RECLAMATION

*Managing Water in the West*

# 2013 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 2014

## Mission of the 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.

## Mission of the Bureau of Reclamation

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.

*Photograph on front cover: North Fork Boise River, 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 (Reclamation 2004). In March 2005, USFWS completed a non-jeopardy Biological Opinion (2005 Opinion) for Reclamation operations and maintenance activities in the Snake River basin above Brownlee Reservoir (USFWS 2005). The 2005 Opinion contained a 30-year incidental take statement (ITS) and corresponding reasonable and prudent measures (RPMs) that outlined nondiscretionary actions to minimize take of species listed under the Endangered Species Act (ESA) that may be impacted by Reclamation operations (USFWS 2005).

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) RPMs to minimize the amount or extent of take without altering the basic design, location, scope, duration, or timing of the action. The 2005 Opinion requires Reclamation to provide an annual report to USFWS by December 31 of each year, reporting incidental take monitoring efforts and implementation status of all RPMs and terms and conditions. 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 (WY) 2013 (October 1, 2012 to September 30, 2013).

## 1.1 Bull Trout

Bull trout (*Salvelinus confluentus*) are present in five of Reclamation's facilities in the upper Snake River basin. This report covers the four facilities assessed in the 2004 Biological Assessment and 2005 Opinion shown in Figure 1: Anderson Ranch Dam and Reservoir; Arrowrock Dam and Reservoir; Deadwood Dam and Reservoir; and Beulah Dam and Reservoir. Bull trout were discovered in Phillips Reservoir in 2011 and Reclamation is currently in the process of consulting with USFWS on operations at that facility.

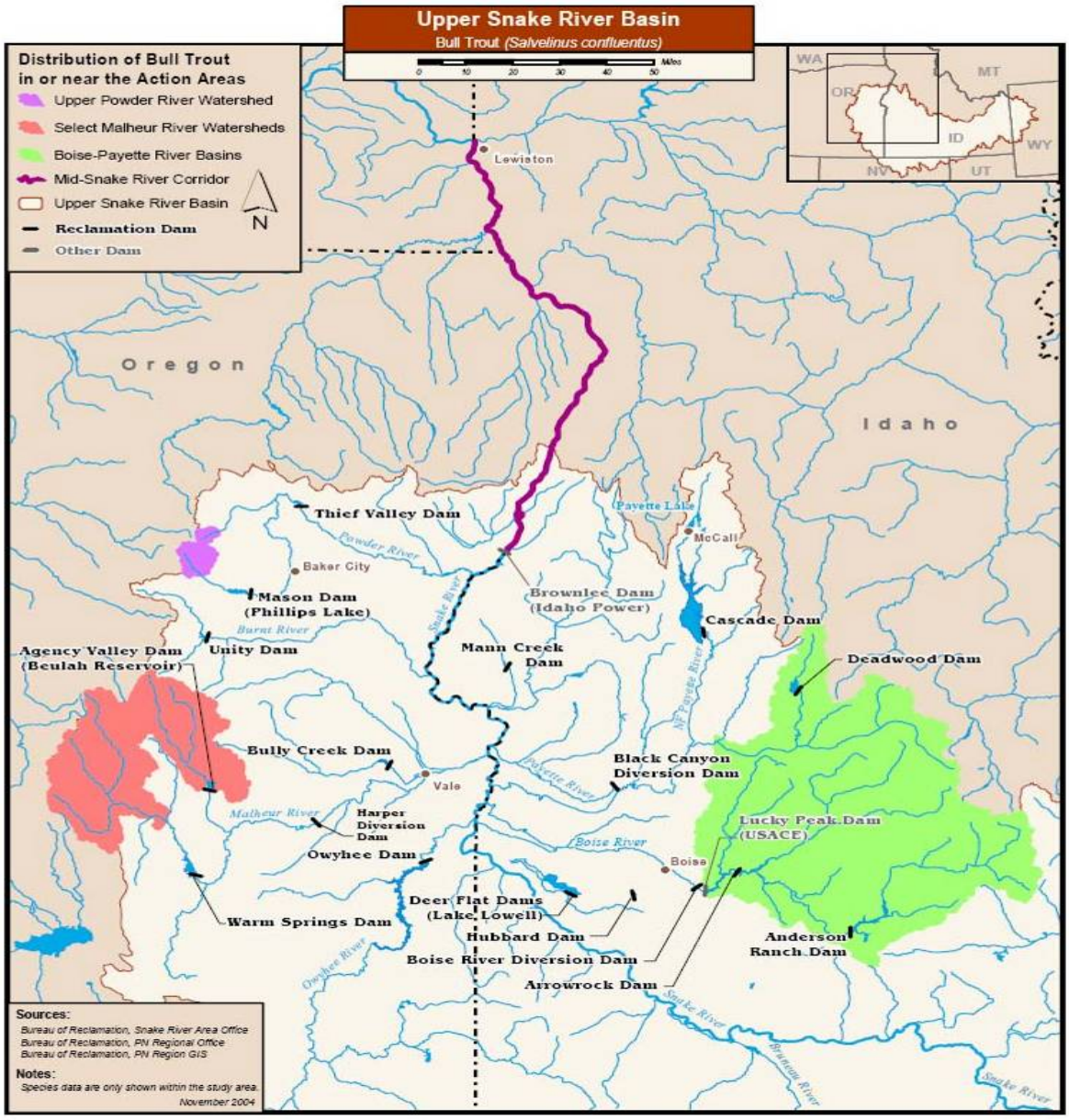


**Figure 1. Known distribution of bull trout populations (shaded areas on map) associated with Reclamation facilities in the upper Snake River basin (Reclamation 2004).**

Operational thresholds, population monitoring, and other relevant bull trout work managed by Reclamation and work associated with projects that address specific RPMs are described in this report. In addition, other relevant bull trout work not managed by Reclamation may be discussed in this report if directly relevant to bull trout or bull trout critical habitat within Reclamation's projects.

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. USFWS then described the amount or extent of incidental take at each facility based on operational thresholds.

### 1.1.1 Bull Trout Monitoring

The Monitoring and Implementation Plan (Reclamation 2006) identifies how Reclamation will monitor bull trout throughout the duration of the 2005 Opinion. Monitoring elements include evaluating operational indicators and tracking population trends. To monitor compliance with the operational thresholds defined in the ITS, operations for WY 2013 were monitored, evaluated, and summarized using Reclamation's Hydromet system (Reclamation 2014). Operational thresholds affecting the amount or extent of anticipated take are described in Section 2. Population-trend monitoring does not occur annually at each of the four facilities; however, during this reporting period population monitoring is ongoing in the North Fork and Middle Fork Boise rivers and will be reported in a different report when finished.

## 1.2 Snake River Snails

In addition to bull trout, previous annual reports to the USFWS reported on two species of snails in the Snake River basin: Utah valvata and Snake River physa. USFWS determined that Utah valvata did not meet the definition of an endangered or threatened species under the Act. The Utah valvata was removed from the ESA list, thereby removing all protections, and subsequent monitoring and reporting requirements, provided by the ESA (75 FR 52272). Accordingly, 2010 was the last year Reclamation monitored the Utah valvata.

The Snake River physa (*Physa* [*Haitia*] *natricina*, hereafter physa) remains an ESA-listed species; however, the 2005 Opinion did not provide an ITS, monitoring requirements, or terms and conditions for physa due to the uncertainty of their presence in the action area. Subsequent to the 2005 Opinion, physa were confirmed in the action area and a supplemental consultation is currently underway to address possible effect from long-term operation. The current take coverage for operations is covered under Minidoka Spillway Construction Biological Opinion (USFWS 2010). The construction of the spillway began in 2011 and is scheduled for completion in spring 2015. Information reported in this document is related to requirements of the Minidoka Spillway Construction Biological Opinion. The supplemental Section 7 consultation process for long-term operations is expected to be finished when the spillway construction is completed.

In 2013, physa surveys were conducted to gather baseline data that can be used to determine trends of occurrence and abundance across their known range, determine the effects of reduced spillway flows on physa in the Minidoka Dam Spillway, further characterize physa habitats, and meet the reporting requirements of ESA Section 10 (Permit No. TE 056557-5).

# 2.0 SUMMARY OF 2013 OPERATIONS

## 2.1 Idaho

November 1 carryover storage from WY 2012 was below the 30-year average (1981-2010) because of poor runoff and high demand during the 2012 irrigation season, with carryover in the Payette River basin at 96 percent, the Boise River basin at 107 percent, and the upper Snake River basin above Milner Dam at 69 percent. The winter season in the Payette River, Boise River, and upper Snake River basins progressed similarly between all the basins. The winter season started off strong with large snow falls and above average snowpack in December, but in January, dry conditions existed and snowpack fell to below average. As the winter progressed, the snow packs never caught up, and final snow packs were well below average. The observed unregulated runoff during April through July was 63 percent for the Payette River at Horseshoe Bend, 50 percent at the Boise River near Boise, and 70 percent for the Snake River at Heise, based on the 30-year average for 1981-2010. Due to above average temperatures and drought conditions, the irrigation season in 2013 started early with demand being above average. From June through July, Idaho experienced record setting temperatures, ranking second warmest on record for the last 119 years (Crouch 2014).

In the Boise River system, April started off with irrigation districts already warning of possible reduction in allocations for water users due to poor water-supply outlook. As the summer progressed, strong drafting of the reservoirs occurred and the system went well into drought conditions. In the Payette River basin, storage started to draft in the beginning of June, approximately one week earlier than normal. The early draft was a sign of things to come as the reservoir was drafted upon heavily by the end of irrigation season. Much like the story in the other systems, the upper Snake River experienced the same hot and dry summer as the other basins and drafting of the entire system started early and was nearly empty by the end of the irrigation season.

Due to the below average runoff in all the basins, only the Payette River system came close to filling in 2013. The upper Snake River above Milner Dam reached a maximum combined physical storage of 3,124,297 acre-feet out of 4,045,695 acre-feet. The Boise River system reached a maximum combined physical storage of 811,680 acre-feet out of 949,700 acre-feet. The Payette River system reached a maximum combined physical storage of 799,119 acre-feet out of 800,452 acre-feet. Flow augmentation of 427,000 acre-feet was delivered in WY 2013, although it was very difficult to meet this target due to the significant refill shortage in the Boise and upper Snake River basins. Contributions to the flow augmentation included 154,885 acre-feet from the upper Snake River above Milner Dam, 175,621 acre-feet from the Payette River basin, 18,845 acre-feet from the Boise River basin, and 77,649 acre-feet of natural flows, 17,649 acre-feet of which originated in Oregon.

### 2.1.1 Boise River Basin Operational Indicators

Two operational indicators were exceeded during the 2013 reporting period in the Boise River basin. Anderson Ranch Reservoir stored and released water (Table 1, Figure 2, and Figure 3); however, Reclamation has an exemption for this action 30 out of 30 years in the 2005 Biological Opinion. Also, the reservoir volume in Arrowrock Reservoir was below 200,000 acre-feet at the end of June (Table 2 and Figure 4 through Figure 6). Reclamation has an exemption for this action in 3 of 30 years.

**Table 1. Summary of amount or extent of anticipated take of bull trout associated with Reclamation's Anderson Ranch Dam and Reservoir facility operations during the 2013 reporting period.**

| Facility | Anticipated Take | Operational Indicators | Critical Season | Frequency of Exemptions | 2013 Operations (October 2012 to September 2013) | Quick Reference: Number of times threshold was exceeded |
|---|---|---|---|---|---|---|
| Anderson Ranch Dam and Reservoir | Up to 50 percent of the Middle and North Fork populations 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 South Fork 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<br><br>2006: 9 days<br>2007: 0<br>2008: 0<br>2009: 0<br>2010: 0<br>2011: 0<br>2012: 0<br>2013: 0 |

| Facility | Anticipated Take | Operational Indicators | Critical Season | Frequency of Exemptions | 2013 Operations (October 2012 to September 2013) | Quick Reference: Number of times threshold was exceeded |
|---|---|---|---|---|---|---|
| Anderson Ranch Dam and Reservoir | Up to 50 percent of the Middle and North Fork populations 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 WY 2013 are shown in Figure 2 | 8 of 30 years<br><br>2006: spring/fall<br>2007: spring/fall<br>2008: spring/fall<br>2009: spring/fall<br>2010: spring/fall<br>2011: spring/fall<br>2012: spring/fall<br>2013: spring/fall |
| | Up to 4 percent of bull trout in the reservoir experience degraded water quality | Reservoir storage volume falls below 62,000 acre-feet (Figure 3) | Summer | 2 of 30 years | Reservoir storage volume was maintained above 62,000 acre-feet (Figure 3) | 0 of 2 years<br><br>2007: 0<br>2008: 0<br>2009: 0<br>2010: 0<br>2011: 0<br>2012: 0<br>2013: 0 |

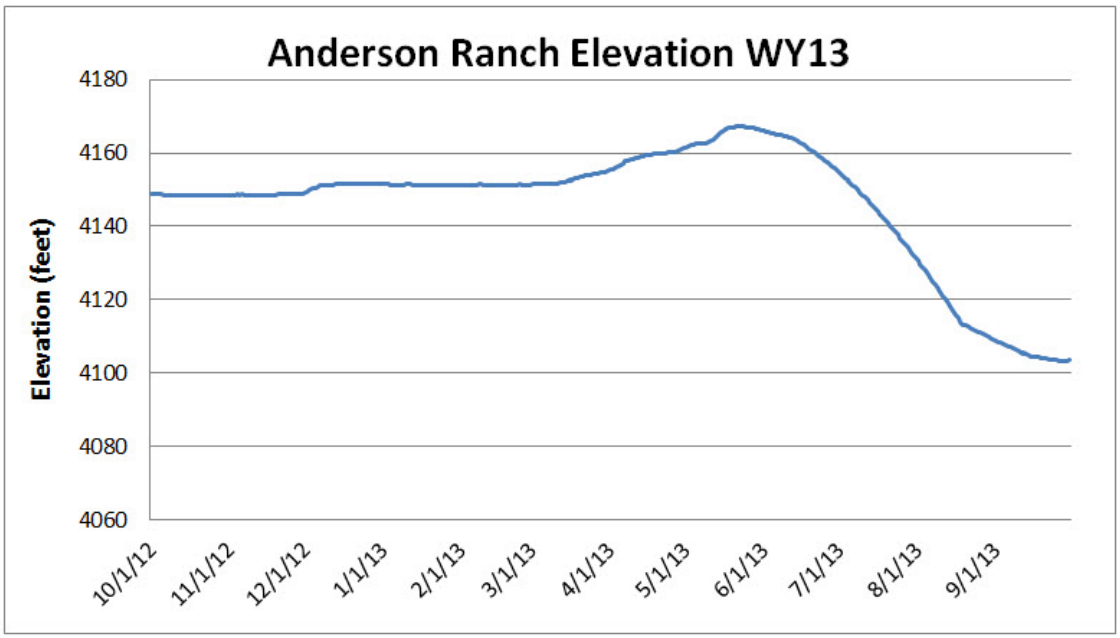


**Figure 2. Anderson Ranch Reservoir elevations (feet above sea level) for Water Year 2013 (WY13).**

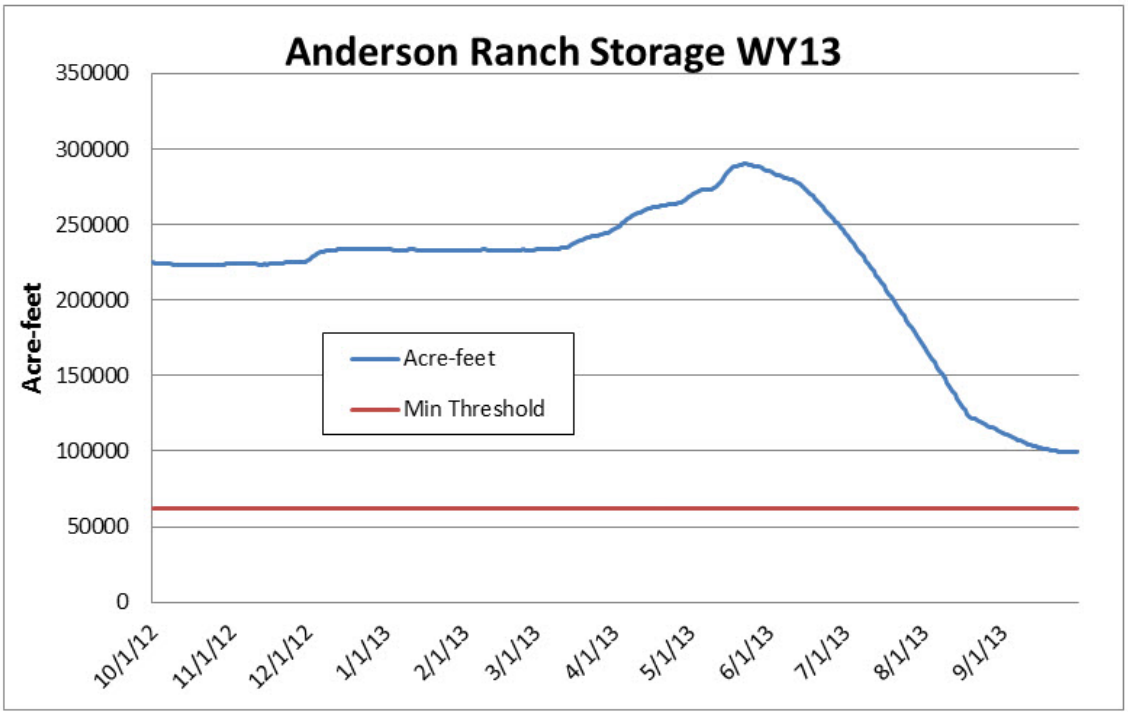


**Figure 3. Anderson Ranch Reservoir storage volumes (acre-feet) for Water Year 2013 (WY13). The straight line represents Reclamation's Operational Indicator minimum threshold of 62,000 acre-feet of storage.**

**Table 2. Summary of amount or extent of anticipated take of bull trout associated with Reclamation's Arrowrock Dam and Reservoir facility operations during the 2013 reporting period.**

| Facility | Anticipated Take | Operational Indicators | Critical Season | Frequency of Exemptions | 2013 Operations (October 2012 to September 2013) | Quick Reference: Number of 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 at the end of June | June 30 | 3 of 30 years | Reservoir volume fell below 200,000 acre-feet at the end of June 2013 | 2 of 3 years<br>2006: 0<br>2007: yes<br>2008: 0<br>2009: 0<br>2010: 0<br>2011: 0<br>2012: 0<br>2013: 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<br>2006: 9 days<br>2007: 0<br>2008: 0<br>2009: 0<br>2010: 0<br>2011: 0<br>2012: 0<br>2013: 0 |

| Facility | Anticipated Take | Operational Indicators | Critical Season | Frequency of Exemptions | 2013 Operations (October 2012 to September 2013) | Quick Reference: Number of times threshold was exceeded |
|---|---|---|---|---|---|---|
| Arrowrock Dam and Reservoir | 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 3111 feet | July through September | 30 of 30 years | Reservoir Surface elevation did not drop below 3111 feet. | 5 of 30 years<br>2006: 6 days<br>2007: 48 days<br>2008: 1 day<br>2009: 3 days<br>2010: 0 days<br>2011: 0 days<br>2012: 4 days<br>2013: 0 days |
| | 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 3100 feet | September 15 through October 31 | 18 of 30 years | Reservoir surface elevation did not drop below 3100 feet during the WY 2013 (Figure 4) | 0 of 18 years<br>2008: 0<br>2007: 0<br>2008: 0<br>2009: 0<br>2010: 0<br>2011: 0<br>2012: 0<br>2013: 0 |

| Facility | Anticipated Take | Operational Indicators | Critical Season | Frequency of Exemptions | 2013 Operations (October 2012 to September 2013) | Quick Reference: Number of times threshold was exceeded |
|---|---|---|---|---|---|---|
| Arrowrock Dam and Reservoir | 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 3111 feet (Figure 5) | Winter | 20 of 30 years | Reservoir elevations did not drop below 3111 feet in the winter months of 2013 (Figure 4) | 0 of 20 years<br>2006: 0<br>2007: 0<br>2008: 0<br>2009: 0<br>2010: 0<br>2011: 0<br>2012: 0<br>2013: 0 |

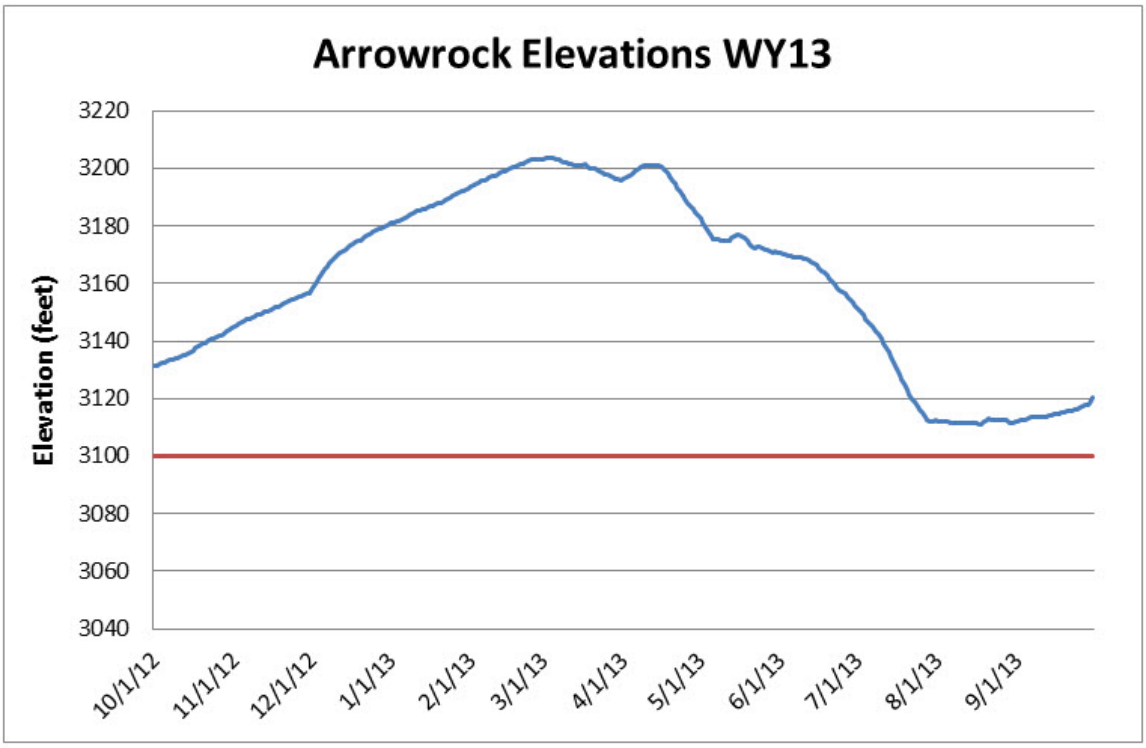


**Figure 4. Arrowrock Reservoir elevation (feet above sea level) for Water Year 2013 (WY13). The straight line represents Reclamation's Operational Indicator fall minimum threshold at elevation 3100 feet.**

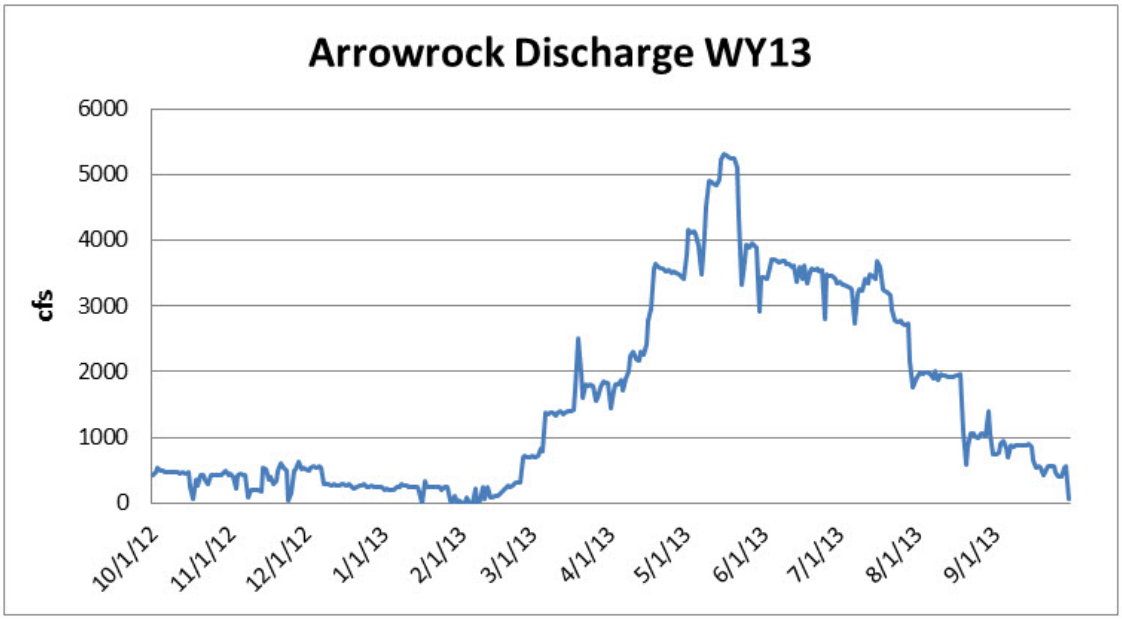


**Figure 5. Arrowrock Reservoir discharge in cubic feet per second (cfs) for Water Year 2013 (WY13).**

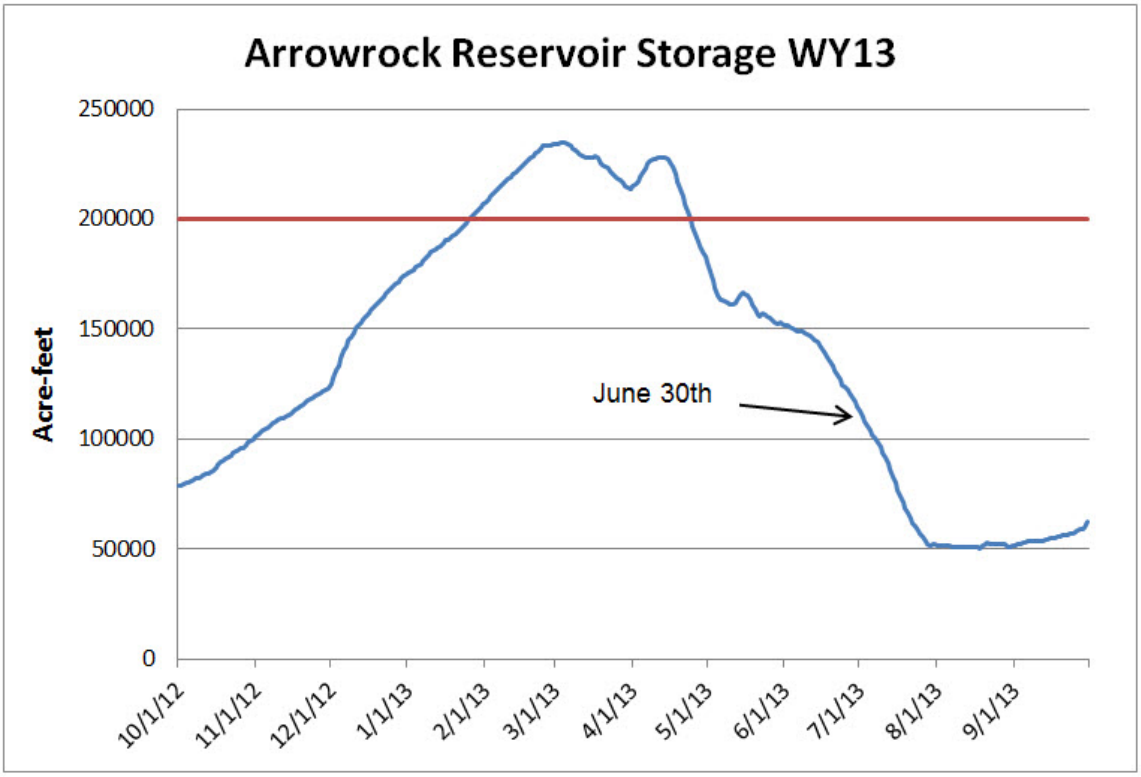


**Figure 6. Arrowrock Reservoir storage volume (acre-feet) for Water Year (WY) 2013. Straight line represents Reclamation's Operational Indicator of reservoir volume of less than 200,000 acre-feet at the end of June.**

### 2.1.2 Payette River Basin Operational Indicator

One operational indicator was exceeded during the 2013 reporting period in the Payette River basin with deep water releases occurring throughout the year at Deadwood Dam (Table 3). Reclamation has an exemption for this action 30 of the 30 years. Figure 7 illustrates Deadwood Reservoir storage volume in WY 2013.

**Table 3. Summary of amount or extent of anticipated take of bull trout associated with Reclamation's Deadwood Dam and Reservoir facility operations during the 2013 reporting period.**

| Facility | Anticipated Take | Operational Indicators | Critical Season | Frequency of Exemptions | 2012 Operations (October 2012 to September 2013) | Quick Reference: Number of times threshold was exceeded |
|---|---|---|---|---|---|---|
| Deadwood Dam and Reservoir | Up to 2 to 4 percent of bull trout in Deadwood Reservoir are entrained into the Deadwood River below the dam | Water is discharged over the spilway | Spring | 11 of 30 years | Water was not discharged over the spillway during WY 2013 | 4 of 11 years<br>2006: 32 days<br>2007: 33 days<br>2008: 33 day<br>2009: 0 days<br>2010: 15 days<br>2011: 0 days<br>2012: 0 days<br>2013: 0 days |
| | Up to 2 to 4 percent of bull trout in Deadwood Reservoir are affected by degraded water conditions | Reservoir storage volume falls below 50,000 acre-feet | August through October | 2 of 30 years | Reservoir storage volumes did not drop below 50,000 acre-feet (Figure 7) | 0 of 2 years<br>2006: 0<br>2007: 0<br>2008: 0<br>2009: 0<br>2010: 0<br>2011: 0<br>2012: 0<br>2013: 0 |

| Facility | Anticipated Take | Operational Indicators | Critical Season | Frequency of Exemptions | 2012 Operations (October 2012 to September 2013) | Quick Reference: Number of times threshold was exceeded |
|---|---|---|---|---|---|---|
| Deadwood Dam and Reservoir | 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 0 days during water year 2013 | 4 of 11 years<br>2006: 32 days<br>2007: 33 days<br>2008: 33 day<br>2009: 0 days<br>2010: 15 days<br>2011: 0 days<br>2012: 0 days<br>2013: 0 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 | 8 of 30 years<br>2006: all year<br>2007: all year<br>2008: all year<br>2009: all year<br>2010: all year<br>2011: all year<br>2012: all year<br>2013: all year |

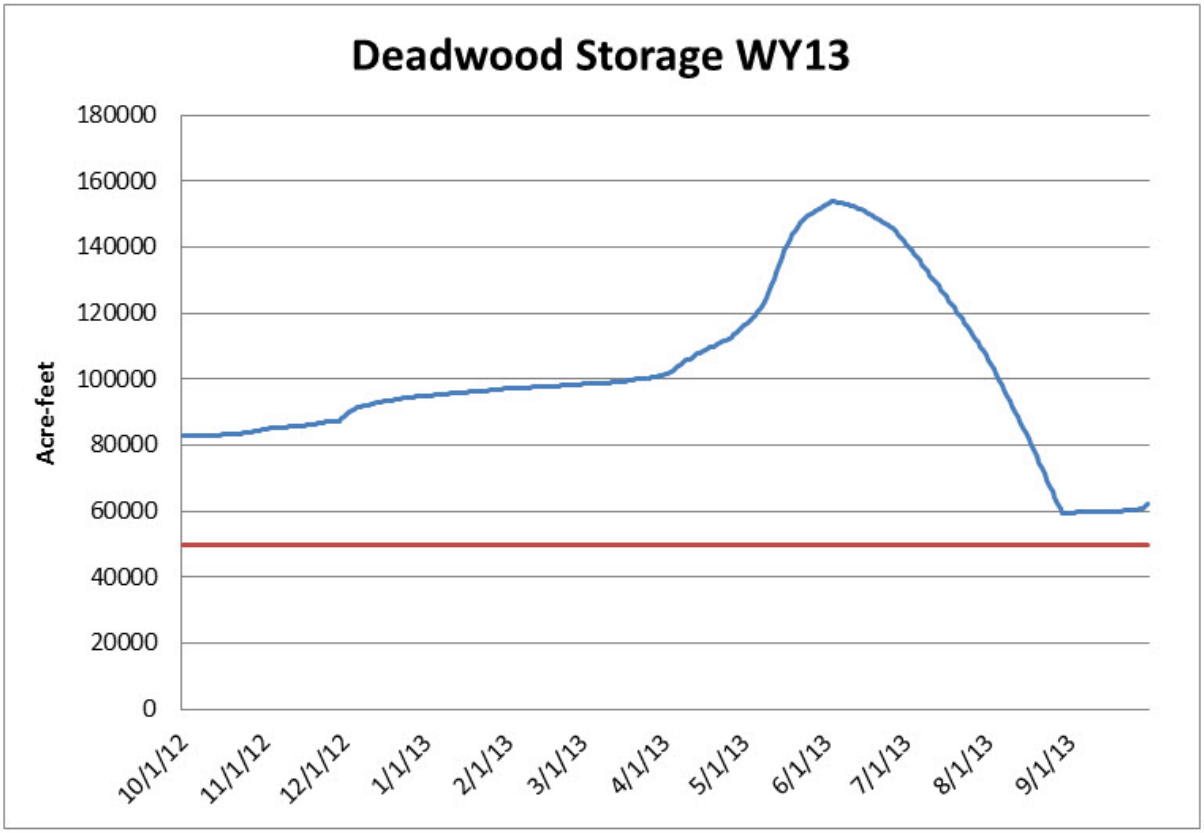


**Figure 7. Deadwood Reservoir storage volumes (acre-feet) for Water Year 2013 (WY13). The straight line represents Reclamation's Operational Indicator minimum threshold of 50,000 acre-feet of storage.**

## 2.2 Oregon

Carryover storage in Beulah Reservoir for WY 2013 was very low, at 2,269 acre-feet on October 9, 2012. In the Malheur River basin, WY 2013 was a below-average year and unregulated runoff during April through July was 47 percent of the 1971-2000 average for Beulah Reservoir. This low runoff filled Beulah Reservoir to only 38,014 acre-feet, or about 64 percent of its capacity (59,212 acre-feet) in 2013. The reservoir was drafted to 2.4 percent of reservoir capacity (1,412 acre-feet) on September 4, 2013. Reservoir content dropped below the 2,000 acre-foot threshold on August 12, 2013. In an effort to preserve remaining storage, Vale Irrigation District ceased delivery to its patrons on August 11, 2013, which dropped reservoir discharge from 260 cfs to 45 cfs. Deliveries past the dam after August 11, 2013 were natural flows delivered to senior water right holders through the remainder of the irrigation season. This was accomplished by matching outflows with measured reservoir inflows.

Flow information for WY 2013 (October 1, 2012 to September 30, 2013) can be found at Reclamation's Hydromet website (Reclamation 2014).[1] Reservoir water operations, including daily average reservoir elevations, contents in acre-feet, storage, and outflow, for Reclamation facilities are discussed in detail later in this report.

### 2.2.1 Malheur River Basin Operational Indicators

Beulah Reservoir fell below 2,000 acre-feet for 45 days during WY 2013 (Table 4). Figure 8 illustrates the water storage volume in Beulah Reservoir during WY 2013.

[1] See Reclamation's Hydromet website at http://www.usbr.gov/pn/hydromet/select.html.

**Table 4. Summary of amount or extent of anticipated take of bull trout associated with Reclamation's Beulah Dam and Reservoir facility operations during the 2013 reporting period.**

| Facility | Anticipated Take | Operational Indicators | Critical Season | Frequency of Exemptions | 2013 Operations (October 2012 to September 2013) | Quick Reference: Number of times threshold was exceeded |
|---|---|---|---|---|---|---|
| Beulah Dam | Up to 10 percent of bull trout in Beulah Reservoir are entrained into the North Fork Mahleur River below the dam | Water is discharged over the spillway | May through June | 3 of 30 years | Spillway was not used in WY 2013 | 2 of 3 years<br>2006: yes<br>2007: 0<br>2008: 0<br>2009: 0<br>2010: 0<br>2011: yes<br>2012: 0<br>2013: 0 |
| | All bull trout returning to Beulah Reservoir to over-winter are affected by a reduced prey base | Reservoir storage falls below 2,000 acre-feet | August through October | 10 of 30 years | Reservoir storage volume fell below 2,000 acre-feet for 45 days in this reporting period (Figure 8) | 5 of 10 years<br>2006: 0 days<br>2007: 60 days<br>2008: 34 day<br>2009: 53 days<br>2010: 28 days<br>2011: 0 days<br>2012: 0 days<br>2013: 45 days |

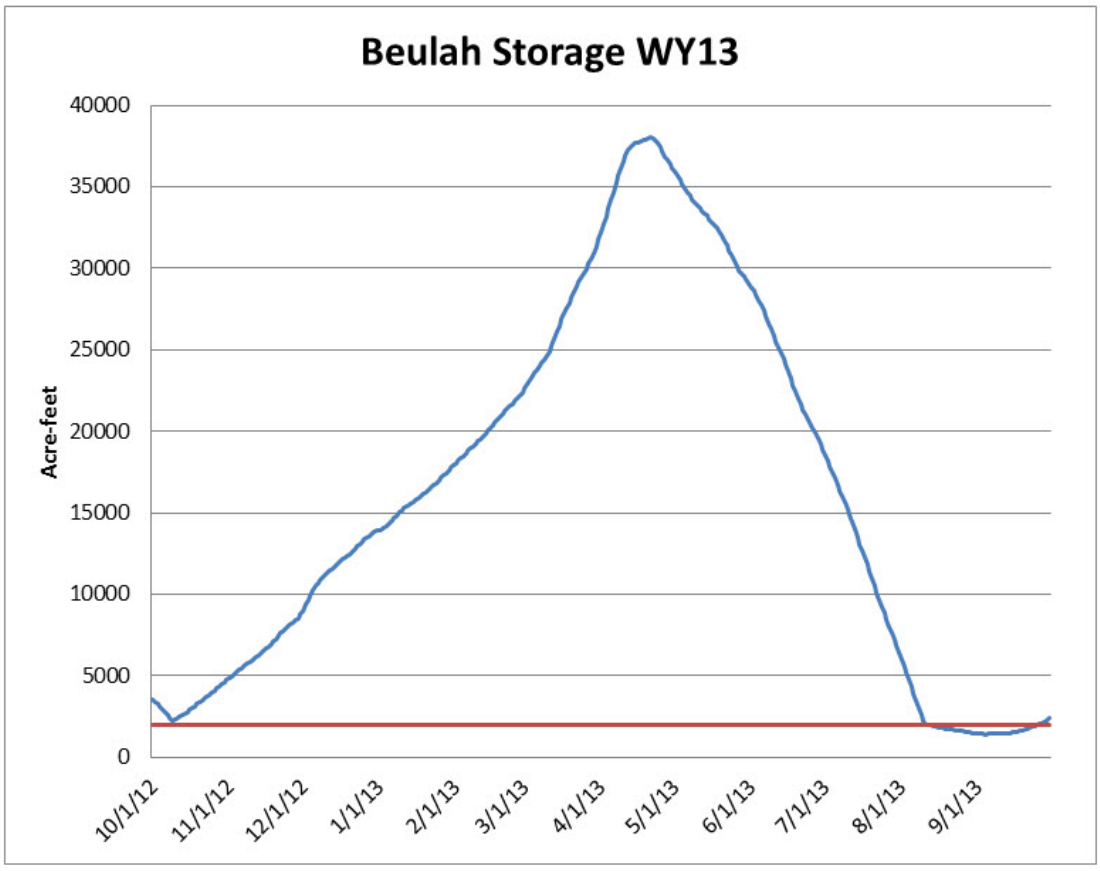


**Figure 8. Beulah Reservoir storage volumes (acre-feet) for Water Year 2013 (WY13). The straight line represents Reclamation's Operational Indicator minimum threshold of 2,000 acre-feet of storage.**

# 3.0 BULL TROUT

This chapter describes the bull trout ITS and RPMs, including monitoring efforts during WY 2013. The ITS includes four RPMs and their associated terms and conditions to minimize incidental take of bull trout related to operations at Reclamation's facilities in the identified action areas where bull trout are present. Data collected to address these efforts may be used to satisfy the terms and conditions and/or monitoring requirements. For example, data collected during a fish sampling activity may be used to help monitor population trends. In 2013, Reclamation was involved with RPM activities and/or monitoring at Deadwood, Arrowrock, Anderson Ranch, and Beulah reservoirs.

## 3.1 Boise River Basin

The 2005 Opinion identified five terms and conditions for minimizing the effect and/or amount of take associated with the operation of Arrowrock Dam and two terms and conditions for Anderson Ranch Dam. Each of the terms and conditions addresses a different aspect of the effects of operations on bull trout or bull trout critical habitat. Most data collection efforts described in the following sections will be used to assess terms and conditions for both Arrowrock and Anderson reservoirs because the influences of both facilities overlap.

Data collection efforts discussed for the Boise River basin during this reporting period include fish sampling; tracking radio-tagged bull trout; hydrologic and water chemistry sampling; a review of 2013 Arrowrock Hydroelectric Project operations; and fisheries management activities performed by the Idaho Department of Fish and Game (IDFG). For the purpose of this report, the Boise River basin study area includes the Arrowrock Reservoir; the South Fork Boise River below Anderson Ranch Dam; the Middle and North Fork Boise rivers; and Grouse and Cottonwood creeks (Figure 9). Sampling locations in the Middle Fork and North Fork Boise Rivers are depicted in Figure 9, sampling locations in Arrowrock Reservoir are depicted in Figure 10 and sampling locations in the South Fork Boise River are depicted in Figure 11.

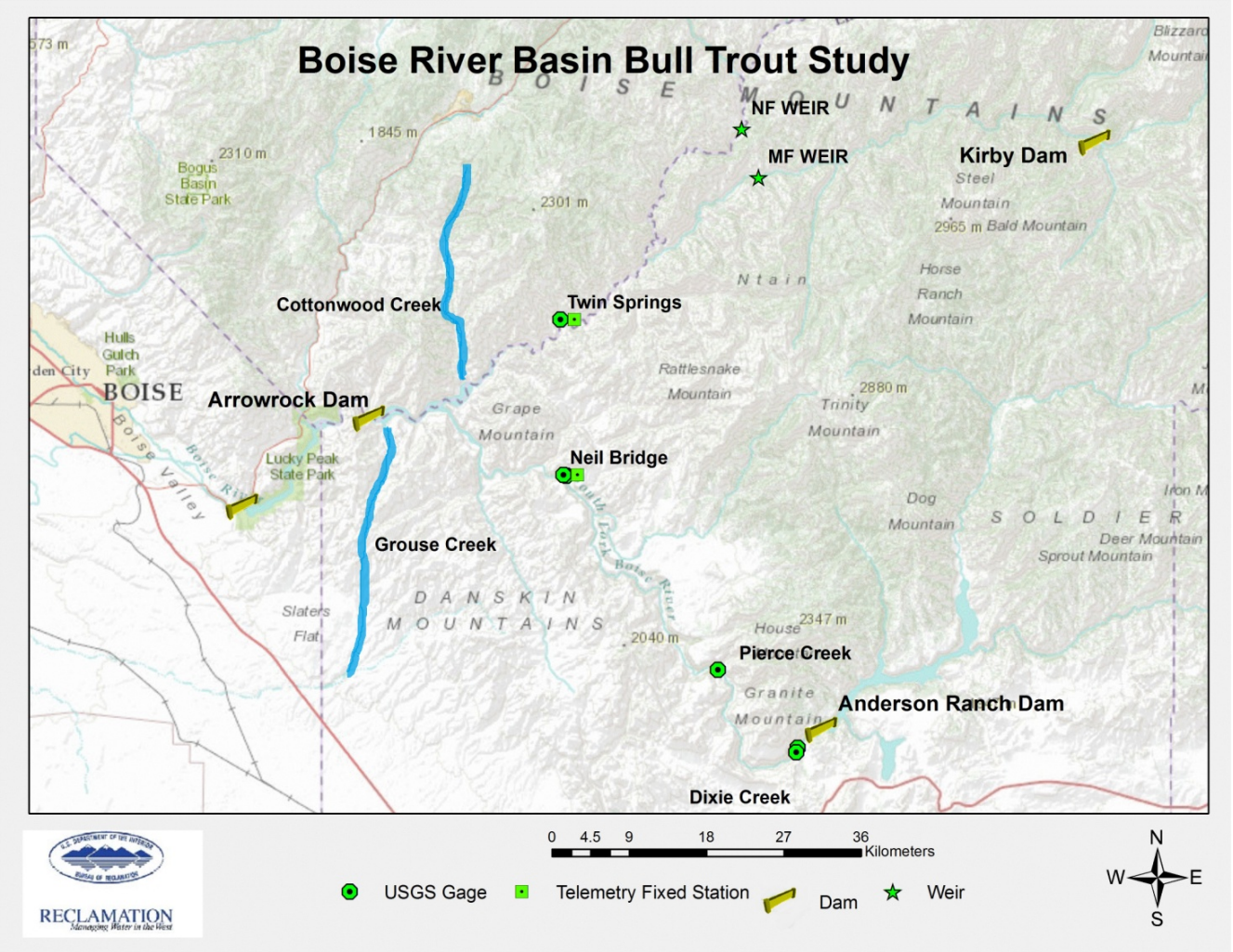


**Figure 9. Sampling locations in the Middle Fork and North Fork Boise rivers using telemetry receivers housed in U.S. Geological Survey (USGS) gages, telemetry fixed stations, and weirs.**

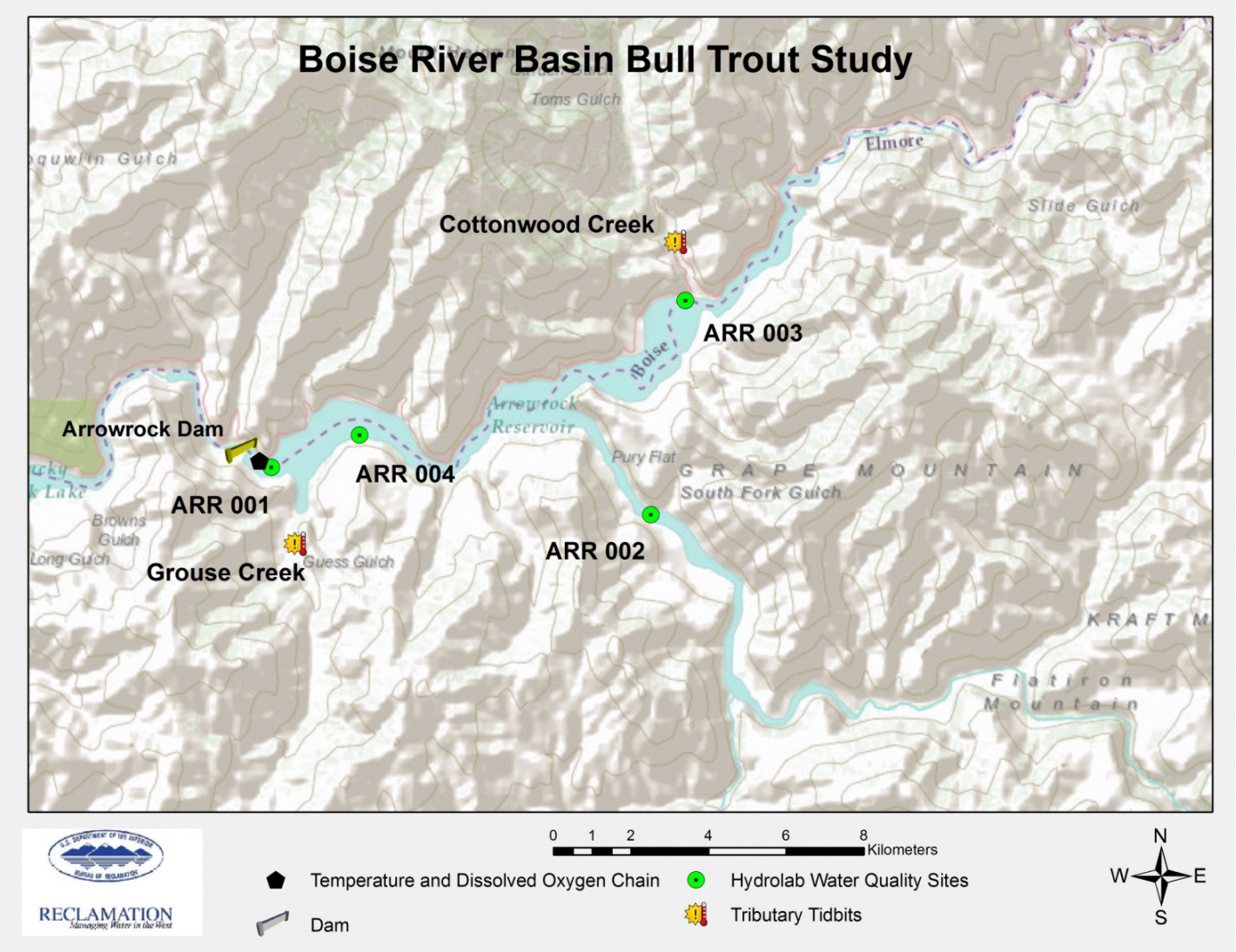


**Figure 10. Limnologic and hydrologic sampling locations in Arrowrock Reservoir (ARR), Idaho 2013. Locations for Onset® TidbiT temperature loggers, a temperature and dissolved oxygen chain, and water profile stations are shown.**

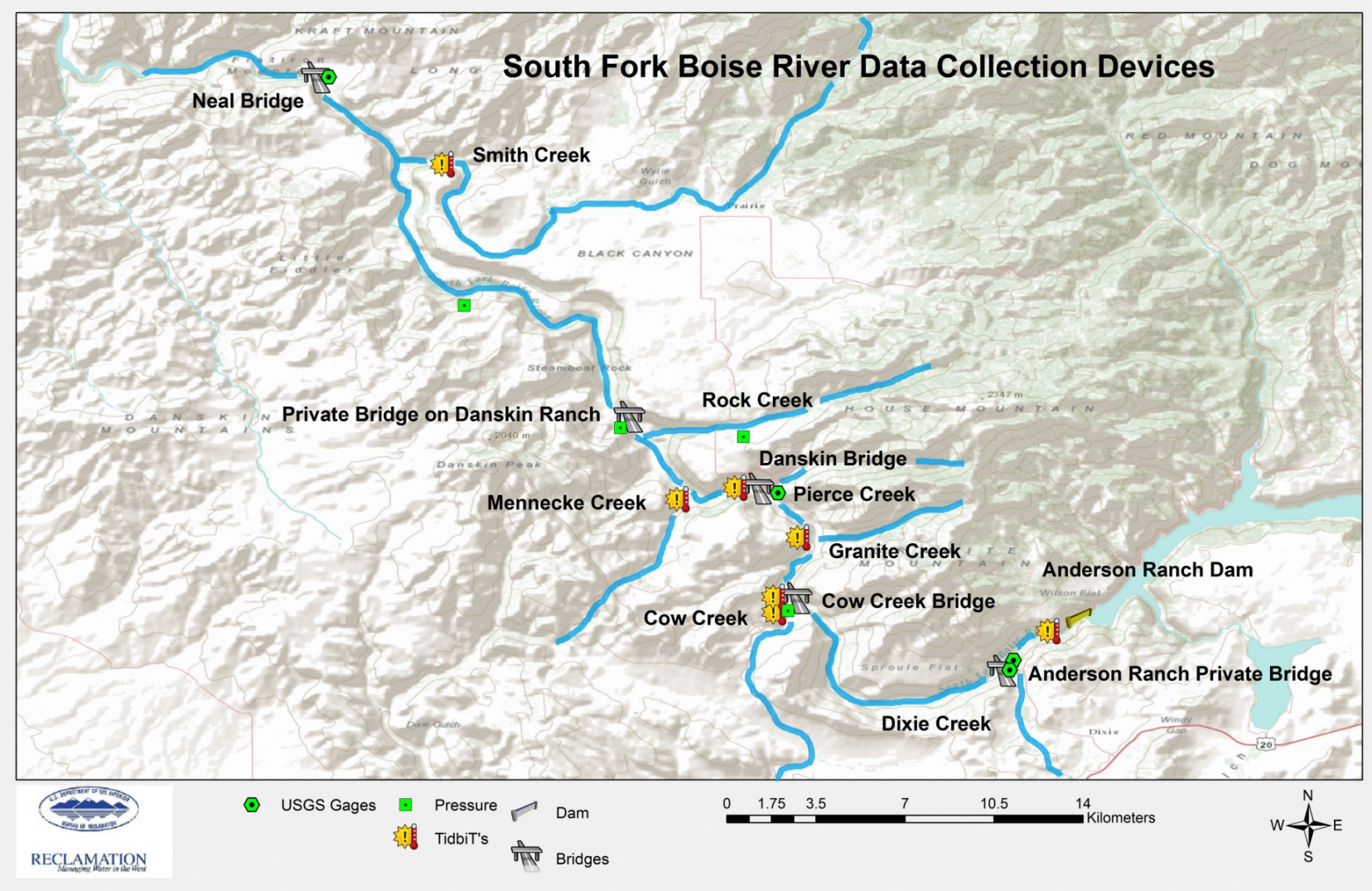


**Figure 11. South Fork Boise River basin study area, 2013. Locations of Onset® TidbiTs temperature loggers, pressure transducers and U.S. Geological Survey water gages (USGS gages), one of which also house a telemetry receiver (Neal Bridge) are shown.**

### 3.1.1 South Fork Boise River Data Collection and Arrowrock Reservoir Data Collection

The Middle Fork and North Fork Boise River data collection included both hydrology and fisheries efforts necessary to address Terms and Condition 1.c which directs Reclamation to minimize conditions that increase the risk of bull trout entrainment past Arrowrock Dam. Bull trout migration, reservoir water quality, and pool elevation were evaluated to assess how operations at Arrowrock Dam can minimize harassment and take of bull trout. Bull trout from the Arrowrock Reservoir migratory population were radio tagged and tracked in the Middle Fork and North Fork Boise rivers in 2013 (see Section 3.1.2).

The South Fork Boise River data collection included both hydrology and fisheries efforts necessary to address Term and Conditions 2.a and 2.b, which direct Reclamation to determine ramping rates that reduce harassment to bull trout and to examine system flexibility to minimize impacts associated with disruption of migratory cues, respectively. Bull trout migration behavior and river hydrology conditions will be coupled to assess how operations at Anderson Ranch Dam influence bull trout in the South Fork Boise River below the dam. Bull trout from the Arrowrock Reservoir migratory population were radio tagged and tracked in the South Fork Boise River (see Section 3.1.2).

Streamflow and water temperatures were monitored on the South Fork Boise River and selected tributaries (Figure 11). In 2013, Reclamation continued funding the U.S. Geological Survey (USGS) to maintain flow/temperature gages at Neal Bridge (USGS gage No. 13192200) on the South Fork Boise River and two tributaries to the South Fork Boise River (Pierce Creek [USGS gage No.13190565] and Dixie Creek [USGS gage No. 13190505]) for the purpose of monitoring flow below Anderson Ranch Dam. The flow/temperature gages at the Pierce and Dixie creek sites were destroyed in the Elk Complex wildfires. The Dixie Creek gage was destroyed by the wildfire on August 14, 2013 and replaced on September 10, 2013. The Pierce Creek gage was destroyed on August 14, 2013 and has not been replaced due to the amount of destruction in that area. Pre-fire data from these gages will be used in conjunction with the bull trout migration work and water quality monitoring for Arrowrock Reservoir. USGS has not yet determined if Pierce and Dixie creek gages will be maintained into the 2014 field season due to the significant changes in river morphology and the continued instability in the basin. In addition to the stream gages that were destroyed, a pressure transducer in Rock Creek and temperature logger in Granite Creek, both tributaries to the South Fork Boise River, were buried under a large sediment load and could not be recovered.

Data collection in Arrowrock Reservoir focuses on water quality, prey base, and fish migration data necessary to address Terms and Conditions 1.a through 1.e., which directs

Reclamation to minimize impacts to bull trout resulting from habitat loss, reduction in reservoir productivity, impacts to food base, and entrainment. Water quality parameters and prey base conditions will be used in conjunction with bull trout migration behavior to assess how operations at Arrowrock Dam influence bull trout in Arrowrock Reservoir.

Fish tracking and migratory data collection efforts overlap all three forks of the Boise River and Arrowrock Reservoir, as it is an open system allowing fish to move freely between the water bodies.

### 3.1.2 Fish Sampling

Fish sampling was performed to address Terms and Conditions 1.c, 2.a, and 2.b and included these objectives: 1) deploy all available radio transmitters and archival temperature and pressure tags; 2) recover previously archival tagged fish to retrieve stored data; and 3) tag bull trout that could be used in calculating a population estimate. Monitoring requirements were also met by conducting this work (Reclamation 2006). A total of four sampling events occurred during this reporting period: 1) South Fork Boise River spring hook-and-line sampling conducted by Reclamation and IDFG; 2) North Fork and Middle Fork Boise rivers fish migration weirs in the fall by Reclamation; 3) Kirby Dam electrofishing and fish ladder monitoring in the summer by Reclamation and IDFG; and 4) South Fork Boise River rainbow young-of-year sampling in the fall by IDFG. Sampling events performed by Reclamation are described in the following text and in Sections 3.1.2.1, 3.1.2.2, and 3.1.2.3. The sampling effort conducted by IDFG is described in Section 3.1.5.4.

A total of 255 fish representing 8 species, including 112 bull trout, were sampled in the Boise River study basin between March and November 2013 (Table 5). One bull trout was sampled at Kirby Dam and is included in the total, as described in Section 3.1.5.5. As shown in Table 5, bull trout and mountain whitefish (*Prosopium williamsoni*) made up over 92 percent of the total catch in 2013.

**Table 5. Total catch summary for Boise River basin in 2013, including numbers of each species captured (total catch) and percent of total catch.**

| Species | Total Catch | Percent |
|---|---|---|
| Bull trout (*Salvelinus confluentus*) | 112 | 43.9 |
| Brook Trout (*Salvelinus fontinalis)* | 3 | 1.20 |
| Rainbow trout (*Oncorhynchus mykiss*) | 10 | 3.90 |
| Mountain whitefish (*Prosopium williamsoni*) | 125 | 49.0 |
| Rainbow trout/Cutthroat Hybrid | 1 | 0.40 |
| Bridgelip Sucker (*Castostomus columbianus*) | 1 | 0.40 |
| Kokanee salmon (*Oncorhynchus nerka kennerlyi*) | 2 | 0.80 |
| Sculpin (*Cottid)* | 1 | 0.40 |
| **Total** | **255** | **100** |

All captured fish were identified to species, enumerated, and measured for total length (millimeter [mm]). All bull trout were scanned for a Passive Integrated Transponder (PIT) tag for individual identification. Individuals not containing a PIT tag were fitted with a PIT tag from Biomark Incorporated, Boise, Idaho. The 12-mm PIT tags were inserted into the dorsal sinus of all bull trout greater than 125 mm in total length. Newly captured bull trout that met the four percent weight requirements were implanted with radio telemetry transmitters (radio tags Lotek models MCFT2-3BM, MCFT2-3EM, MCFT2-3FM, SR-TP11-25, SR-TP11-35, and NTC-M-1[nano tag]) and archival temperature recording tags (archival tags Lotek Internal model 1410 or Lotek External model 1100). Radio transmitters were implanted with the modified shielded needle technique described by Ross and Kleiner (1982). The external archival tags were attached with the method described by Howell et al. (2010). Fish were anesthetized by electronarcosis consistent with Hudson et al. (2011).

All information and biological samples collected were non-lethal to the fish and were collected while the fish were anesthetized. Biological samples collected from bull trout included fin clips (n= 99) and scales (n= 111). Fin clips were sent to the USFWS Genetics Lab in Abernathy, Washington for storage and potential future genetic analysis. Genetic analysis may be used for population assignment within the Boise River basin.

Bull trout scales are being analyzed by Reclamation staff to determine general age and growth patterns in the population. 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.

#### 3.1.2.1 Hook-and-line Sampling South Fork Boise River

A total of 5 bull trout ranging from 381 mm to 652 mm in total length were captured during 3 days of hook-and-line sampling between March 8 and March 29 in the South Fork Boise River below Anderson Ranch Dam. All newly captured bull trout received PIT tags (n=4) for unique identification and radio transmitters (n=5) for tracking. Two bull trout captured during this sampling effort were recaptures, with one originally tagged at the North Fork Weir in 2011 and the other originally tagged at the Middle Fork Weir in 2011. The radio transmitters in these bull trout were close to expiration and were surgically removed and replaced with new radio transmitters. No other species were documented during hook-and-line sampling. A total of one bull trout expired in the South Fork Boise River sampling in 2013 which accounted for 10 percent of the expired bull trout in the Boise basin for 2013. This fish was captured in poor condition and found expired at a later date. Otoliths were extracted from the mortality and will be analyzed at a later date.

#### 3.1.2.2 Picket Migration Weirs

Two picket migration weirs (North Fork and Middle Fork Boise rivers) were operated by Reclamation in 2013 (Figure 9). The North Fork Boise River weir was located near Barber Flat and operated between September 4 and October 22, with the exception of September 30. Operations were suspended as a result of a precipitation-induced, high-flow event. At the North Fork weir, 105 bull trout were captured, ranging from 135 mm to 692 mm in total length. Radio transmitters were surgically implanted into 25 of the bull trout with 5 of the trout being tagged with both a radio transmitter and an archival temperature and pressure tag. Of the 25 radio transmitters that were deployed, 8 were nano transmitter tags with a warranty life of 17 days. These nano transmitters were deployed in fish that measured less than 300 mm in total length. A total of 16 bull trout were recaptures, representing previous sampling efforts from 2011 to 2013. Of these 16 recaptured fish, 3 had archival temperature tags that were recovered. Data recorded from the recovered archival temperature tags will be presented when population estimate computations are completed.

The second weir was operated on the Middle Fork Boise River near Alexander Flats between August 9 and August 14 (Figure 9). The weir was washed out on August 14 and the decision was made to terminate the operation of this weir for the 2013 field season due to substantial sediment and debris loads associated with the 2013 Little Queens fire and the 2012 Trinity Ridge fire. One bull trout was captured by hook and line just above the weir measuring 290 mm in total length. The bull trout was surgically implanted with a nano radio transmitter and released below the weir. No other fish were captured.

In summary, a total of 236 fish, including 106 bull trout, were sampled at the Boise River weirs between September 4 and October 22, 2013 (Table 6). The most abundant fish sampled at the weirs were Mountain whitefish (53.0 percent of the total catch) and bull trout (44.90 percent).

**Table 6. Weir sampling summary for North Fork Boise and Middle Fork Boise rivers in 2013, including species, total count, and percent of total catch.**

| 2013 North Fork Boise and Middle Fork Boise Rivers Weir Sampling Summary | | | | |
|---|---|---|---|---|
| **Species** | **North Fork Weir** | **Middle Fork Weir** | **Total Count** | **Percent of Total** |
| Bull trout (*Salvelinus confluentus*) | 105 | 1 | 106 | 44.90 |
| Rainbow trout (*Oncorhynchus mykiss*) | 1 | 0 | 1 | 0.40 |
| Mountain whitefish (*Prosopium williamsoni*) | 125 | 0 | 125 | 53.0 |
| Bridgelip Sucker (*Castostomus columbianus*) | 1 | 0 | 1 | 0.40 |
| Kokanee salmon (*Oncorhynchus nerka kennerlyi*) | 2 | 0 | 2 | 0.80 |
| Sculpin (*Cottid)* | 1 | 0 | 1 | 0.40 |
| **Total** | **235** | **1** | **236** | **100.0** |

A total of 9 bull trout expired during the migration weir sampling in 2013 which accounted for 90 percent of the expired bull trout in the Boise River basin for 2013. Of the expired bull trout found, 10 percent (n=1) were washed up against the weir (cause of mortality unknown), 10 percent (n=1) were found on the river bank near the picket weir, and 60 percent (n=6) were captured in poor condition and found expired at a later date. The remaining mortality was confirmed through tracking (i.e., mortality signal); however, it was never recovered. One of the mortalities is attributed to handling and the respective surgical process. Otoliths were extracted from all mortalities and will be analyzed at a later date.

### 3.1.3 Radio Telemetry

The use of radio transmitters and archival temperature tag technology is used to address the terms and conditions outlined in the 2005 Opinion. Bull trout spatial and temporal use of Arrowrock Reservoir and the South Fork, North Fork, and Middle Fork Boise rivers can be documented with these technologies. Information collected on bull trout movement patterns coupled with continuous measurements of water temperature and discharge will be used to describe migratory cues for bull trout migration. Ultimately, this will provide information to implement ramping rates that minimize harassment and/or harm of bull trout in the South Fork Boise River below Anderson Ranch Reservoir.

As part of this ongoing investigation, 176 bull trout have been surgically implanted with radio transmitters or archival temperature and pressure tags since fall 2011. Of those 176 tagged fishes, 144 were tagged with radio transmitters and 96 of the 144 were also tagged with an internal or external archival temperature and pressure tag. Twenty-three bull trout were surgically implanted with archival temperature and pressure tags only. The radio transmitters have varying battery life, none of which exceed a warranty date of 675 days (80 percent of expected life). Only 34 radio tags (24 percent) are likely to be active in the basin by the end of this reporting period (December 31, 2013). Data from the radio transmitters and archival tags will be summarized upon completion of the telemetry project.

Movement of radio-tagged fish was monitored using fixed telemetry sites, mobile tracking, and boat tracking. Fixed telemetry sites were located with the USGS flow monitoring equipment at Neal Bridge (South Fork Boise River) and Twin Springs (Middle Fork Boise River) (Figure 9). Mobile tracking occurred one to two times per week during 2013. Mobile telemetry was limited in the North Fork, Middle Fork, and South Fork Boise rivers during the fire season due to road closures. Additionally, 24-hour tracking was conducted during all up-ramping events in the South Fork Boise River to monitor behavioral changes that could be associated with dam operations (Term and Conditions 2.a and 2.b). All telemetry efforts will continue biweekly on both the North Fork Boise and Middle Fork Boise rivers, and weekly on the South Fork Boise River through the 2014 field season.

### 3.1.4 Hydrology and Water Chemistry

Hydrology and water chemistry data were collected in Arrowrock Reservoir and select tributaries during this reporting period. These data are being used to assess Term and Condition 1.b and coupled with bull trout migration behavior to assess Term and Condition 2.b. Reservoir vertical profiles were collected biweekly from May through October and every 6 weeks from November to April. Seven water quality parameters were measured at four locations on the reservoir (Figure 10). Water quality parameters included water temperature, dissolved oxygen concentration, pH, conductivity, turbidity, florescence (chlorophyll), and barometric pressure. Hydrology and water quality samples will continue to be sampled through the 2014 field season.

Onset® TidbiTs temperature thermographs were deployed in Grouse Creek and Cottonwood Creek on May 12, 2011, and set to record water temperature hourly (Figure 10). Data are manually downloaded a minimum of two times a year. Water temperatures will continue to be collected in Grouse and Cottonwood creeks through the 2014 field season.

On April 4, 2013, a semi-permanent water quality monitoring station was installed at Arrowrock Reservoir. The station is located approximately 200 yards upstream of the dam in the deepest portion of the reservoir (approximately 264 feet deep at full pool; Figure 10).

Onset® TidbiTs temperature thermographs were attached to a rope at 1-meter intervals from 1- to 25-meter depths. Three Minidot temperature/dissolved oxygen sensors were attached at 4 meters, 8 meters, and 20 meters to measure dissolved oxygen above, within, and below the anticipated annual thermocline. Data were downloaded and the station was removed on November 15, 2013 for winter storage. The site will be redeployed in the spring of 2014 when conditions allow.

## 3.1.5 Trap-and-Haul Efforts

Bull trout work associated with the 2005 Opinion includes a trap-and-haul effort every 2 years to relocate bull trout from Lucky Peak Reservoir to Arrowrock Reservoir. A trap-and-haul effort was conducted during the spring of 2012; therefore, no trap-and-haul effort was required for the 2013 field season. A trap-and-haul effort is scheduled for the spring 2014 field season.

## 3.1.6 Other Activities

### 3.1.6.1 Arrowrock Dam Hydroelectric Project – Boise Project Board of Control

Arrowrock Dam Hydroelectric Project (Project), Federal Energy Regulatory Commission (FERC) licensee No.4656-020, started operations in 2010. Among the requirements of the FERC license, the licensee is obligated to:

1. Monitor water temperature and dissolved oxygen of the water that exits the project.

2. Conduct a fish salvage effort in the project tailrace if a shutdown occurs for more than 24 hours when the Lucky Peak Reservoir pool elevation is below 3022 feet.

3. Meet with the Arrowrock Hydro Team (IDFG, Reclamation, U.S. Army Corps of Engineers, and USFWS) annually to report operations of the project.

The annual coordination meeting between the licensee and the Hydro Team was not conducted prior to the completion of this report. Results of WY 2013 monitoring will be reported in the WY 2014 report.

### 3.1.6.2 Fish Management in Arrowrock Reservoir – IDFG

A total of 263,923 triploid rainbow trout ranging from fry to 6-plus inches were stocked into Arrowrock Reservoir between April and October 2013 (IDFG 2014).

#### 3.1.6.3 Stranding Pool Pilot Study in South Fork Boise River – Reclamation, IDFG, and Trout Unlimited

Reclamation, IDFG, and Trout Unlimited cooperatively designed and conducted a pilot study in 2012 to investigate the occurrence of stranding pools in the South Fork Boise River during the annual fall down-ramping events. This was scheduled to occur again in 2013, but was cancelled due to wildfires and landslide closures in the area. IDFG and Reclamation were able to access the river and conduct a limited survey at the same sites sampled the previous year, but the results are not comparable to the 2012 sampling data due to the significant effects caused by the fires and landslides. Reclamation, IDFG, and Trout Unlimited have planned to postpone the stranding pool study until conditions in the river stabilize. Results from this pilot effort are being used to design a more comprehensive study looking at the effect and occurrence of stranding pools in the South Fork Boise River.

#### 3.1.6.4 Fall Rainbow Trout Young of Year Survey in South Fork Boise River below Anderson Ranch Dam – IDFG

IDFG conducted a post-fire/landslide survey of age-0 salmonids (fry) in the South Fork Boise River below Anderson Ranch Dam. This was done during the spring in previous years to estimate winter survival of fry in the river; however, in 2013, the survey was conducted in the fall to assess the density of fry present following the fire and landslide events.

IDFG found post-fire/landslide fry density was approximately 0.6 fry per meter at 6 trend sites, down from 2.3 fry per meter average for previous years sampled (IDFG 2014). IDFG estimated winter survival of fry at the 6 trend sites to be approximately 15 percent (IDFG 2014). Density estimates in the spring 2014 will be critical to understand the total effect the fire and landslides may have had on the year class of salmonids in the South Fork Boise River. These results will be reported in the 2014 annual report.

#### 3.1.6.5 Bull Trout Capture at Kirby Dam in the Middle Fork Boise River – Reclamation and IDFG

In previous years, bull trout and other salmonids have been observed occupying the pool near the base of the Kirby Dam fish ladder. In 2012, one bull trout was captured in the pool and fitted with an internal transmitter for tracking purposes. In 2013, Reclamation observed similar activity in the pool near the base of Kirby Dam and conducted an electrofishing survey (Smith-Root backpack electrofisher) on August 9, 2013. A total of 14 fish representing 4 species, including 1 bull trout, was sampled from the pool (Table 7). The bull trout was too small for a transmitter; however, all other biological data were collected and a PIT tag implanted. Additional sampling efforts at Kirby Dam were cancelled due to the Little Queens Fire that started August 17, 2013. In addition, sampling at Kirby Dam is not part of bull trout trend sampling; therefore, further statistical analysis was not completed for this data set.

In addition to electrofishing, Reclamation assisted IDFG in monitoring the fish ladder gage at Kirby Dam.

**Table 7. Electrofishing sampling summary for Kirby Dam in 2013, including species, total count, and percent of total catch.**

| Species | Total Count | Percent of Total |
|---|---|---|
| Bull trout (*Salvelinus confluentus*) | 1 | 7.14 |
| Rainbow trout (*Oncorhynchus mykiss*) | 9 | 64.29 |
| Brook trout (*Salvelinus fontinalis)* | 3 | 21.43 |
| Hybrid Cutthroat/Rainbow trout | 1 | 7.14 |
| **Total** | **14** | **100** |

#### 3.1.6.6 Bull Trout Boise River Basin PIT Tag Database- Reclamation, U.S. Forest Service, and IDFG

A Boise River basin pit tag database was created in 2013 as a collaborative effort between Reclamation, USFS, and IDFG. All fish collected during routine field sampling efforts within the Boise River basin and implanted with pit tags will be included in the database. The creation of the pit tag database was discussed at the annual Boise River Coordination Meeting as a way to track the movement of bull trout within the Boise River basin by any agency. The database initially included 194 bull trout and will be updated as data become available.

## 3.2 Payette River Basin – Deadwood River System

The 2005 Opinion identified five terms and conditions for minimizing the effects to bull trout and/or amount of take associated with the operation of Deadwood Dam. Each term and condition addressed a different aspect of the effects of operations on bull trout and made assumptions regarding the reservoir operation effects on bull trout. Addressing each aspect individually limited Reclamation's understanding of how much flexibility it has in the operation of the system as a whole and the systemic impacts of individual changes in operations; therefore, before an evaluation of the operational flexibility could be done, those impacts needed to be understood and quantified. By addressing the terms and conditions jointly and examining the system in its entirety, Reclamation can evaluate operational flexibility to minimize biological impacts.

WY 2011 was the final year of an intensive 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. Reclamation requested permission to conduct interim operational changes at Deadwood Dam in a continuing effort to comply with terms and conditions outlined in the 2005 Opinion. These changes were proposed as a result of the preliminary flexibility study findings for Deadwood Reservoir, and current drought conditions and the associated volume of Deadwood Reservoir. The interim operational changes are in place till the end of 2014 irrigation releases to validate assumptions, models, and study results.

The primary focus of the 2013 data collection process was interim operations monitoring to document the habitat conditions below Deadwood Dam when winter flows were maintained at 2.4 cfs. A trap-and-haul effort was also completed to move bull trout captured in the stilling basin below Deadwood Dam upstream above the dam. Ongoing work to download and replace water temperature recording Onset® TidbiTs continued in 2013. Remaining radio tags from the 2012 bull trout radio tagging effort were implanted in fish captured near the mouth of Trail Creek in 2013. This was done as part of an additional study to examine travel time through the varial zone of tributaries into the reservoir. Results of this work will be described under a separate cover.

A final comparison between all previous years' data will be summarized in the final *Deadwood Flexibility Study Report*. A detailed description of the methods can be found in the Flexibility Study Proposal (Reclamation 2008) and detailed fish sampling results can be found in Reclamation's 2013 fish sampling report to IDFG (Reclamation 2013c). The Deadwood Flexibility Study involved data collection methods for fish population dynamics, productivity, hydrology, and water chemistry monitoring (Reclamation 2008). These data are being used in physical and hydrodynamic modeling. Instruments in Deadwood Reservoir and the Deadwood River above and below the dam are recording temperature as well as inflow and outflow quantities (Figure 12). The information collected from the reservoir is key to understanding how releases from the dam affect the habitat conditions below the dam under varying operational conditions.

Evaluating the flexibility of the operations and the effects of Deadwood Dam on aquatic fauna requires an understanding of the potential overall ecosystem response to an operational change over time. Using modeling of physical and biological parameters measured over the course of this project has allowed for an ecosystem analysis of the terms and conditions for Deadwood Reservoir operations and its influence on bull trout populations. These efforts involve collaboration between multiple agencies and include annual activities not detailed in this report. The results of the Deadwood Flexibility Study will be provided at the completion of the project and reported under a separate cover titled *Deadwood Flexibility Study Report*.

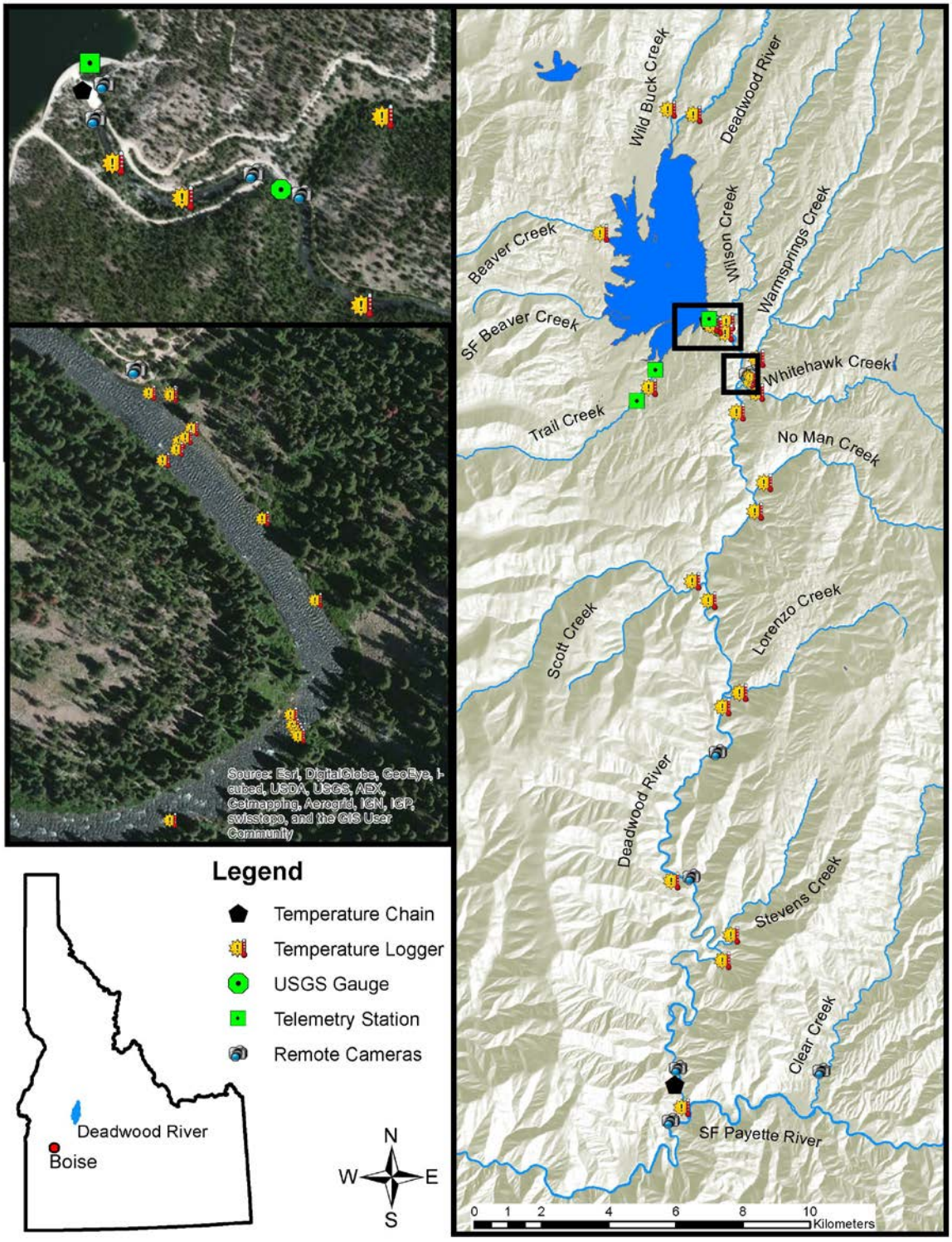


**Figure 12. Limnologic and hydrologic sampling locations in the Deadwood study area, Idaho 2013. Equipment used to record data varied between locations and included Onset® TidbiTs (individual loggers and strings set up to collect data at different depths within pools), Bushnell® game cameras, and a U.S. Geological Survey water gage (USGS gage).**

### 3.2.1 Data Collection in the Reservoir and Tributaries above the Dam

In the Deadwood River system above Deadwood Dam, fyke netting was used in 2013 to sample fish in Deadwood Reservoir near the mouth of Trail Creek. All fishes, including bull trout, were released at the point of capture. Bull trout captured that were of proper size (large enough that the tag weight did not exceed 4 percent of the fish's body weight) were surgically fitted with radio transmitters before being released. Physical, hydrologic, and water quality data were collected in the river, reservoir, and selected tributaries as outlined in the Deadwood Flexibility Study Proposal (Reclamation 2008).

#### 3.2.1.1 Fish Sampling

In 2013, fyke nets were operated in Deadwood Reservoir from June 3 to June 6, as well as the night of July 9, for a total of 138.9 hours (Table 8; Reclamation 2013b). A total of 333 fish representing 9 species, including 26 bull trout (21 unique fish), were captured. Species composition was similar to previous accounts for littoral fish assemblages in the reservoir. Mountain whitefish were the most abundant fish sampled (69.1 percent of the total catch) while bull trout were the third most abundant fish captured representing 7.8 percent of the total catch. The total catch per unit effort (CPUE) was 2.40 fish per hour in 2013.

**Table 8. Total catch summary for 2013 including numbers of each species captured (total catch), catch per unit effort (CPUE), and percent of total catch. Sampling occurred in Deadwood Reservoir, Idaho.**

| Species | Soak Time Hours = 138.9 | | |
|---|---|---|---|
| | Total Catch | CPUE (fish/hour) | Percent of total |
| Bull Trout (*Salvelinus confluentus*) | 26 | 0.19 | 7.8 |
| Cutthroat Trout (*Oncorhynchus clarki lewisi*) | 23 | 0.17 | 6.9 |
| Cutthroat/Rainbow hybrid | 1 | 0.01 | 0.3 |
| Rainbow Trout (*Oncorhynchus mykiss*) | 15 | 0.11 | 4.5 |
| Redside Shiner (*Richardsonius balteatus)* | 2 | 0.01 | 0.6 |
| Sculpin (*Cottus spps.)* | 1 | 0.01 | 0.3 |
| Longnose Dace (*Rhinichthys cataractae)* | 1 | 0.01 | 0.3 |
| Mountain Whitefish (*Prosopium williamsoni*) | 230 | 1.66 | 69.1 |
| Speckled Dace (*Rhinichthys osculus*) | 34 | 0.24 | 10.2 |
| **Total** | **333** | **2.40** | **100.0** |

All captured fish were identified to species and enumerated; total length was recorded for all game species. Some of the newly-captured bull trout were implanted with radio tags (Lotek models SR-TP11-25, MCFT-3A, MST-930, NTC6-2 and SR-TP16-25). PIT tags (12 mm) were inserted into the dorsal musculature of all previously untagged bull trout greater than 125 mm in total length. Fish were anesthetized using electronarcosis as described by Hudson et al. (2011). Surgery methods used to implant radio transmitters followed a modified shielded needle technique described by Ross and Kleiner (1982).

Of the 21 unique bull trout captured in 2013, 8 were recaptures from previous years, 2 from 2011, 4 from 2012, and 2 were captures from both 2011 and 2012. All newly captured bull trout were fitted with a 12 mm PIT tag (n=13). PIT tags were inserted via dorsal musculature for all bull trout greater than 125 mm. Bull trout captured ranged from 411 mm to 549 mm in total length and 640 to 1420 grams in weight. A total of 17 radio transmitters were deployed in 2013. Bull trout were surgically implanted with radio transmitters (n=17) as long as the tag weight did not exceed 4 percent of the body weight of that fish. Three of these radio tags were implanted into fish that had only been PIT tagged in previous years and one tag that had expired was replaced. Behavior of radio-tagged bull trout will be summarized upon completion of this project.

There were no handling related mortalities in 2013. In very limited mortality surveys, four radio transmitters were found as expelled tags or mortalities in the 2013 sampling season. Three of the four transmitters were from the 2013 tagging season for a minimum expulsion and/or mortality rate of 17.6 percent. Mortality surveys in 2013 were limited to the varial zones of Trail Creek and the mainstem Deadwood River; therefore, this mortality rate cannot be compared to past years. An additional eight bull trout did not down migrate after spawning in Trail Creek. Four of these fish were tagged in 2013, increasing the minimum mortality/expulsion rate to 41.2 percent. Based on remote telemetry stations, 12 of the 19 fish that migrated (or attempted to migrate) into Trail Creek in 2013 were mortalities, expelled their tags, or tag batteries expired. This would give an overall Trail Creek spawning mortality/expulsion rate of 63.2 percent for 2013. Ground tracking to verify mortalities in Trail Creek upstream of the high water line was precluded due to the government furlough, so true mortality/expulsion rates are likely between the 17.6 and 63.2 percent estimates.

Biological samples collected from bull trout included fin clips (n=13) and scales (n=19) (collected while anesthetized). None of the methods for taking these biological samples were lethal to the fish. Fin clips were sent to the USFWS Genetics Lab in Abernathy, Washington. Genetic analysis may be used for population assignment to a specific tributary within the Deadwood River basin using methods described in DeHann and Ardren (2008).

Bull trout scales are being analyzed by Reclamation staff to determine general age and growth patterns in the population. Digital images of scales from each fish are created and multiple readers assign ages by identifying growth annuli. Aging techniques and back-calculating length-at-age measurements from scales are described by Devries and Frie (1996). Scale samples are being housed at Reclamation's Snake River Area Office in Boise, Idaho.

#### 3.2.1.2 Radio Telemetry

Behavior of radio-tagged bull trout has varied since 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 and out of the reservoir.

#### 3.2.1.3 Hydrology and Water Chemistry

Collection of water temperature data using Onset® TidbiT continued in 2013 in four tributaries to the reservoir: Deadwood River, Trail Creek, Beaver Creek, and Wildbuck Creek (Figure 12). Onset® TidbiTs recorded hourly water temperature data that were manually downloaded a minimum of one time per year. Temperature, flow, and stage data are stored at Reclamation's Snake River Area Office and are being used for the biological and hydrologic modeling (Reclamation 2013).

#### 3.2.1.4 Other Activities

IDFG ran kokanee weirs on Trail Creek and the mainstem Deadwood River during the fall spawning period to limit escapement and collect eggs for brood stock. In 2013, the Trail Creek weir was operated from August 13 to September 16, while the mainstem weir was operated from August 14 to September 19. IDFG handled 13 bull trout at the mainstem weir and 11 at Trail Creek. Additionally, IDFG conducted curtain netting as well as hydroacoustic surveys of the reservoir to estimate the kokanee population.

IDFG also stocked 5,498 fingerling Chinook salmon (3-6 inches) and 9,644 fingerling triploid Hayspur rainbow trout into Deadwood Reservoir as a measure to control kokanee salmon and provide a sport fishery.

### 3.2.2 Data Collection in the Deadwood River Reach Downstream of Deadwood Dam

Since 2007, 59 bull trout have been captured in the stilling basin below the dam and 197 bull trout have been captured in tributaries to the river below the dam. During the 2013 reporting period, 17 bull trout were captured in the stilling basin below Deadwood Dam. No radio tagging or tracking occurred below the dam in 2013.

In 2013, fyke netting was the only method used for sampling fish in the Deadwood River system below Deadwood Dam. Captured bull trout were hauled above Deadwood Dam and released in the Trail Creek arm of the reservoir. Water temperatures at capture and release locations were well within the 5° C guidelines provided by IDFG. All other fish species were released in close proximity to their capture location. In addition to conducting a trap and haul effort, connectivity surveys, stranding pool surveys, general habitat surveys, physical, hydrologic, and water chemistry data were collected throughout the year.

#### 3.2.2.1 Fish Sampling Below Deadwood Dam

As part of a trip-and-haul effort, fyke nets were operated in the stilling basin below Deadwood Dam September 25-27, 2013 for a total of 140.7 hours (Table 9; Reclamation 2013b). A total of 2,477 fish representing 8 species, including 17 bull trout (17 unique fish), were captured. Speckled dace were the most abundant fish sampled (79.19 percent of the total catch) while bull trout were the fifth most abundant fish captured, representing 0.69 percent of the total catch. The total CPUE was 17.6 fish per hour in 2013. Hook-and-line sampling was also conducted in the stilling basin below the dam for 1.5 hours on September 26, 2013. One rainbow trout was captured during this hook-and-line effort.

**Table 9. Total fyke net catch summary for 2013 including numbers of each species captured (total catch), catch per unit effort (CPUE), and percent of total catch. Sampling occurred in the stilling basin just below Deadwood Dam, Idaho.**

| Species | Soak Time Hours = 140.7 | | |
|---|---|---|---|
| | Total Catch | CPUE (fish/hour) | Percent of total |
| Bull Trout (*Salvelinus confluentus*) | 17 | 0.12 | 0.69 |
| Cutthroat Trout (*Oncorhynchus clarki lewisi*) | 9 | 0.06 | 0.36 |
| Rainbow Trout (*Oncorhynchus mykiss*) | 235 | 1.67 | 9.48 |
| Redside Shiner (*Richardsonius balteatus)* | 8 | 0.06 | 0.32 |
| Sculpin (*Cottus spps.)* | 6 | 0.04 | 0.24 |
| Kokanee salmon (Oncorhynchus nerka) | 172 | 1.22 | 6.94 |
| Mountain Whitefish (*Prosopium williamsoni*) | 69 | 0.49 | 2.78 |
| Speckled Dace (*Rhinichthys osculus*) | 1963 | 13.95 | 79.19 |
| **Total** | **2479** | **17.6** | |

All captured fish were identified to species and enumerated; total length was recorded for all game species. PIT tags (12 mm) were inserted into the dorsal musculature of all previously untagged bull trout greater than 125 mm in total length. No bull trout captured in 2013 were

recaptures from previous years. Bull trout captured ranged from 110 mm to 350 mm in total length and 30 to 508 grams in weight. All captured bull trout (except one that escaped) were released in the Trail Creek arm of the reservoir above the dam. There were no handling-related mortalities in 2013.

Biological samples collected from bull trout included fin clips (n=16) and scales (n=16). Fin clips were sent to the USFWS Genetics Lab in Abernathy, Washington. Genetic analysis may be used for population assignment to a specific tributary within the Payette River basin using methods described in DeHann and Ardren (2008).

Bull trout scales are being analyzed by Reclamation staff to determine general age and growth patterns in the population. Digital images of scales from each fish are created and multiple readers assign ages by identifying growth annuli. Aging techniques and back-calculating length-at-age measurements from scales are described by Devries and Frie (1996). Scale samples are being housed at Reclamation's Snake River Area Office in Boise, Idaho.

#### 3.2.2.2 Stranding Pool and Connectivity Surveys

Stranding pool and connectivity surveys were conducted in the Deadwood River below the dam as an ongoing effort from work initiated in 2010. In 2013, this effort was initiated when flows from the dam were reduced to 2.4 cfs.

The 7.25 km of river initiating at the dam and extending downstream as well as the lower 21 km from the confluence of the South Fork Payette upstream were surveyed for connectivity and stranding pools. The middle 9.5 km were not surveyed due to time limitations from the government furlough and weather conditions. Results will be available in the final report upon completion of the project following the outline described in the Deadwood Flexibility Study Proposal (Reclamation 2008).

#### 3.2.2.3 Habitat Surveys

A total of 11.25 km of river habitat were surveyed following a modified R1/R4 stream habitat survey protocol (Overton et al 1997). Nine 1.6-km-long reaches were randomly selected from the Deadwood River below Deadwood Dam. Seven of these nine reaches were surveyed in 2013; the other two reaches were not surveyed due to time constraints from the government furlough and weather conditions (Figure 13). Results will be available in the final report upon completion of the project following the outline described in the Deadwood Flexibility Study Proposal (Reclamation 2008).

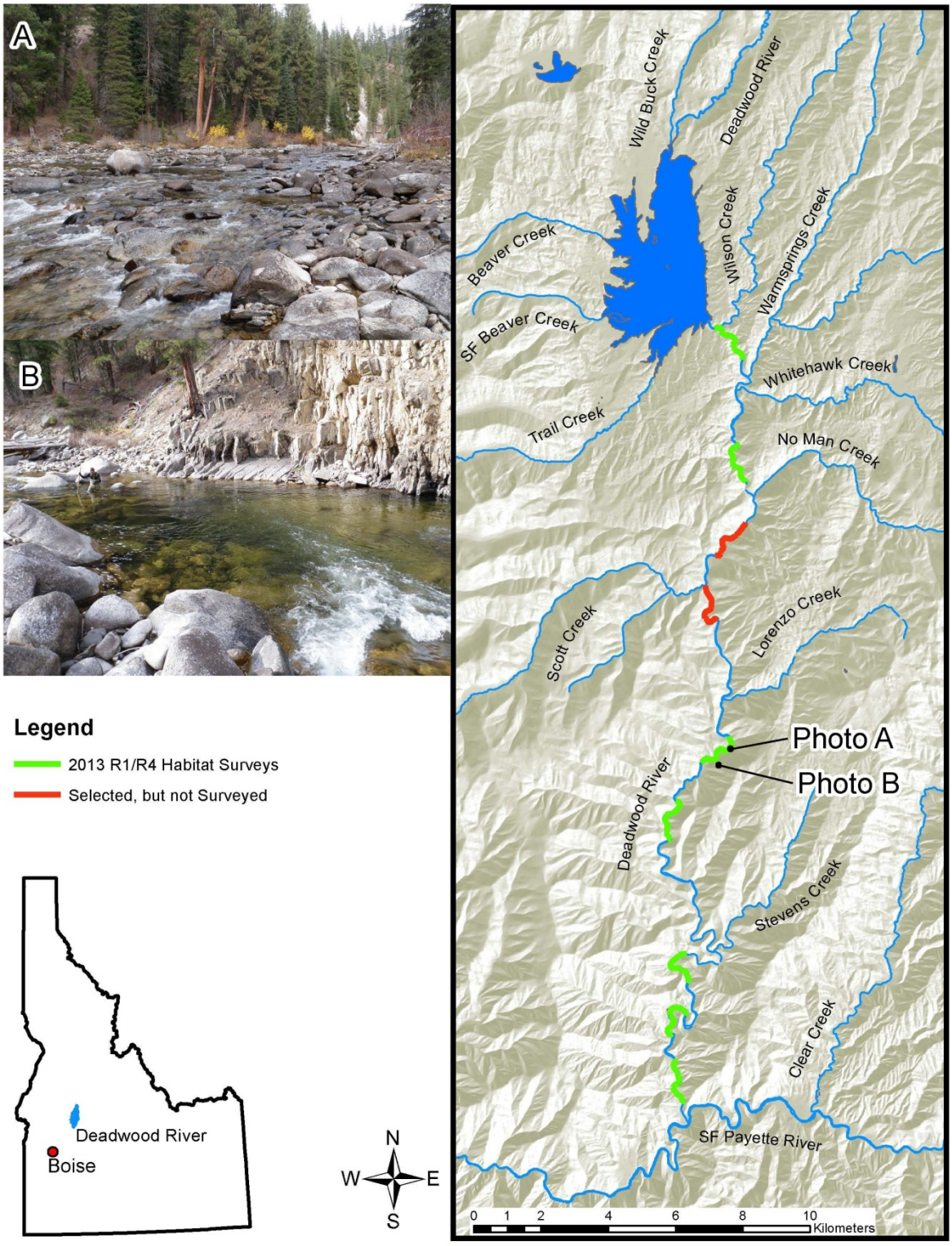


**Figure 13. R1/R4 habitat survey locations on the Deadwood River below Deadwood Dam, 2013. Photos represent lower-reach conditions during 2.4 cfs discharge from Deadwood Dam.**

#### 3.2.2.4 Radio Telemetry

A remote station on Deadwood Dam is still currently operating to record possible entrainment of radio tagged fish. No entrainment has been documented since the station was installed in 2006. Telemetry data will be summarized in the *Deadwood Flexibility Study Report*.

#### 3.2.2.5 Hydrology and Water Chemistry

Onset® TidbiTs temperature loggers continued monitoring water temperatures downstream of Deadwood Dam at multiple locations in the mainstem Deadwood River and in six tributaries to the Deadwood River: Wilson Creek, Whitehawk Creek, No-Man Creek, Scott Creek, Lorenzo Creek, and Stevens Creek (Figure 13). Thermographs recorded water temperature hourly throughout the year and were manually downloaded. Some loggers were not downloaded in 2013 due to time constraints after the government furlough and weather conditions. The Onset® Tidbits can store up to 3 years of data, allowing Reclamation to download the backlog of data in 2014. Locations of all temperature thermographs in the Deadwood River basin are illustrated in Figure 13.

The network of Onset® TidbiTs that are deployed near Warmsprings Creek, but within the Deadwood River, to track the thermal "plume" or "regime" of Warmsprings Creek (the creek is geothermally influenced) were downloaded during the 2013 field season. The goal of this data collection effort was to characterize the thermal signature, determine whether it provides a thermal refuge for bull trout, and/or how a different operation of the dam may affect the warm water entering the river from Warmsprings Creek.

All temperature, flow, and stage data is stored in Reclamation's Snake River Area Office 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 Flexibility Study Proposal (Reclamation 2008).

## 3.3 Malheur River Basin - Beulah Reservoir and the North Fork Malheur River

The 2005 Opinion identifies four terms and conditions for minimizing the effect and/or amount of take associated with the operation of Agency Valley Dam (Beulah Reservoir). Each of the terms and conditions addresses a different aspect of the effects of operations on bull trout. Reclamation is working to develop recommendations for a minimum pool level for Beulah Reservoir that would maintain a prey base for bull trout returning to the reservoir to overwinter (Terms and Conditions 4.a and 4.c).

In 2010, USFWS approved a time extension to allow Reclamation to collect additional data at Beulah Reservoir and its tributaries. A 4-year study was initiated in 2010 to extend fish, invertebrate, zooplankton, and water quality sampling to lower drawdown levels and to complete bioenergetics modeling. Prey base and bull trout studies (Term and Condition 4.a) will be conducted during the first 3 years. In the last year, the collected data will be combined with previous sampling efforts to conduct bioenergetics modeling and to develop a defensible minimum pool recommendation for Beulah Reservoir and the efficacy of prey supplementation (Term and Condition 4.b).

Bull trout marking and tagging is being used to determine bull trout population levels, seasonal use of Beulah Reservoir, and the timing and extent of migration. A migration weir fish trap is being installed in the North Fork Malheur River near the inlet to Beulah Reservoir during spring and fall periods of 2011 through 2013, when conditions allow. A PIT-tagging program was instituted in 2011 with the installation of a PIT-tag antenna array on the North Fork Malheur River near the inlet to Beulah Reservoir to record bull trout migration to and from the reservoir. A PIT-tag antenna array was also installed below the dam in 2012 to monitor for the entrainment of PIT tagged bull trout. Hydroacoustic surveys are being conducted to estimate fish numbers and distribution in the deeper portions of the reservoir where other sampling methods are not effective.

Reclamation will strive to maintain the reservoir pool elevation at or above 2,000 acre-feet until minimum pool recommendations are presented to USFWS (April 2015 deadline). 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. A final summary report for the prey base, bioenergetic modeling, and fish salvage work will be prepared by the April 30, 2015 deadline.

Other bull trout work performed during this reporting period included hydroacoustic, limnologic and macroinvertebrate surveys in the reservoir. The spillway at Agency Valley Dam was not used during this reporting period; therefore, a trap-and-haul effort for bull trout in the tailrace below the dam was not required (Term and Condition 4.d). Bull trout spawning nest surveys (redd counts) have been conducted annually since 1992, but were not performed in 2012 due to budget limitations by all partnering agencies. Redd counts were, however, resumed in 2013.

### 3.3.1 Beulah Reservoir and Tributary Data Collection

Fish sampling efforts conducted during this reporting period included reservoir fish sampling (fyke and gill netting), hydroacoustics survey on the reservoir, a migration weir on the North Fork Malheur River, and tributary backpack electroshocking and hook-and-line sampling.

Fish sampling efforts were conducted to meet the following objectives:

1. Pit tag bull trout to monitor migration to and from the reservoir.
2. Estimate the population of adfluvial bull trout using Beulah Reservoir.
3. Estimate and describe the bull trout prey base in Beulah Reservoir seasonally (spring and fall).

By tagging adfluvial bull trout in the reservoir and tributaries, Reclamation will also be able to monitor the entrainment risk of bull trout through Agency Valley Dam (Term and Condition 4.d). Methods and results are summarized in the following subsections and described in more detail in the USFWS *Annual Sampling Permit Report* (Best 2014).

## 3.3.2 Fish Sampling

In the Malheur River basin, five methods of fish sampling were conducted in 2013: fyke netting, picket migration weirs, backpack electroshocking, hook-and-line sampling, and gill netting. All bull trout captured during the sampling were anesthetized in a solution of one tablet of Alka Seltzer Gold in 2.5 L of water. Bull trout were then tagged with a floy tag and a 23 mm half-duplex PIT tag inserted into the dorsal sinus if the fish was over 300 mm in total length. The fork length (mm) and weight (g) were also recorded for each fish. Stomach samples were collected on all bull trout captured in the reservoir. Recaptured bull trout were not subjected to repeat stomach pumping to minimize negative effects.

### 3.3.2.1 Fyke Netting

In 2013, spring reservoir sampling was conducted between April 10 and May 8. Fyke nets were usually set in the afternoon to fish overnight and pulled the following day. A total of 56 bull trout were collected in fyke nets, 31 of which were recaptures from previous years' efforts (Figure 14). Total lengths of sampled bull trout averaged 311 mm and ranged between 255 and 465 mm. Weights averaged 385 grams, and ranged between 126 and 969 grams.

Fall reservoir sampling was conducted between October 1 and October 16. Three bull trout were collected in fyke nets (Figure 15). Total lengths of sampled bull trout averaged 378 mm and ranged between 328 and 465 mm. Weights averaged 590 grams and ranged between 386 and 969 grams. Two of the bull trout were recaptures from previous years' efforts.

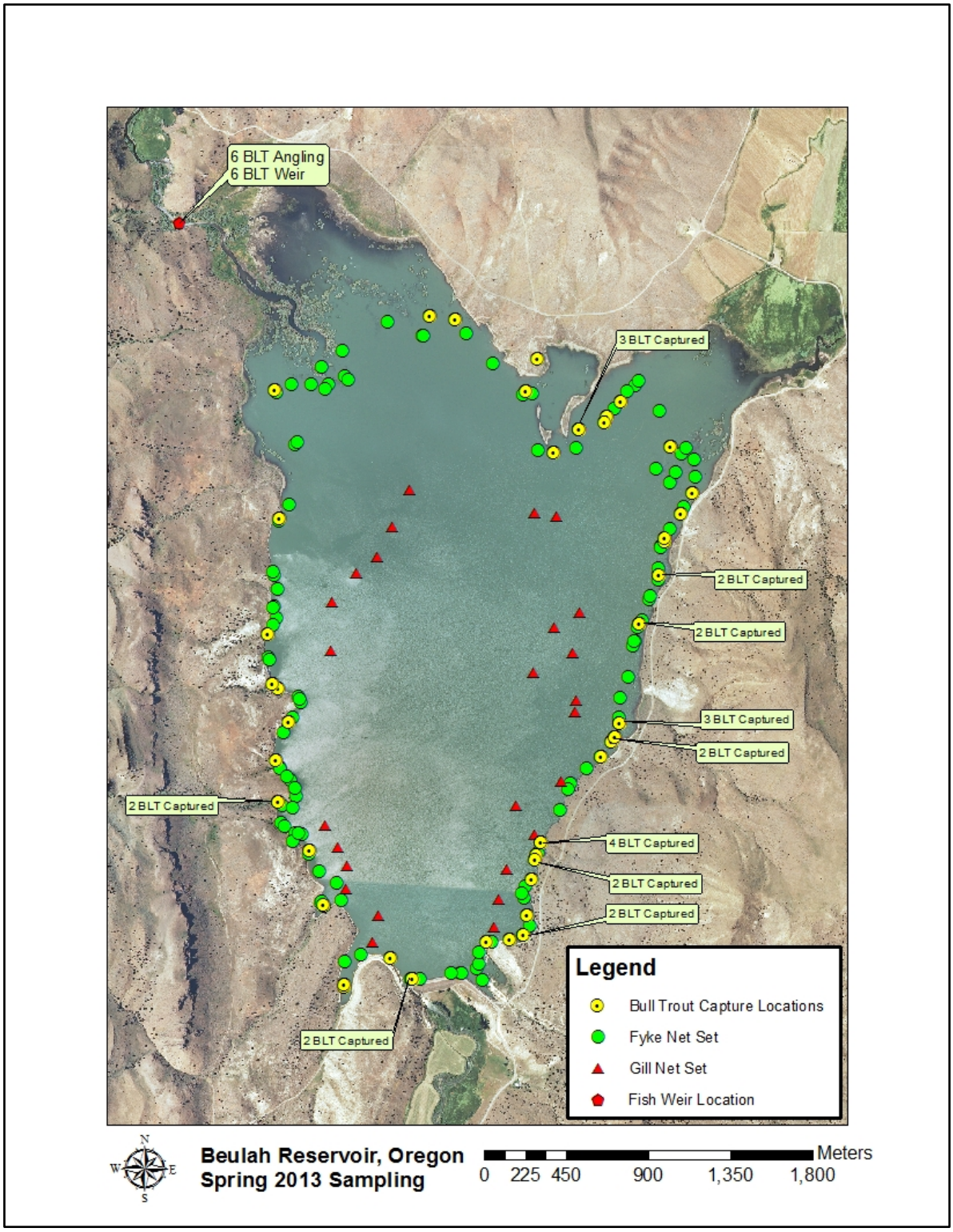


**Figure 14. Locations of experimental gill net and fyke net sets and bull trout capture locations during the spring 2013 sampling in Beulah Reservoir. Each bull trout capture location represents one fish, unless otherwise noted.**

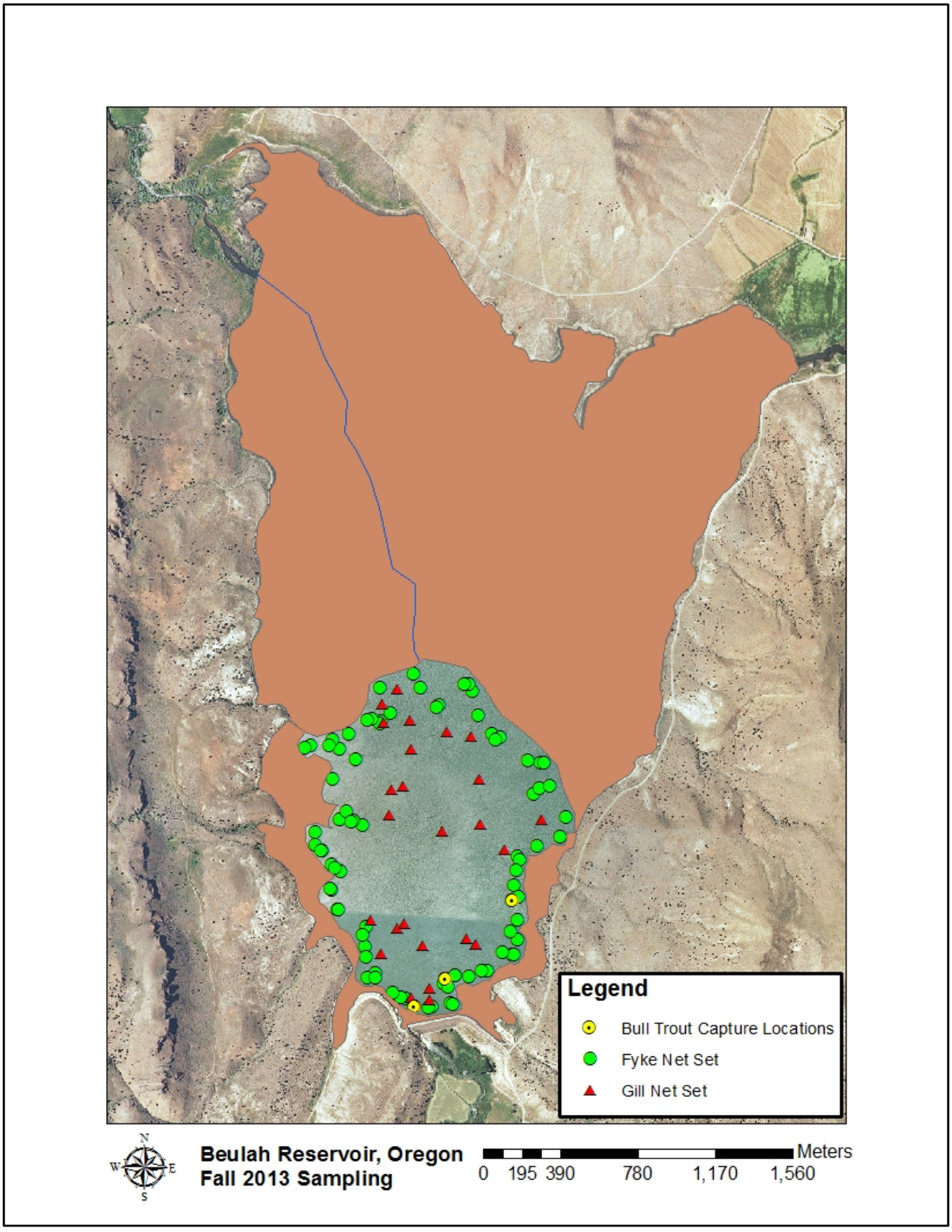


**Figure 15. Locations and numbers of experimental gill net and fyke net set locations during the fall 2013 sampling in Beulah Reservoir. Each bull trout capture location represents one fish.**

#### 3.3.2.2 Picket Migration Weirs

A picket weir was deployed and fished during the spring sampling period. Bull trout were observed behind the weir along with numerous rainbow trout and largescale suckers, all of which were reluctant to pass through the weir into the trap box. This was confirmed through angling as well as from PIT-tag antenna arrays. As soon as the weir was removed, tagged bull trout were immediately detected by the PIT-tag array traveling upstream. Efforts to redesign the weir and trap boxes, as well as the configuration of the weir in the river channel to avoid this spring backup were unsuccessful (backups were also observed the previous fall) and thus, it was determined that the weir would not be deployed the following fall (Figure 17).

A total of six bull trout were captured at the weir in 2013. Total lengths of the bull trout averaged 292 mm and ranged between 185 and 365 mm. Weights averaged 259 grams and ranged between 60 and 460 grams.

#### 3.3.2.3 Backpack Electroshocking

Backpack electrofishing took place using a backpack electroshocker (LR-24 Electrofisher, Smith Root Inc., Vancouver, Washington) to capture bull trout in the North Fork Malheur River and tributaries upstream of the reservoir from July 23 to July 25. Five bull trout were captured with a backpack electroshocker that averaged 216 mm in total length and ranged between 197 mm and 229 mm. Weights averaged 104 grams and ranged from 90 to 130 grams. All trout were captured in the North Fork Malheur River.

#### 3.3.2.4 Hook-and-Line Sampling

In 2013, hook-and-line surveys were conducted on April 14, 16, 22, and 28 in the North Fork Malheur River immediately upstream and downstream of the weir in an attempt to capture bull trout that would not pass through the weir. Six bull trout were collected during this effort, three above and three below the weir. The total lengths of the bull trout averaged 334 mm and ranged between 290 and 379 mm. Weights averaged 369 grams, ranging between 232 and 659 grams.

Hook-and-line surveys were again conducted in the fall from October 1-16, with no bull trout encountered.

#### 3.3.2.5 Gill Netting

In 2013, reservoir sampling was conducted between April 10 and May 8 and again between October 1 and 16, with no bull trout encountered. Experimental mesh gill nets were generally fished on the bottom during daylight hours for 30 minutes or less (Figure 14 and Figure 15).

### 3.3.3 Malheur Productivity

Hydroacoustic surveys were again conducted during the spring and fall 2013 as an alternative method of estimating reservoir fish populations. As the years progress from the 2009 reservoir drawdown to run-of-river, increasing numbers of large size-class fish can be seen, although the smaller fish continue to dominate the reservoir. Fall populations track well with the net estimates as during the fall low water levels provided less habitat for fish, and they were more easily detected using acoustics.

A series of Onset® Tidbit temperature loggers were deployed from a buoy moored near the center of the reservoir from May 2012 through October 2013. Temperature data will be used, along with known times that bull trout were in the reservoir, during the course of bioenergetics modeling for the fish population.

Aquatic macroinvertebrate samples were also collected during the spring and fall survey periods; however, final analysis of macroinvertebrate samples was not completed in time for inclusion in this report.

### 3.3.4 Temporary Water Lease

In 2011, Reclamation entered into a 4-year temporary water lease with the Vale Irrigation District to maintain reservoir pool elevation above 2,000 acre-feet until minimum pool recommendations are presented to the USFWS (April 2015 deadline). The pool elevation at Beulah Reservoir fell below 2,000 acre-feet for a total of 45 days. Minimum pool elevation (3,282.96 feet) occurred on September 4, 2013 and carryover was 1,417 acre-feet.

### 3.3.5 Trap-and-haul Efforts

During 2013, trap-and-haul efforts were not conducted because the spillway was not used to release water from the reservoir (Term and Condition 4.d).

### 3.3.6 Other Activities

#### 3.3.6.1 Redd Counts

In 2013, a total of 38 bull trout redds were counted in the North Fork Malheur River basin, with an adjusted number of 57. Assuming 2.68 bull trout per redd (Al-Chokhachy et al. 2005), an estimated 153 adfluvial adult bull trout were present in 2013.

# 4.0 SNAKE RIVER PHYSA

## 4.1 Introduction and Background

The 2005 Opinion found that operations associated with the proposed operations of Minidoka Dam may adversely affect Snake River physa in the Minidoka reach of the Snake River; however, inadequate information existed to adequately predict impacts. One of Reclamations proposed actions in the 2004 consultation (Reclamation 2004) was to conduct presence/absence surveys of physa to characterize the environmental variables and physical habitats where they are found. During surveys conducted from 2006 through 2008, over 274 live physa specimens were found between Minidoka Dam downstream to above Milner Pool (Figure 16; Gates and Kerans 2010). Live physa were found in low densities, primarily among pebble and gravel substrates in the main channel of the Snake River. Physa were also found in the spillway area of Minidoka Dam, though sample sizes were too small to characterize habitat use and spatial distribution.

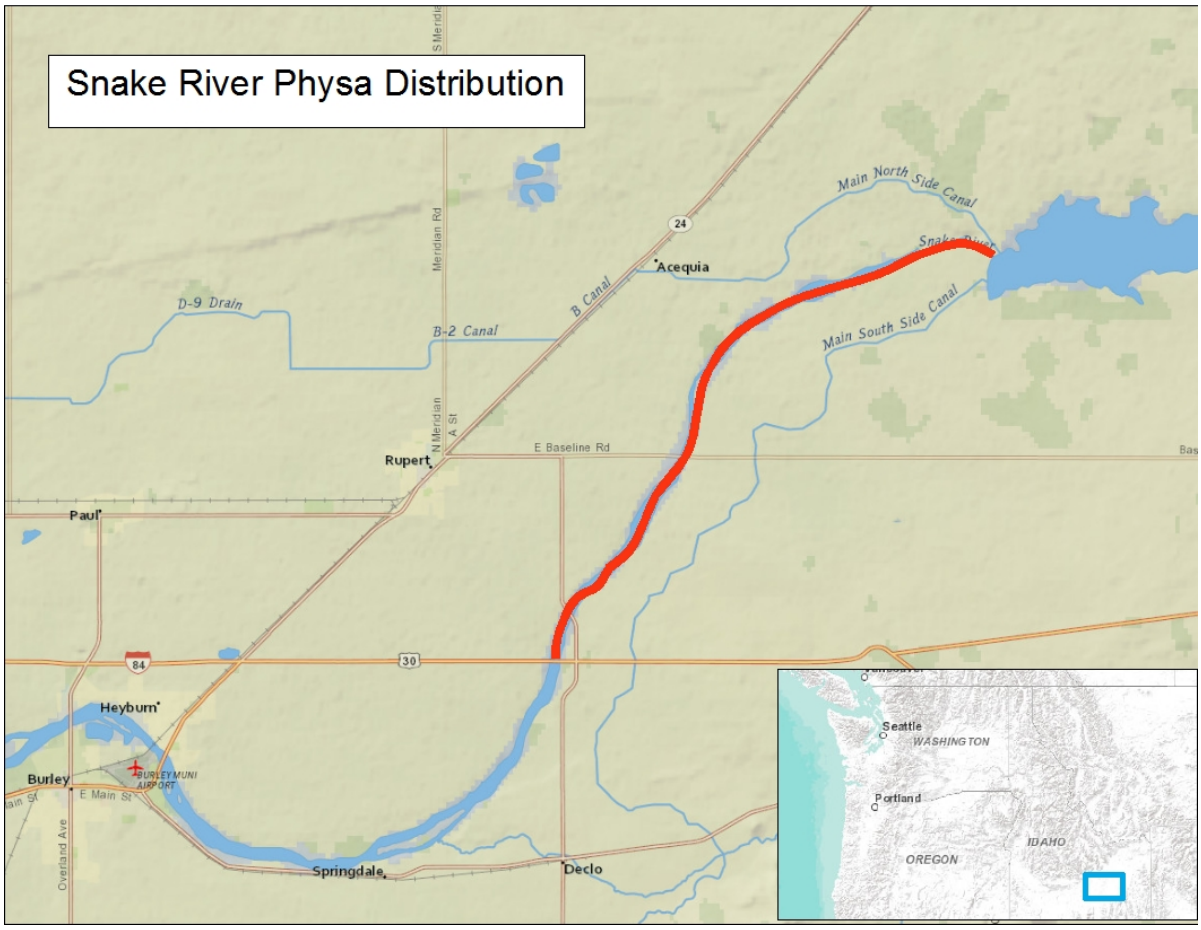


**Figure 16. Red line represents the known distribution of Snake River physa (*Physa natricina*) in the upper Snake River.**

Physa surveys were not conducted from 2009 through 2011; however, during this time, data and specimens were being analyzed and a completion report prepared for physa identification, habitat characteristics, and distribution (Gates and Kerans 2010). Survey efforts were reinitiated in 2012 in response to the Minidoka Spillway Replacement Project. Current and future Reclamation management of Minidoka Dam includes replacement of the spillway structure and two canal headworks structures. Construction is scheduled to be completed by April 1, 2015. Post-construction operations may include the diversion of more water, when available, through the Inman Powerplant located at Minidoka Dam. In consultation with USFWS and a multiagency technical team, Reclamation designed a multiyear proposal to reduce minimum spillway flow (Table 10) and monitor physa to determine what, if any, effects reduced flow has on physa occurrence and abundance in the spillway. Although Table 10 identifies minimum spillway and powerplant flows, it does not fully represent Reclamation's proposed post-construction operations, due to complexity. Water rights, provisions of spaceholder contracts, commitments to implement the existing biological

opinions, and Total Maximum Daily Loads (TMDL) will not change as a result of the spillway replacement project. Project operations following construction will be addressed separately to better align with ongoing actions associated with the long-term operation and maintenance of the current biological opinion (USFWS 2005). The primary purpose of Table 10 is to illustrate the proposed spillway flow reduction schedule.

**Table 10. Current and proposed minimum spillway and powerplant flows at the Minidoka Dam.**

| | Spillway Flow | | | | | Powerplant Flow | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 2013 | 2014 | 2015 | 2016 | 2017 | 2013 | 2014 | 2015 | 2016 | 2017 |
| **Nov. 01** | <1 | <1 | <1 | <100 | <100 | 400 | 400 | 400 | 400 | 400 |
| **Dec. 01** | <1 | <1 | <1 | <100 | <100 | 400 | 400 | 400 | 400 | 400 |
| **Jan. 01** | <1 | <1 | <1 | <100 | <100 | 400 | 400 | 400 | 400 | 400 |
| **Feb. 01** | <1 | <1 | <1 | <100 | <100 | 400 | 400 | 400 | 400 | 400 |
| **Mar. 01** | <1 | <1 | <1 | <100 | <100 | 400 | 400 | 400 | 400 | 400 |
| **Apr. 01** | <1,300 | <1,300 | <1,300 | <1,000 | <500 | <5,035 | <5,035 | <5,035 | <5,335 | <5,835 |
| **Apr. 15** | 1,300 | 1,300 | 1,300 | 1,000 | 500 | <8,850* | <8,850 | <8,850 | <8,850 | <8,850 |
| **May 01** | 1,300 | 1,300 | 1,300 | 1,000 | 500 | <8,850 | <8,850 | <8,850 | <8,850 | <8,850 |
| **June 01** | 1,300 | 1,300 | 1,300 | 1,000 | 500 | <8,850 | <8,850 | <8,850 | <8,850 | <8,850 |
| **July 01** | 1,900 | 1,900 | 1,500 | 1,000 | 500 | <8,850 | <8,850 | <8,850 | <8,850 | <8,850 |
| **Aug. 01** | 1,900 | 1,900 | 1,500 | 1,000 | 500 | <8,850 | <8,850 | <8,850 | <8,850 | <8,850 |
| **Sep. 01** | 1,300 | 1,300 | 1,300 | 1,000 | 500 | <8,850 | <8,850 | <8,850 | <8,850 | <8,850 |
| **Sep. 15** | <1,300 | <1,300 | <1,300 | <1,000 | <500 | <5,035 | <5,035 | <5,035 | <5,335 | <5,835 |
| **Oct. 01** | <1,300 | <1,300 | <1,300 | <1,000 | <500 | 400 | 400 | 400 | 400 | 400 |

* Irrigation season powerplant flows are highly variable within and among years and are dependent upon several factors. Accurate monthly flows cannot be precisely expressed in a single table. The maximum powerplant capacity at Minidoka Dam is 8,850 cfs.

The objectives of the Minidoka-reach physa surveys in 2013 was to gather baseline data that can be used to determine trends of occurrence and abundance within the Minidoka reach; determine the effects of reduced spillway flows on physa in the Minidoka Dam Spillway, further characterize physa habitats, and meet the reporting requirements of ESA Section 10, Permit No. TE 056557-5.

## 4.2 Survey Area

The survey area is located in south-central Idaho and includes the Snake River from Minidoka Dam downstream to the upper end of Milner Pool (Figure 16, River Mile [RM] 675-663). The elevation changes from 4134 feet to 4245 feet. Minidoka Dam is operated by

Reclamation and managed primarily for water storage and hydroelectric generation. Powerplant and spillway discharges from Minidoka Dam bifurcate flow between the original wetted channel of the Snake River and a series of bedrock outcrops not originally wetted. Flows through Minidoka Dam consist of regulated discharge through the Reclamation and Inman powerplants as well as controlled and uncontrolled spillage/leakage along the spillway structure. A replacement spillway designed to eliminate leakage flows is scheduled for completion in spring 2015. Flows from Minidoka Dam downstream to Milner Dam are almost entirely regulated by controlled releases and spillage at Minidoka Dam, as there are no major tributaries or irrigation returns in the Snake River along this reach.

## 4.3 Methods

### 4.3.1 Sample Locations

A before/after, control/impact (BACI) study design was implemented to examine changes in the occurrence and abundance of physa at the Minidoka Dam spillway before, during, and after planned reductions in spillway flow. Analyzing physa occurrence and abundance within the spillway in comparison to a downstream location where changes in flow are not expected to occur seeks to provide the ability to detect changes in physa occurrence and abundance due to spillway management, as opposed to changes in physa occurrence that may be simultaneously occurring throughout the study area. Two long-term survey sites were selected at locations where physa were collected during previous surveys (Gates and Kerans 2010).

The downstream site (Control) near the demolished Jackson Bridge (RM 669) is in the original Snake River channel and consists primarily of gravel substrate within a wide, shallow, braided channel. The bankfull width of the Snake River along the Jackson Bridge site is over 400 meters wide, with maximum depths of approximately 4 meters. As a result, approximately 30 percent of the river channel is exposed during non-irrigation season flows. Flows outside of irrigation season at the Jackson Bridge site typically consist of a minimum of 400 cfs through the powerplants. This regulated winter flow is approximately 1.2 meters lower than average August bankfull width flows.

The upstream site (Impact) is located at the Minidoka Dam spillway pool (RM 674.5). The spillway pool, wetted as a result of spillway releases since Minidoka Dam was constructed in 1906, is characterized by braided flows over primarily bedrock and sand substrate. Live physa were discovered in a portion of the spillway area in 2005. It is unknown whether physa colonized the spillway from upstream or downstream, how long they have persisted in the spillway area, or whether they are ephemeral in this nonnative habitat.

Four randomly-selected transects were derived by dividing the shoreline length of each site into 1-meter-wide cross sections perpendicular to the channel. Each transect was divided into 1-square-meter segments, and 20 segments were randomly selected along each transect as potential sampling plots. The Jackson Bridge sampling plots were selected by sampling the first 10 plots occupied from south to north at depths equal to or greater than 1.2 meters deep since previous surveys found virtually no physa in the seasonally-dewatered channel (Gates and Kerans 2010). Spillway sampling sites were selected by sampling the first 10 plots occupied along each transect that were at least 1 meter deep, from north to south.

### 4.3.2 Snail Collection

Each station was sampled using a venturi suction dredge operated by a SCUBA diver. A 0.25-square-meter plot was excavated to approximately 2.5 centimeters deep at stations where the primary substrate consisted of unconsolidated material such as mud, sand, and gravel. At stations having consolidated substrates such as cobble, boulder, and bedrock, timed samples were suction dredged for a timed duration of 60 seconds. Timed samples were collected for variable-sized areas and hence, suitable only for presence/absence analysis. Each sample was transported through flexible tubing and collected in a 1,000-micrometer sieve on board the boat or buoy station from which dive operations were conducted. Samples were immediately transferred to plastic trays and examined by trained samplers from Reclamation and USFWS under the direction of John Keebaugh from the Orma J. Smith Museum of Natural History. Live physa were enumerated for each plot and returned in proximity to the location from which they were collected.

### 4.3.3 Habitat Measurements

Physical water quality measurements were made at each sampling plot. Water depth (meters), temperature (°C), pH, dissolved oxygen (milligrams per liter [mg/L]), and turbidity (NTU) were measured at each plot using a Hydrolab® Sonde DS5 meter and Surveyor® handheld monitor (Table 11). Current velocity (meters per second [m/s]) was measured approximately 10 centimeters above the substrate at each plot using a SonTek® Argonaut ADV current meter operated by USGS staff (Table 12). Acoustic Doppler Current Profiles (ADCP) were also collected by USGS staff at each transect using a TRDI® Rio Grande ADCP operating at 12 kHz. Dominant and subdominant substrate types were classified by particle size as modified from Overton et al. (1997) (Table 13). Estimates of dominant and secondary substrate composition were made by direct observation of each sampling plot by a SCUBA diver and from inspection of the sieved contents of each sampling plot by snail collection samplers on board the dive vessel.

**Table 11. Mean physical parameters observed at Jackson Bridge plots with (+) and without (-) physa and spillway pool plots for 2013 (standard error in parenthesis).**

| Parameter | Jackson Bridge Physa (+) n=24 | Jackson Bridge Physa (-) n=16 | Spillway Pool Physa (+) n=2 | Spillway Pool Physa (-) n=38 |
|---|---|---|---|---|
| Flow (m/s) | 0.52 (0.03) | 0.34 (0.03) | 0.21 (0.11) | 0.09 (0.01) |
| Temp (°C) | 22.4 (0.13) | 22.8 (0.16) | 22.5 (0.005) | 22.8 (0.05) |
| DO (mg/L) | 7.62 (0.12) | 7.81 (0.17) | 7.59 (0.03) | 7.89 (0.05) |
| pH | 8.66 (0.01) | 8.69 (0.01) | 8.68 (0.005) | 8.69 (0.01) |
| Turbidity (NTU) | 6.64 (0.10) | 6.74 (0.15) | 5.0 (0.10) | 6.87 (0.79) |

**Table 12. Range and mean of physical habitat parameters measured during the 2013 physa survey. The mean ($\bar{x}$) is given in parenthesis.**

| Site | Current Velocity (m/s) | pH | Temperature (°C) | Dissolved Oxygen (mg/L) | Turbidity (NTU) |
|---|---|---|---|---|---|
| Jackson Bridge | 0.18-0.83 (0.45) | 8.6-8.8 (8.7) | 21.2-24.2 (22.6) | 6.5-9.2 (7.7) | 5.4-7.7 (6.7) |
| Spillway Pool | 0.01-0.4 (0.10) | 8.6-8.8 (8.7) | 22.4-23.3 (22.8) | 7.5-8.6 (7.9) | 4.4-32.5 (6.8) |

**Table 13. Substrate classifications used to characterize suction dredge plots surveyed in 2013.**

| Substrate Type | Size Class (mm) |
|---|---|
| Bedrock | Solid rock |
| Boulder | >256 |
| Cobble | 64-256 |
| Pebble | 16-64 |
| Gravel | 2-16 |
| Sand | 0.1-2 |
| Silt | <0.1 |

## 4.4 Results

Forty plots were sampled at each the Jackson Bridge and spillway pool sites in 2013. At the Jackson Bridge site, 24 plots (60 percent) contained live physa, ranging in abundance from 1 to 19 per plot (Figure 17). Two live physa were found among the 40 samples collected at the spillway pool site (Figure 18). Similar to previous studies, physa were broadly distributed in low densities in the permanently wetted channel of the Snake River at the Jackson Bridge site. The frequency of occurrence data for physa collected at the Jackson Bridge site in 2006, 2007, 2012, and 2013 resulted in no detectable difference between years (Table 14).

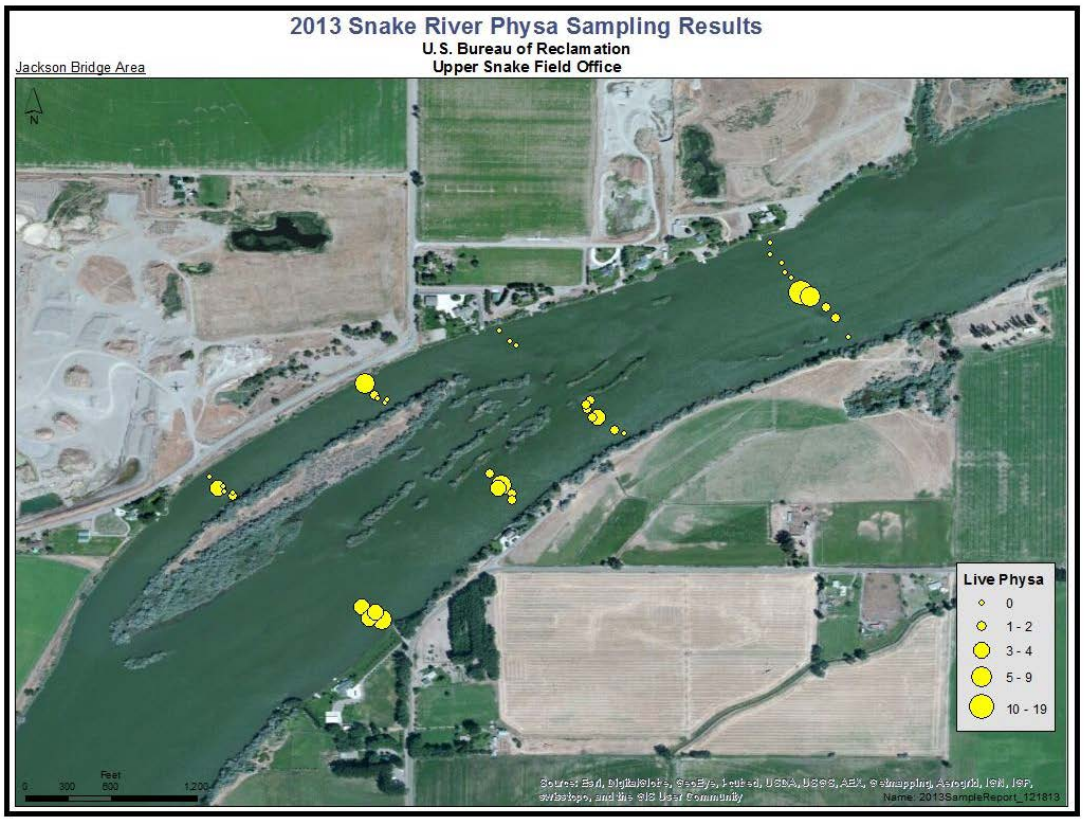


**Figure 17. Distribution and abundance of Snake River physa at the Jackson Bridge monitoring site in 2013.**

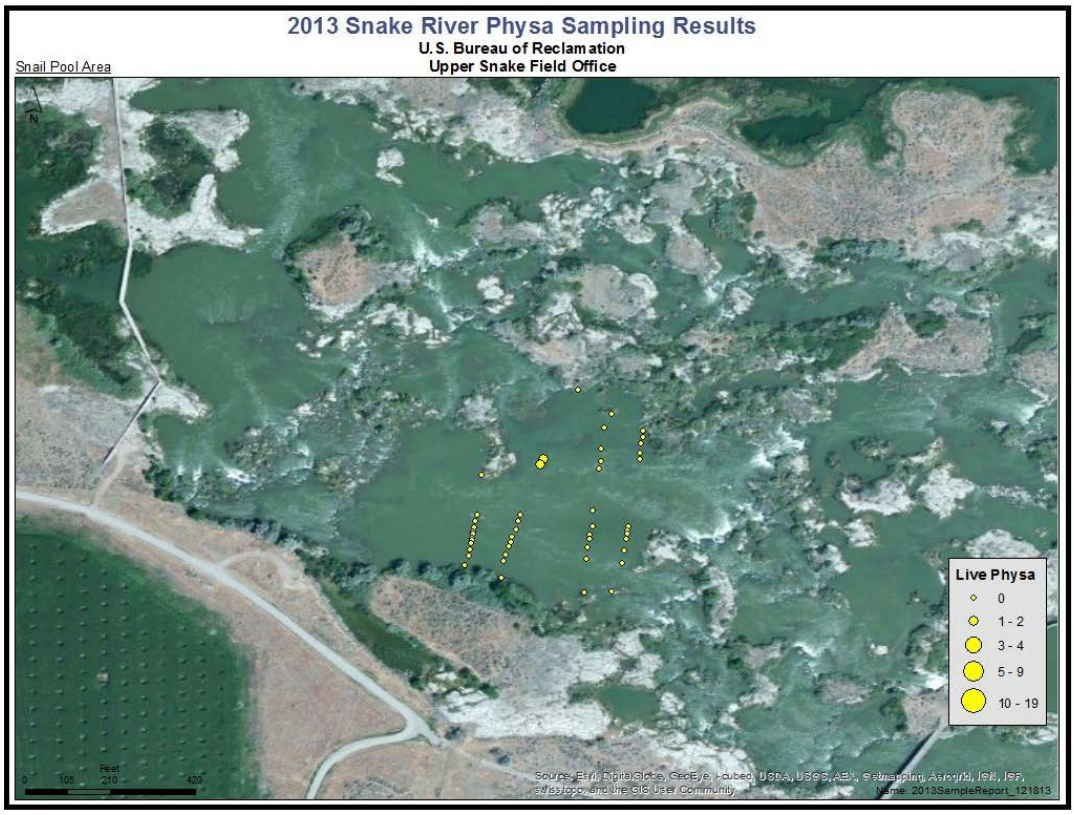


**Figure 18. Distribution and abundance of Snake River physa at the spillway pool monitoring site in 2013.**

**Table 14. Physa occurrence at the Jackson Bridge site during 2006, 2007, 2012, and 2013.**

| Year | Sample Size (n) | Mean | Standard Deviation | Proportion of Samples Containing Physa |
|---|---|---|---|---|
| 2006 | 32 | 2.500 | 3.835 | 0.500 |
| 2007 | 28 | 3.000 | 3.702 | 0.689 |
| 2012 | 40 | 1.125 | 1.539 | 0.500 |
| 2013 | 40 | 1.175 | 2.759 | 0.600 |

A total of 94 live Snake River physa were collected during field surveys in 2013. Of these, 56 live Snake River physa were returned to the water in apparently good condition. The remaining 38 specimens were preserved on ethyl alcohol and are being stored at Reclamation's Upper Snake River Field Office in Heyburn, Idaho (n=14), Idaho Power in Boise, Idaho (n=20), and USFWS in Boise, Idaho (n=4) as voucher specimens for use in species identification training. Voucher specimens collected in 2013 will be held at each respective facility and are available upon request to the designated depository listed in USFWS ESA Section 10 Permit No. TE056557-5.

A total of 8 timed sample plots were conducted at the spillway site in 2006. Of these plots, physa occurrence was 50 percent and ranged in abundance from 1 to 15 per plot. In 2007, 17 timed sample plots were conducted at the spillway pool, resulting in 1 plot containing 1 live physa. Physa were not detected in the spillway pool during 2012; however, in 2013, 2 live physa were collected from the spillway pool. In response the scarcity of physa detected at the spillway pool, Reclamation may modify the sampling methodology in future years by adding transects oriented along the thalwegs (portions of the pool having higher current velocity), so a greater proportion of preferred physa habitat could be sampled at this site. Continued monitoring for physical and environmental parameters will also provide the basis for assessing the effects of reduced spillway flow on the suitability of the spillway pool waters for physa occurrence.

Post-hoc analyses of environmental and physical parameters between sites resulted in significant differences for factors that are likely to affect the survival and persistence of physa. Current velocity was significantly lower at the spillway pool sample stations than at the Jackson Bridge stations (t-test, $\alpha$=0.05, P<0.001 [Figure 19]). In addition, substrates composed primarily of cobble, gravel, and pebble substrates with lesser amounts of embedding fines (such as sand and silt) comprised the 88 percent of benthic habitats where physa occurred in 2013. Substrates composed predominantly of cobble, gravel, and pebble were found in 95 percent of the samples collected at the Jackson Bridge site, but only 5 percent of the samples collected at the spillway pool site (Figure 20 and Figure 21). Future efforts to sample the spillway may be stratified by current velocity in order to ascertain presence/absence of physa there. Efforts to resample specific sites where physa occurred from 2006 through 2008 will also be considered.

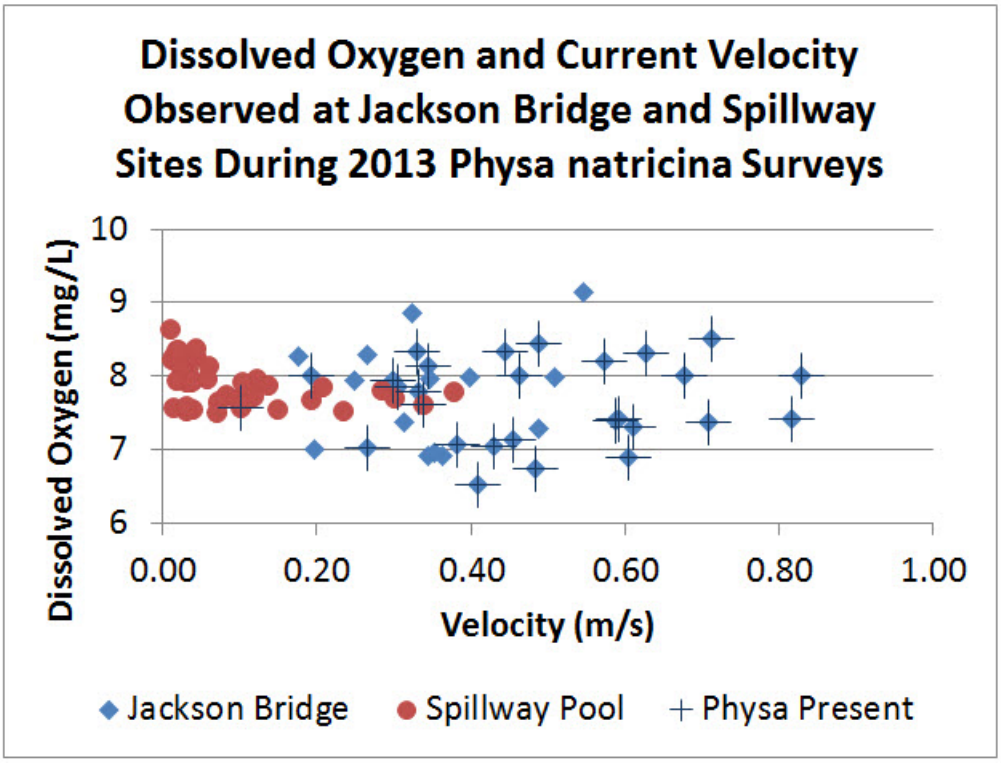


**Figure 19. Dissolved oxygen (mg/L) and current velocity (m/s) measured at Jackson Bridge and spillway pool sampling sites during the 2013 physa sampling effort.**

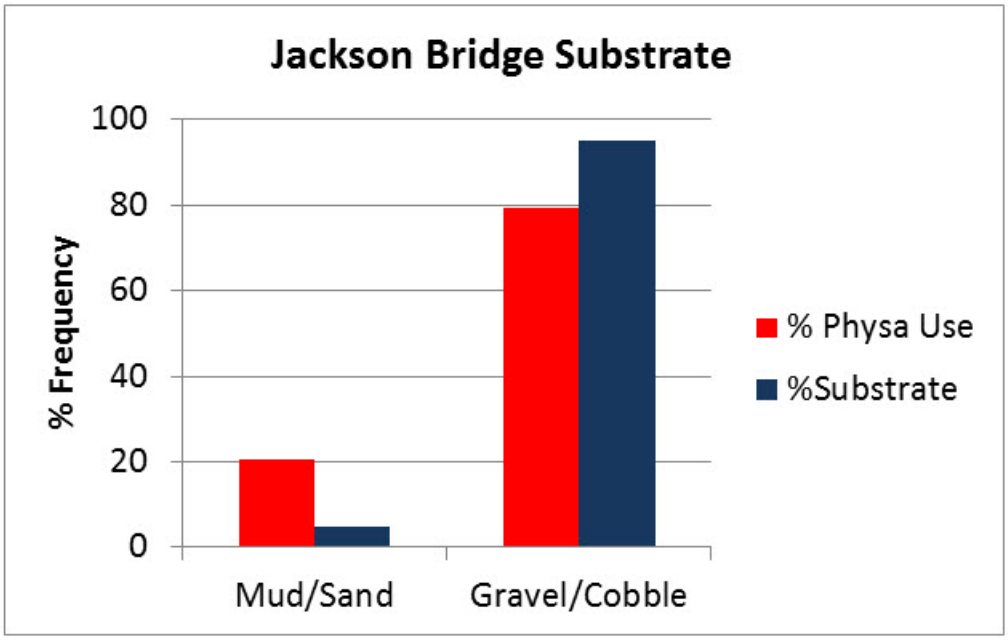


**Figure 20. Substrate and physa observed at the Jackson Bridge site during 2013 survey.**

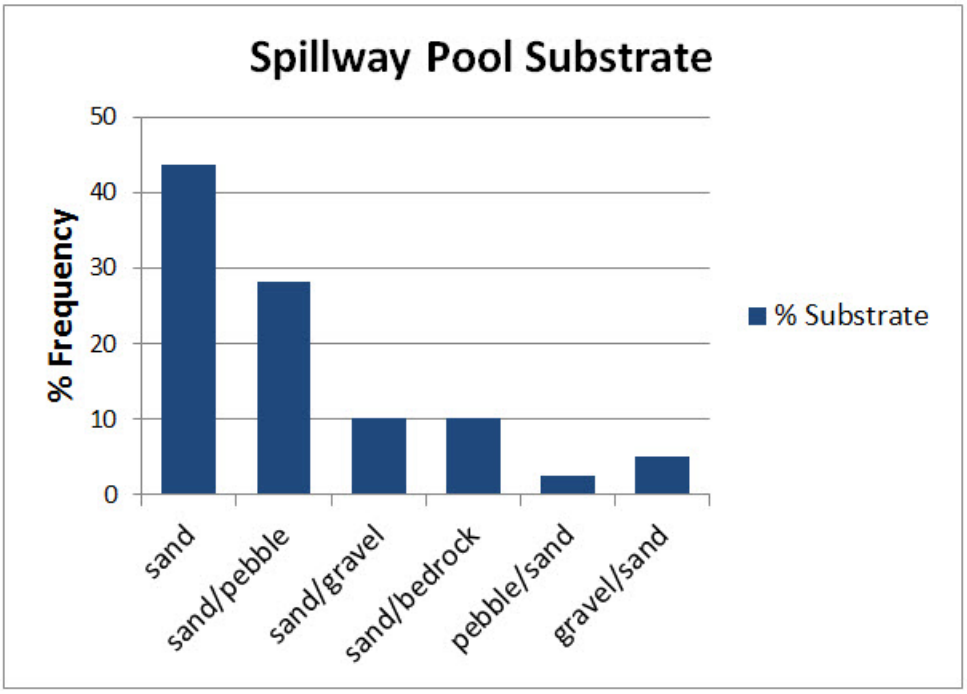


**Figure 21. Substrate observed at the spillway pool site during 2013 survey.**

# 5.0 OTHER ACTIVITIES

## 5.1 Water Quality

Reclamation participated in several water quality related activities in the upper Snake River basin during 2013. 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 Pacific Northwest Regional Office participated in all appropriate watershed advisory groups and watershed council meetings in the upper Snake River basin. These included activities in the North Fork Payette River, Lower Payette River, Middle 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
- Duck Valley Reservation
- Burley Irrigation District
- Lower Boise River Watershed Advisory Group
- A & B Irrigation District
- Minidoka Irrigation District
- Lake Walcott Watershed Advisory Group
- University of Idaho (Kimberly Field Office)
- Oregon Stream Restoration Monitoring
- Warm Springs Irrigation District
- 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 2013, Reclamation and USGS maintained a total of 52 stream temperature loggers throughout the basin. The intent of the ongoing study is to describe temperature regimes in the Snake River relative to Reclamation's management activities; this work will continue through 2014. The information from this study was reported in Reclamation's 2012 Annual Report to the NOAA Fisheries Service.

Reclamation also performed routine water sampling across the region. Reclamation monitored nutrients in the drains that return water to Lake Lowell to identify the effects of added nutrients on the water quality in Lake Lowell. In 2013, Reclamation performed routine water quality sampling at Jackson Lake, Island Park, Little Wood, American Falls, Deadwood, Arrowrock, Anderson Ranch, Beulah, Ririe, Phillips, Grassy, Palisades, Owyhee, Black Canyon, Thief Valley, Bully Creek, Lake Lowell, Cascade, Unity, Warm Springs, and Walcott reservoirs. This sampling was performed as part of an ongoing regional reservoir sampling regime and invasive species monitoring (zebra/quagga mussels). Similar sampling is scheduled for the 2014 field season. The conditions at American Falls Reservoir triggered sediment and nutrient monitoring in 2013. 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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