

There were 34 fish captured using a boat electroshocker on September 13 and 14, 2010 (Reclamation 2011b). The most abundant fish caught were dace and rainbow trout (cumulatively 94.2 percent of the total catch) while mountain whitefish represented 5.9 percent of the total catch. The total sampling time between the two days was 1.06 hours. The total CPUE for this method was 32.1 fish per hour.

Between August 24 and September 22, 2010, a total of 884 fish were caught using fyke nets and gill nets (Reclamation 2011b). Dace and rainbow trout were the most abundant species, cumulatively 96.0 percent of the total catch. Remaining species included Mountain whitefish (4.2 percent), redside shiner (1.5 percent), and bull trout (1.2 percent) which were only caught by fyke net. Cutthroat trout, cutthroat/rainbow hybrids, and sculpin all represented less than 1.0 percent of the total catch. The total sampling time for trap netting and gill netting in the stilling basin was 221.6 hours. The total CPUE for these methods was 3.99 fish per hour.

Eleven bull trout were captured in the stilling basin, ranging from 136 to 341 mm total length and 22 to 406 grams in weight (Reclamation 2011b). Ten bull trout were implanted with

radio transmitters and PIT tags. One was too small to be implanted with a radio transmitter and only received a PIT tag. Bull trout were transported immediately upstream of Deadwood Dam into the first available suitable habitat (Table 15). When water temperatures and dissolved oxygen conditions were suitable (IDEQ cold water suitability standards; IDEQ 2010), bull trout were released into the reservoir. When conditions in the reservoir were not suitable for bull trout, tributaries above the dam were used as alternative release locations. Trail Creek was used most often because bull trout are known to be present there and the transport time was less than 30 minutes (USFWS 2010). Fish capture and transport authorization is covered under Section 6 permitting with the IDGF, including a sampling permit (F-02-07-10; Appendix A) and transport permit (HQ-10-037; Appendix A). Section 4.6.1 reports the tracking details of these 10 bull trout. Tracking activities are planned to continue through the end of 2011.

Table 15. Bull Trout captured in the stilling basin below Deadwood Dam during salvage efforts, release locations, date they were last tracked, and tag recovery location (when applicable).

Date	Tag ID	Release location	Last tracked	Tag recovery location
8/25/2010	4 (freq. 148.800)	Trail Creek	mortality	1.5 miles up trail creek (on shore)
8/25/2010	7	Trail Creek	11/3/2010	n/a
8/25/2010	77	Trail Creek	10/13/2010	n/a
8/25/2010	64	Trail Creek	9/11/2010	n/a
8/25/2010	75	Trail Creek	12/16/2010	n/a
8/25/2010	65	Trail Creek	not found	n/a
8/25/2010	76	Trail Creek	10/14/2010	n/a
8/26/2010	4 (freq. 148.640)	Beaver Creek	mortality	On island in reservoir (in trees above high water mark)
9/12/2010	88	SF Beaver Bay	not found	n/a
9/23/2010	8	Cozy Cove	10/13/2010	n/a

Second Salvage Effort (Stranding Pools along the Mainstem Deadwood River below the Dam)

Reclamation used green LiDAR data to delineate the 24 miles of the Deadwood River from the dam to the South Fork Payette River into 16 separate reaches based on geomorphological features. In nine of those reaches, 78 stranding pool surveys were conducted between August 24 and September 15, 2010, with both 0 and 2.25 to 2.30 cfs discharge from the hydroelectric generator. The direct effects of reduced flows (connectivity and water temperatures) was

primarily limited to the first 0.3 miles downstream of the dam; however, the action area extended to the confluence of the South Fork Payette River due to a detectable change in flow at the confluence (USFWS 2010, Reclamation 2010b). A summary of stranding pool survey results are shown in Table 16. A final summary will be provided upon completion of the Deadwood Reservoir Flexibility Study report.

A total of 230 fish were captured from the 78 surveyed stranding pools (Table 16; Reclamation 2011b). The most abundant species captured was sculpin, representing 54 percent of the total catch, followed by rainbow trout (25.6 percent), kokanee salmon (20 percent), and mountain whitefish (0.4 percent). All fishes were released into the closest mainstem pool habitat.

Table 16. Total numbers of each species captured (total catch) and percent (%) of total catch for all 2010 stranding pool salvage efforts along the mainstem Deadwood River below Deadwood Dam.

Species	Total Catch	Percent
Sculpin *Cottus spps.*	124	54.0
Rainbow Trout (*Oncorhynchus mykiss*)	59	25.6
Kokanee (*Oncorhynchus nerka kennerlyi*)	46	20.0
Mountain Whitefish *(Prosopium williamsoni)*	1	0.4
Total	**230**	**100**

Additional Salvage Efforts (Mainstem Deadwood River below Deadwood Dam)

Reclamation used a backpack electroshocker to sample sections of the mainstem Deadwood River as part of the salvage effort during the period of low releases from the dam. The first 1.9 miles of Deadwood River downstream of Deadwood Dam was chosen for this effort because of the potential for in-channel stranding pools to occur when the flows through Deadwood Dam were reduced to zero. Three tributaries (Wilson, Warmsprings, and Whitehawk creeks) provide measurable flow year-round within this reach in addition to riparian and in-channel spring water contributions. Downstream of Whitehawk Creek, natural flow in the main river channel is increased and connectivity between in-channel pool habitat is maintained (Reclamation 2010b).

Backpack electroshocking of the mainstem Deadwood River below Deadwood Dam took place on three separate dates: September 12, 14, and 20, 2010. A total of 110 fish were salvaged within the 417.1 meters that was sampled (Table 17; Reclamation 2011b). The most abundant fish captured were rainbow trout and sculpin, cumulatively 75.4 percent of the total catch, followed by dace (16.4 percent) and mountain whitefish (8.2 percent). All collected fish were dispersed into the main channel flow of the river as close to the capture location as possible, but still allowing for migration.

Table 17. Total numbers of each species captured (total catch) and percent (%) of total catch for all 2010 salvage efforts within the first 1.9 miles of the mainstem Deadwood River below Deadwood Dam.

Species	Total Catch	Percent
Rainbow Trout *(Oncorhynchus mykiss)*	36	32.7
Sculpin *Cottus spps.*	47	42.7
Dace *Rhinichthys spps*.	18	16.4
Mountain Whitefish *(Prosopium williamsoni)*	9	8.2
Total	**110**	**100**

4.7.6 Habitat Survey

Habitat surveys conducted during the minimal flows characterized stream habitats, including low-flow conditions not easily measured under normal conditions. Overwintering refuge, shelter, and the general quality of suitable habitat for bull trout provided the framework for this surveying effort.

Surveys were conducted from August 30 to October 20, 2010, during Deadwood Dam discharges of 0, 2.3 to 2.5, and 50 cfs in an effort to capture various habitat characteristics. LiDAR data was used to delineate the river into 16 separate reaches based on geomorphological features; 13 of those 16 reaches accounted for 22.71 miles of the 24-mile-long river. Each reach was further segregated into nine microhabitat types consisting of a sequence of pools, riffles, and runs. Various parameters were sampled at each location. Sampling protocols were based on the works of Rosgen and Silvey (1998), Overton et al. (1997), Montgomery and Buffington (1997), and Flosi and Reynolds (1994). Field crews were dispatched at each flow to document and sample existing conditions using a wide range of measuring devices. General characteristics measured for each habitat unit included length, average stream width, counts of large woody debris, depth (maximum depth for pools, average for others), bank stability, and more. A detailed methodology can be found in Reclamation (2008). To prevent discrepancies and bias between different observers, the same personnel were used to sample the same locations at each flow whenever possible. Observer results were validated by another field crew member at frequent intervals to maintain consistency. A final summary will be provided upon completion of the Deadwood Reservoir Flexibility Study report.

Five of the individual habitat units were sampled for fish using a backpack electroshocker on September 20 and October 6, 2010. Rainbow trout were the only species captured, with a total catch of 35. After being measured (total length) and enumerated, all fishes were released back into the habitat units they were sampled from.

4.7.7 Deadwood River Reach Discussion

Prior to 2007, no bull trout had been sampled in the Deadwood River below the dam using a combination of gill nets, fyke nets, tributary weirs, hook-and-line, and electrofishing methods. Since 2007, 32 bull trout were sampled in the mainstem Deadwood River and 151 bull trout in tributaries below the dam. Movement of radio-tagged fish has varied between years and seasons.

During the 2010 reporting period, a total of 11 bull trout were captured in the stilling basin and 151 were sampled from tributaries. The difference in numbers of fish captured this year as compared to past years could be attributed to the drawdown of the stilling basin pool and increased sampling efforts. Genetic analyses from these bull trout show that all were derived from reservoir populations. It is unknown when the fish were entrained; however, past sampling success may suggest entrainment occurred in 2007. In 2010, all 11 bull trout captured from the stilling basin were transported to locations above the dam due to the results of the genetic samples (Reclamation 2010b). Seven of these fish were still being tracked through the end of the reporting period and tracking will continue through 2011. Eighteen of the 151 bull trout captured in the tributaries received radio tags (all in Scott Creek), 17 of which were still being tracked through the end of the reporting period.

Two of the bull trout that were radio tagged below Deadwood Dam in 2010, died in 2010, resulting in a 1.2 percent annual mortality rate. Both confirmed mortalities occurred in bull trout that had been transplanted above the dam. The tags were both recovered on land, one in Trail Creek and the other on an island in the reservoir. No mortality during this reporting period was directly attributable to handling associated with this research.

4.7.8 Payette River Basin - Deadwood River System Discussion

The Deadwood Reservoir Flexibility Study involves methods that include fish population dynamics, productivity, hydrology, and water chemistry monitoring (Reclamation 2008). These data are being used in physical, hydrodynamic, and bioenergetic modeling. These efforts involve a collaborative effort between multiple agencies and include annual activities not detailed in this report. The results of the Deadwood Reservoir Flexibility Study will be provided at the completion of the project and reported under a different cover.

4.8 Malheur River Basin - Beulah Reservoir Data Collection

A memorandum sent to the USFWS in 2009 (May 15, 2009: Mark Robertson, USFWS) described revisions to the Monitoring and Implementation Plan. The Monitoring and Implementation Plan (March 16, 2006) originally identified trap-and-haul sampling to be initiated when reservoir pool elevations dropped below 2,000 acre-feet or when the spillway was used. Trap-and-haul sampling was conducted in the spring from 1999 to 2008 (excluding 2007) and in the fall from 2000 to 2002. Bull trout have only been collected during spring sampling efforts during or following a spill. Based on this data, the May 15 memorandum revises the trap-and-haul requirement to be conducted only when spill occurs. Spill did not occur at Agency Valley Dam during Water Year 2010 precluding the need for trap-and-haul activities to be conducted.

The USFWS approved an extension of terms and conditions 4a and 4c from the Opinion until April 30, 2015 (memo April 23, 2010: Gary Burton, USFWS). As part of the extension, Reclamation will provide work with VOID to secure water at the end of each year to provide an adequate prey base for adfluvial bull trout in the basin and make a reasonable effort to avoid run-of-river conditions in the reservoir. A study was recently initiated to achieve those goals. Field efforts begin in Water Year 2011 and annual progress summaries will be provided in subsequent annual reports.

Reclamation continues to work with the USFWS and Malheur Bull Trout Working Group to identify other measures to protect bull trout in the Malheur River basin in addition to pool elevation in Beulah Reservoir. A pilot fish salvage effort was conducted October 17-21, 2010 in the tailrace of Agency Valley Dam to explore the possibility of trapping and transporting entrained prey fishes back into the reservoir. This cooperative effort involving the Burns Paiute Tribe, Oregon Department of Fish and Wildlife, the Vale Oregon Irrigation District, and Reclamation was successful in returning 2,682 native fishes to the reservoir (Table 18). After irrigation releases were completed for the year and discharge from the reservoir ceased, the salvage effort began. Water was pumped out of the stilling basin while fish were collected using minnow traps, trap nets, beach seine, hoop nets, and gill nets. Trap nets and beach seines were the most efficient means of capture. A full summary of the project with catch statistics will be provided in the Burns Paiute Tribe 2010 Annual Report. Future fish salvage efforts will be considered in Reclamation's recommendations to USFWS in 2015.

Table 18. Catch data for 2010 fish salvage effort below Agency Valley Dam, Oregon. Total Catch per Unit Effort (CPUE) for all gears is measured in fish captured per hour.

	Total CPUE (mean)	3.19
	Total Fish	2682
	Total Hours	839.86
Species	**Number of fish Caught**	**CPUE (fish/hr)**
Chiselmouth chub (*Acrockeilus alutaceus*)	734	0.45
Redside Shiner (*Richardsonius balteatus*)	721	0.15
Largescale Sucker (*Catostomus macrocheilus*)	716	0.04
Northern Pikeminnow (*Ptychocheilus oregonensis*)	247	0.22
Speckled Dace (*Rhinichthys osculus*)	186	0.16
Sculpin - *Cottus spps*	26	0.05
Mountain whitefish (*Prosopium williamsoni*)	12	0.01
Rainbow trout (*Oncorhynchus mykiss*)	11	0.00
Bullheads - *Ictalurus spps*	9	0.01
Crayfish	20	0.00

4.8.1 Malheur River Basin - Beulah Reservoir Discussion

In 2010, the USFWS extended the deadline to address Terms and Conditions 4a and 4c from 2010 to April 2015. Reclamation hosted a coordination meeting with the Malheur Bull Trout Working Group and the Vale Oregon Irrigation District to formulate research objectives to address the terms and conditions for Beulah Reservoir. Following the coordination meeting, Reclamation prepared a study plan to complete the requirements of the Terms and Conditions 4a and 4c. The study plan is described in general in this section.

In general, the study design for the 2011-2015 work is consistent with past work on Beulah Reservoir performed by USGS (Rose and Mesa 2009). This consistency will allow data collected during previous studies to be combined with new data and used in the bioenergetics model currently under development and testing by the USGS. This consistency will also allow for year-to-year comparisons with earlier work at Beulah Reservoir during 2006, 2007, and the spring of 2008 (Rose and Mesa 2009) as well work conducted in 2001 and 2002 (Petersen et al. 2002, 2003). The current study involves three general components (prey base data collection, bioenergetic modeling, and data summary and formulation of minimum pool recommendations to USFWS) which are described in the following sections.

Prey Base Data Collection

The current prey base work will differ from past work in that the reservoir pool elevation will be kept at or above 2,000 acre-feet during the data collection period. New work will build from past prey base studies by increasing the sampling effort for prey fish and benthic invertebrates and adding sampling for zooplankton. Basic limnology data will also provide information on primary and secondary productivity.

Bull trout data collections will aim to determine bull trout population levels; seasonal use of Beulah Reservoir; and the timing and extent of migration. A picket weir fish trap will be installed on the North Fork Malheur River near the inlet to Beulah Reservoir. A PIT-tagging program will be instituted in Fiscal Year 2011, with a PIT-tag antenna array also installed on the North Fork Malheur River near the inlet to Beulah Reservoir. Hydroacoustic surveys will be conducted to estimate fish numbers and distribution in the deeper portions of the reservoir where other sampling methods are not effective.

Bioenergetic Modeling

Results from the prey base studies will be used in a bioenergetic model to estimate the effects of different pool elevations on the bull trout prey base and growth of bull trout under different pool elevation scenarios. Empirical, if available, and hypothetical population numbers will be used in the modeling scenarios. Hypothetical population numbers will be based on the most recent 10-year average of bull trout redd surveys, 500 spawning adults (number to minimize inbreeding), and 1,000 spawning adults (effective population size to preserve a given population) (Rieman and Allendorf 2001).

The USGS research laboratory in Cook, Washington (Matt Mesa) is developing bull trout specific bioenergetic parameters for use in bioenergetic modeling. Bull trout specific bioenergetic parameters do not currently exist for use in the type of modeling this project aims to achieve. Bioenergetic modeling at this time must use parameters from surrogate species to model for bull trout. Work currently taking place by Matt Mesa is expected to be completed by Fiscal Year 2012 and used in this project. Reclamation understands the importance of using the best available science and uses site and species specific data whenever possible.

Data Summary and Formulation of Minimum Pool Recommendations to USFWS

A summary report for the prey base, bioenergetic modeling, and fish salvage work will be prepared upon completion of the study. Data from this study and other relevant data provided from the Malheur Bull Trout Working Group will be considered when formulating minimum pool recommendations and to identify measures that will protect bull trout while meeting irrigation responsibilities. A summary report and recommendations will be provided to the USFWS by the April 30, 2015, deadline.

5.0 OTHER ACTIVITIES

5.1 Physa Surveys

No surveys were conducted for physa during this reporting period. In 2010, MSU finalized work on Reclamation's Snake River physa study; therefore, no data collection activities were required by MSU in 2010 as part of Reclamation's Snake River physa study. All work conducted in 2010 associated with the Snake River physa study involved final data analysis and final reporting. No field collection activities for Snake River physa were conducted.

5.2 Water Quality

Reclamation participates in several water quality related activities in the upper Snake River basin. This discussion describes the breadth of Reclamation's participation in 2010. First, as part of Idaho and Oregon's ongoing Total Maximum Daily Load development and implementation activities, Reclamation staffs from the Snake River Area Office and/or Pacific Northwest Regional Office participated in all appropriate watershed advisory group and watershed council meetings in the upper Snake River basin. These include activities in the North Fork Payette River, Lower Payette River, Mid Snake River, Lake Walcott, and American Falls Reservoir Watershed Advisory Groups, as well as the Malheur Watershed Council.

Reclamation also provided technical assistance to irrigation system operators and other appropriate entities throughout its project areas in the upper Snake River basin. Reclamation's Pacific Northwest Region Laboratory provided analytical laboratory services to several entities in the basin, including:

- Idaho Department of Environmental Quality
- Aberdeen Springfield Irrigation District
- Burley Irrigation District
- Lower Boise River Watershed Advisory Group
- A & B Irrigation District
- Minidoka Irrigation District
- Lake Walcott Watershed Advisory Group
- Malheur Soil & Water Conservation District

In addition, Reclamation has developed and implemented a basin-wide temperature monitoring study for the upper Snake River basin. In 2010, Reclamation and the USGS maintained a total of 52 stream temperature loggers throughout the basin. The intent of the on-going study is to describe temperature regimes in the Snake River relative to Reclamation's management activities; this work will continue through 2011. The information from this study was reported in Reclamation's 2009 Annual Report to the National Marine Fisheries Service (Reclamation 2009).

Reclamation also performed routine water sampling across the region. Reclamation performed nutrient monitoring on drains that return water to Lake Lowell; this monitoring is aimed at identifying the affects of added nutrients on the water quality in Lake Lowell. Lastly, Reclamation performed routine water quality sampling at American Falls, Deadwood, Arrowrock, Anderson Ranch, Beulah, Warm Springs, Ririe, Palisades, and Walcott reservoirs in 2010. This sampling was performed as part of an on-going regional reservoir sampling regime. The conditions at American Falls Reservoir did not trigger sediment and nutrient monitoring in 2010. When threshold conditions are met, monitoring is performed to track the effects of low pool elevations on water quality below the reservoir.

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