RECLAMATION

*Managing Water in the West*

# 2017 Annual Report for Activities under the Endangered Species Act Biological Opinion

**(For the period October 31, 2016 to December 31, 2017)**

**Lewiston Orchards Project, Lewiston Idaho**
**Submitted to the National Marine Fisheries Service**
**Boise, Idaho**

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

**May 2018**

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.

*Front cover photograph – Sweetwater Creek looking upstream from the Sweetwater Diversion on the Lewiston Orchards Project*

# Acronyms and Abbreviations

| | |
|---|---|
| 2010 Opinion | National Marine Fisheries Service 2010 Biological Opinion under the Endangered Species Act |
| 2017 Opinion | National Marine Fisheries Service 2017 Biological Opinion for the Lewiston Orchards Project Water Exchange and Title Transfer |
| cfs | cubic feet per second |
| EPA | Environmental Protection Agency |
| ESA | Endangered Species Act |
| ESU | Evolutionarily significant units |
| IDEQ | Idaho Department of Environmental Quality |
| LOID | Lewiston Orchards Irrigation District |
| LOP | Lewiston Orchards Project |
| NMFS | National Oceanic and Atmospheric Administration National Marine Fisheries Service |
| Reclamation | U.S. Bureau of Reclamation |
| RPM | Reasonable and prudent measures |
| The Parties | Lewiston Orchard Irrigation District General Manager, Nez Perce Tribe Project Leader, and Reclamation's Project Manager |
| Tribe | Nez Perce Tribe |
| UI | University of Idaho |
| USGS | U.S. Geological Survey |

# CONTENTS

# Contents (continued)

## List of Figures

# CONTENTS (CONTINUED)



**List of Tables**

# 1. INTRODUCTION

On April 15, 2010, the National Oceanic and Atmospheric Administration National Marine Fisheries Service (NMFS) issued a 2010 Biological Opinion (2010 Opinion) under the Endangered Species Act (ESA) to the U.S. Bureau of Reclamation (Reclamation) for the operation and maintenance of the Lewiston Orchards Project (LOP). On July 11, 2017, NMFS issued a 2017 Biological Opinion (2017 Opinion) for the Lewiston Orchards Project Water Exchange and Title Transfer. This report is submitted to comply with Reasonable and Prudent Measure (RPM) 6 from the 2010 Opinion as well as RPM 4 from the 2017 Opinion, requiring Reclamation to report to the NMFS annually on activities related to implementing Opinions (NMFS 2010; NMFS 2017).

The 2010 Opinion requires that Reclamation provide minimum flows below the diversion dams as described in the proposed action. Reclamation may be required to provide additional flows from June through mid-September, based upon combined storage as of June 1 in Soldiers Meadow Reservoir and Reservoir A. The 2017 Opinion requires additional flows as the wells for the water exchange become operational. A summary of the multiple requirements and agreements can be found in the 2017 Annual Plan (Appendix A). This Annual Plan is developed cooperatively by the Lewiston Orchard Irrigation District (LOID) General Manager, Nez Perce Tribe Project Lead, Reclamation's Project Manager (the Parties).

Reclamation would like to point out that in Section 1.3.3 of the 2017 Opinion, NMFS noted that "How water in excess of minimum flows will be managed within the system will largely be dependent upon the water year." However, in Section 2.9.3 NMFS is suggesting Reclamation/LOID "provide additional instream flows to Sweetwater and Webb creeks in amounts equal to the sustainable productive rate of the well."

It should be noted the Parties' collective intent is to efficiently manage water supply in Sweetwater and Webb creeks to maximize benefits to both LOID patrons and ESA-listed steelhead. It is recognized by the Parties' that each water year is unique and in dry years, it is possible there will not be enough physical water in the system to equal the sustainable productive capacity of the wells. To work through these uncertainties, the Parties meet annually to develop the Annual Plan which establishes water exchange amounts at each diversion point specific to that water year. In 2017, exchange amounts as agreed upon in the Annual Plan, were fully met.

As a result of court-sponsored mediation in January 2011, Reclamation agreed to provide 90 acre-feet of LOP water annually to supplement instream flows in both Sweetwater and Webb creek. The 90-acre-feet is timed to be released during normal operation periods in accordance with the direction of the Nez Perce Tribe (Tribe).

This annual report covers the LOP operation and maintenance activities from October 31, 2016 to December 31, 2017 for published streamflows, irrigation operations, and fisheries monitoring. The LOID operated the surface water collection system from March 13, 2017, until October 31, 2017.

To enhance the project's ability to consistently meet minimum flow requirements, Reclamation and the LOID continue to operate and maintain water measurement and gate automation equipment at the headgates to Sweetwater Canal and Webb Creek Diversion Dam. The gate automation equipment continually self-adjusts to maintain minimum streamflow past the diversion dam. Gate automation greatly improves LOP's ability to maintain flow targets and minimize daily variability related to operations.

No injuries or mortalities of ESA-listed steelhead, associated with operations, were observed during the 2017 reporting period.

# 2. RPM 1: Flow Management

## 2.1 Minimum Bypass Streamflow Requirements in Sweetwater and Webb Creeks

### 2.1.1 Background

RPM 1 of the 2010 and 2017 Opinions require LOP operations to bypass flows in Sweetwater and Webb creeks based on the life stage of steelhead. The minimum daily bypass flows for Sweetwater and Webb creeks are shown in Table 1.

**Table 1. Instream flow minimum releases (cubic feet per second [cfs]) for Sweetwater and Webb creeks at their respective diversion dam sites (NMFS 2010).**

| Life Stage | Spawning | | | Juvenile Rearing | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Month** | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep 1-15 | Sep 16-30 | Oct | Nov Dec Jan |
| **Sweetwater Creek** | 7.8/I[b] | 7.8/I | 7.8 | 3.0 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | I[a] |
| **Webb Creek** | 4.0/I[b] | 4.0/I | 4.0 | 1.5 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | I[a] |

[a] During November, December, and January, all inflow (I) at Sweetwater and Webb Creeks Diversion Dams will be bypassed.
[b] During February and March, either the specified streamflow will be provided or all inflow (I) to the Sweetwater and Webb Creek Diversion Dams will be bypassed, whichever is less.

The instream flow regime in Table 1 addresses all months of the year. These flows will be used to support spawning conditions during February through April and juvenile rearing conditions from May through January. The LOP will not operate the Sweetwater and Webb Diversion Dams during November, December, and January; therefore, all instream flow reaching the dams will be bypassed during those months. During February and March, if the inflows to either Sweetwater or Webb Diversion Dams are below the specified minimum flow, the LOID will bypass all inflow (I) to that diversion dam until it reaches the specified targets before beginning any diversions. In October the specified minimum flows will be passed when the diversion dams are in operation. When the diversion dams are turned off for the season, all inflow will be bypassed. For Webb Creek, the “I” flow is composed of all runoff from the watershed upstream of the diversion and below Soldiers Meadow Dam. For Sweetwater Creek, the “I” flow is composed of all runoff from the watershed upstream of the dam, except for any diversions occurring at the West Fork diversion which are being conveyed to Lake Waha (NMFS 2010).

In addition, Reclamation may supply additional flows into Sweetwater and Webb creeks for June through mid-September, based on the combined storage in Soldiers Meadow Reservoir and Reservoir A, as assessed on June 1. The additional increments allocated for Sweetwater and Webb creeks, and the storage conditions under which they would occur, are shown in Table 2. As of June 1, 2017, the combined storage was greater than 4,250 acre-feet. The additional 1.0 cfs for both Sweetwater and Webb creeks can be seen in Table 3.

**Table 2. Increments of additional juvenile rearing flow as a function of combined storage for June 1 through September 15 (NMFS 2010).**

| **Combined Storage (acre-feet)** | <3,800 | 3,900 | 4,000 | 4,100 | 4,200 | >4,250 |
|---|---|---|---|---|---|---|
| **Sweetwater Creek (cfs)** | +0 | +0.5 | +0.9 | +1.0 | +1.0 | +1.0 |
| **Webb Creek (cfs)** | +0 | +0 | +0 | +0.3 | +0.8 | +1.0 |
| **Total Flow (cfs)** | 3.50 | 4.00 | 4.40 | 4.80 | 5.30 | 5.50 |

**Table 3. Total flows required in Sweetwater and Webb Creek with the additional volume and incremental add-in flows.**

| 2017 - Current as of 6/01/17 | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Life Stage | Spawning | | | Juvenile Rearing | | | | | | | |
| Month | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep 1-15 | Sep 16-30 | Oct | Nov, Dec, Jan |
| Sweetwater Creek Base ByPass Flows | 7.8* | 7.8* | 7.8 | 3.0 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | Bypass |
| Incremental Add-In | 0.0 | 0.0 | 0.0 | 0.0 | 1.0 | 1.0 | 1.0 | 1.0 | 0.0 | 0.0 | |
| Total Sweetwater Creek ByPass Flows | 7.8 | 7.8 | 7.8 | 3.0 | 3.5 | 3.5 | 3.5 | 3.5 | 2.5 | 2.5 | |
| | | | | | | | | | | | |
| Webb Creek Base ByPass Flows | 4.0* | 4.0* | 4.0 | 1.5 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | Bypass |
| Incremental Add-In | 0 | 0 | 0 | 0 | 1.0 | 1.0 | 1.0 | 1.0 | 0.0 | 0.0 | |
| Total Webb Creek ByPass Flows | 4.0 | 4.0 | 4.0 | 1.5 | 2.0 | 2.0 | 2.0 | 2.0 | 1.0 | 1.0 | |

In 2014, the U.S. District Court issued an order staying litigation through January 2020 in the ESA case, Nez Perce Tribe vs. National Oceanic and Atmospheric Administration Fisheries and the Bureau of Reclamation. The order is based on a 2014 Term Sheet memo that provides a framework for collaboration to address issues related to the LOP. The principal component of the 2014 Term Sheet Agreement is to advance the Lewiston Orchards Water Exchange and Title Transfer Project as a comprehensive solution to LOP system issues concerning ESA-listed steelhead, Tribal cultural and natural resources, and irrigation water supply reliability.

The Water Exchange and Title Transfer Project involves incrementally replacing the existing surface water system, located primarily on the Nez Perce Reservation, with an off-Reservation groundwater system comprised of multiple wells. As groundwater wells come online, diversion of surface water from LOP are reduced in an amount equal to an agreed upon in-lieu water exchange quantity, to be left instream for the direct benefit of ESA-listed steelhead. Once full surface water supply is exchanged, title transfer to LOID and the Bureau of Indian Affairs in trust for the Tribe may occur.

The first groundwater well (pilot well or Well No. 5) was completed in November 2016 and tested in January 2017. Final testing resulted in a full well production capacity of approximately 4.5 cfs (2,000 gallons per minute or 9 acre-feet per day).

To develop a strategy with multiple benefits including establishing water exchange in the critical months for steelhead spawning/rearing and recognizing LOID's domestic component, the Parties collaboratively developed water exchange amounts at each diversion point.

The exchange flows for each month in Table 4 were determined recognizing the value in managing the instream flows to maximize the designated instream habitat, rather than bypassing a consistent monthly amount throughout the irrigation season. The monthly exchange flows allow for more flexible water management capabilities, allowing more than

4.5 cfs to be left instream in the more critical fish habitat months, and recognizing LOID's domestic component for Well No. 5.

**Table 4. Total flows with water exchange flows added in for Sweetwater and Webb creeks.**

| 2017 - Current as of 6/01/17 | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Life Stage | Spawning | | | Juvenile Rearing | | | | | | | |
| Month | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep 1-15 | Sep 16-30 | Oct | Nov, Dec, Jan |
| Sweetwater Creek Base ByPass Flows | 7.8* | 7.8* | 7.8 | 3.0 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | Bypass |
| Incremental Add-In | 0.0 | 0.0 | 0.0 | 0.0 | 1.0 | 1.0 | 1.0 | 1.0 | 0.0 | 0.0 | |
| Water Exchange Flows | 2.2 | 2.2 | 1.0 | 2.0 | 1.5 | 1.5 | 1.0 | 1.0 | 1.0 | 1.0 | |
| Total Sweetwater Creek ByPass Flows | **10.0** | **10.0** | **8.8** | **5.0** | **5.0** | **5.0** | **4.5** | **4.5** | **3.5** | **3.5** | |
| | | | | | | | | | | | |
| Webb Creek Base ByPass Flows | 4.0* | 4.0* | 4.0 | 1.5 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | Bypass |
| Incremental Add-In | 0 | 0 | 0 | 0 | 1.0 | 1.0 | 1.0 | 1.0 | 0.0 | 0.0 | |
| Water Exchange Flows | 2.3 | 2.3 | 2.3 | 5.5 | 3.8 | 1.5 | 1.5 | 1.5 | 1.5 | 1.5 | |
| Total Webb Creek ByPass Flows | **6.3** | **6.3** | **6.3** | **7.0** | **5.8** | **3.5** | **3.5** | **3.5** | **2.5** | **2.5** | |

The proposed action states that Reclamation will monitor daily mean streamflows whenever the LOID is diverting water. Currently, one-hour averages are posted for Sweetwater and Webb creeks onto Reclamation's public Hydromet page. The 2010 Opinion describes the minimum flows as a mean daily average, with criteria that flows be adjusted when they fall more than 20 percent below the target as monitored on an hourly basis.

In past water years, Reclamation and LOID installed gate automation and water measurement equipment at the Sweetwater Diversion Dam and Webb Creek Diversion Dam to improve the ability to measure and maintain the target minimum streamflows. Although the gate automation equipment substantially improved the project's ability to meet instream flow requirements, occasional operational problems occur with the mechanical and electrical equipment. Operation or technical limitations may occur when equipment malfunctions or debris catches at the structures or around the gates. Debris can physically prevent the gate from adjusting and/or cause inaccurate measurement due to backwatering near the gaging equipment that sends information to the gate controls.

## 2.1.2 Data Collection

The streamflow data are collected at one-hour intervals below the weirs at Sweetwater and Webb diversion dams. The automated data loggers record the bypass streamflow released over the compound weirs installed on the top of the diversion dams and the 4-foot weir located in the sluiceways. The data logger is located on the diversion dam. Reclamation posts data from these measurement points at http://www.pn.usbr.gov/hydromet.

All data collected during the irrigation season is provisional and could contain recording errors. The U.S. Geological Survey (USGS) and Reclamation reconcile the data at the end of irrigation season and post the data on the Hydromet at the end of the calendar year. The reconciled data is the official record.

## 2.2 Sweetwater Creek

### 2.2.1 Bypass Streamflow Results for Spring Spawning Period March 1 through May 31

It is important to note that the minimum flows are provided under the terms of the 2010 Opinion, which describes the minimum flows as a mean daily average, with criteria that flows be adjusted when they fall more than 20 percent below the target. These criteria recognize that some fluctuations are expected while meeting the target minimum flows. The Sweetwater Diversion operated from March 13, 2017 to September 28, 2017. There were a few large spikes in mid-March and then in early May due to high runoff. There was a period in early February before LOID began operating that inflows were below the target flows. LOID is not required to supplement inflows to meet target flows when they are not operating. While LOID was operating during the spring spawning period, LOID met the Opinion's required flows and the added water exchange flows as seen in Figure 1. The raw data for both the hourly and daily flows can be found in Appendix B. This appendix notes the target bypass flow rates and the corresponding hourly rate in Sweetwater Creek.

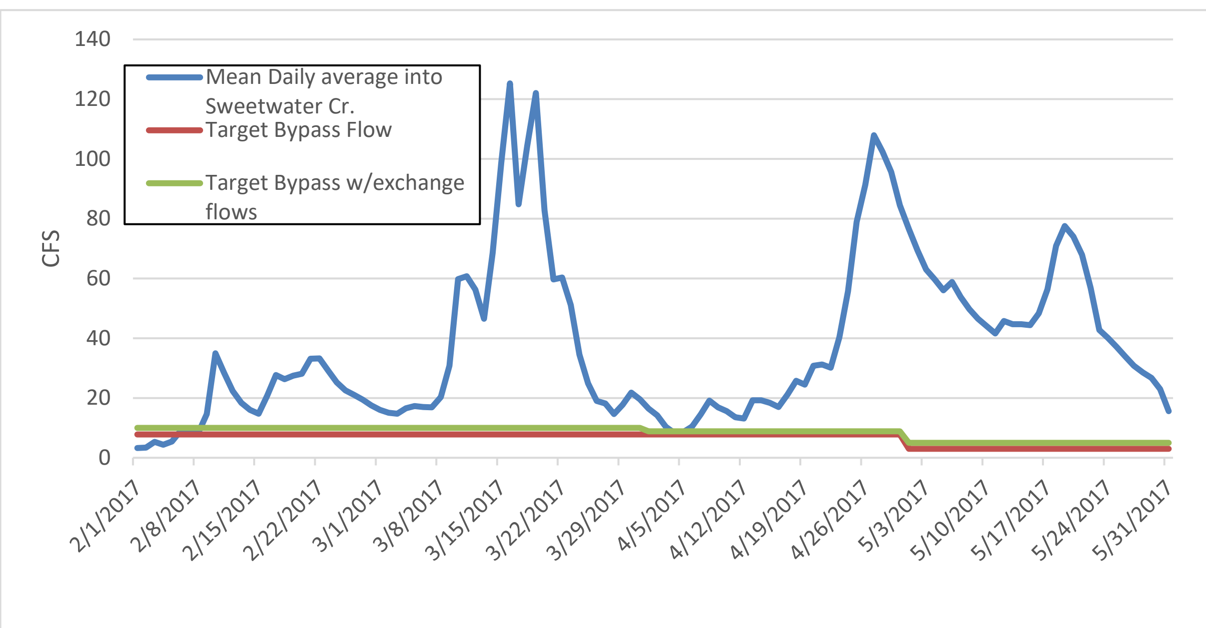



**Figure 1. Mean daily streamflow (cfs) measured past the Sweetwater Diversion Dam and bypass flow targets and flow targets with water exchange flows for February 1 to May 31, 2017.**

### 2.2.2 Bypass Streamflow Results for Juvenile Rearing Period June 1 through October 31

Minimum streamflows for juvenile rearing in Sweetwater Creek are 2.5 cfs. Additional juvenile rearing flows are made available based on combined reservoir volumes of Soldiers Meadows and Reservoir A as of June 1 (Table 2). On June 1, the combined storage of Soldiers Meadows and Reservoir A were greater than 4,250 acre-feet thus adding additional juvenile rearing flows, in Sweetwater Creek between June 1 and October 31. In 2017, the incremental flows were added to Sweetwater Creek and Webb Creek as shown in Table 2. The additional water exchange flows were released into Sweetwater Creek according to Table 4 during June to September as seen in Figure 2. The combined flows resulted in minimum flow targets for June through July at 5.0 cfs; August through September 15 at 4.5 cfs; September 16 through October at 3.5 cfs. During the juvenile rearing period, LOID met the Opinion's required flows and met the added water exchange flows as seen in Figure 2.

There were some gaging issues that started on July 31, 2017 at 12:30 p.m. A bug infestation occurred in the equipment monitoring the instream flow below Sweetwater Diversion causing errors in stage height and cfs readings. The bugs caused a pressure build up artificially increasing the pressure on the sensor. As the pressure increased, the bugs would periodically get pushed out and the sensor would work again until the bugs moved back in or fixed their nest again. This problem was fixed this on August 10, 2017. The data was cleaned up as best as it could be. The raw data can be found in Appendix B.

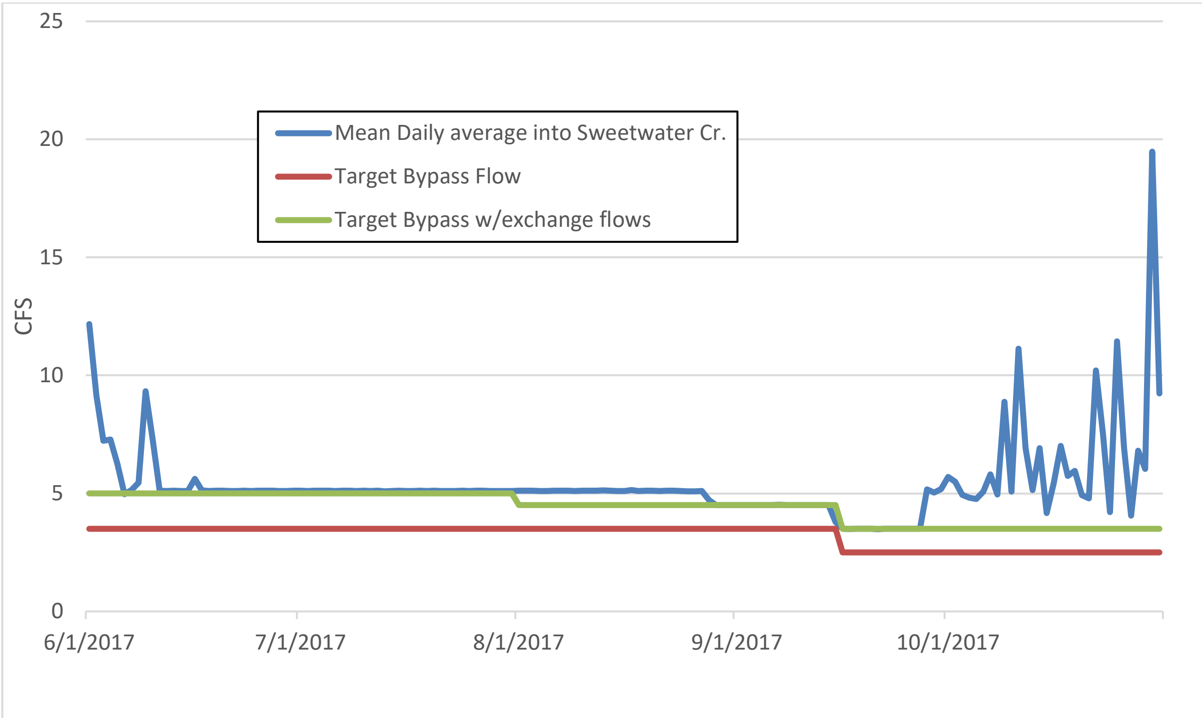



**Figure 2. Mean daily streamflow (cfs) measured past the Sweetwater Diversion Dam and bypass flow targets and flow targets with water exchange flows for the second half of the irrigation season (June 1 through October 31, 2017).**

## 2.3 Webb Creek

### 2.3.1 Minimum Bypass Streamflow Requirements in Webb Creek

The Webb Creek Diversion was operated from April 5, 2017, until October 12, 2017. Measured streamflows, in relation to the bypass flow targets and the added in water exchange flows are shown in Figure 3. Minimum flow targets with water exchange flows for 2017 were 6.3 cfs in February, March, and April; 7.0 cfs in May; 5.8 cfs in June; 3.5 cfs July through September 15; and 2.5 cfs September 16 through October. LOID met the Opinion's required flows and met the added water exchange flows as seen in Figure 3. Similar to Sweetwater Creek, there was a period in early February before LOID began operations that inflows were below target flows. The raw data for both the hourly and daily flows can be found in Appendix B. This appendix notes the target bypass flow rates and the corresponding hourly rate in Webb Creek.

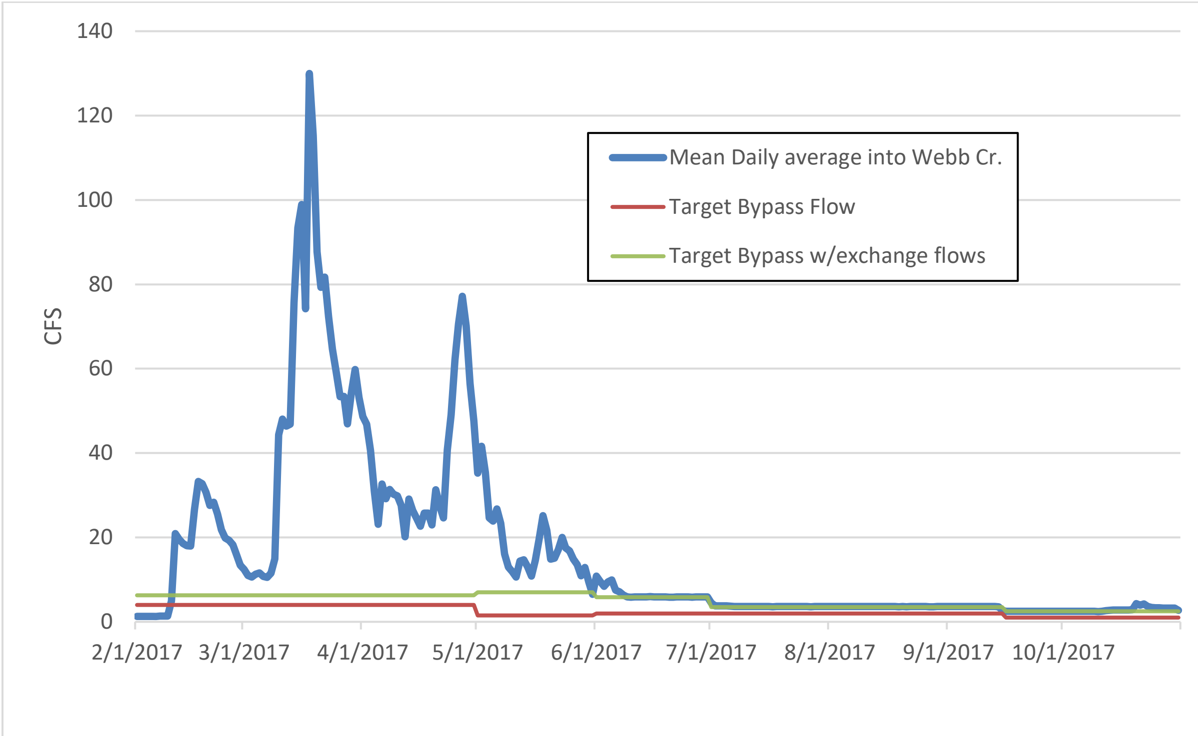



**Figure 3. Mean daily streamflow (cfs) measured past the Webb Creek Diversion Dam for the 2017 irrigation season.**

## 2.4 Well 5 Production

Well 5 began providing water to the LOID system in January 2017. While LOID is diverting water (March through October of 2017) additional water is left instream as decided by the Parties in each year's Annual Plan. Term and Condition 3b from the 2017 Opinion requires a monthly calculation to ensure the level of take is not exceeded (Table 5). Flow is used as a surrogate for take and there should not be a reduction in Snake River flows of more than 18 cfs below baseline. This equates to a positive 18 cfs in the last column of Table 5. With LOID's ability to discretionally operate the well and 2017 being a good water year, there was always more flow being bypasses below the diversions than being pumped by the existing well.

**Table 5. Mean monthly well production and bypass flows. "I" indicates all inflows were bypassed. Production minus bypass did not exceed +18 cfs in 2017.**

| Month | Mean Monthly Well Production (cfs) | Mean Monthly Sweetwater Bypass Flow (cfs) | Mean Monthly Webb Bypass Flow (cfs) | Total Bypass Flow (cfs) | Production – Bypass Not to Exceed +18 (cfs) |
|---|---|---|---|---|---|
| January | 3.75 | I[a] | I[a] | I[a] | NA |
| February | 1.48 | I[a] | I[a] | I[a] | NA |
| March | 0 | 45.68 | 53.01 | 98.69 | -98.69 |
| April | 0 | 35.16 | 37.54 | 72.7 | -72.70 |
| May | 0 | 49.32 | 18.26 | 67.58 | -67.58 |
| June | 0 | 5.9 | 6.63 | 12.53 | -12.53 |
| July | 0 | 5.1 | 3.66 | 8.76 | -8.76 |
| August | 3.47 | 5.04 | 3.6 | 8.64 | -5.17 |
| September | 3.64 | 4.14 | 3.02 | 7.16 | -3.52 |
| October | 0.18 | 6.76 | 2.95 | 9.71 | -9.53 |
| November | 0 | I[a] | I[a] | I[a] | NA |
| December | 0.31 | I[a] | I[a] | I[a] | NA |

[a] During November, December, and January, all inflow (I) at Sweetwater and Webb Creeks Diversion Dams will be bypassed.

## 2.5 Ramping Rates

Ramping flows were incorporated into the proposed action and described in Reclamation's 2009 Biological Assessment (Reclamation 2009, pages 4 through 11). The ramping rates were modified for the 2017 water year to help operational issues which were negatively affecting flows in the stream system. In a letter dated June 14, 2017, NMFS the benefits to steelhead and concluded that "the adjusted action will not result in any effects to Snake River Basin steelhead or their critical habitat that were not previously considered in the 2010 Opinion" (Thom 2017). Ramping will occur during the start of the irrigation period; the down-ramping from spawning flows to juvenile rearing flows on May 1; the end of the irrigation season; and any other time during the irrigation season for scheduled operation or maintenance purposes. Ramping rates were identified to simulate natural conditions of the stream as much as possible. The 2017 ramping rates can be seen in Table 6.

**Table 6. The 2017 ramping rates for Sweetwater and Webb creeks.**

**Ramping Water into the Stream Below Diversion**

| | | Max cfs Ramp | |
|---|---|---|---|
| 0.00 | 4.00 | 2.00 | Per Day |
| 4.01 | 12.00 | 4.00 | Per Day |
| 12.01 | 25.00 | 6.00 | Per Day |
| 25.01 | or Greater | 10.00 | Per Day |

**Ramping Water into the Canal**

| | | Max cfs Ramp | |
|---|---|---|---|
| 0.00 | 4.00 | 1.00 | Per Day |
| 4.01 | 8.00 | 2.00 | Per Day |
| 8.01 | 15.00 | 3.00 | Per Day |
| 15.01 | 30.00 | 5.00 | Per Day |
| 30.01 | or Greater | 10.00 | Per Day |

There is some confusion regarding ramping related to the daily fluctuations of streamflow in Sweetwater and Webb creeks when gate changes are not being made at the facilities. Ramping is a requirement directly associated with gate changes (see excerpt from Reclamation 2009 below). Other fluctuations in streamflow occur naturally from climatic and precipitation conditions and these fluctuations in streamflow would be natural hydrologic conditions in the stream.

> *Proposed Action (Reclamation 2009, pages 4 through 11)*
>
> "Ramping of streamflows is intended to make gradual changes during gate operations that avoid stranding fish in dewatered or pooled areas when streamflows are reduced (diversion gates opened) or flushing fish downstream when increasing streamflows (diversion gates closed). These gradual alterations in streamflow are intended to allow fish that are rearing in the streams sufficient time to adjust to changes in stream habitat. Streamflow ramping will be implemented at the Sweetwater and Webb diversion headgates during the following periods: initial opening of the headgates at the start of the irrigation season; down-ramping from spawning flows to juvenile rearing flows on May 1; during the end of the irrigation season when the headgates are closed; and any other time that the headgates are opened or closed during the irrigation season for operation or maintenance purposes."

In 2017, there are instances where streamflows fluctuate but are not associated with gate changes and therefore are not subject to ramping criteria. Some instances occur naturally as the system fluctuates during spring runoff and hydrologic events; other instances are caused by mechanical failures and can be evaluated on a case-by-case basis.

## 2.6 Gravel Management Activities

Maintenance of the Sweetwater Creek Diversion Dam requires periodic removal of sediment that accumulates behind the dam, typically conducted every 4 to 6 years. Sediment removal did not occur in 2017.

# 3. RPM 2: Connectivity Monitoring

On July 14, 2010, Reclamation submitted its connectivity monitoring plan to NMFS as required by Term and Condition 2 of the 2010 Opinion. Measurements in Sweetwater Creek were discontinued after 2012 with no connectivity issues identified. To better understand channel connectivity conditions in Webb Creek, walk-through surveys were conducted in 2012 and 2013 on the lower 3.3 km of Webb Creek between the upper University of Idaho (UI) sampling site (UWU) and the mouth. The connectivity survey on Webb Creek was reported in Reclamation's 2012 and 2013 Annual Reports submitted in the springs of 2013 and 2014, respectively. No additional connectivity monitoring was conducted in 2017.

# 4. RPM 3: Streamflow Monitoring

Streamflows are measured at both the mouth of Sweetwater and Webb Creek via USGS streamflow gages. Gage number 13342340 is the mouth of Sweetwater and gage number 13342295 is the mouth of Webb Creek. These gages are monitored to validate fluctuations and/or erroneous readings caused by malfunctions at the diversion sites.

Mean daily streamflow ranged from 5.46 to 125.0 cfs at the mouth of Sweetwater Creek, and from 1.56 to 66.6 cfs at the mouth of Webb Creek during water year 2017. Hydrographs from these sites show that peak flows occurred during February through June, and low flows occurred from August through September (Table 7; Figures 4 and 5).

**Table 7. Mean monthly streamflow (cfs) measured from daily average data at the USGS monitoring gages at the mouth of Sweetwater and Webb creeks during water year 2017.**

| Sweetwater Creek at Mouth | | Webb Creek at Mouth | |
|---|---|---|---|
| **Month** | **Mean** | **Month** | **Mean** |
| Oct-16 | 8.37 | Oct-16 | 2.35 |
| Nov-16 | 6.97 | Nov-16 | 1.56 |
| Dec-16 | 6.26 | Dec-16 | 1.58 |
| Jan-17 | 5.46 | Jan-17 | 1.82 |
| Feb-17 | | Feb-17 | |
| Mar-17 | 125.0 | Mar-17 | 66.6 |
| Apr-17 | 87.0 | Apr-17 | 44.5 |
| May-17 | 80.3 | May-17 | 24.5 |
| Jun-17 | 21.1 | Jun-17 | 9.56 |
| Jul-17 | 10.4 | Jul-17 | 4.23 |
| Aug-17 | 9.91 | Aug-17 | 3.84 |
| Sep-17 | 9.36 | Sep-17 | 3.43 |

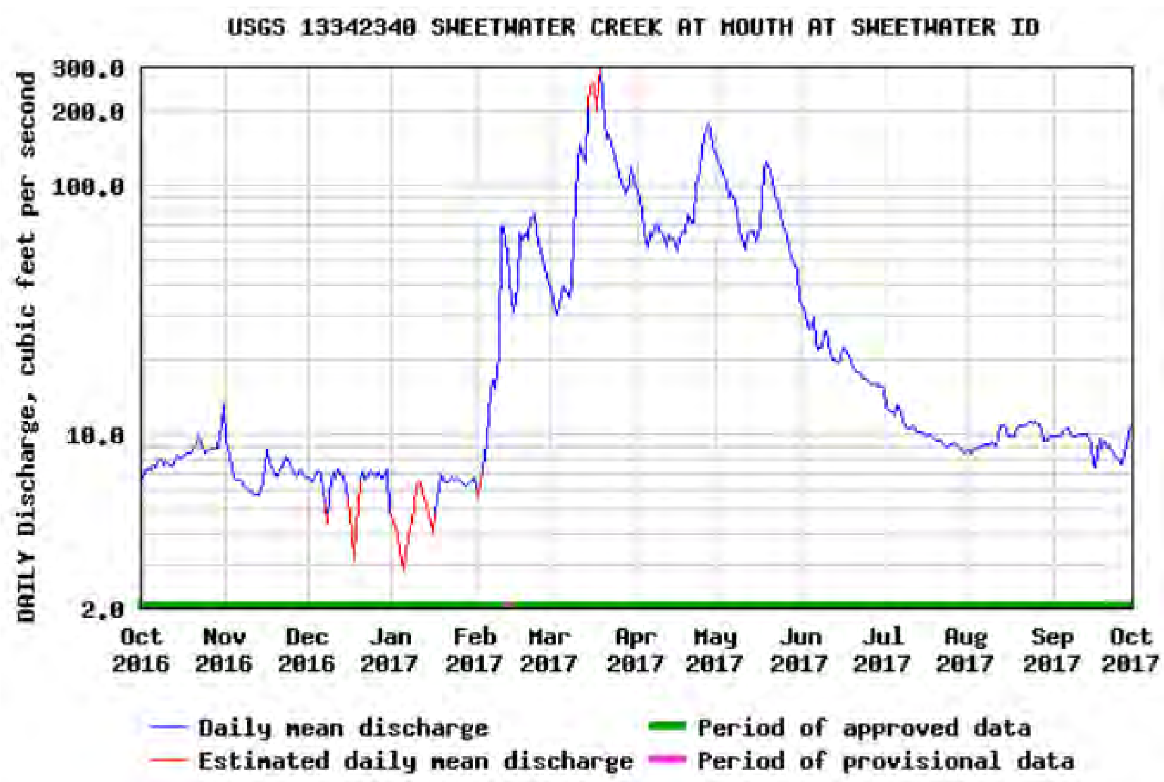



**Figure 4. Mean daily streamflows (cfs) measured near the mouth of Sweetwater Creek (USGS gage 13342340) during water year 2017.**


**Figure 5. Mean daily streamflows (cfs) measured near the mouth of Webb Creek (USGS gage 13342295) during water year 2017.**

Both graphs show the large variability in streamflows, even when LOID is not operating the diversion structures. The spring runoff and corresponding peak occurs in early February followed by the descending arm of the hydrograph in June. Flows continue on a downward trend through October. The year 2017 was a good water year with very good natural flow volumes. Some areas marked in red are estimated daily mean flows. These flows were estimated due to malfunctions in the gaging sites.

# 5. RPM 4: Monitoring Critical Uncertainties

RPM 4 requires Reclamation to monitor listed steelhead in areas of the Lapwai Basin impacted by the project and to address several critical uncertainties in relation to the project effects and the listed steelhead. As a result, Reclamation has collected information to address the critical uncertainties either directly, or through partnerships with either the State of Idaho, the Tribe, or the UI.

Reclamation completed the monitoring plan for steelhead densities and critical uncertainties on January 27, 2011 (Reclamation 2011). This steelhead monitoring project was started under RPM 3 of the 2006 Opinion and continues as RPM 4 in the 2010 Opinion. The RPM required Reclamation to monitor steelhead densities in the action area and to answer critical uncertainties regarding the effects of the action.

Reclamation had a multi-year agreement (Agreement Number R12AC11005) with the UI to research and monitor the effects of streamflow on the growth and survival of juvenile steelhead and address several of the critical uncertainties identified in the Opinion. That agreement ended May 31, 2015. A new agreement (Agreement Number R14AC00042) with the UI, which goes through May 31, 2019, has been put in place to continue the steelhead density monitoring described in the monitoring plan for steelhead densities and critical uncertainties. The data collected during 2017 is summarized in an annual report located in Appendix C. During these surveys, a total of 2,525 steelhead were captured during electroshocking. Total incidental mortality rate among all sites and visits during the 2017 sampling season was 0.44 percent.

PIT tag reading stations are being used to record the movement of tagged individuals. All systems use multiple antenna arrays (two or three) to determine direction of movement and detection efficiency. During 2017, PIT tag interrogation stations were operating at Lapwai, Sweetwater, Mission, and Webb. The downstream antenna at Mission Creek was washed away during high flows in spring of 2017. The upper antenna at mission Creek was also damaged and was collecting minimal data over the summer. Both antennas were replaced the week of October 23, 2017. The other stations did not experience any considerable downtime in 2017.

## 5.1 *O. mykiss* Density Monitoring

Monitoring of juvenile *O. mykiss* densities was scaled back starting in 2014 as the objectives transitioned from monitoring critical uncertainties to long-term density monitoring. Due to low steelhead abundance, poor access, inadequate reach representation, and other physical issues resulting in little or poor-quality data, monitoring was discontinued at two of the original six sites where sampling started in 2008. Reclamation and the UI exchanged these two, original long-term density monitoring sites with two of the sites developed by the UI in 2010. During a conference call on March 25, 2014, NMFS, UI, and Reclamation agreed on the six long-term monitoring sites that will be used until 2020.

Four of the original six sites remain, which include: ULU, UMU, UWM and LSX (Figure 6). The other two original sites, LLL and USM were replaced by sites that have been monitored by the UI since 2010. The LLL site experiences annual channel shifts due to spring high flows. This leads to shifts in steelhead densities that are linked more towards inter-annual changes in structural habitat conditions rather than temperature and flow conditions. Sampling at LLL is further complicated by the presence of spawning Coho in the fall. The USM site was inundated behind a beaver dam in the spring of 2010. Portions of the pool above the beaver dam were filled in with gravel in the spring of 2011, further complicating the site and reducing the viability of this site for meaningful long-term monitoring. The beaver dam no longer exists; however, due to the extreme habitat changes that have occurred since the original sampling in 2008, the UI and Reclamation have determined this site will no longer provide relevant, statistically viable data for inclusion into the overall monitoring framework.

Reclamation replaced LLL and USM with MLX and USU, respectively. MLX is more stable from year to year than LLL and has a lower likelihood of being influenced by spawning Coho. USU is also more stable than USM and is more representative of the available habitat within Sweetwater Creek. Even though LLL and USM were part of the original six sampling sites, habitat modifications described above limit the number of years of data that would be comparable to future sampling. Long-term density monitoring at MLX and USU will provide more meaningful data with regards to the critical uncertainties identified in Term and Condition 4 and will provide statistically valid data, allowing for long-term trend analysis. The density monitoring from 2014 through 2020 includes three sites located in Webb and Sweetwater Creeks (USU, UWM, LSX) that are influenced by the LOP water operations and three sites (MLX, UMU, ULU) that are not influenced by the project.

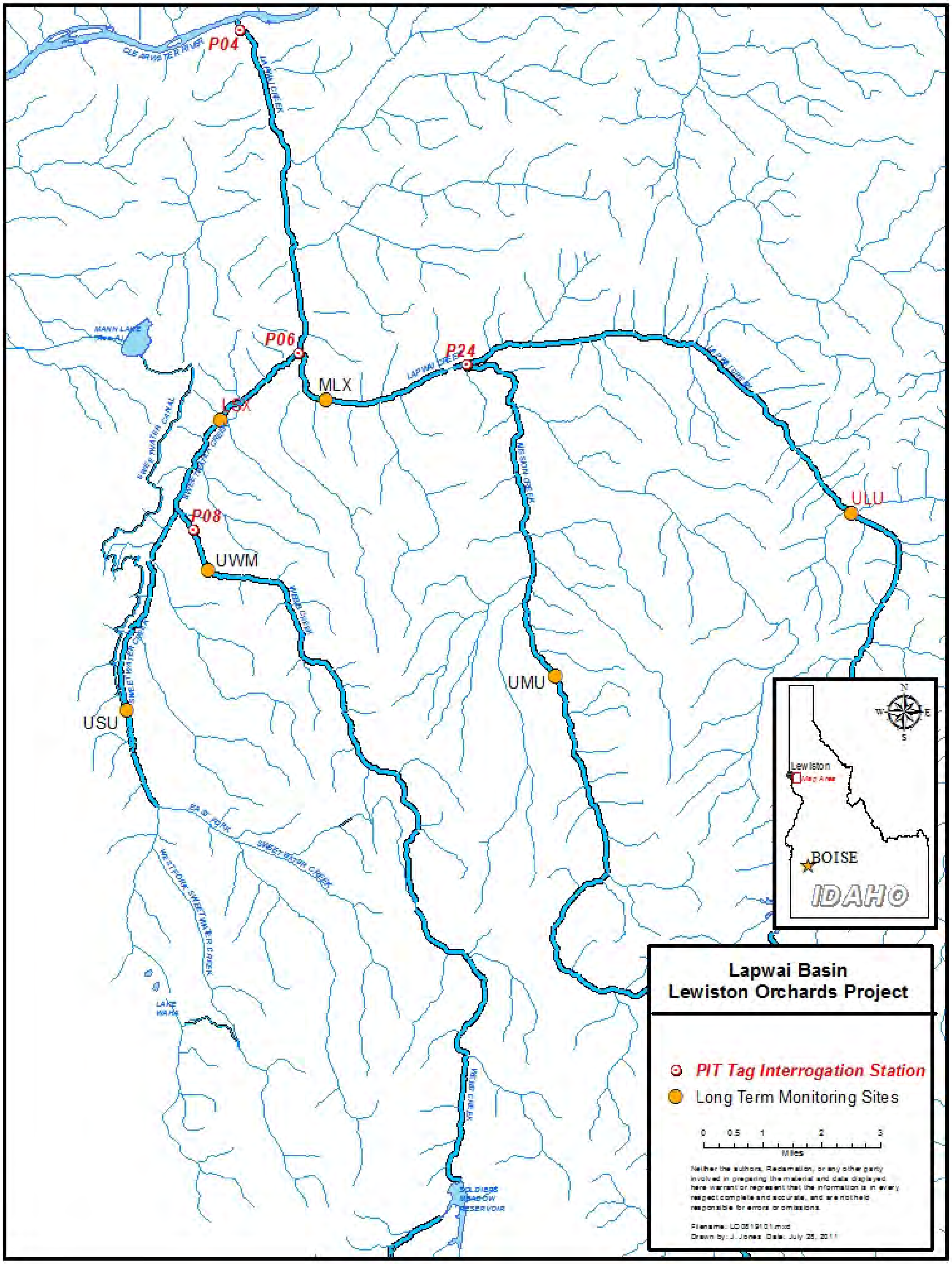



**Figure 6. Map of the Lapwai Basin showing the six long-term monitoring sites.**

Densities are based on abundance values estimated through three-pass depletion in stream reaches 100 meters in length. Reach-scale area is calculated from several measurements of reach width made within the study area at each sampling event. Stream area generally decreases from July to September, though this change has little influence on density estimates compared to change in fish abundance. The total densities estimated during August for young of year (0+) combined with older fish (1+) are shown in Figure 7 for 2010 through 2017.

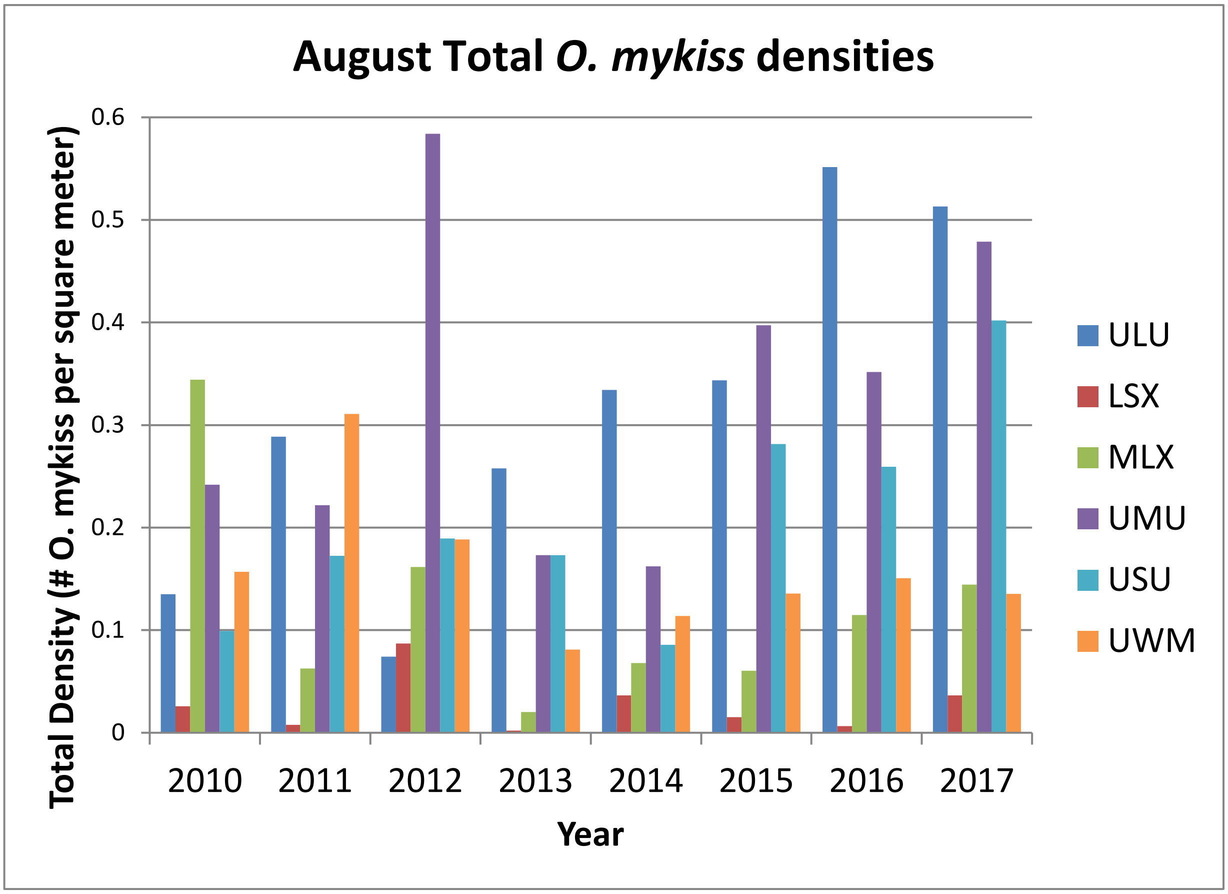



**Figure 7. Total *O. mykiss* densities at 6 monitoring sites during August 2010 through 2017. Site codes are: LSX (lower Sweetwater), MLX (Lapwai below Mission), ULU (upper Lapwai), UMU (upper Mission), UWM (upper Webb), and USU (upper Sweetwater).**

## 5.2 *O. mykiss* Adult Returns

In 2012, Reclamation entered into agreements with LOID and the Tribe to operate, maintain, and manage four PIT tag arrays in the Lapwai Basin to collect fish-movement data within the basin. The operation and maintenance of the four arrays provide tributary-scale data for populations in the Snake River evolutionarily significant units (ESUs); including the Lower Clearwater population. Data collected about escapement into this basin would be very informative in relation to the status of listed *O. mykiss* in the Snake River ESUs as well as the role and potential of Lapwai Creek at the spawning aggregate, local population, and larger ESU-level scales.

The 2017 adult PIT tag detections at the four Lapwai Basin instream arrays are summarized in an annual report to Reclamation from the Nez Perce Tribe Department of Fisheries Resource Management (Appendix D).

## 5.3 Water Quality and Temperature Monitoring

### 5.3.1 Introduction

The year 2017 was the 9$^{th}$ year for temperature monitoring in the Sweetwater and Webb creek drainages of the Lapwai watershed. Temperature monitoring continues to track and develop an understanding of temperature shifts, or lack thereof, as a result of discharge changes in the watersheds. The most pronounced changes noted in previous years were water year changes driven by climactic variables such as day time temperature or annual precipitation.

Temperature is integral to the life cycle of fish and other aquatic species. Different temperature regimes also result in different aquatic community compositions. Water temperature dictates whether a warm, cool, or cold-water aquatic community is present. The temperature of stream water usually varies on seasonal and daily time scales, and differs by location according to climate, elevation, extent of streamside vegetation, and the relative importance of groundwater inputs. Other factors affecting stream temperatures include solar radiation, cloud cover, evaporation, humidity, air temperature, wind, inflow of tributaries, and width-to-depth ratio. Anthropogenic factors affecting water temperature include riparian zone alteration, channel alteration, and flow alteration.

Diurnal temperature fluctuations are common in small streams, especially if stream-side shade is lacking, due to day versus night changes in air temperature and absorption of solar radiation during the day. Aquatic species distributions are restricted to certain temperature ranges; many respond more to the magnitude of temperature variation and amount of time spent at a particular temperature rather than an average value. Although species have adapted to cooler and warmer extremes of most natural waters, few cold-water taxa are able to tolerate very high temperatures. Reduced oxygen solubility at high water temperatures can compound the stress on fish caused by marginal dissolved oxygen concentrations. Indirect effects of elevated stream temperatures could include reduced growth and feeding, greater susceptibility to disease, and increased metabolic costs. However, most stream environments often have cold water refugia (such as areas with groundwater or spring inflows) that biota may utilize to reduce some of these effects.

Water quality criteria for temperature primarily focus on time of year and consider maximum temperature thresholds (either instantaneous or averaged) above which the water body is considered impaired. Alterations to the thermal regime of a water body may influence incubation time and growth rates of anadromous fish and other aquatic organisms in either a positive or negative manner. The Lewiston Orchards impoundments and diversions themselves do not act as heat sources, but rather they act to change the temperature regime within the drainages.

### 5.3.2 Monitoring

In 2008, Reclamation, as required by Term and Condition 4 of the 2010 Opinion, established monitoring stations throughout the Sweetwater, Webb, and lower portions of Lapwai Creek drainages. Water temperature monitoring has been conducted at most of these locations since that time. An additional temperature logger was installed at the Webb Canal Hydromet station in spring of 2014.

The current temperature monitoring in the LOP includes data loggers or Hydromet stations deployed at 13 of the monitoring locations to assess the changes in temperature that occur as water moves from the impoundments and springs in the headwaters to the lower reaches of Sweetwater Creek and into Lapwai Creek. In 2017, Reclamation had data loggers deployed at the following locations:

- Webb Creek (four loggers deployed, one Hydromet location) – Soldiers Meadow's outflow (logger and Hydromet), Webb Creek Diversion pool, near Webb Creek mouth, and the Webb Creek Canal Hydromet station (logger, Hydromet only collects flow).
- Upper Sweetwater Creek (three loggers deployed) – East Fork Sweetwater Creek, West Fork Sweetwater Creek, and below the Sweetwater Creek Diversion Dam
- Lower Sweetwater Creek (three loggers deployed) – upstream from confluence of Webb Creek, downstream from confluence of Webb Creek, near Sweetwater Creek mouth
- Lapwai Creek (three loggers deployed) – downstream from the confluence of Sweetwater Creek, upstream from the confluence of Sweetwater Creek, and near mouth of Lapwai Creek. The logger at the Tom Beal bridge was lost and will not be replaced.

The data loggers collect water temperature (degrees Celsius) data every 15 to 60 minutes. Reclamation or LOID staff downloads the data from the monitoring loggers every few months. Occasionally loggers are lost, dewatered, or buried due to flow events, channel reconfiguration, or vandalism. Periodic downloads minimize data lost due to these events. The data loggers used by Reclamation arrive from the factory pre-calibrated.

#### 5.3.2.1 Temperature Data Summary

Below is a summary of stream temperatures at the Reclamation and LOID-maintained locations throughout the three watersheds from January through December of 2017. Summary statistics for the available site data are presented below.

*Webb Creek*

Temperature data from the Webb Creek system available for 2017 at three locations. The first of these was just below the outfall from Soldiers Meadows Reservoir (Figure 8). Hydromet collects temperature data at 15-minute intervals at this location. Temperatures are consistent with data collected throughout the study and seems to be representative of the reservoir discharge.

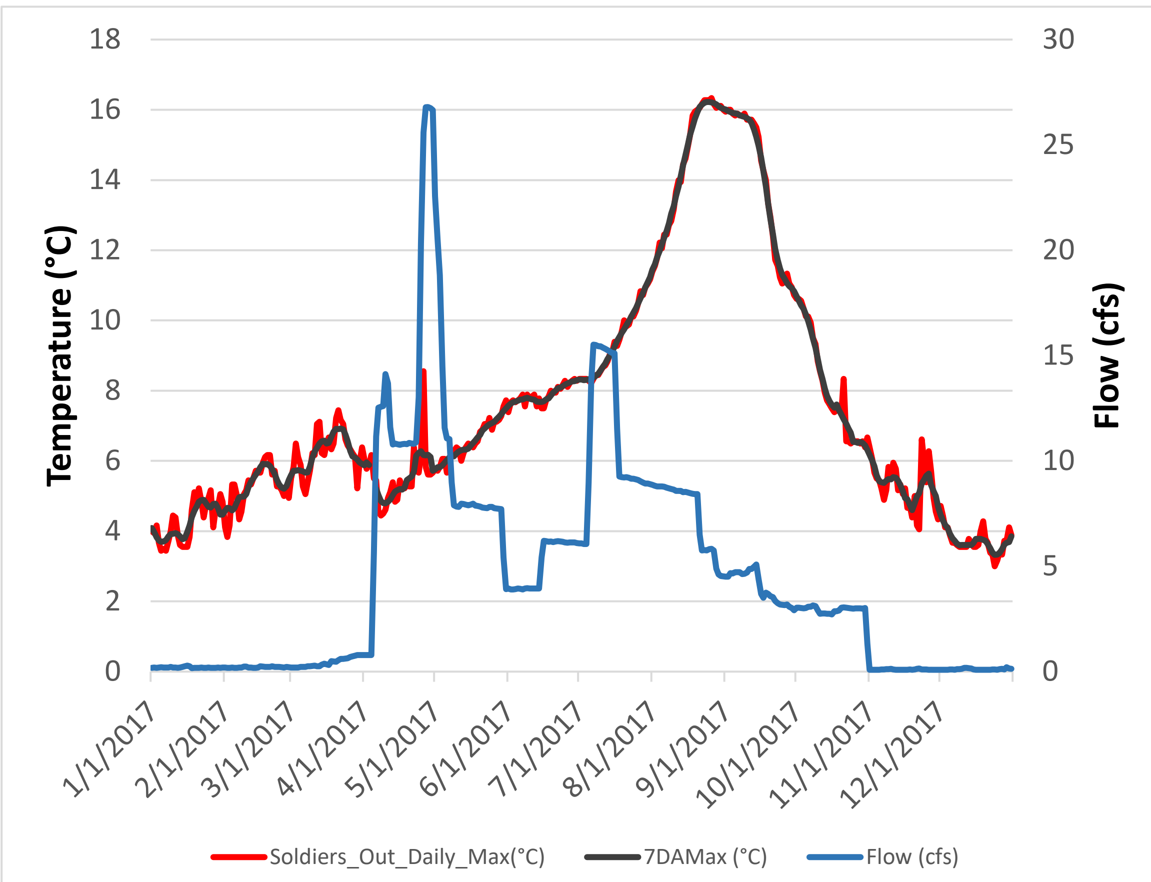



**Figure 8. Maximum daily stream temperature (ºC) and mean daily flow (cfs) measured near the outflow from Soldiers Meadow Reservoir during 2017.**

Daily average temperature variations during reservoir operations portion of the data set show daily variation was below 1°C (Figure 9). This is likely due to the modulating effect from the reservoir discharge, and likely corresponded to the temperature of the hypolimnion of the reservoir.

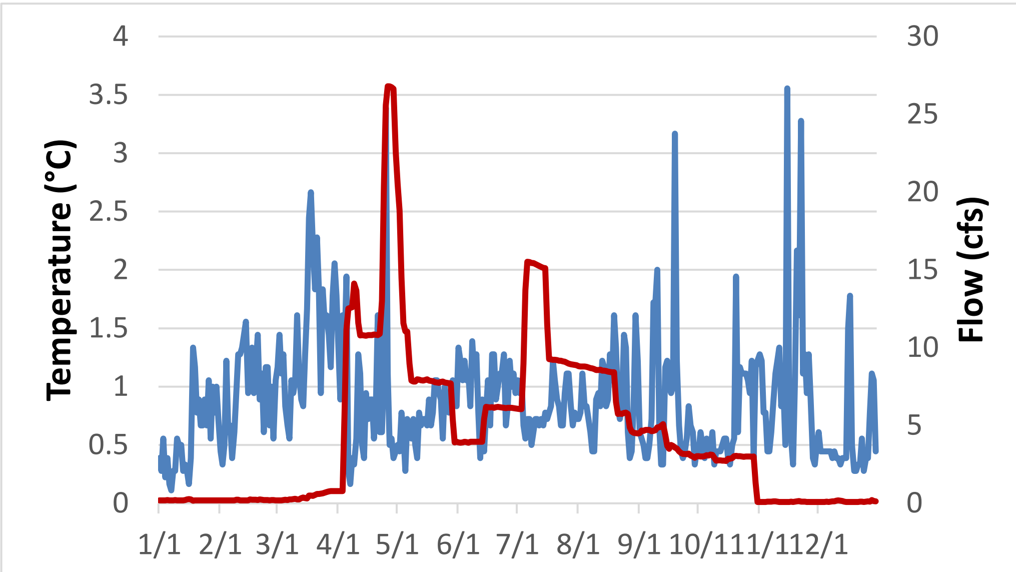



**Figure 9. Daily stream temperature variation (°C) measured near the outflow from Soldiers Meadow Reservoir 2017 (daily maximum – daily minimum).**

Reclamation collected data at a second location on Webb Creek at the diversion dam (Figure 10). This logger was buried in 2016 and replaced in spring of 2017.

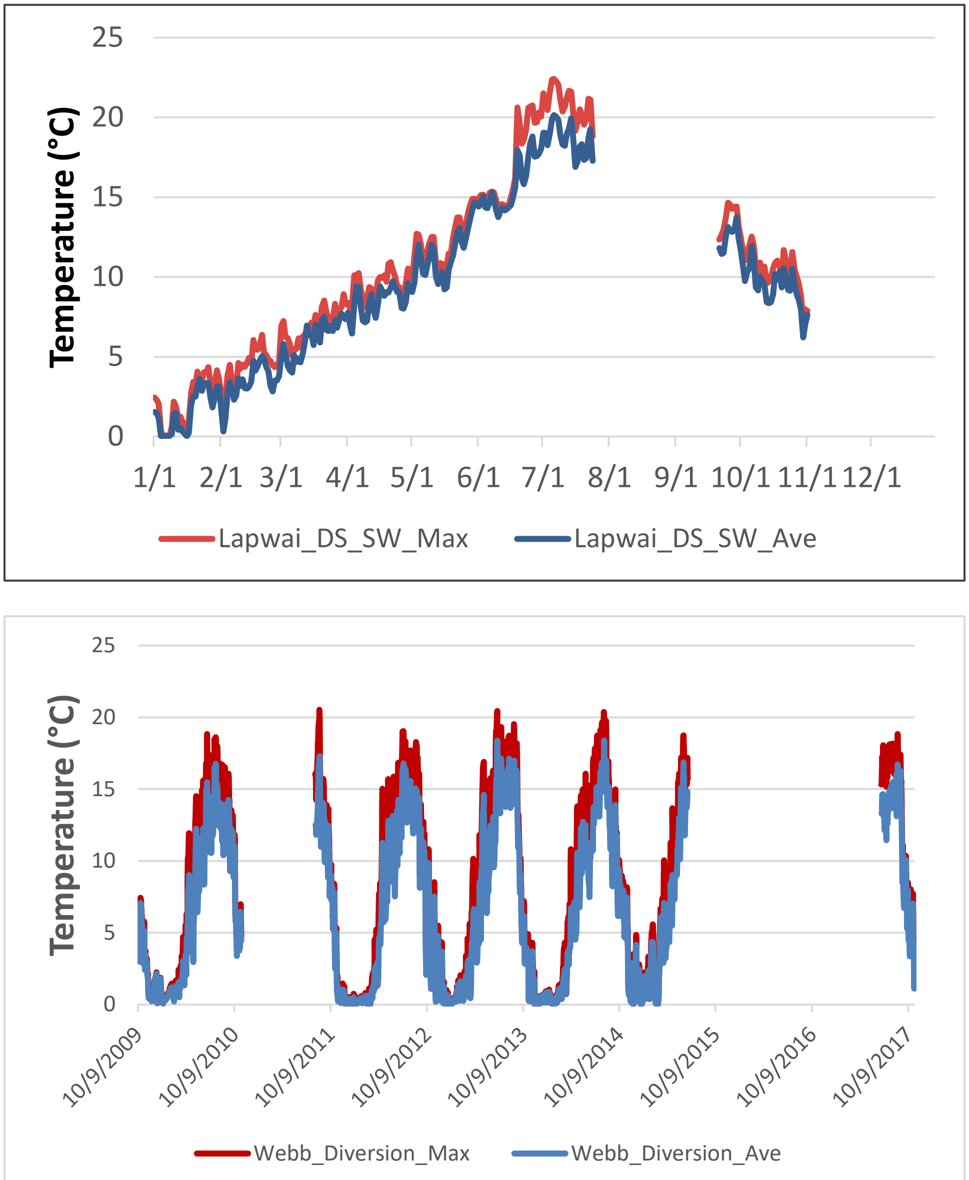



**Figure 10. Maximum and average daily stream temperature (ºC) measured at the Webb Creek diversion.**

Reclamation collected data at a third location on Webb Creek at the mouth of the system (Figure 11). Temperatures in 2017 were cooler than most of the previous years, but within the range of variability documented at this site.

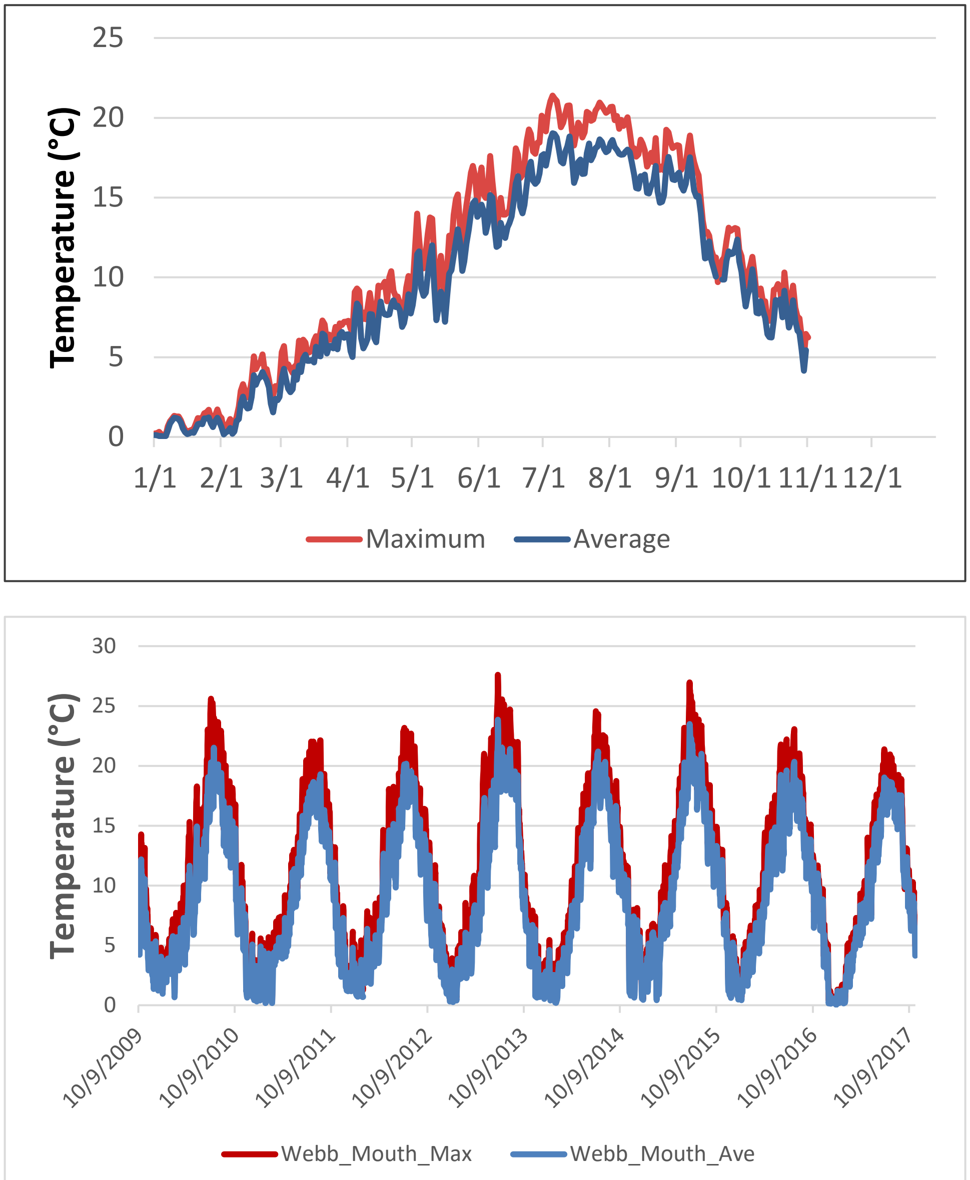



**Figure 11. Maximum and average daily stream temperature (ºC) measured near the mouth of Webb Creek.**

#### 5.3.2.2 Sweetwater Creek

Reclamation and LOID have temperature loggers in seven locations in the Sweetwater Creek system. The East Fork Sweetwater site was not able to be downloaded in 2016 and at a 15-minute logging interval the internal memory filled up and the logger stopped recording on

January 28, 2017. Therefore, the 2016 data was not presented in last year's report and is shown below in Figure 12 through Figure 16 below.

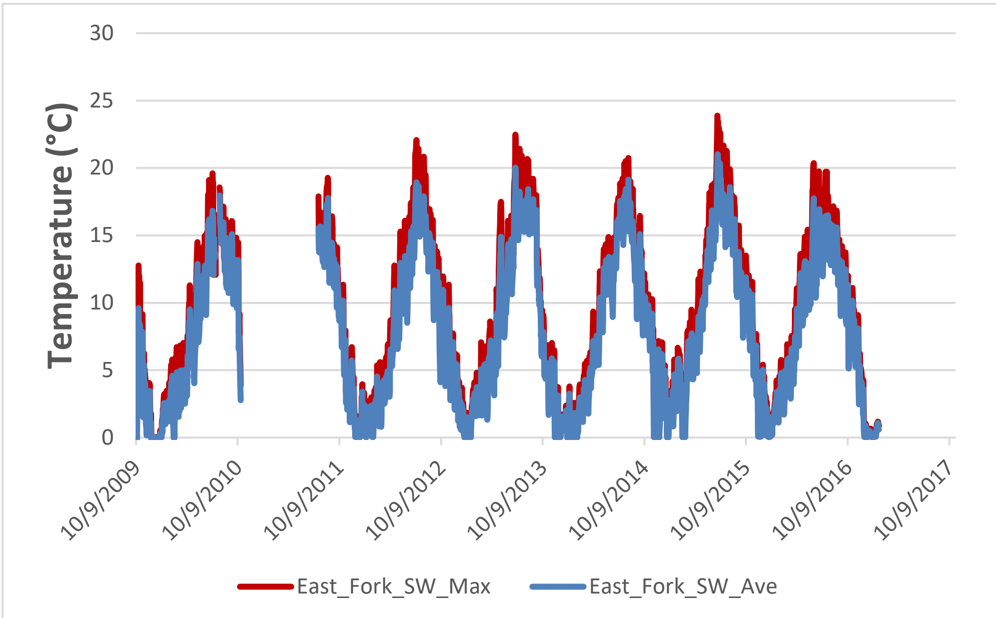



**Figure 12. Mean and maximum daily stream temperature (ºC) measured in the east fork of Sweetwater Creek just upstream of the confluence with the west fork.**

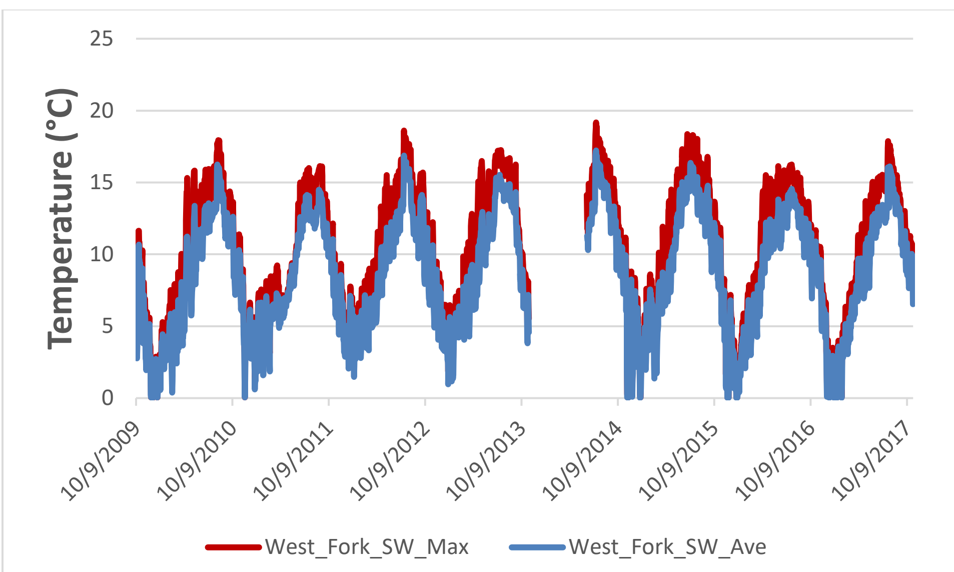



**Figure 13. Mean and maximum daily stream temperature (ºC) measured in the east fork of Sweetwater Creek just upstream of the confluence with the west fork.**

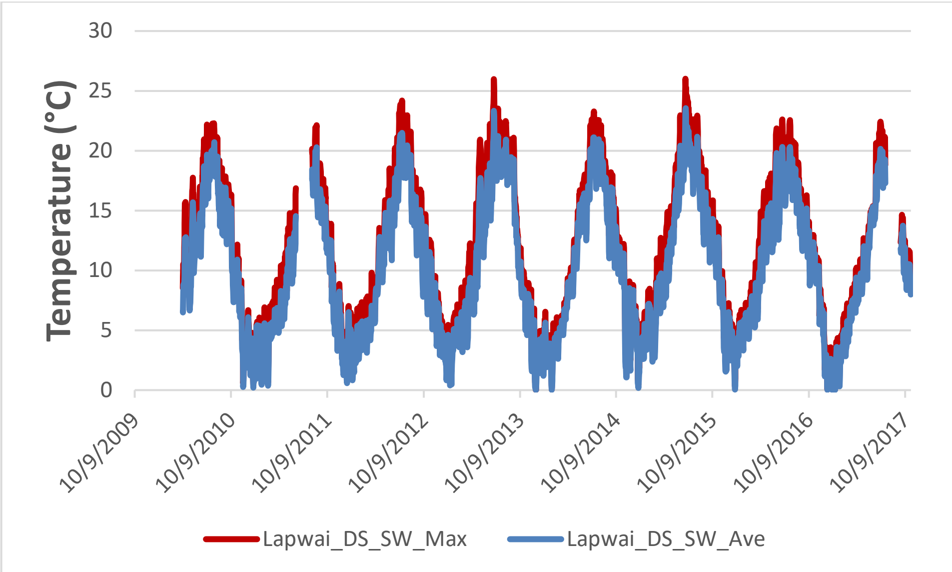



**Figure 14. Maximum daily stream temperature (ºC) measured in the east fork and west fork of Sweetwater Creek just upstream of the confluence.**

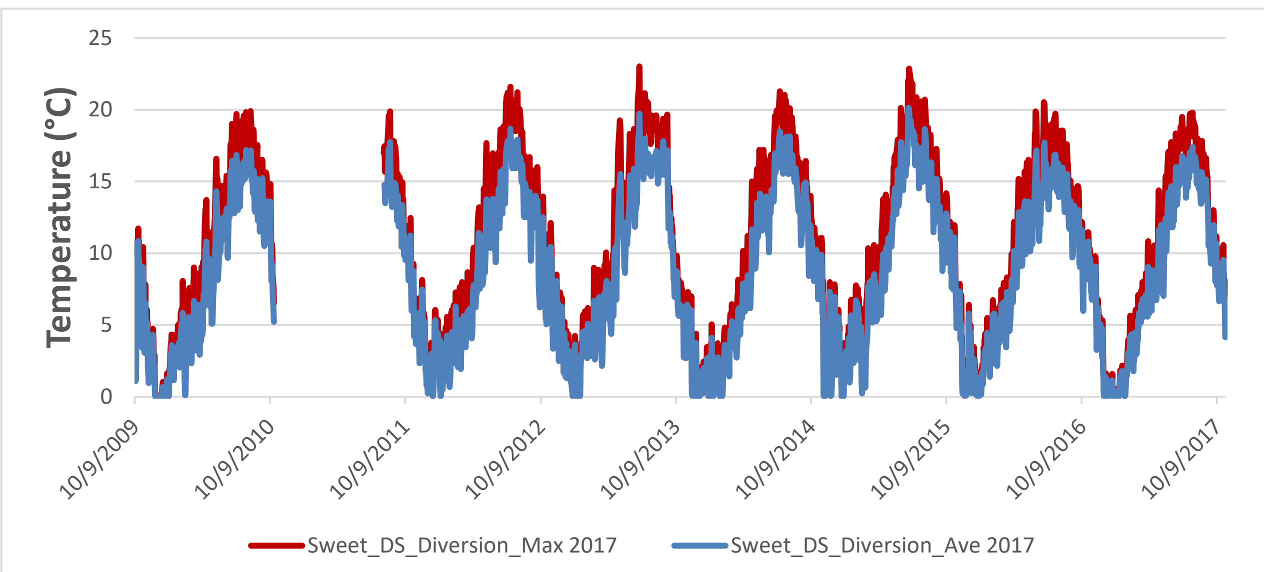



**Figure 15. Mean and maximum daily stream temperature (ºC) measured downstream from the Sweetwater Diversion.**

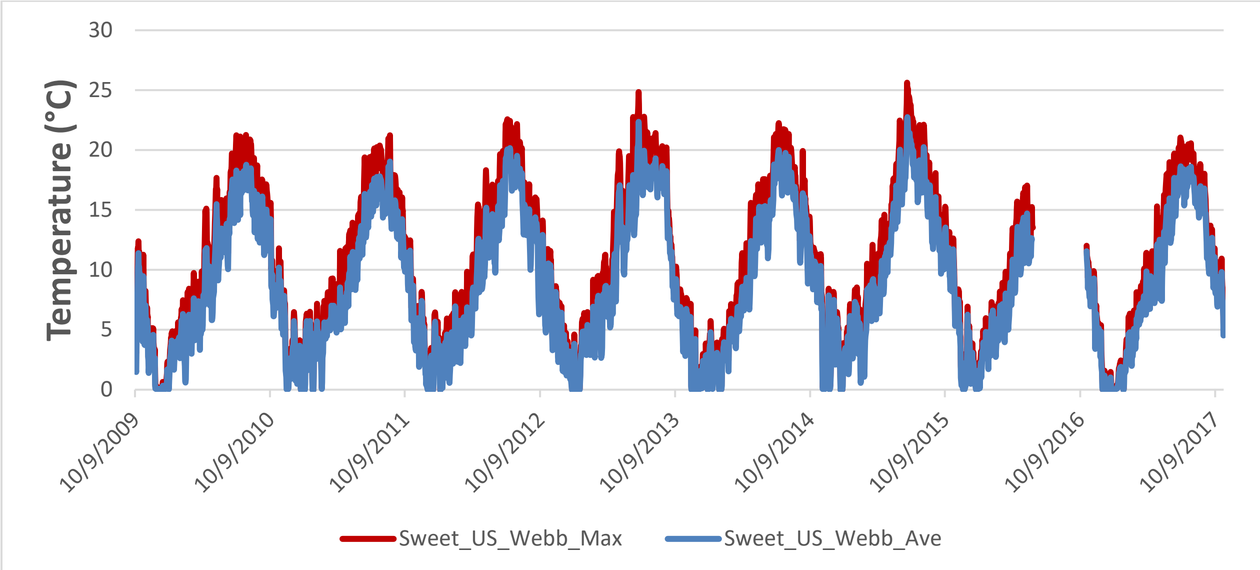



**Figure 16. Mean and maximum daily stream temperature (ºC) measured upstream from the Webb Creek confluence with Sweetwater Creek.**

The next logger location on the mainstem Sweetwater Creek system was just below the confluence with Webb Creek, this site has shown similar trend to the above Webb Creek logger over the years (Figure 17).

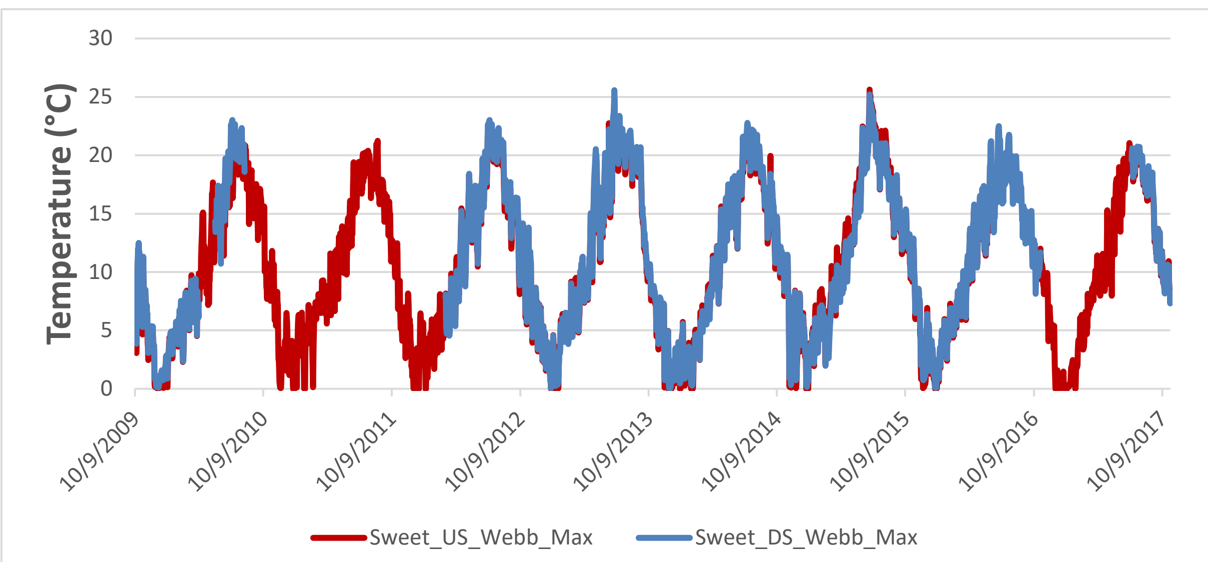



**Figure 17. Mean and maximum daily stream temperature (ºC) measured upstream from the Webb Creek confluence with Sweetwater Creek.**

At this location, Sweetwater Creek is slightly warmer than Webb Creek during the winter months and slightly cooler in the summer months. The summertime differences have decreased with higher summer base flows (Figure 18).

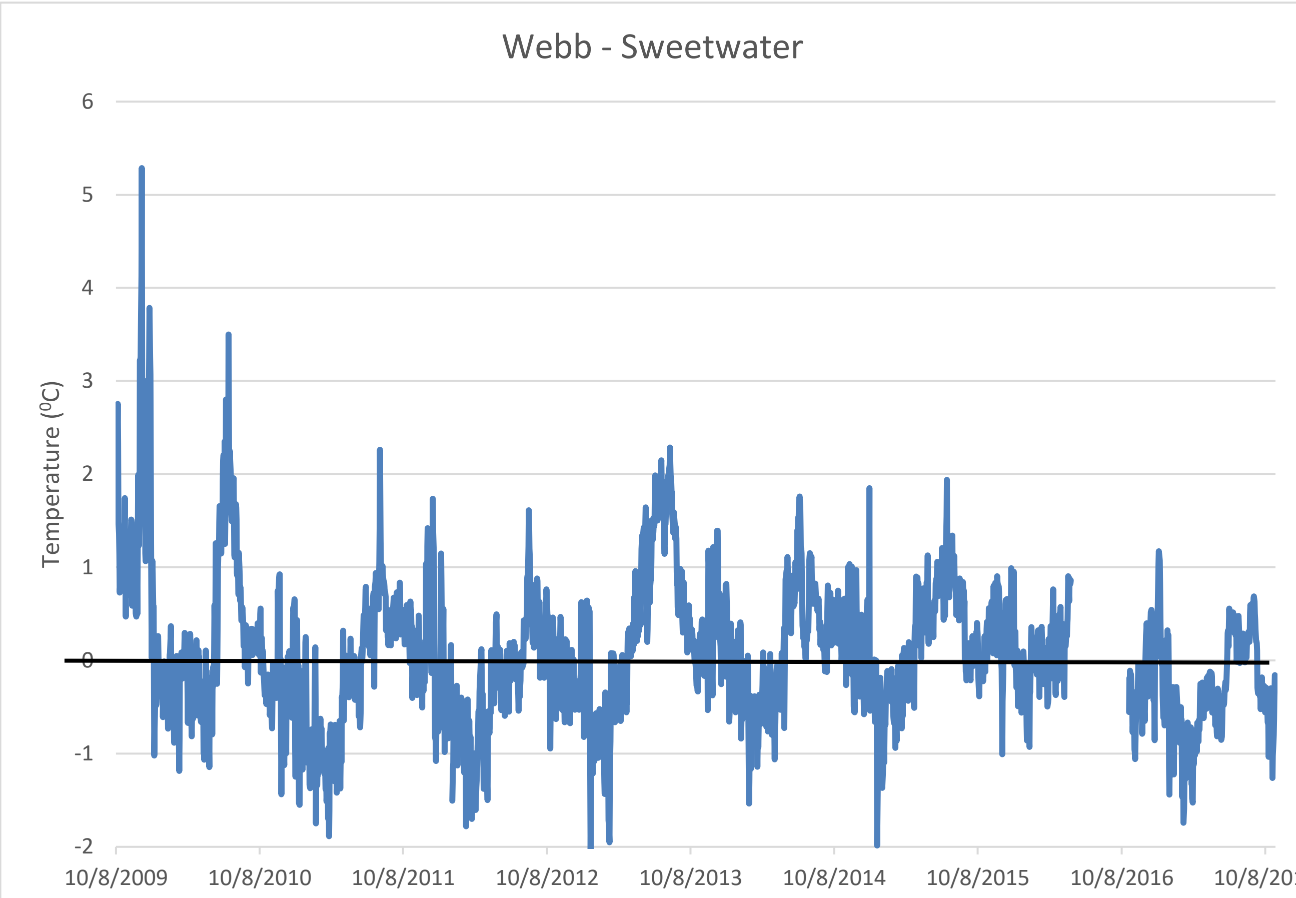
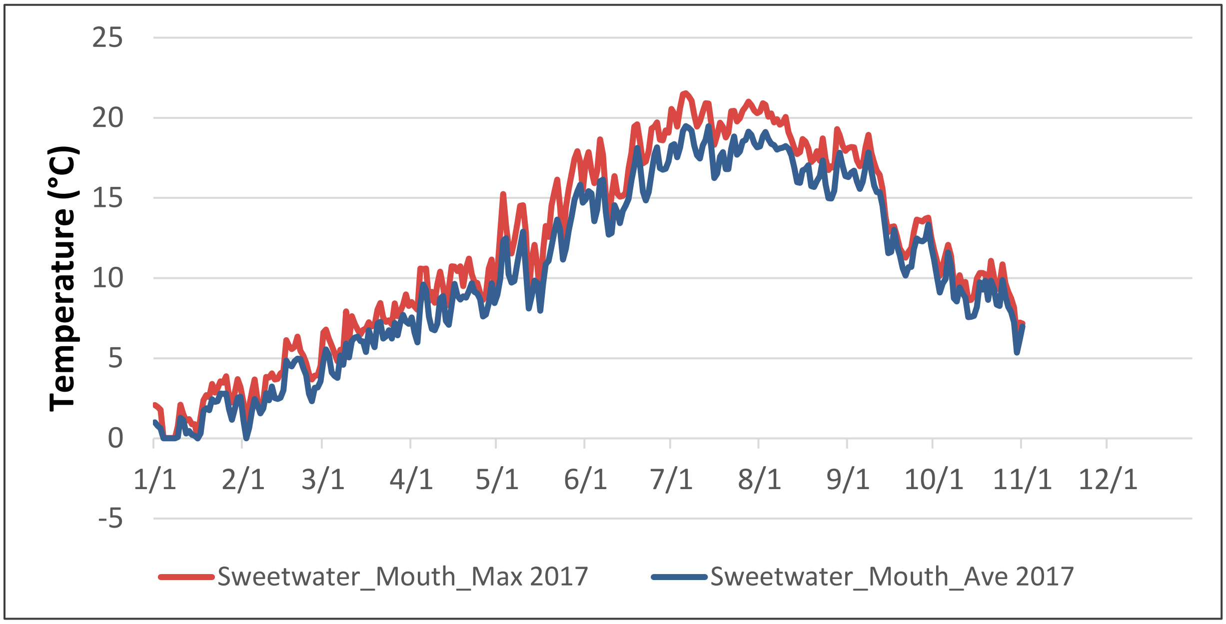



**Figure 18. Differences in temperature between Webb and Sweetwater creeks just upstream from their confluence.**

The final logger location on the mainstem Sweetwater Creek system was at the mouth of Sweetwater Creek before it meets with Lapwai Creek (Figure 19).



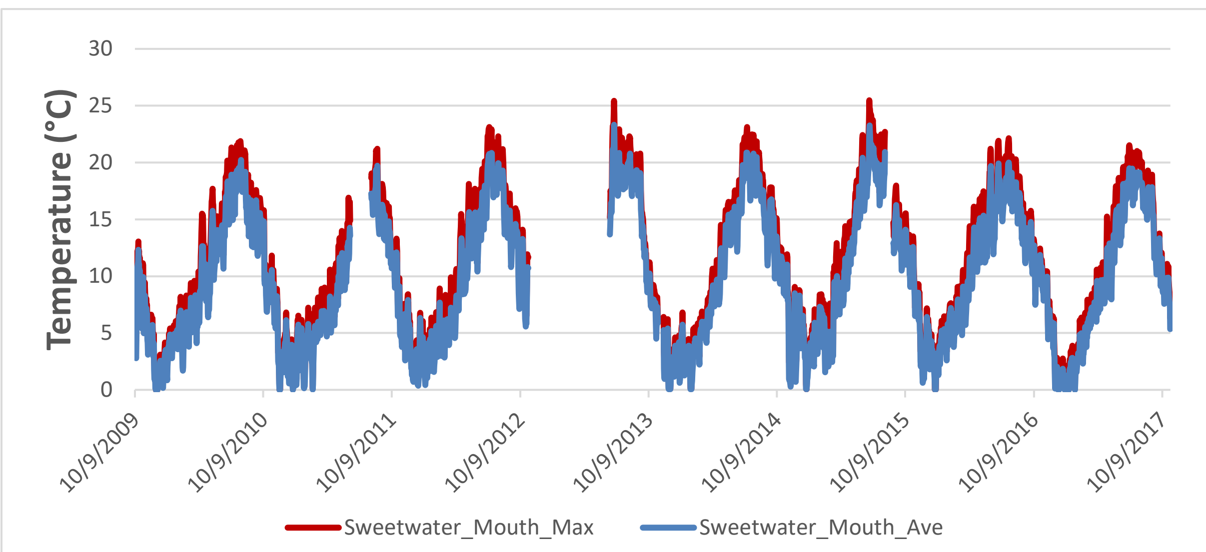
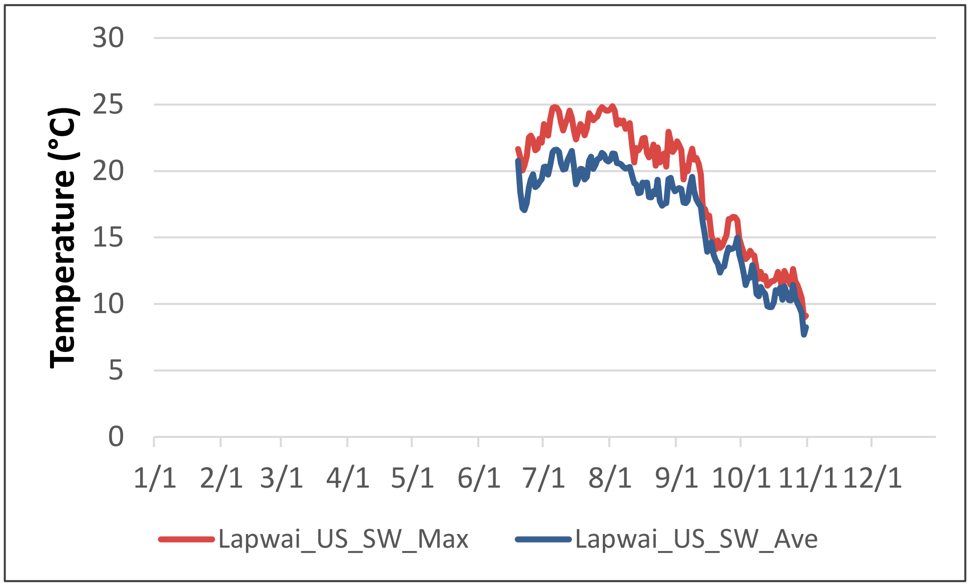




**Figure 19. Maximum and average daily stream temperature (°C) measured near the Sweetwater Creek mouth.**

### *Lapwai Creek*

Reclamation also collected temperature data at three locations in Lapwai Creek. The first of these was just above the Sweetwater Creek confluence (Figure 20). This logger was buried during high flows in spring of 2017 and replaced with a new one in late June.



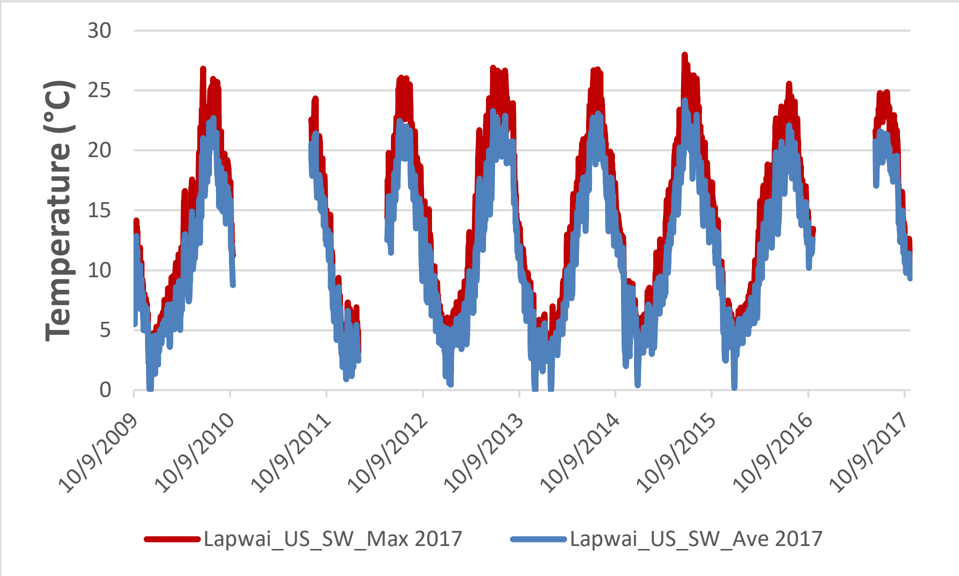




**Figure 20. Maximum and average daily stream temperature (°C) of Lapwai Creek measured upstream from Sweetwater Creek.**

The second Reclamation data collection location on Lapwai Creek was downstream from the Sweetwater Creek confluence, which allows for comparison with the effects from Sweetwater Creek (Figure 21). The influence of Sweetwater Creek cools Lapwai Creek down, especially during the summer (Figure 22). The following graphs show the slow increase in temperatures from downstream from the confluence of Sweetwater Creek to the mouth of Lapwai Creek (Figures 21 through 23). The cooling influence of Sweetwater Creek leads to cooler temperatures at the mouth of Lapwai than in Lapwai upstream from Sweetwater Creek.

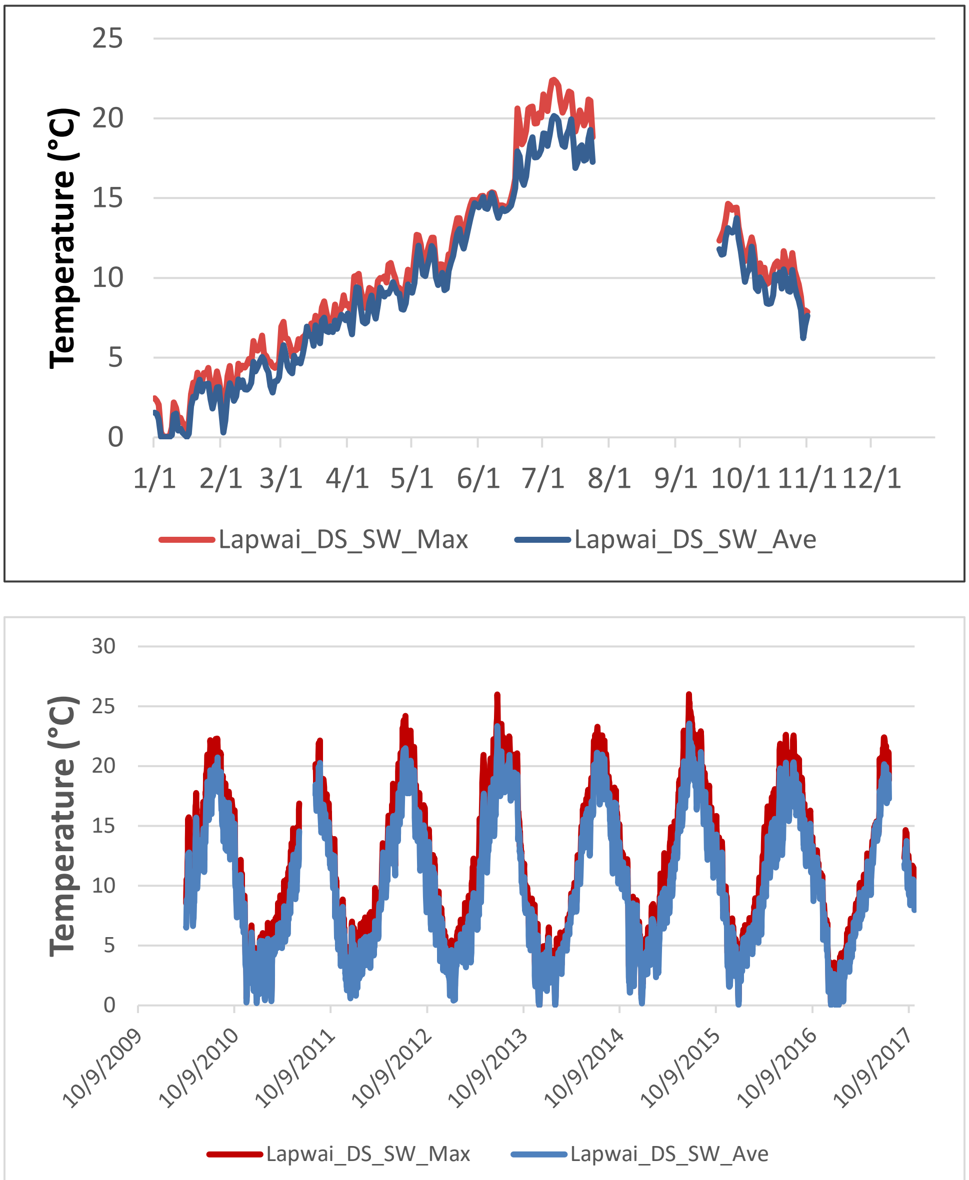



**Figure 21. Maximum and average daily stream temperature (ºC) of Lapwai Creek measured downstream from Sweetwater Creek.**

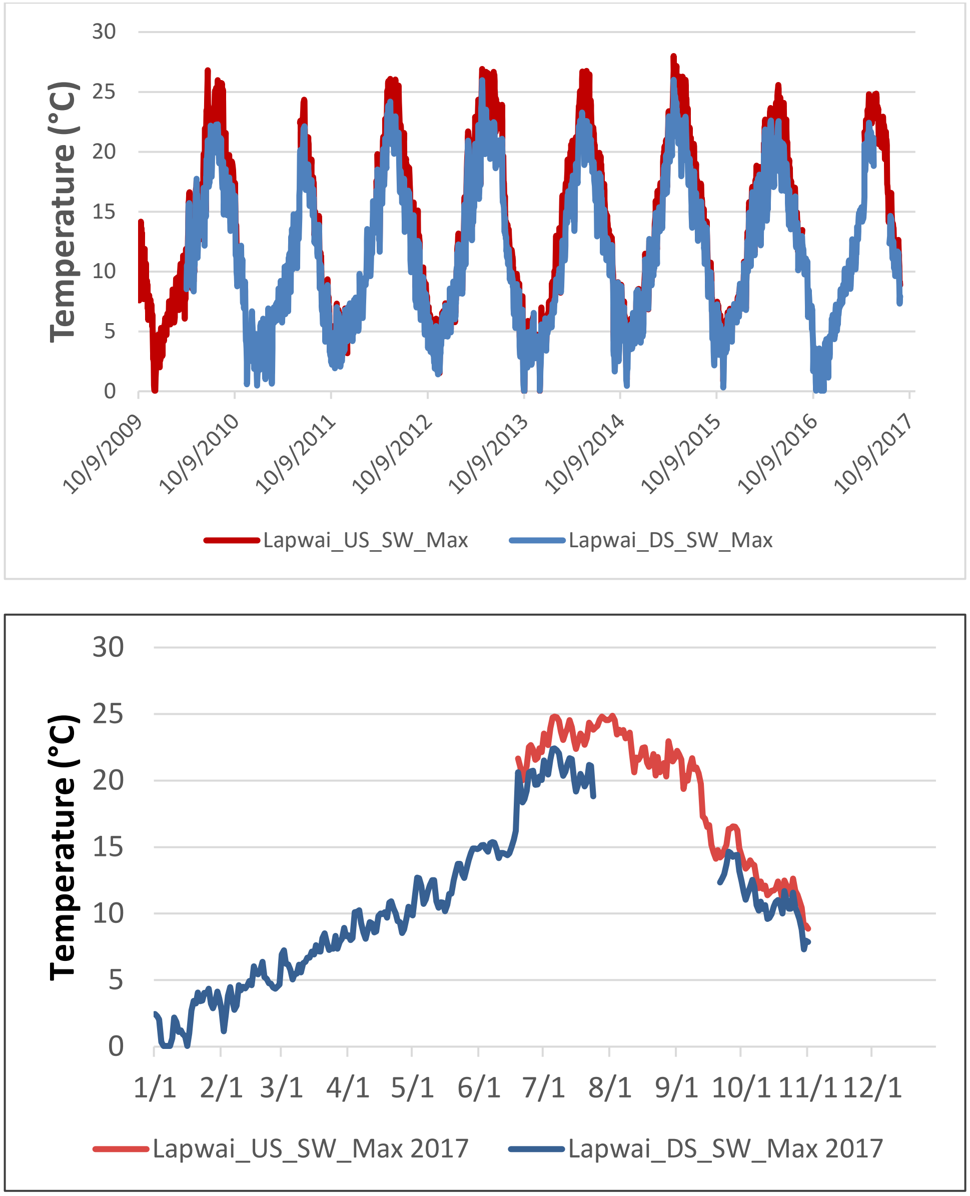
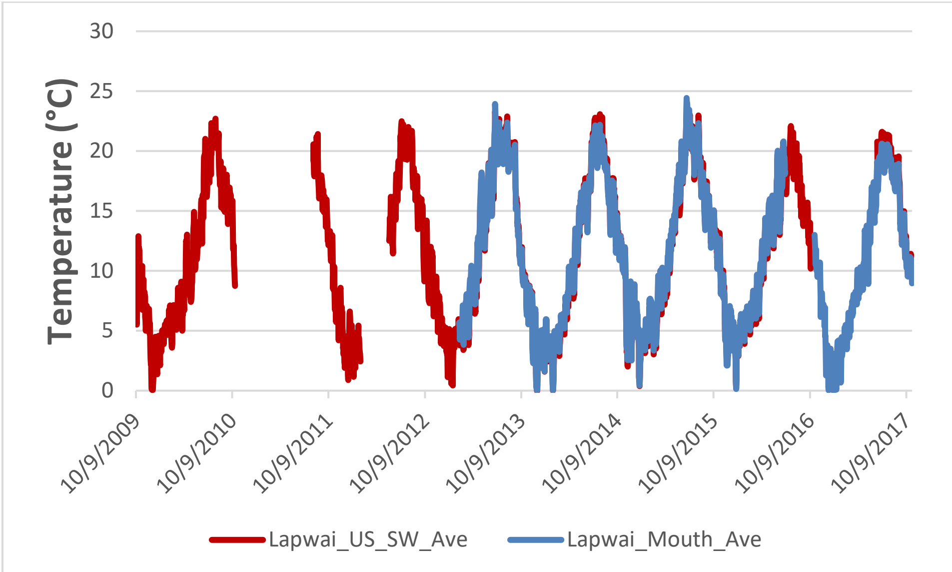



**Figure 22. Mean daily stream temperature (°C) of Lapwai Creek measured upstream and downstream from the Sweetwater Creek Lapwai Creek confluence.**



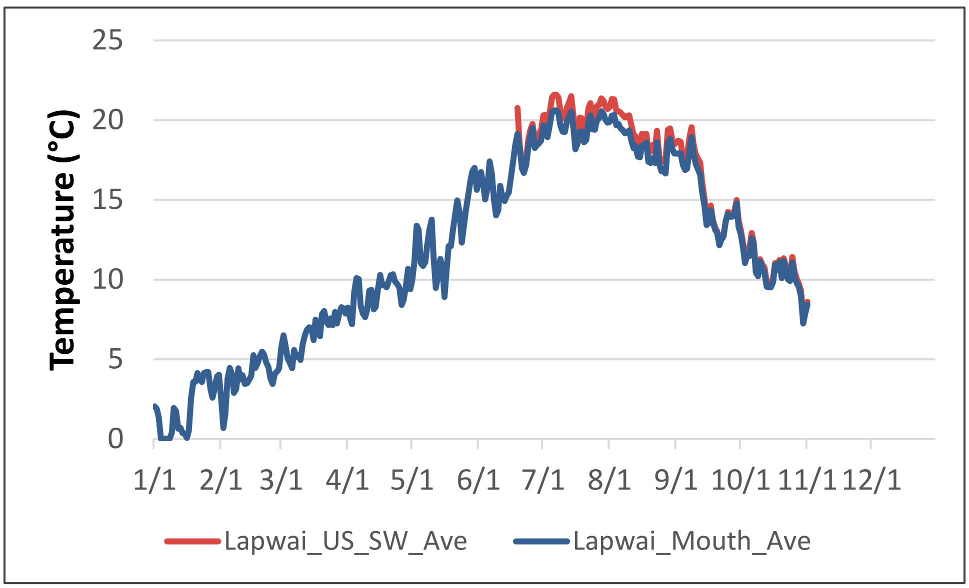




**Figure 23. Mean daily stream temperature (°C) of Lapwai Creek measured upstream from the Sweetwater Creek Lapwai Creek confluence and the mouth of Lapwai Creek.**

*Streamflow Impact on Water Temperatures*

Instantaneous stream and air temperatures at the mouth of Webb Creek were compared during 2013 low flows at 1 cfs and 2017 high flows at 4 cfs (see Figure 24). It appears that at higher flows, water temperatures tend to be cooler than lower flows at the same air temperature. The increased water volume is likely buffering the influence of air temperature and solar radiation.

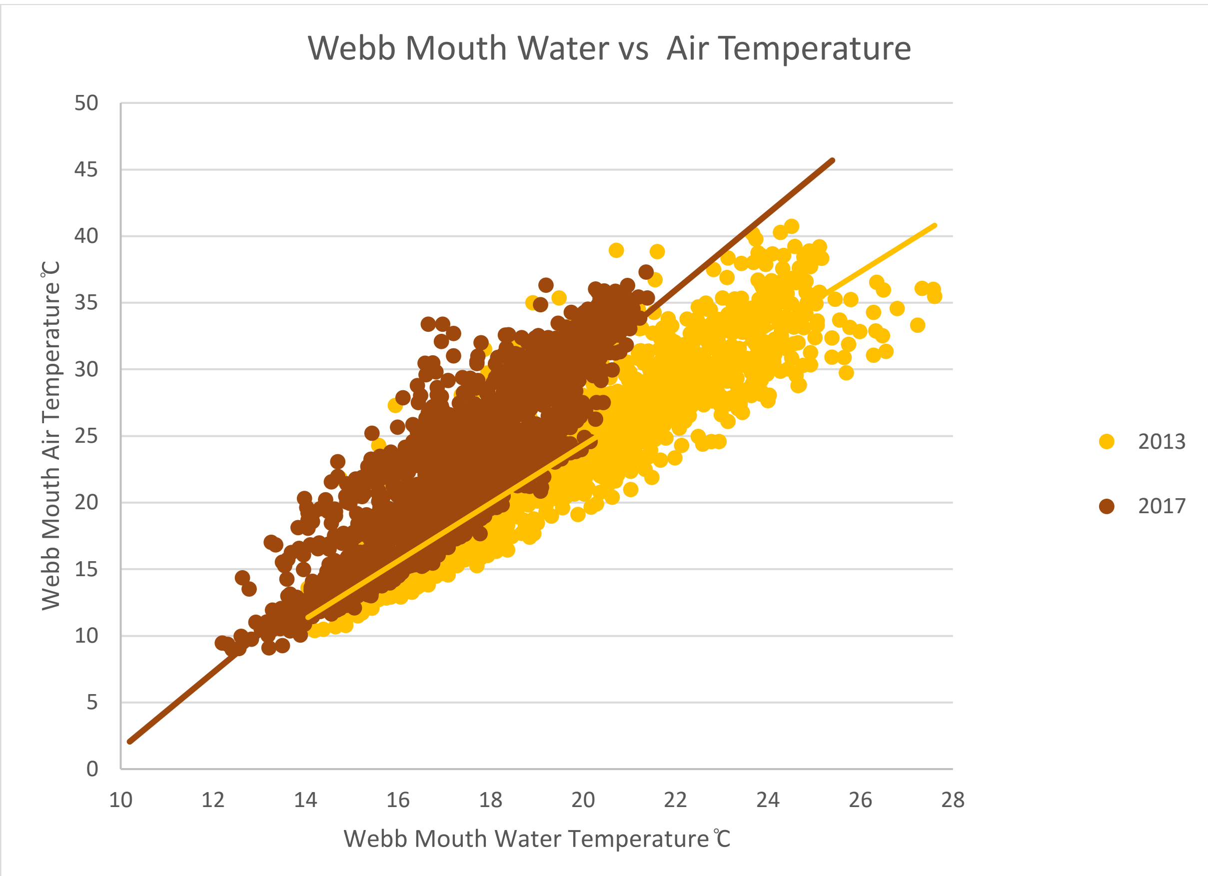



**Figure 24. July and August instantaneous stream and air temperatures (°C) measured at Webb Creek mouth during 2017 high (4 cfs) and 2013 low (1 cfs) flows.**

# 6. RPM 5: Optimal Streamflow Allocation

Reclamation's proposed action and streamflow allocations are based on the best available scientific data and were developed cooperatively with NMFS and the Tribe. Term and Condition 5 of the 2010 Opinion requires Reclamation to submit a completed study and report to NMFS, related to optimizing streamflow allocations between Sweetwater and Webb creeks. After discussions with the Tribe, Reclamation submitted the *Lewiston Orchards Project Sweetwater and Webb Creek Flow Allocation Analysis Report* to NMFS on July 7, 2015.

# 7. LITERATURE CITED


| Parenthetical Reference | Bibliographic Citation |
|---|---|
| NMFS 2010 | National Oceanic and Atmospheric Administration National Marine Fisheries Service. 2010. *Endangered Species Act Section 7 Formal Consultation 2010 Opinion and Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat Consultation for the Operation and Maintenance of the Lewiston Orchard Project.* NMFS Consultation number 2009/06062. Submitted to the Bureau of Reclamation, Boise, Idaho. |
| NMFS 2017 | National Oceanic and Atmospheric Administration National Marine Fisheries Service. 2017. *Endangered Species Act Section 7(a)(2) Biological Opinion and Magnuson-Stevens Fishery and Conservation Management Act Essential Fish Habitat Response for the Lewiston Orchards Project Water Exchange and Title Transfer*. NMFS Consultation number WCR-2017-7167. Submitted to the Bureau of Reclamation, Boise, Idaho. |
| Reclamation 2009 | Bureau of Reclamation. 2009. *Biological Assessment for Operation of the Lewiston Orchards Project, Idaho*. Snake River Area Office. Boise, Idaho. October. |
| Reclamation 2011 | Bureau of Reclamation. 2011. *Monitoring Plan for Steelhead Densities and Critical Uncertainties for the Lewiston Orchards Project 2010 Opinion*. Submitted to the National Marine Fisheries Service, Boise, Idaho. |
| Thom 2017 | Thom, Barry. 2017. Letter from Barry Thom to James B. Taylor – Bureau of Reclamation, and Barney Metz – Manager, Lewiston Orchards Irrigation District, Re: Proposed Adjustment to Ramping Rate, Sweetwater and Webb Creek Diversion Dams, Lewiston Orchards Project, Idaho. Portland, Oregon: National Marine Fisheries Service. June 14. |

*This page intentionally left blank.*

# APPENDICES

# APPENDIX A

## 2017 ANNUAL PLAN

### LEWISTON ORCHARDS PROJECT ESA AND WATER EXCHANGE SCHEDULE

April 25, 2017

## 2017 Annual Plan

### Lewiston Orchards Project ESA and Water Exchange Schedule

In 2014, the U.S. District Court issued an order staying litigation through January 2020 in the Endangered Species Act (ESA) case, Nez Perce Tribe (Tribe) vs. NOAA Fisheries and Bureau of Reclamation. The order is based on a 2014 Term Sheet Agreement that provides a framework for collaboration to address issues related to the Lewiston Orchards Project (LOP). The primary focus of the 2014 Term Sheet Agreement is to advance the Project as a potential comprehensive solution to LOP system issues concerning ESA-listed steelhead, Tribal cultural and natural resources, and irrigation water supply reliability.

In accordance with the 2014 Term Sheet Agreement, Water Exchange Appendix, and 2010 Biological Opinion for the Operation and Maintenance of the LOP, the Tribe, Lewiston Orchards Irrigation District (LOID), and Reclamation (collectively the Parties) have collaboratively developed the following 2017 Annual Plan, which establishes water exchange in the critical months for steelhead spawning/rearing and recognizes LOID's domestic component of the pilot well (also referred to as Well No. 5).

### Minimum Instream Flows

The 2010 Biological Opinion for the Operation and Maintenance of the LOP states:

> *The BOR is proposing new operating and maintenance procedures that ensure certain minimum flows for conservation of Snake River Basin steelhead. The LOID will provide instream flows through the Idaho State Water Bank, consistent with LOP authorities and Idaho State law. The LOP will forego storage in Reservoir A and diversions at Sweetwater and Webb Creeks diversion dams to provide the minimum flows described in this proposed action. It is the responsibility of the Idaho Department of Water Resources Board [sic] to protect and monitor water rights and releases. The BOR's authority and ability to control this water ends at the Sweetwater and Webb diversion dams where the bypass flows will be provided. The proposed minimum instream flow regime for the LOP is shown in Table 1.*
>
> *The proposed instream flow regime in Table 1 addresses all months of the year; these flows will be used to support spawning conditions during February through April and juvenile rearing conditions from May through January. The LOP will not operate the Sweetwater and Webb diversion dams during November, December, and January; therefore, all instream flow reaching the dams will be bypassed during those months. During February and March, if the inflows to either Sweetwater or Webb diversion dams are below the specified minimum flow, the LOID will bypass all inflow to that diversion dam.*

The 2014 Term Sheet Agreement states:

> *Reclamation will operate the LOP consistent with the provisions of the Biological Assessment and 2010 Biological Opinion through January 31, 2020.*

Minimum instream flow requirements in both Sweetwater and Webb Creeks will remain the same, as required by the 2010 Biological Opinion for the Operation and Maintenance of the LOP. The minimum instream flows in cubic feet per second (cfs) for each month are listed in Table 1.

| Life Stage | Spawning | | | Juvenile Rearing | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Month** | **Feb** | **Mar** | **Apr** | **May** | **Jun** | **Jul** | **Aug** | **Sept 1-15** | **Sept 16-30** | **Oct** | **Nov Dec Jan** |
| *Sweetwater Creek (cfs)* | *7.8** | *7.8** | *7.8* | *3.0* | *2.5* | *2.5* | *2.5* | *2.5* | *2.5* | *2.5* | *BP* |
| *Webb Creek (cfs)* | *4.0** | *4.0** | *4.0* | *1.5* | *1.0* | *1.0* | *1.0* | *1.0* | *1.0* | *1.0* | *BP* |

*BP=Bypass Flows*

*Specified stream flow or all stream flow, whichever is less, will be bypassed. Flows measured below Sweetwater and Webb creek diversions.

**Table 1. Minimum instream flows for Sweetwater and Webb Creeks at their diversion dam sites (2010 BiOp)**

## Incremental Add-in

The 2010 Biological Opinion for the Operation and Maintenance of the LOP states:

> *When conditions permit, the BOR proposes to supply water to the system in addition to the minimum flows shown in Table 1. Due largely to the high variability in local hydrologic and climatic conditions, the BOR will provide additional flows for June through mid-September based on the status of the combined storage in Soldiers Meadow Reservoir and Reservoir A, as assessed on June 1. Table 2 shows the BOR's proposed allocations for Sweetwater and Webb Creeks and the storage conditions under which they would occur.*

The 2014 Term Sheet Agreement states:

> *The Parties here agree that combined storage volumes are limited to natural flow diversions and exclude water pumped by LOID and stored in Reservoir A, also known as Mann Lake. LOID is expected to maintain records which document the volume of pumped water stored in Reservoir A each water year, estimated to the nearest acre-foot in accordance with the timeframe specified for Table 2 of the 2010 Biological Opinion. Carryover to subsequent water years will not be considered. Volumes will be converted to elevations in Mann Lake for use in application of Table 2 to exclude pumped water.*

Incremental add-in will be calculated on June 1, as in years past, to determine additional bypass flows for the water year as shown in Table 2. As stated in the 2014 Term Sheet Agreement, beginning November 1[1], LOID will subtract the pumped water quantity from the total storage in Mann Lake prior to calculating the combined storage of Mann Lake and Soldiers Meadow to determine annual incremental add-in.

| **Combined Storage – June 1<br>Mann Lake & Soldiers Meadow (acre-feet)** | <3,800 | 3,900 | 4,000 | 4,100 | 4,200 | >4,250 |
|---|---|---|---|---|---|---|
| *Sweetwater Creek (cfs)* | *0.0* | *0.5* | *0.9* | *1.0* | *1.0* | *1.0* |
| *Webb Creek (cfs)* | *0.0* | *0.0* | *0.0* | *0.3* | *0.8* | *1.0* |

**Table 2. Incremental flow as a function of combined storage (2010 BiOp)**

[1] Intended that October 31 would mark the end of the previous water year and November 1 to mark the beginning of the new water year.

## Water Exchange Flows

The 2014 Term Sheet Agreement states:

> *…As groundwater wells come online, diversions of surface water from the LOP would be reduced in an amount equal to an agreed upon in-lieu water exchange quantity, to be left instream through the Idaho State Water Bank for instream flows…*
>
> *…There will be an exchange of water between the Pilot well and LOP surface water diversions to be determined quantitatively only after the Pilot well becomes fully operational. For present understanding of the exchange of water for the Pilot well, a quantity of water will be protected instream for fish improvements in the Sweetwater Creek watershed in accordance with the Memorandum of Agreement (MOA) with LOID. Under the MOA, which applies to the Pilot well only, the exchange will be based on two points: 1) the well's full productive capacity (not how it is discretionarily operated by LOID) which is 2) applied during the time the LOP is diverting surface water from the Sweetwater or Webb diversions…*

The pilot well (Well No. 5) was completed in November 2016 and tested in January 2017. Final testing resulted in a full well production capacity of approximately 4.5 cubic feet per second (cfs) (2,000 gallons per minute or 9 acre-feet per day).

In order to develop a strategy with multiple benefits including establishing water exchange in the critical months for steelhead spawning/rearing and recognizing LOID's domestic component, the Parties collaboratively developed the following water exchange amounts at each diversion point.

The exchange flows for each month in Table 3 were determined recognizing the value in managing the instream flows to maximize the designated instream habitat, rather than bypassing a consistent monthly amount throughout the irrigation season. The monthly exchange flows allow for more flexible water management capabilities, allowing more than 4.5 cfs to be left instream in the more critical fish habitat months, and recognizing LOID's domestic component for Well No. 5.

| Life Stage | Spawning | | | Juvenile Rearing | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Month** | **Feb** | **Mar** | **Apr** | **May** | **Jun** | **Jul** | **Aug** | **Sept 1-15** | **Sept 16-30** | **Oct** | **Nov Dec Jan** |
| *Sweetwater Creek (cfs)* | *2.2** | *2.2** | *1.0* | *2.0* | *1.5* | *1.5* | *1.0* | *1.0* | *1.0* | *1.0* | *BP* |
| *Webb Creek (cfs)* | *2.3** | *2.3** | *2.3* | *5.5* | *3.8* | *1.5* | *1.5* | *1.5* | *1.5* | *1.5* | *BP* |
| **TOTAL** | **4.5*** | **4.5*** | **3.3** | **7.5** | **5.3** | **3.0** | **2.5** | **2.5** | **2.5** | **2.5** | **BP** |

*BP=Bypass flows*

*Specified stream flow or all stream flow, whichever is less, will be bypassed. Flows measured below Sweetwater and Webb creek diversions.

**Table 3. Water exchange flows to be left instream for Sweetwater and Webb Creeks and replaced by flows pumped from the pilot well.**

The water exchange flows combined with the instream flows established by the 2010 Biological Opinion will provide increase flows to designated critical habitat. These combined flows are shown in Table 4 which contains the sum of the values in Tables 1 and 3. The flows do not include the incremental add-in based on combined storage to be determined on June 1st.

| Life Stage | Spawning | | | Juvenile Rearing | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Month** | **Feb** | **Mar** | **Apr** | **May** | **Jun** | **Jul** | **Aug** | **Sept 1-15** | **Sept 16-30** | **Oct** | **Nov Dec Jan** |
| *Sweetwater Creek (cfs)* | *10.0** | *10.0** | *8.8* | *5.0* | *4.0* | *4.0* | *3.5* | *3.5* | *3.5* | *3.5* | *BP* |
| *Webb Creek (cfs)* | *6.3** | *6.3** | *6.3* | *7.0* | *4.8* | *2.5* | *2.5* | *2.5* | *2.5* | *2.5* | *BP* |

*BP=Bypass flows*

*Specified stream flow or all stream flow, whichever is less, will be bypassed. Flows measured below Sweetwater and Webb creek diversions.

**Table 4. Total minimum instream flows in Sweetwater and Webb Creeks for 2017**[2]

## Concurrence

The 2014 Water Exchange Appendix states:

> *After the pilot well is completed, by April 1st of each year, LOID, in consultation with the other Parties, will develop an annual plan using modeling and analysis to characterize the water year and how LOID operations are projected to meet the flows determined in Section 6.2. If there are concerns, the Parties will meet to resolve the issue, and if necessary, will use the dispute resolution process in Section 10.1.*

As described in the Term Sheet Agreement, this Annual Plan was developed by the Parties. It is recognized and agreed that this Annual Plan is for the 2017 Water Year and the team will reevaluate and develop a new plan annually.

[2] Total minimum flow does not include incremental add-in (Table 2) based on reservoir storage as of June 1.

# APPENDIX B

## SWEETWATER AND WEBB CREEK FLOW TABLES

**(This is an excel data file for data sharing and is included as a CD at the back of this report)**

# APPENDIX C

## UNIVERSITY OF IDAHO 2017 REPORT "THE ECOLOGY OF *ONCORHYNCHUS MYKISS* IN THE LAPWAI BASIN: DENSITY AND GROWTH MONITORING

# The ecology of *Oncorhynchus mykiss* in the Lapwai Basin: Density and growth monitoring

Continuation of the Lewiston Orchards Project:
Sweetwater Basin Fish & Flow Study

Period of Study: July 1, 2014 – May 31, 2019

Progress report (January 2017 – December 2017) prepared for:
**Bureau of Reclamation**
USBR Snake River Area Office
Boise, Idaho

Prepared by:
**Brian P. Kennedy,**
**Natasha Wingerter, Ph.D. student, and Austin Anderson, M.S. student**
Department of Fish and Wildlife Resources and Water Resources Graduate Program
College of Natural Resources
University of Idaho

# LAPWAI ACTIVITIES REPORT 2017

## Introduction and Background

The Bureau of Reclamation (Reclamation) owns a series of water storage reservoirs, diversion dams and canals that provide irrigation water to the Lewiston Orchards area of Lewiston, Idaho. The Lewiston Orchards Project (LOP) is operated by the Lewiston Orchards Irrigation District (LOID), which distributes the water to agricultural, urban and suburban users. The Lewiston Orchards Project is contained entirely within the Lapwai Creek watershed. In order to maintain minimum water supplies to these users during long dry summer growing seasons, operations of the water diversions capture much of the water that would naturally be feeding Webb and Sweetwater Creeks, which together comprise approximately half of the area of the Lapwai basin.

Lapwai Creek contributes to one of the 6 major population groups (MPG), the Clearwater River, of the Snake River *Distinct Population Segment* (DPS) of federally endangered steelhead, *Oncorhynchus mykiss*. Within the Clearwater MPG, Lapwai provides a portion of the spawning and rearing habitat within one of 5 functional populations of interest (the Clearwater River – Lower Mainstem population). The LOP withdraws water from these creeks, some of which are designated as critical habitat for this subpopulation. Importantly, the major temporal impact that water withdrawals have are during the summer months when juvenile fish are trying to gain mass before smolting (migrating to the ocean) and diversion operations can have measureable impacts on in-stream flows. Decreased flows during spring may also impact spawning of adult A-run *O. mykiss* in the basin (NOAA 2006). Temporally, impacts during the other times of year are expected to be less severe. Spatially, the Lapwai basin likely represents habitat that could have supported approximately 1-2% of the population of the Clearwater-Lower Mainstream (CRLMA) population of the Snake River DPS (289 watersheds and 26 independent populations).

On April 15, 2010, the Bureau of Reclamation received the Biological Opinion prepared by National Ocean and Atmospheric Administration Fisheries (NOAA) pursuant to the Section 7(a)(2) of the Endangered Species Act (ESA) on the effects of the operation and maintenance of the LOP. In this Opinion, NOAA concludes that the proposed action is not likely to jeopardize the continued existence of ESA listed species or adversely modify critical habitat. Reclamation and NOAA have cooperatively proposed a monitoring plan that includes annual monitoring activities and critical uncertainties relevant to this project. This monitoring plan identifies the University of Idaho as an independent scientific entity who has been working on questions related to steelhead growth and survival since 2007 and identifies a more focused monitoring plan that seeks to identify annual and spatial trends in abundance and growth of juvenile steelhead in sites for which long term data now exist. Reclamation will continue these research activities to complete investigation into these critical uncertainties through 2019. This Interagency Agreement implements specific tasks from this monitoring plan using the University of Idaho as an independent research institution. The University of Idaho has been working on several of the tasks listed below since 2007, and this agreement will complete this research effort aimed at providing specific information on the impacts of the LOP operations on listed *O. mykiss* in the Lapwai Basin and understanding the status and role of the Lapwai Basin in relation to the Snake River ESU and Lower Clearwater Local Population.

Understanding the effects of hydrologic changes on fish populations requires an integrative approach that addresses 1) how the growth potential of individual fish is affected, 2) how changes in growth and growth potential influence survival of individuals and, ultimately, how processes for the individual scale up to population level dynamics, and 3) how population dynamics are influenced by altered connections among subpopulations. These changes can be a direct result of hydrologic change (Lopes et al. 2004) or an indirect effect through altered temperatures, productivity or trophic relationships (Almodovar and Nicola 1999, Horne et al. 2004, Hartson and Kennedy 2014, Myrvold and Kennedy 2014). Our monitoring efforts will continue to address how environmental conditions in the Lapwai system influence density, growth, and survival of juvenile *O. mykiss* and are designed to identify mechanistic relationships between fish performance and habitat. Herein, we report on the data collection and results from our seventh field season in the Lapwai basin.

Six of the possible 16 sites monitored in 2010 - 2013 were selected for continued abundance measurements of *O. mykiss* in 2014 - 2019 in order to quantify spatial and temporal variation among sites. The 16 original sites were intended to identify variables related to growth and production representing the elevation, geologic and ecological gradients across the Lapwai Basin. The six continued-monitoring sites were selected such that all sites provide enough production for a robust statistical design, and such that both impacted and "unimpacted" sites in the basin are represented. Unimpacted in this context is meant to simply refer to those sites that are not directly affected by BOR projects; impacts from land use, roads and other local disturbances are realized and documented.

As outlined in the monitoring plan for this project, beginning in 2014, the University of Idaho has begun (and will continue) ongoing research on the following tasks, in accordance with the timeline detailed in Table 1:

**Task 1.1**: Capture, PIT tag, and collect data on juvenile *O. mykiss* (i.e., length, weight, condition factor) at six established monitoring sites during the juvenile growing season (July - September) 2014 - 2019.

**Task 1.2**: Cooperatively collect and edit stream temperature data with Reclamation, Snake River Area Office and LOID efforts.

**Task 1.3**: Use data collected in task 1.1 to compare observed juvenile *O. mykiss* densities across years sampled at six established monitoring sites from 2008 through 2013 (and more sites if available, i.e. between 2010 and 2013).

Table 1. Reporting timeline (timeline of research activities in agreement).

| Task | Deliverable | Draft due | Final due |
|---|---|---|---|
| 1 | Annual reports that include: data summary, *O. mykiss* density and growth estimates (with confidence intervals) and other data collected during the previous year | Feb 1, 2015 for 2014; and each year thereafter. | Mar 1, 2015 for 2014; and each year thereafter to 2019. |
| 2 | Synthesis of density trends based upon annual monitoring activities | Sept 30, 2019 | Dec 31, 2019 |
| 3 | Final Financial and Performance Reports | Semiannually at the end of each 6 month period beginning April 1 and October 1. | 30 days after the end of each 6 month period (e.g. April 30 and October 30) |

## Methods

*Study sites*

In the first year of the study (2008) we established six study sites at which to obtain consistent information on productivity, fish population metrics, and mark-recapture information throughout the growing seasons. In the second year of the study, 2009, we continued sampling at five of these sites and moved one site (lower Lapwai) upstream approximately 4 km in an effort to sample more representative *O. mykiss* rearing habitat (Hartson and Kennedy, 2014). In 2010 and 2011 we continued to sample the same six sites as in 2009, and sampled ten additional sites (Fig. 1) despite our funding obligations only requiring monitoring at the original six sites. We learned from our 2008-09 field seasons that the survival and emigration models were data intensive and ideally were based upon more individually-tagged fish than we were sampling.

We developed a new naming scheme for our sites in 2010 (Table 2) in which the six sites from 2009 were renamed to fit the new naming scheme. Lower Lapwai is now lower Lapwai lower (LLL), lower Sweetwater is now lower Sweetwater (LSX), upper Sweetwater is now upper Sweetwater middle (USM), lower Webb is now upper Webb middle (UWM), upper Lapwai is now upper Lapwai upper (ULU) and upper Mission is now upper Mission upper (UMU). Each site is approximately 100 m in length. We added two sites to each of the tributaries (Sweetwater, Webb, Mission, and Lapwai), one on Lapwai below the Mission confluence (MLX), and one site on Lapwai below the Sweetwater confluence (LLU). In sum, nine of the 16 sites are considered within the project affected area, however, all sites represent some level of anthropogenic alteration, as even those outside of the affected area exhibit some hydrographic (e.g. irrigation withdrawal) and some geomorphic (e.g. leveeing) alteration.

In 2012 and 2013 we scaled back our sampling efforts in response to reduced field support. We sampled nine of the 16 sites that were sampled in 2010 and 2011; five are considered within the project affected area (LLU, LSX, USM, USU, and UWM), while four are not within the project affected area (MLX, ULU, UMM, and UMU). The nine sites we sampled spanned the environmental conditions in the basin, and the temporal detail was similar to previous years.

As the density and growth monitoring phase of the project began in 2014, we scaled back our sampling efforts to focus on six of the 16 sites that were sampled in 2010 and 2011: LSX, USU, UWM, MLX, ULU, and UMU (Table 2; Fig. 1). Sites were sampled three times over the field season from 2014-2016. In 2017, in order to capture more detailed information about short-term and long-term changes in growth and densities sites were visited four to five times. These six sites reflect the variety of environmental conditions within the basin, represent all four main tributaries, and four of them have been sampled consistently since the beginning of our fieldwork in the Lapwai basin in 2008. Half of the sites fall within the project affected area (LSX, USU, and UWM); the other half do not (MLX, ULU, and UMU).

*Study design*

*Task 1.1: Density Monitoring*

We visited each site four to five times between July and October 2017 despite our funding obligations only requiring two monitoring visits at each site; additional visits allowed us to estimate growth rates over three to four periods, capturing fine scale differences in growth rates. The dates for the visits are shown in Table 2. At each visit we collected data on: 1) the fish community diversity, 2) *O. mykiss* density, 3) individual *O. mykiss* size & condition, 4) food availability in the stream reaches, and 5) a suite of physical environment factors.

Fish were captured during three-pass depletion electrofishing surveys (described below); non-salmonids were identified to species (except for sculpin, which were identified to genus), counted, and measured in order to determine average individual length for each taxa and each pass. Benthic invertebrate samples were collected using a Hess sampler (250 um mesh) at the six sites on all visits of the field season (dates shown in Table 2) as a measure of energy resources available in the streams. Due to the time consuming nature of processing invertebrate samples, we have not yet processed the benthic samples from 2017. In order to estimate habitat availability for juvenile *O. mykiss*, we measured physical habitat factors at each visit. We measured velocity using a Marsh McBirney flow meter (cm $sec^{-1}$), depth (using a wading rod), stream width at regular intervals, and continuously monitored stream temperature.

*Task 1.2: Data Collection*

We employed a combination of direct counting and mark-recapture techniques to estimate *O. mykiss* abundance and density. Direct counts were made by conducted three-pass depletion electrofishing surveys. For depletion estimates of population size we used R-gui and based our calculations on the methods of Carle and Strub (1978). Combined with estimates of stream area taken following each electrofishing effort, we used these population estimates to calculate densities of *O.*

*mykiss*. Steelhead were scanned for a PIT (passive integrated transponder) tag, and, if not present, fish ≥ 65 mm (fork length) were equipped with one. For both first-time captures and recaptures, lengths and weights were recorded; recaptures were noted.

PIT tags are small glass encapsulated tags that are inserted into the body cavity of the fish; each tag has an individual identification code, making it possible to follow individuals through time in their natural environment. Additionally, PIT tags are used to monitor salmon and steelhead throughout the Columbia Basin, allowing fish that migrate out of our study area to be detected during outmigration and allowing us to make inferences about the migration behavior and success of juvenile fish tagged in the study area.

Fish recaptured over time were used to assess growth during various seasonal and environmental conditions as well as survival. We estimated age-specific cohort growth by measuring the change in average size of all individuals of each age class (subyearling and yearling) present at a site. Individual growth estimates were made by comparing recorded length and weight data over time for fish that were recaptured. We also used length and weight data to calculate the Fulton condition factor of *O. mykiss* individuals using the following equation:

$$K = (W(g)/L(mm)^3)*100{,}000$$

Individual *O. mykiss* were assigned to age classes (subyearling or yearling) using cut-off lengths based on body length histograms. Age class data are critical in order to establish environmental or annual effects on age classes within sites and to compare biomass across sites.

*Task 1.3: Data summary and comparison across years of consistent sampling*

We estimated *O. mykiss* density for each date we visited each site as described above. We compared densities across years over the maximum time record possible; four of the sites visited in 2017 have been monitored since 2008 (LSX, UWM, ULU, and UMU), while the other two have been monitored since 2010 (USU and MLX).

## Results from reporting period (July 2017 – December 2017)

We have reported annually on the previous year's activities, and we refer to these reports for results from 2008 through 2016. Data from 2017 are presented here, and include demographic estimates (body size histograms, abundance, density, cohort growth, and condition factor) and their derivatives for juvenile *O. mykiss* and long-term *O. mykiss* density trends.

*Tasks 1.1 and 1.2: Density monitoring and data collection of juvenile* O. mykiss

For the 2017 sampling activity described in this report, we handled a total of 2,436 fish. For this sampling we PIT tagged 1,063 individual O. mykiss and had 786 recapture events (any rehandled previously tagged fish – including multiple recaptures of some individuals). In 2017 we performed some additional sampling for research related purposes on the same dates and in the same locations as the sampling visits described in this report (200 m up and downstream of 100 m reported reaches). This additional sampling resulted in handling an additional 4,427 fish, tagging an additional 1,089 fish, and 631 more recapture events.

Histograms of abundance and size distributions describe the dominant patterns throughout the six study reaches (Figs. 2 – 7). In general, two size/age classes were distinguishable (i.e., sites tended to have bimodal size distributions), one composed of subyearling (0+) individuals that emerged in spring 2017 and a second composed of yearling or older fish (1+) that emerged in previous springs. During the first visit, yearling fish were more abundant or equal to subyearling fish at LSX, UMU, USU, and UWM, while less abundant at MLX and ULU. By the second visit in August, when we were able to more effectively collect subyearlings with our sampling gear, subyearlings were relatively more abundant than they had been earlier in the season, and that pattern generally continued throughout the sampling season with the exception of UMU, where subyearlings were relatively small (average body length was 58.3 mm at the conclusion of 2017 sampling) compared to other sites. Subyearling body size at lower elevation sites (LSX and MLX) was larger on a given date compared to sites at higher elevations (USU, UWM, ULU, and UMU).

Notable abundance patterns this year included the high abundance of both subyearlings and yearlings at ULU relative to all other sites, the high yearling to subyearling ratios observed at UMU and LSX, and the high subyearling to yearling ratios observed at MLX and USU compared to other sites (Tables 3 – 7). These patterns are consistent with previous years, with the exception of the high yearling to subyearling ratio observed at UMU and LSX. Yearling density at UMU was especially high (approximately twice the typically observed densities) compared to previous years while subyearling densities were consistent with those observed during low subyearling density years (eg. 2011, 2014). In 2017, total densities of juvenile *O. mykiss* did not display the same temporal pattern across the six sampled sites. Over the course of the summer sampling season, total density increased slightly at one site (UWM), changed little at two sites (LSX and MLX), and peaked followed by a decline from August to September in ULU, UMU, and USU (Fig. 8). Subyearling densities displayed the same temporal pattern as total densities with the exception of MLX which followed the parabolic pattern observed at ULU, UMU, and USU (Fig. 9), suggesting that the relatively lower total densities early in the summer may have been due to our inability to sample small subyearlings during that time. Subyearling densities appear to display consistent spatial variation as LSX and MLX had lower subyearling densities than higher elevation sites in the watershed (with the exception of UWM, a pattern which is observed yearly, and UMU due to decreased capture ability of small subyearlings). The highest densities of both age classes were observed at ULU (Figs. 9 – 10). Yearling densities were relatively constant over the summer at all sites except for ULU, where densities peaked midsummer and decreased during the final two visits from the peak density (Fig. 10). Yearling densities were lowest at lower elevation sites (LSX and MLX), and there was little difference in density between those two sites.

We calculated cohort growth rates for juvenile *O. mykiss* over four growth periods at each site (with the exception of LSX for which three growth periods were calculated). Subyearling cohort growth rates were uniformly positive at all sites with the exception of the second growth period for LSX (where low sample sizes likely biased cohort growth) and UMU (Fig. 11). Yearling cohort growth rates were more variable, with all sites showing negative cohort growth during the first growth period, positive growth during the second period (with the exception of USU and ULU where growth was negative, and UMU where growth was near zero), positive growth during the third period (though growth at USU and UMU was near zero), and variable growth during the fourth period where growth was positive at LSX, MLX, and UMU and negative at USU, UWM, and ULU (Fig. 12).

Condition factor for both subyearling and yearling fish (averaged across all individuals within an age class and site) tended to decline slightly over the sampling season and reached a minimum at the end of the sampling season, though the pattern was variable at some sites (e.g. ULU) (Figs. 13-14). For both subyearling and yearling fish, condition factors at sites lower in the watershed were not substantially different from sites higher in the watershed. In general, there also did not appear to be significant differences in condition factor based on hydrologic alteration.

Mortality of *O. mykiss* due to handling over the course of the entire field season was less than 1% (0.70% for activity described in this report, Table 6. Overall mortality including our additional research sampling was 0.44%), comparable to that of previous years. The majority of these mortalities (19/30) were subyearling fish.

*Task 1.3: Compare observed juvenile* O. mykiss *densities across years*

Subyearling *O. mykiss* densities in 2017 fell within the range of variation we have observed in the Lapwai watershed since 2008 (Fig. 15). In previous years, subyearling densities have tended to peak in mid-summer before decreasing (though not all sites have followed this pattern in all years – notably, subyearling density increased throughout the entire field season at ULU in 2009 and 2013). In 2017 this pattern of a mid-summer peak occurred at most sites (USU, UWM, MLX, ULU, and UMU). Subyearling densities were constant at one site (LSX). Since 2008, ULU or UMU have generally been the sites with the highest subyearling densities (with the exception of 2010, when subyearling densities at MLX were the highest). This pattern generally held true for 2017, where the highest subyearling densities during the first three visits were observed at ULU. However, the highest subyearling densities were observed at USU during the fourth and fifth visits, consistent with the pattern observed in 2016. Each year, the highest densities are typically observed at a control site (MLX, ULU, or UMU); however, subyearling densities at the other control sites generally overlap with subyearling densities observed at project affected sites. As in previous years, this pattern occurred in 2017, with highest densities observed at ULU but densities at other sites similar and overlapping.

Yearling *O. mykiss* densities in 2017 also fell within the range of variation we have observed in the Lapwai watershed since 2008, although midsummer densities were near double what is typically observed at UMU (Fig. 16). In previous years yearling densities have tended to decrease throughout the field season at sites where densities are high, and stay constantly low at sites with fewer fish (though not all sites have followed this pattern in all years; for example, densities increased throughout the season at USU in 2010). We observed this pattern of decreasing density at high density sites in 2017 (UMU and ULU), but also observed decreasing densities at some relatively low density sites (LSX, USU, and MLX). Densities increased slightly throughout the season at one low density site (UWM). In the early years of the study (2008-2009), the highest yearling densities were observed at ULU and UMU, while other sites had low densities. Over the next four years (2010-2013), yearling densities continued to be low at LSX, but other sites were more variable, with no one site consistently having the highest densities. In 2014 -2016, we observed a repeat of the earlier pattern, with the highest yearling densities observed at ULU and UMU during each visit. In 2017, the pattern observed was consistent with that seen in 2008-2009 and 2014-2016 at UMU (entire season) and ULU (early visits), however variability in yearling densities among ULU and other sites was observed later in the season.

**Additional Outreach and Educational Activities**

In addition to the field density monitoring program, the following products of the Sweetwater – Lewiston Orchards juvenile steelhead project have been accomplished during this reporting period.

- We have prepared data summaries, draft reports and final copies of the annual report from data collected during the field season in 2016.
- We participated and presented information at the Lapwai Coordinator's meeting at the Nez Perce Tribal Fisheries Offices.
- We planned for and accomplished the proposed field activities for summer 2017, including *Oncorhynchus mykiss* density surveys, habitat analysis and growth assessment based upon agreed upon data objectives.
- We exceeded proposed or expected data acquisition multiple ways including the number of sites we visited, the quantity of visits, the extant of community analysis and our sampling of productivity indices in order to understand growth and density metrics.
- We participated in conversations with personnel from the Bureau of Reclamation to ensure that our products and deliverables are satisfactory and accomplishing the deliverables.
- We have provided the necessary paperwork to IDFG to maintain and report on required scientific collection permits.
- We have cleaned, disinfected, maintained and inventoried equipment that was used 2017 field season in preparation for future years' use on this agreement.

**Current and Future Efforts**

We are currently in the process of analyzing the following data:

- Fish community structure: spatiotemporal variation in composition, densities and the effects on *O. mykiss*
- Diet (stomach samples) and available food resources (emergence, drift and Surber samples)
- Validation of age and analysis of maternal origin (of mortalities)
- Assessing site fidelity of PIT tagged juvenile *O. mykiss*
- Identifying drivers of population densities and the effects on growth rates and movement
- Relationships between habitat conditions and steelhead densities and individual performance.

Future efforts will consist of completing the analyses listed above, as well as continuing to work on the scientific manuscripts currently in preparation. Project members also plan to attend professional meetings throughout the coming year, where they will present the findings of this project.

## Tables

Table 2. Names, three-letter codes, and dates for sites sampled in Lapwai watershed from July to October 2017. Each site in white was sampled five times throughout the field season except LSX which was sampled 4 times due to equipment issues. Sites were sampled five times throughout the season in previous years, except in 2008, 2015, and 2016, when they were sampled four, three, and three times respectively.

| Site name | Site code | Date of first visit | Date of second visit | Date of third visit | Date of fourth visit | Date of fifth visit |
|---|---|---|---|---|---|---|
| Lower Lapwai lower | LLL | Not sampled | Not sampled | Not sampled | Not sampled | Not sampled |
| Lower Lapwai upper | LLU | Not sampled | Not sampled | Not sampled | Not sampled | Not sampled |
| Lower Sweetwater | LSX | Not sampled | 8/6/2017 | 8/17/2017 | 9/25/2017 | 10/7/2017 |
| Middle Lapwai | MLX | 7/5/2017 | 7/30/2017 | 8/10/2017 | 9/17/2017 | 9/29/2017 |
| Upper Lapwai lower | ULL | Not sampled | Not sampled | Not sampled | Not sampled | Not sampled |
| Upper Lapwai middle | ULM | Not sampled | Not sampled | Not sampled | Not sampled | Not sampled |
| Upper Lapwai upper | ULU | 7/6/2017 | 7/31/2017 | 8/11/2017 | 9/18/2017 | 9/30/2017 |
| Upper Mission lower | UML | Not sampled | Not sampled | Not sampled | Not sampled | Not sampled |
| Upper Mission middle | UMM | Not sampled | Not sampled | Not sampled | Not sampled | Not sampled |
| Upper Mission upper | UMU | 7/7/2017 | 8/1/2017 | 8/12/2017 | 9/19/2017 | 10/1/2017 |
| Upper Sweetwater lower | USL | Not sampled | Not sampled | Not sampled | Not sampled | Not sampled |
| Upper Sweetwater middle | USM | Not sampled | Not sampled | Not sampled | Not sampled | Not sampled |
| Upper Sweetwater upper | USU | 7/10/2017 | 8/5/2017 | 8/16/2017 | 9/24/2017 | 10/6/2017 |
| Upper Webb lower | UWL | Not sampled | Not sampled | Not sampled | Not sampled | Not sampled |
| Upper Webb middle | UWM | 7/9/2017 | 8/4/2017 | 8/15/2017 | 9/23/2017 | 10/5/2017 |
| Upper Webb upper | UWU | Not sampled | Not sampled | Not sampled | Not sampled | Not sampled |

Table 3. Number, population size estimated using methods of Carle and Strub (1978), and density (number m$^{-2}$) of *O. mykiss* captured via electrofishing at six sites in Lapwai watershed (four of which have been sampled since 2008: LSX, UWM, ULU, UMU) in **July**, 2017 (first visit to each site). Each site was approximately 100 meters in length. Original name refers to the site name used in calendar years 2008 and 2009 and associated Activities Reports, and new name refers to the site name used in calendar years 2010-2017.

| **Original name (2008-2009)** | **New name (2010-2017)** | **Number *O. mykiss* captured** | **Population estimate (standard error)** | **Density (number m$^{-2}$)** |
|---|---|---|---|---|
| Lower Sweetwater | Lower Sweetwater (LSX) | NA | NA | NA |
| (not sampled) | Upper Sweetwater upper (USU) | 81 | 88 (4.898) | 0.215 |
| Lower Webb | Upper Webb middle (UWM) | 19 | 19 (0.505) | 0.058 |
| (Not sampled) | Middle Lapwai (MLX) | 39 | 58 (19.079) | 0.093 |
| Upper Lapwai | Upper Lapwai upper (ULU) | 147 | 162 (7.873) | 0.323 |
| Upper Mission | Upper Mission upper (UMU) | 80 | 82 (2.297) | 0.198 |

Table 4. Number, population size estimated using methods of Carle and Strub (1978), and density (number $m^{-2}$) of *O. mykiss* captured via electrofishing at six sites in Lapwai watershed (four of which have been sampled since 2008: LSX, UWM, ULU, UMU) in **Late July/Early August**, 2017 (first visit to LSX, second visit to all other sites). Each site was approximately 100 meters in length. Original name refers to the site name used in calendar years 2008 and 2009 and associated Activities Reports, and new name refers to the site name used in calendar years 2010-2017.

| Original name (2008-2009) | New name (2010-2017) | Number *O. mykiss* captured | Population estimate (standard error) | Density (number $m^{-2}$) |
|---|---|---|---|---|
| Lower Sweetwater | Lower Sweetwater (LSX) | 23 | 29 (7.604) | 0.049 |
| (not sampled) | Upper Sweetwater upper (USU) | 111 | 116 (3.583) | 0..329 |
| Lower Webb | Upper Webb middle (UWM) | 41 | 43 (2.363) | 0.125 |
| (Not sampled) | Middle Lapwai (MLX) | 34 | 39 (5.181) | 0.065 |
| Upper Lapwai | Upper Lapwai upper (ULU) | 190 | 213 (9.507) | 0.440 |
| Upper Mission | Upper Mission upper (UMU) | 109 | 120 (6.290) | 0.348 |

Table 5. Number, population size estimated using methods of Carle and Strub (1978), and density (number $m^{-2}$) of *O. mykiss* captured via electrofishing at six sites in Lapwai watershed (four of which have been sampled since 2008: LSX, UWM, ULU, UMU) in **Mid August**, 2017 (Second visit to LSX, third visit to all other sites). Each site was approximately 100 meters in length. Original name refers to the site name used in calendar years 2008 and 2009 and associated Activities Reports, and new name refers to the site name used in calendar years 2010-17.

| Original name (2008-2009) | New name (2010-2017) | Number *O. mykiss* captured | Population estimate (standard error) | Density (number $m^{-2}$) |
|---|---|---|---|---|
| Lower Sweetwater | Lower Sweetwater (LSX) | 20 | 21 (2.220) | 0.036 |
| (not sampled) | Upper Sweetwater upper (USU) | 118 | 128 (5.615) | 0.402 |
| Lower Webb | Upper Webb middle (UWM) | 44 | 45 (1.707) | 0.135 |
| (Not sampled) | Middle Lapwai (MLX) | 82 | 83 (1.375) | 0.144 |
| Upper Lapwai | Upper Lapwai upper (ULU) | 219 | 237 (7.442) | 0.513 |
| Upper Mission | Upper Mission upper (UMU) | 151 | 176 (11.269) | 0.479 |

Table 6. Number, population size estimated using methods of Carle and Strub (1978), and density (number $m^{-2}$) of *O. mykiss* captured via electrofishing at six sites in Lapwai watershed (four of which have been sampled since 2008: LSX, UWM, ULU, UMU) in **September**, 2017 (third visit to LSX, fourth visit to all other sites). Each site was approximately 100 meters in length. Original name refers to the site name used in calendar years 2008 and 2009 and associated Activities Reports, and new name refers to the site name used in calendar years 2010-17.

| Original name (2008-2009) | New name (2010-2017) | Number *O. mykiss* captured | Population estimate (standard error) | Density (number $m^{-2}$) |
|---|---|---|---|---|
| Lower Sweetwater | Lower Sweetwater (LSX) | 19 | 19 (1.097) | 0.033 |
| (not sampled) | Upper Sweetwater upper (USU) | 136 | 142 (3.792) | 0.427 |
| Lower Webb | Upper Webb middle (UWM) | 47 | 51 (3.854) | 0.147 |
| (Not sampled) | Middle Lapwai (MLX) | 76 | 78 (2.224) | 0.122 |
| Upper Lapwai | Upper Lapwai upper (ULU) | 139 | 156 (8.318) | 0.308 |
| Upper Mission | Upper Mission upper (UMU) | 84 | 102 (10.978) | 0.386 |

Table 7. Number, population size estimated using methods of Carle and Strub (1978), and density (number $m^{-2}$) of *O. mykiss* captured via electrofishing at six sites in Lapwai watershed (four of which have been sampled since 2008: LSX, UWM, ULU, UMU) in **Late September/Early October**, 2017 (fourth visit to LSX, fifth visit to all other sites). Each site was approximately 100 meters in length. Original name refers to the site name used in calendar years 2008 and 2009 and associated Activities Reports, and new name refers to the site name used in calendar years 2010-17.

| Original name (2008-2009) | New name (2010-2017) | Number *O. mykiss* captured | Population estimate (standard error) | Density (number $m^{-2}$) |
|---|---|---|---|---|
| Lower Sweetwater | Lower Sweetwater (LSX) | 15 | 15 (0.165) | 0.024 |
| (not sampled) | Upper Sweetwater upper (USU) | 94 | 99 (3.557) | 0.261 |
| Lower Webb | Upper Webb middle (UWM) | 42 | 42 (0.995) | 0.127 |
| (Not sampled) | Middle Lapwai (MLX) | 50 | 52 (2.419) | 0.089 |
| Upper Lapwai | Upper Lapwai upper (ULU) | 129 | 148 (9.434) | 0.288 |
| Upper Mission | Upper Mission upper (UMU) | 97 | 105 (5.087) | 0.265 |

Table 8. Number of *O. mykiss* mortalities during electrofishing and fish handling/processing at six sites in Lapwai watershed (four of which have been sampled since 2008: LSX, UWM, ULU, UMU); includes fish <65 mm fork length. Each site was sampled five times between July and October, 2017, except LSX which was sampled 4 times. For the activity described in this report, total number of *O. mykiss* captured on a given visit is shown in parentheses; mortality rate among all sites and visits during the sampling season was 0.70% (Our additional sampling resulted in 13 more mortalities; our total 2017 mortality when additional sampling is included was 0.44%).

| Site code | First visit | Second visit | Third visit | Fourth visit | Fifth visit |
|---|---|---|---|---|---|
| LSX | NA | 0 (23) | 0 (20) | 1 (19) | 0 (15) |
| USU | 0 (81) | 0 (111) | 0 (118) | 0 (136) | 1 (94) |
| UWM | 0 (19) | 0 (41) | 0 (44) | 0 (47) | 0 (42) |
| MLX | 1 (39) | 0 (34) | 0 (82) | 0 (76) | 1 (50) |
| ULU | 2 (147) | 1 (190) | 0 (219) | 0 (139) | 3 (129) |
| UMU | 0 (80) | 2 (109) | 3 (151) | 0 (84) | 2 (97) |

## Figures

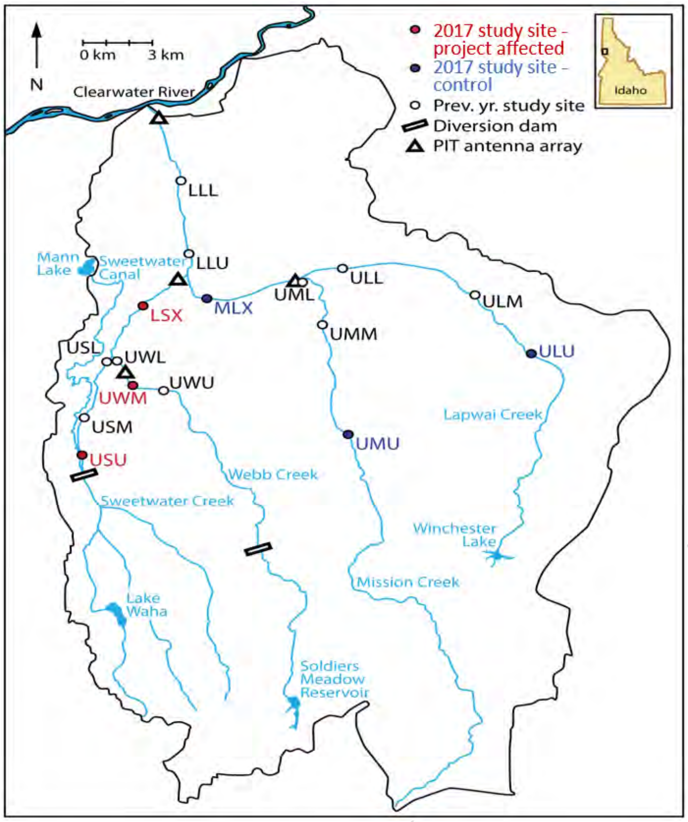



Figure 1. Study site locations in 2017 (and previous years). Red circles denote project affected sites visited in 2017, blue circles denote control sites visited in 2017, and sites visited only in previous years are represented by white circles. Diversion dams and PIT antenna arrays are also noted.

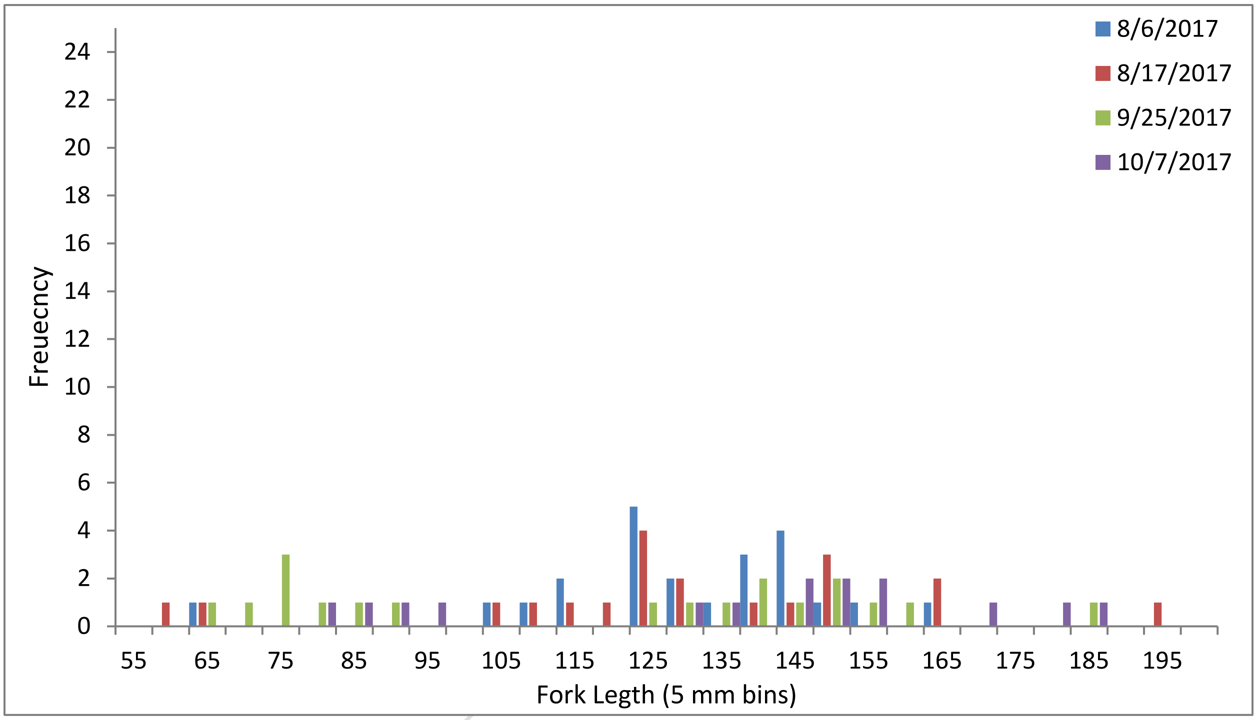



Figure 2. Histogram of juvenile *O. mykiss* fork length (mm) throughout 2017 at the lower Sweetwater site (LSX).

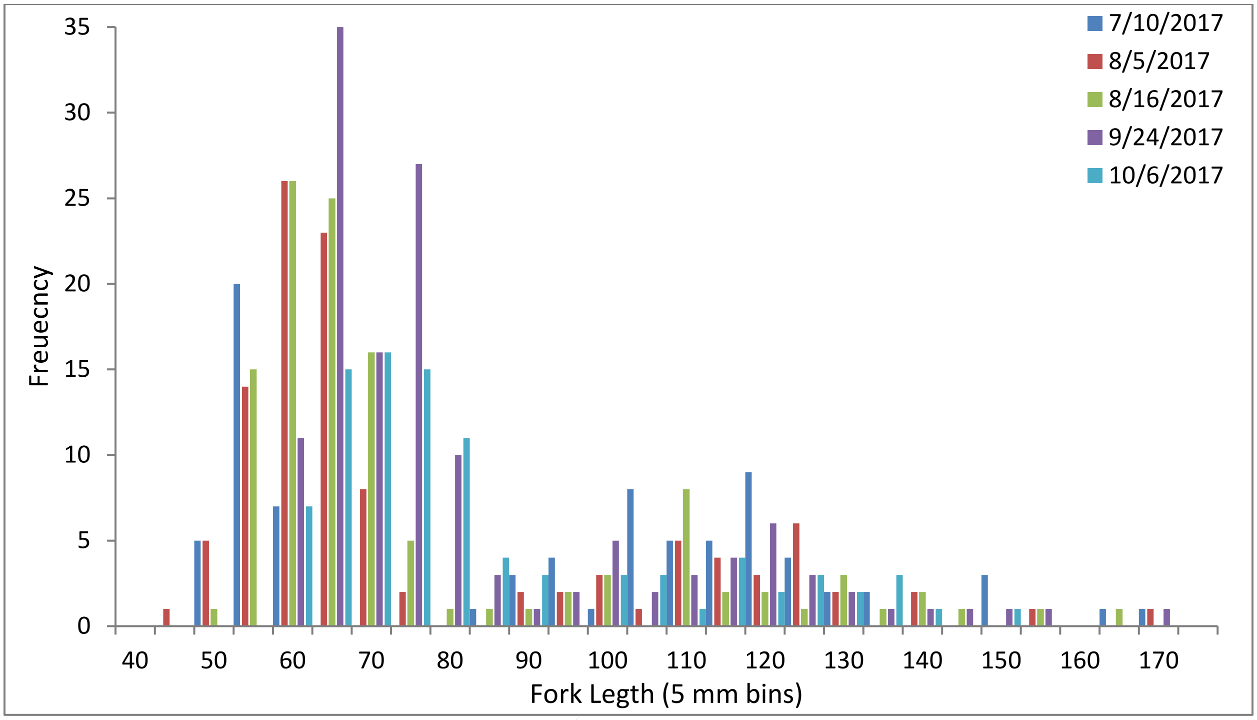



Figure 3. Histogram of juvenile *O. mykiss* fork length (mm) throughout 2017 at the upper Sweetwater upper site (USU). Note that y-axis scale (35) is different from other histograms.

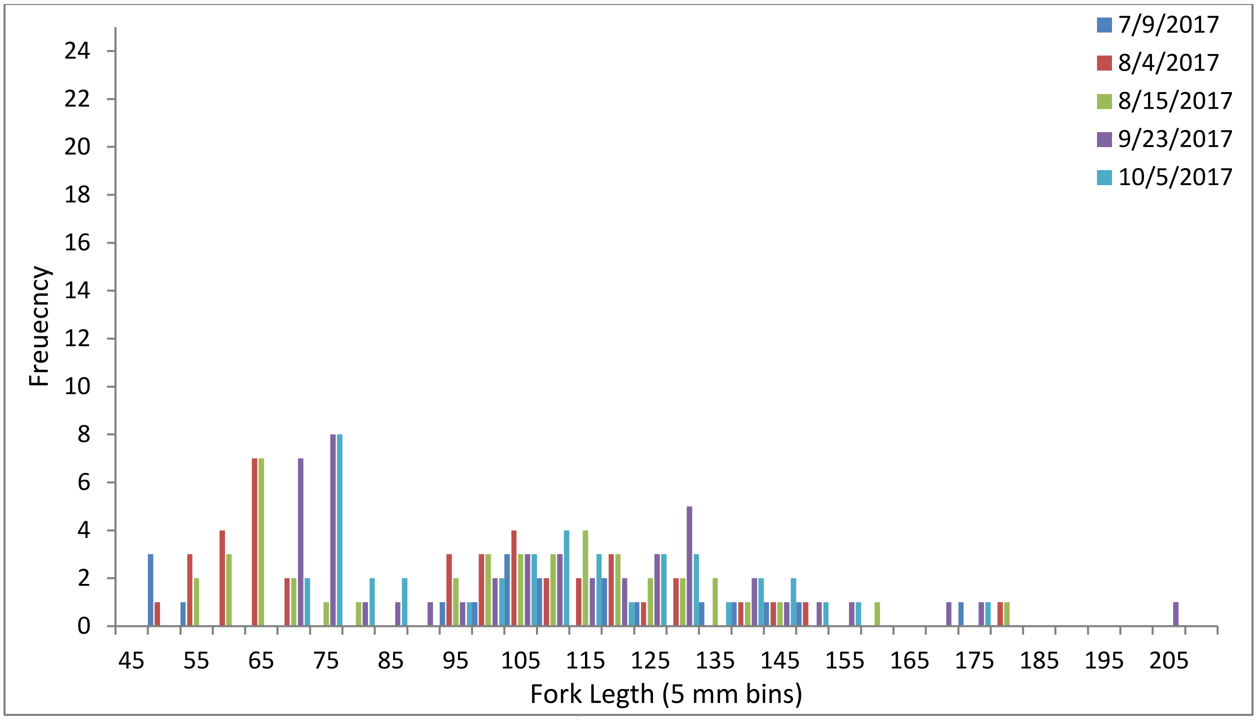



Figure 4. Histogram of juvenile *O. mykiss* fork length (mm) throughout 2017 at the upper Webb middle site (UWM).

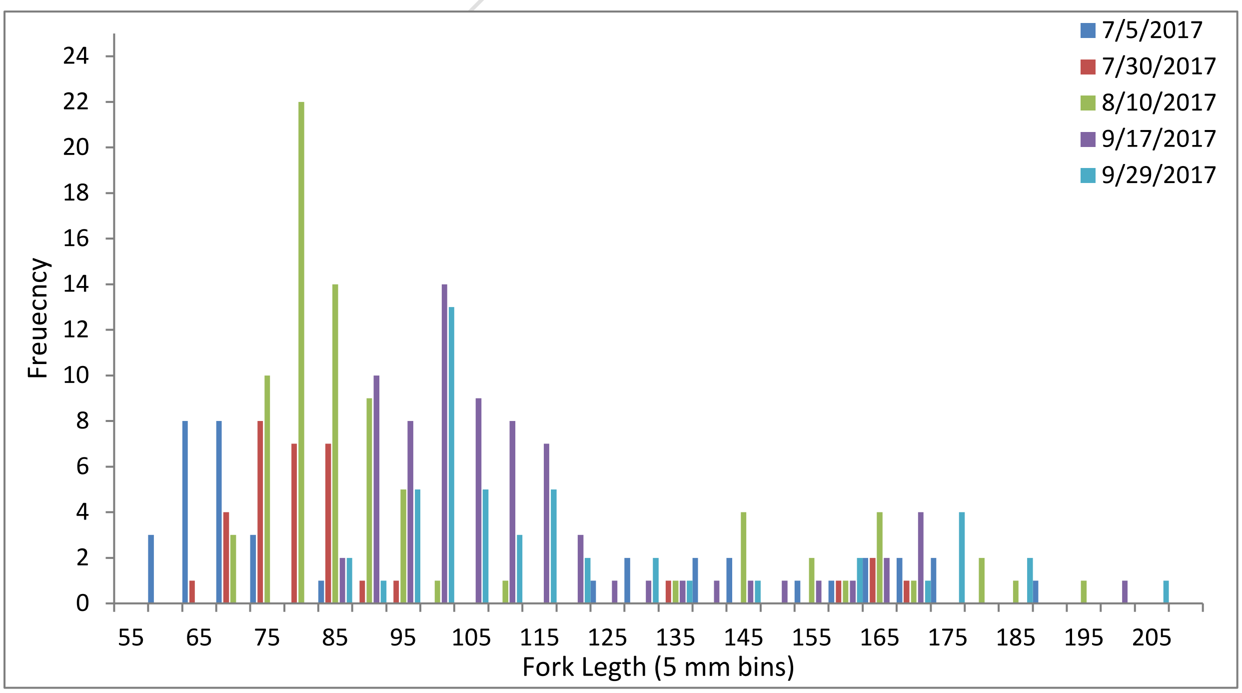



Figure 5. Histogram of juvenile *O. mykiss* fork length (mm) throughout 2017 at the middle Lapwai site (MLX).

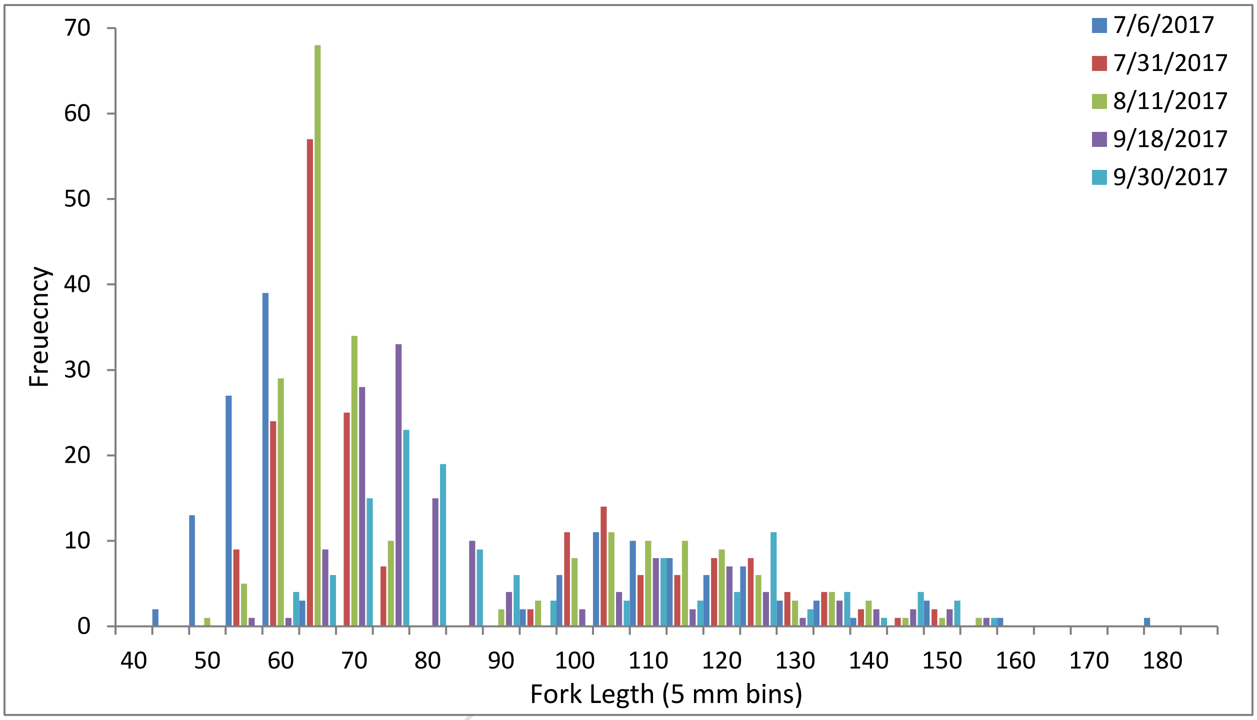



Figure 6. Histogram of juvenile *O. mykiss* fork length (mm) throughout 2016 at the upper Lapwai upper site (ULU). Note that y-axis scale (70) is different from other histograms.

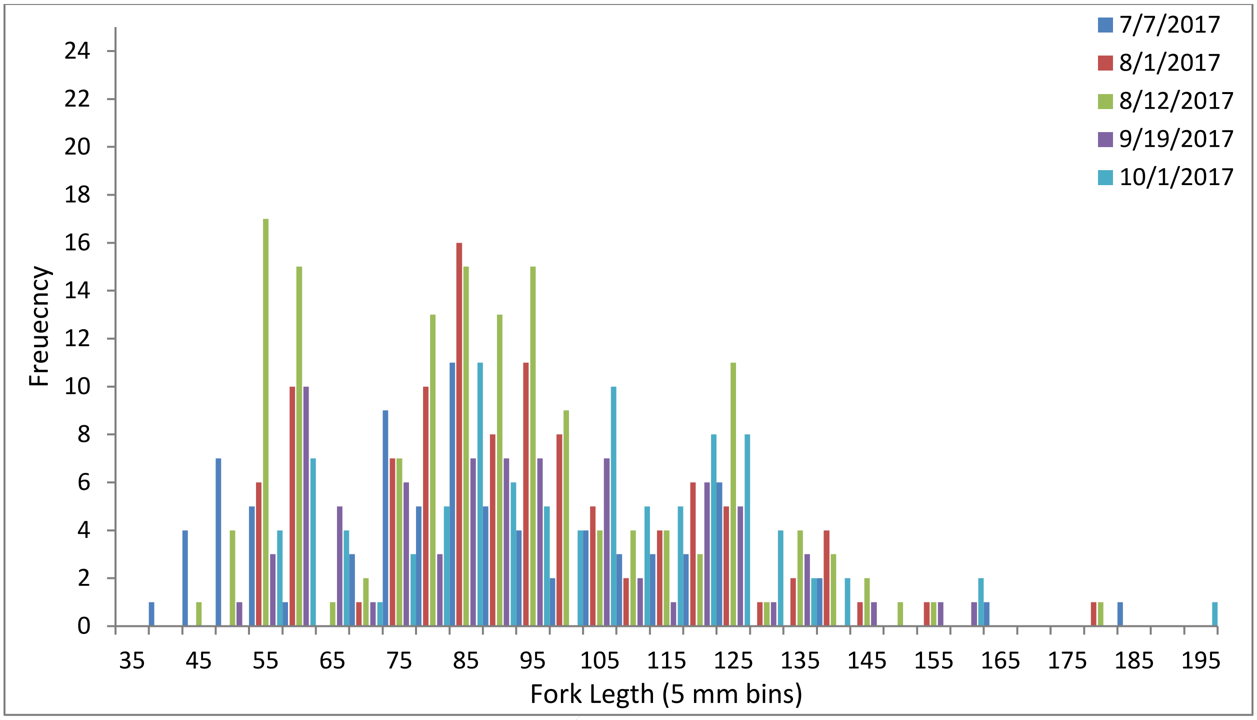



Figure 7. Histogram of juvenile *O. mykiss* fork length (mm) throughout 2017 at the upper Mission upper site (UMU).

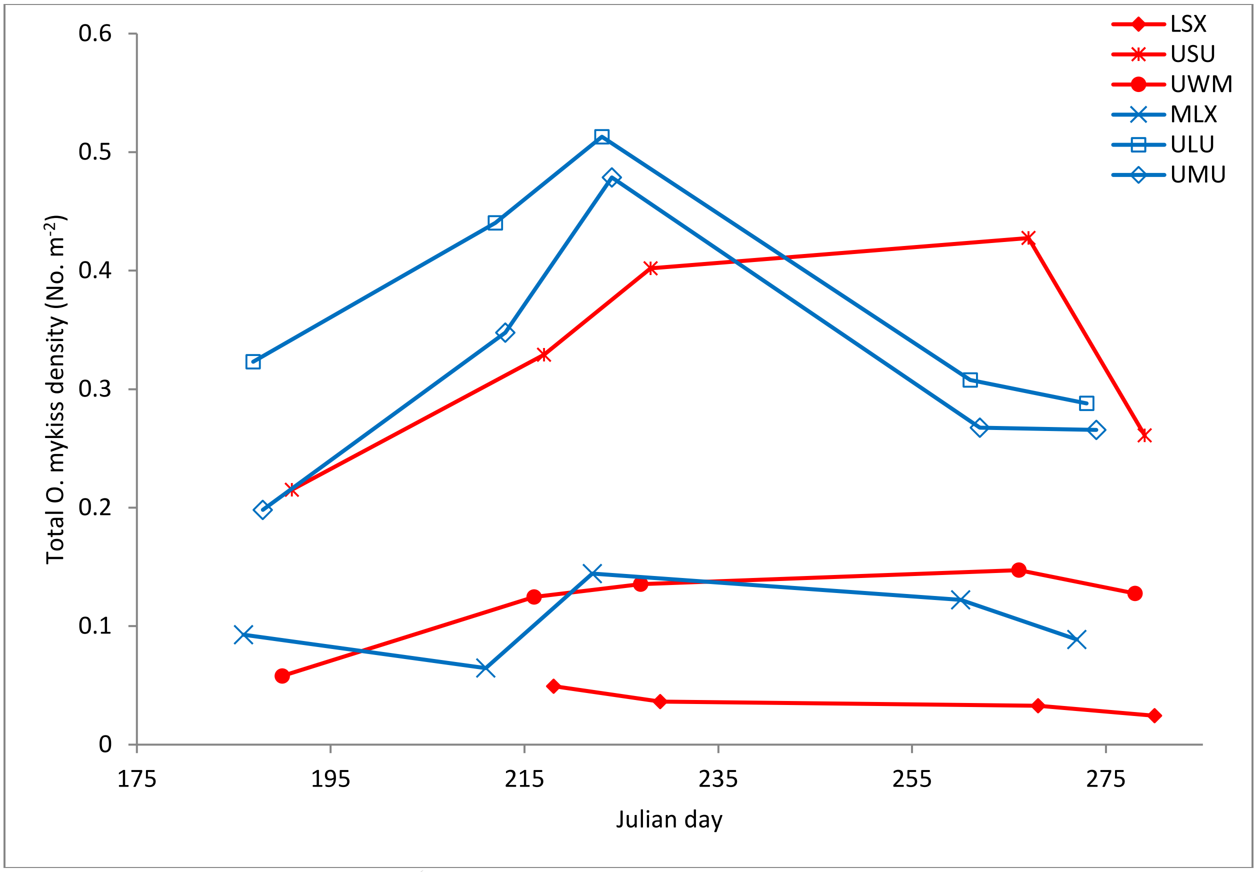



Figure 8. Density of juvenile *O. mykiss* (individuals $m^{-2}$) at six study sites in Lapwai watershed (four of which have been sampled since 2008: LSX, UWM, ULU, UMU) from July to October, 2017. Sites on Webb and Sweetwater Creeks are in the project affected area (indicated by red color). Site names follow new naming scheme.

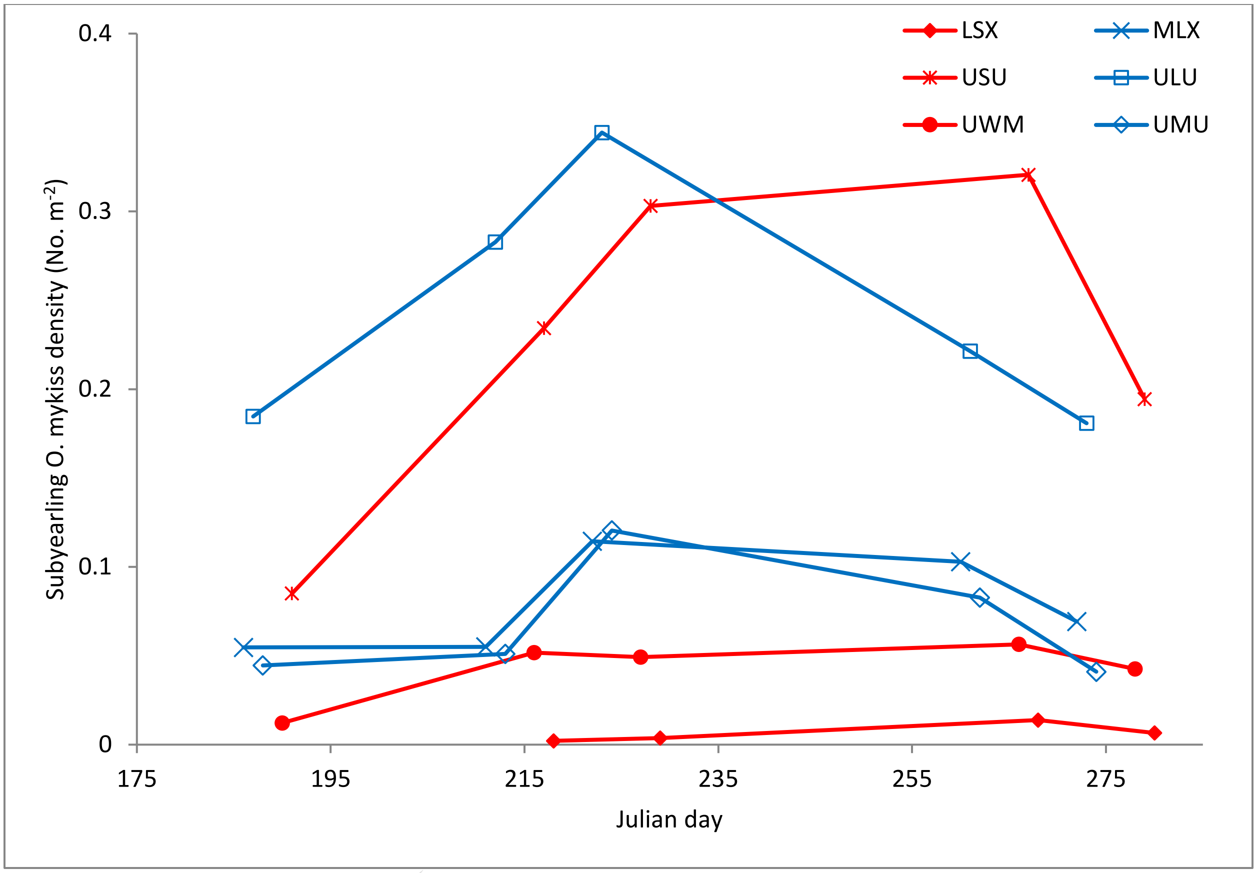



Figure 9. Density of subyearling *O. mykiss* (individuals $m^{-2}$) at six study sites in Lapwai watershed (four of which have been sampled since 2008: LSX, UWM, ULU, UMU) from July to October, 2017. Sites on Webb and Sweetwater Creeks are in the project affected area (indicated by red color). Site names follow new naming scheme.

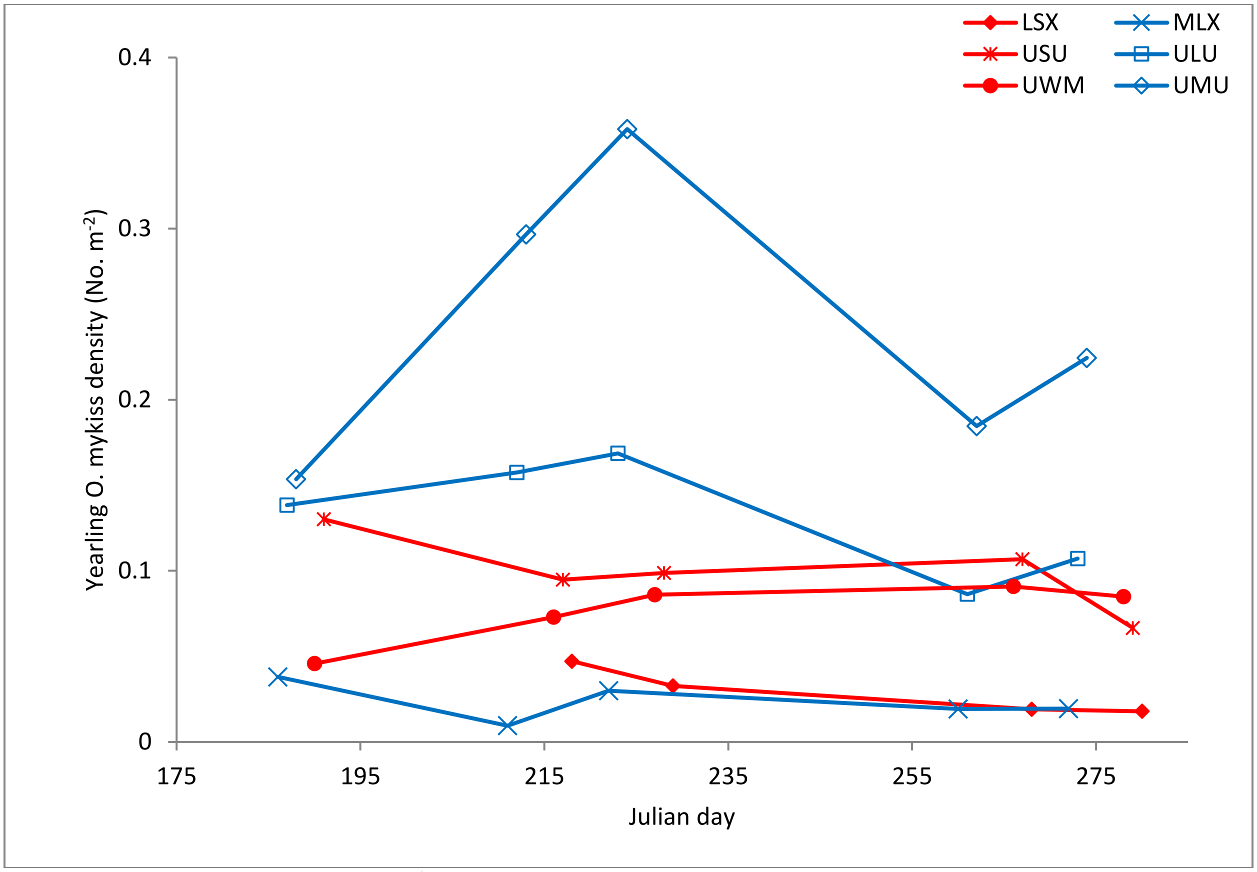



Figure 10. Density of yearling *O. mykiss* (individuals $m^{-2}$) at six study sites in Lapwai watershed (four of which have been sampled since 2008: LSX, UWM, ULU, UMU) from July to October, 2017. Sites on Webb and Sweetwater Creeks are in the project affected area (indicated by red color). Site names follow new naming scheme.

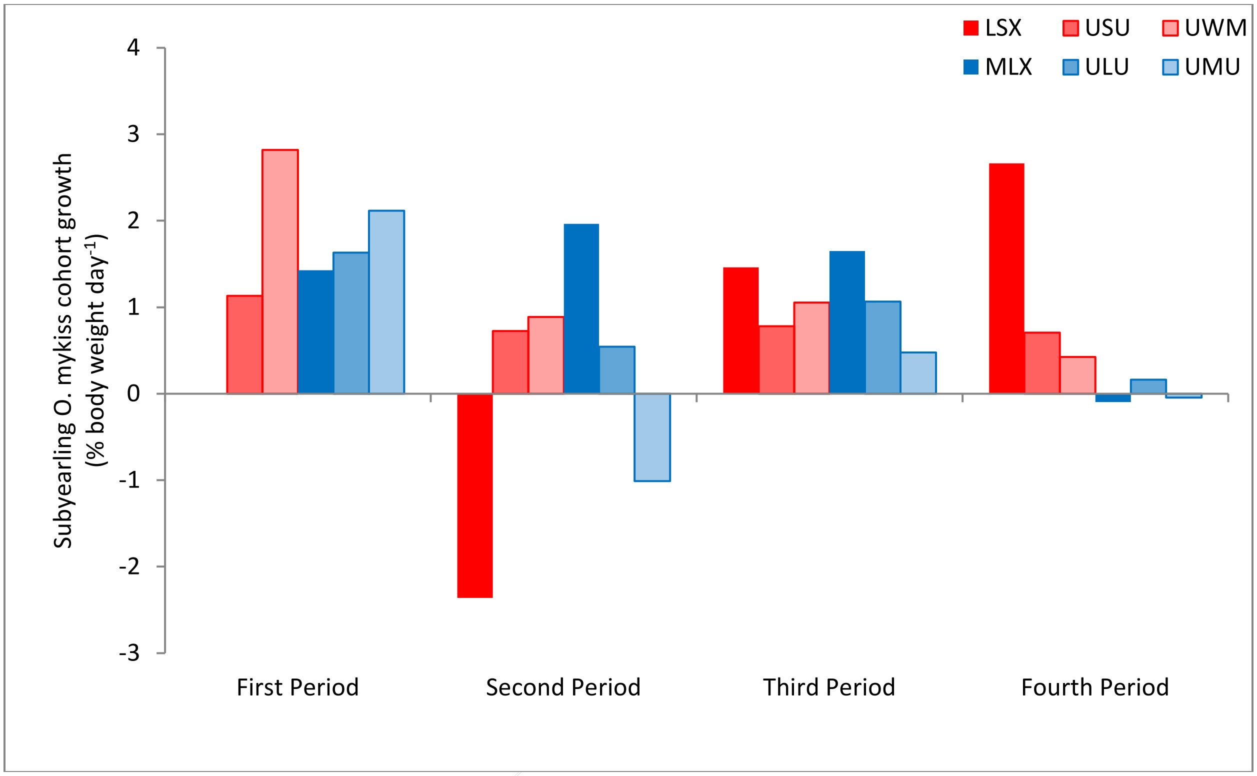



Figure 11. Cohort growth of subyearling *O. mykiss* (% body weight day$^{-1}$) at six study sites in Lapwai watershed (four of which have been sampled since 2008: LSX, UWM, ULU, UMU) from July to October, 2017. Sites on Webb and Sweetwater Creeks are in the project affected area (indicated by red color). Site names follow new naming scheme. There were only four visits to LSX, hence growth data was only available for the second through fourth growth periods.

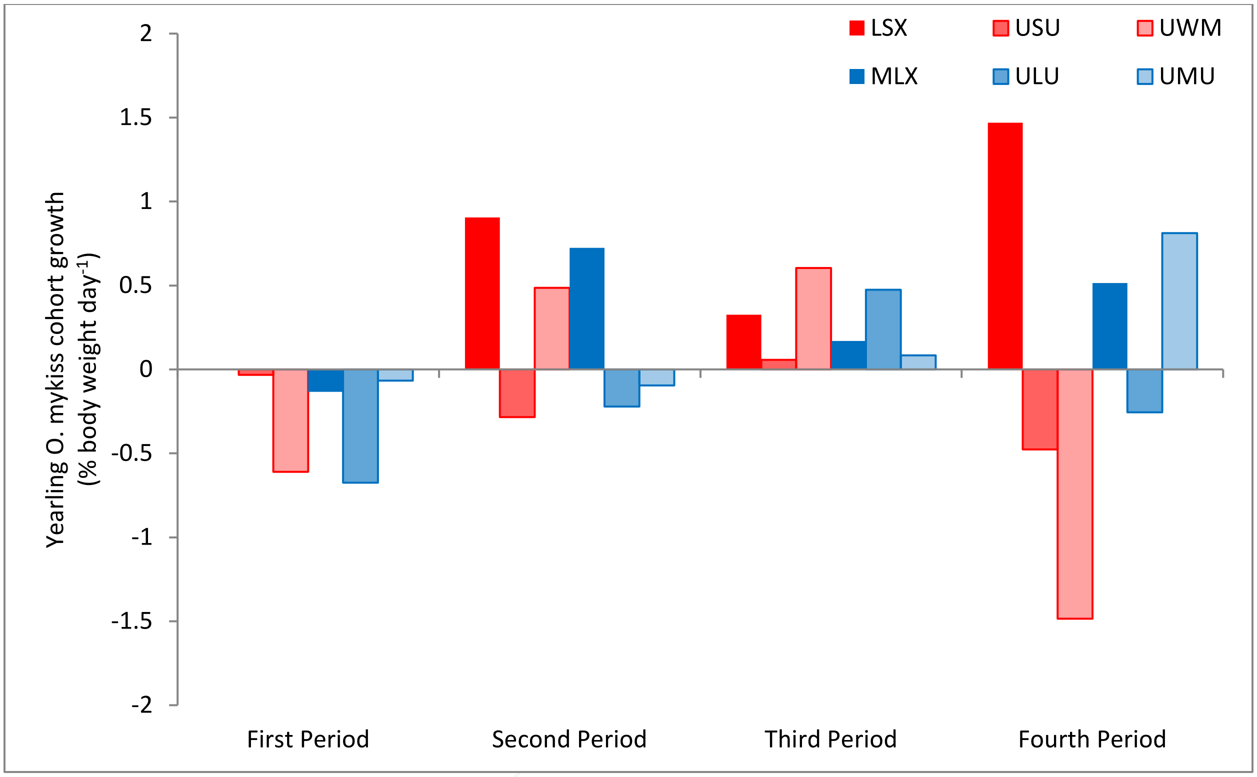



Figure 11. Cohort growth of subyearling *O. mykiss* (% body weight day$^{-1}$) at six study sites in Lapwai watershed (four of which have been sampled since 2008: LSX, UWM, ULU, UMU) from July to October, 2017. Sites on Webb and Sweetwater Creeks are in the project affected area (indicated by red color). Site names follow new naming scheme. There were only four visits to LSX, hence growth data was only available for the second through fourth growth periods.

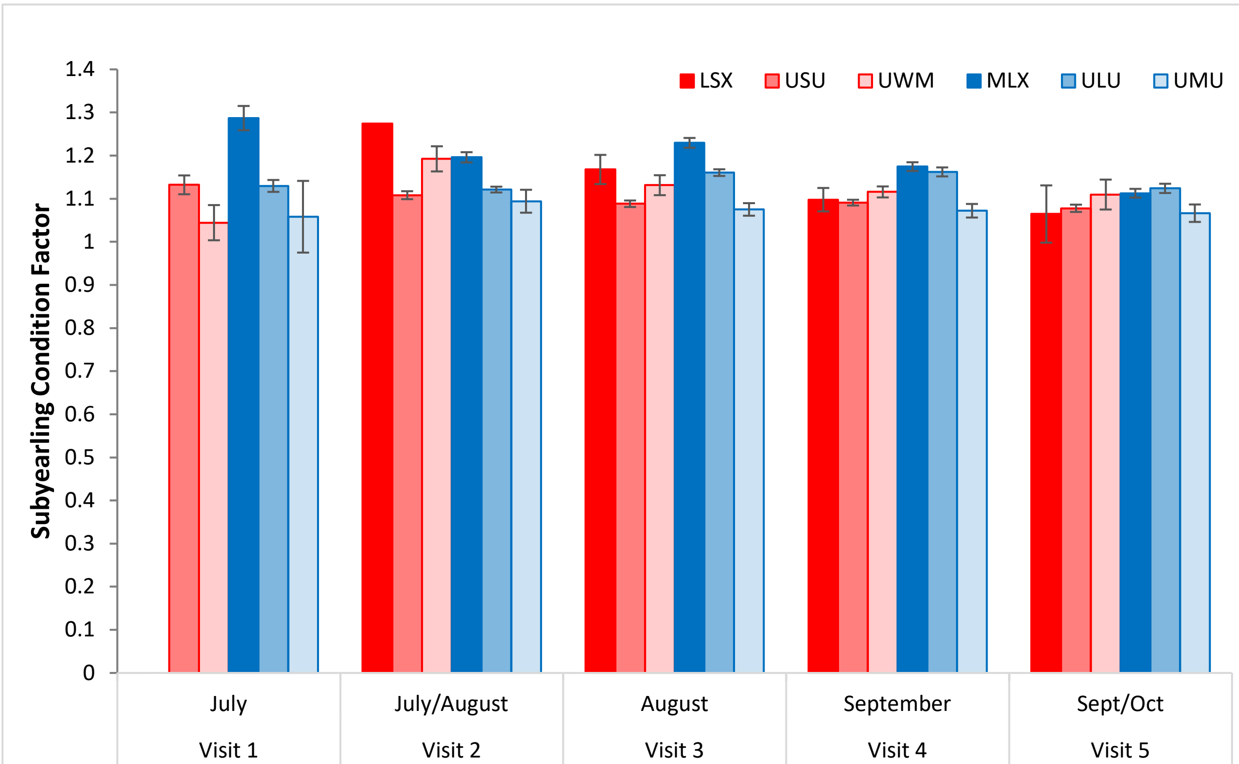



Figure 13. Condition factor of all captured subyearling *O. mykiss* at six study sites in Lapwai watershed (four of which have been sampled since 2008: LSX, UWM, ULU, UMU) from late July to early October, 2017. Sites on Webb and Sweetwater Creeks are in the project affected area (indicated by red color). Error bars indicate +/- 1 standard error. Site names follow new naming scheme.

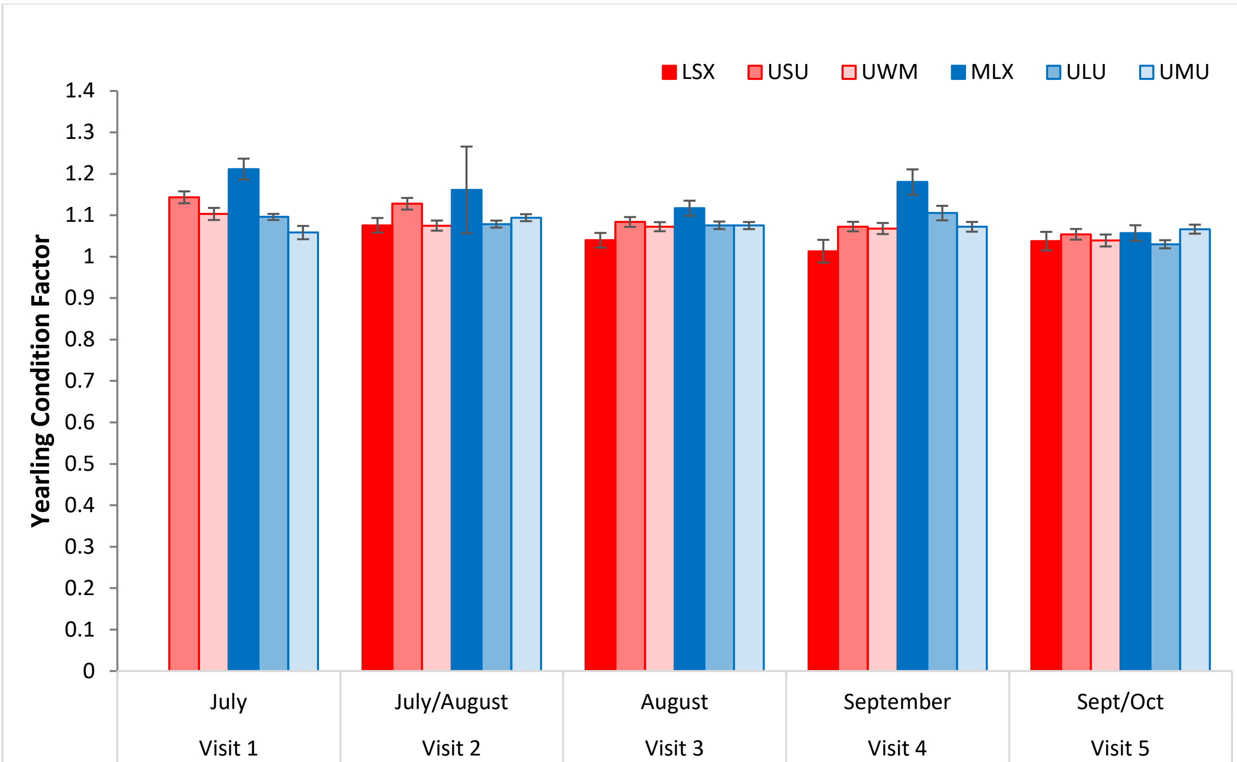



Figure 14. Condition factor of yearling *O. mykiss* at six study sites in Lapwai watershed (four of which have been sampled since 2008: LSX, UWM, ULU, UMU) from late July to early October, 2017. Sites on Webb and Sweetwater Creeks are in the project affected area (indicated by red color). Error bars indicate +/- 1 standard error. Site names follow new naming scheme.

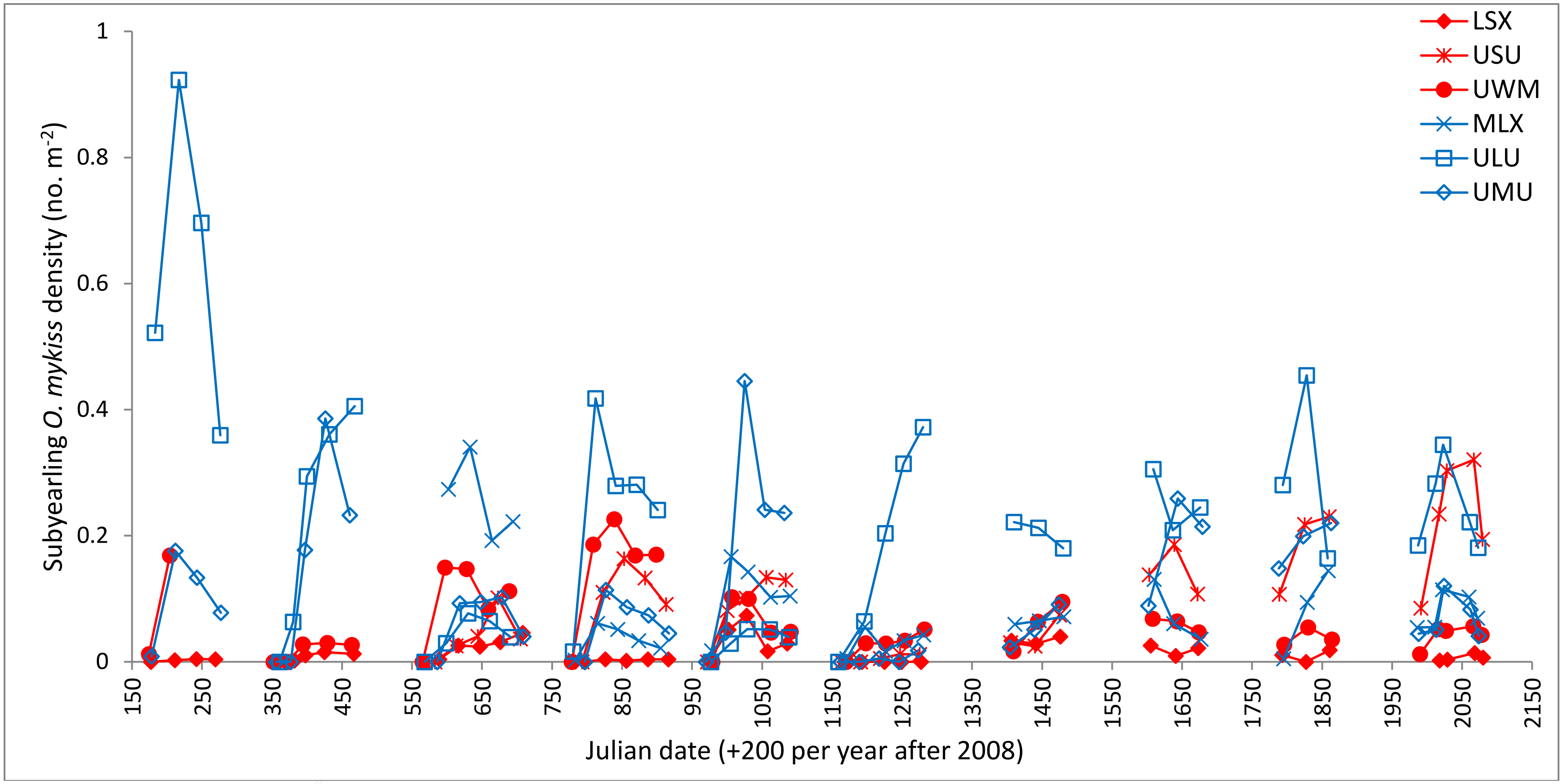



Figure 16. Density of subyearling *O. mykiss* (individuals $m^{-2}$) at six study sites in Lapwai watershed between 2008 and 2017 (note: USU and MLX were not sampled until 2010). Sites on Webb and Sweetwater Creeks are in the project affected area (indicated by red color). Site names follow new naming scheme.

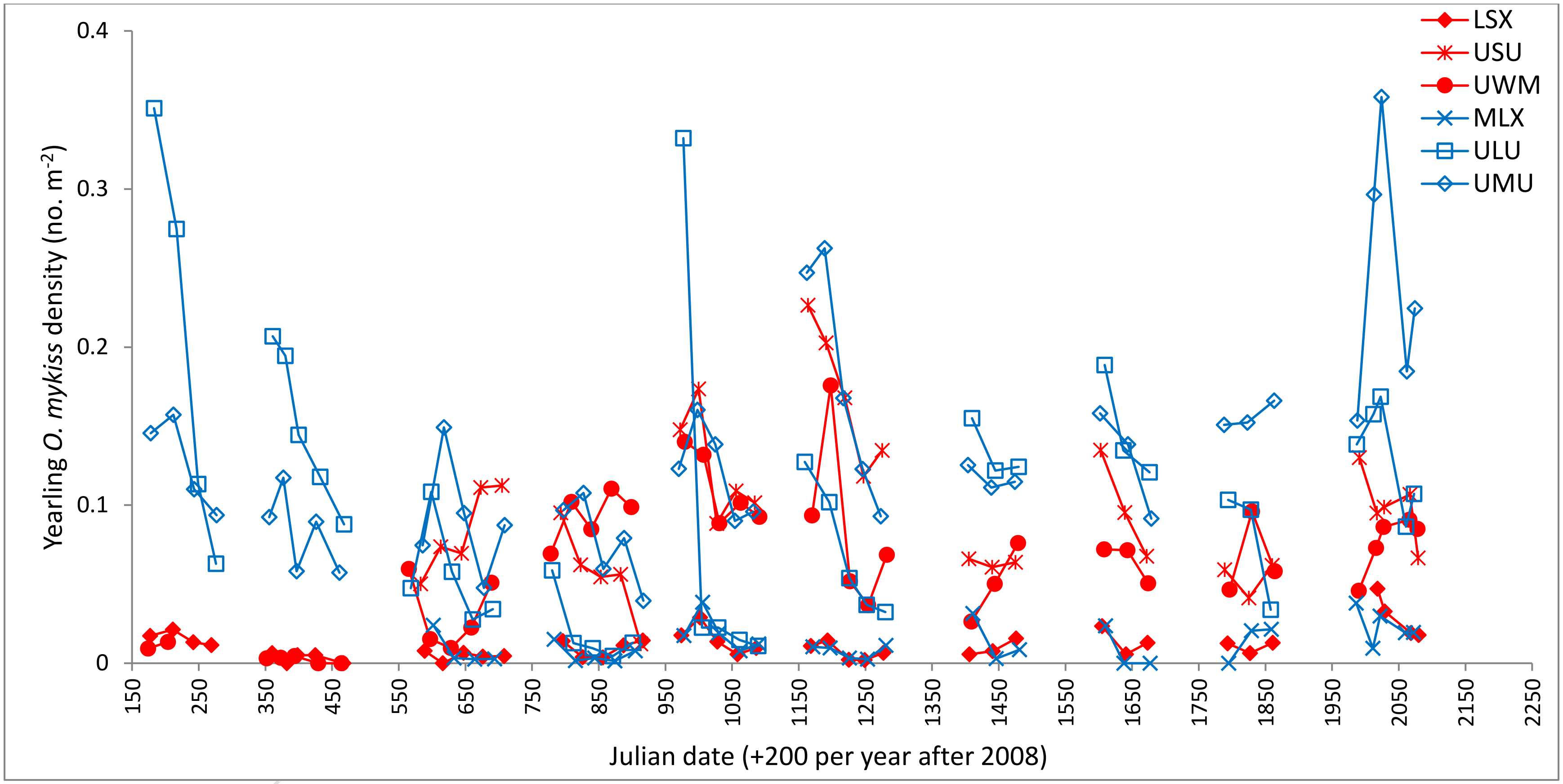



Figure 17. Density of yearling *O. mykiss* (individuals m$^{-2}$) at six study sites in Lapwai watershed between 2008 and 2017 (note: USU and MLX were not sampled until 2010). Sites on Webb and Sweetwater Creeks are in the project affected area (indicated by red color). Site names follow new naming scheme. Note that y-axis scale is different from subyearling figure.

## References and Literature Cited

ALMODOVAR, A. and NICOLA, G. G. (1999). Effects of a small hydropower station upon brown trout Salmo trutta L. in the River Hoz Seca (Tagus basin, Spain) one year after regulation. *Regulated Rivers-Research & Management,* **15**, 477-484.

CARLE, F.L. and STRUB, M.R. (1978). A new method for estimating population size from removal data. *Biometrics*, **34**, 621-630.

HARTSON, R. B. AND KENNEDY, B. P. (2014). Competitive release modifies the impacts of hydrologic alteration for a partially migratory stream predator. *Ecology of Freshwater Fish*.

HORNE, B. D., RUTHERFORD, E. S. and WEHRLY, K. E. (2004). Simulating effects of hydro-dam alteration on thermal regime and wild steelhead recruitment in a stable-flow Lake Michigan tributary. *River Research and Applications,* **20**, 185-203.

LOPES, L. F. G., DO CARMO, J. S. A., CORTES, R. M. V. and OLIVEIRA, D. (2004). Hydrodynamics and water quality modeling in a regulated river segment: application on the instream flow definition. *Ecological Modeling,* **173**, 197-218.

MYRVOLD, K. M. and KENNEDY, B. P. (2014). Interactions between body mass and water temperature cause energetic bottlenecks in juvenile steelhead. *Ecology of Freshwater Fish*.

NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION (NOAA). (2006). Biological Opinion to the Bureau of Reclamation for the Operation and Maintenance of the Lewiston Orchards Project.

# APPENDIX D

## NEZ PERCE TRIBE 2017 LAPWAI CREEK PIT TAG DETECTION SUMMARY

# Nez Perce Tribe

## Department of Fisheries Resources Management

**Administration • Enforcement • Habitat/Watershed • Harvest • Production • Research • Resident Fish**

**RESEARCH DIVISION**

| | |
|---|---|
| **Date:** | May 3, 2018 |
| **To:** | Jay Hesse, Director Research Division |
| | James Taylor, BOR ESA Planning Program Manager |
| **From:** | Rick Orme, NPT ISEMP Project Leader |
| | Cameron M. Albee NPT ISEMP Biologist |
| **Subject:** | 2017 Lapwai Creek PIT Tag Detection Summary |

The Nez Perce Tribe and Bureau of Reclamation entered into a Memorandum of Agreement (MOA) in 2012 to monitor adult steelhead escapement into Lapwai Creek via Passive Integrated Transponder (PIT) tag arrays (Reclamation Agreement NO: R12MA11706). This summary report provides results for the period of July 1, 2016 through June 30, 2017. The data summarized here is generated from the PIT tagging and biological sampling of a known proportion of adult steelhead and Chinook salmon as they migrate through the Lower Granite Dam (LGR) fish ladder and the subsequent detection of those PIT tagged adults at the multiple Lapwai Creek In-stream PIT Tag Detection System (IPTDS). This data and the final regional abundance report are the product of multiple projects and agencies. The Integrated Status and Effectiveness Monitoring Project (ISEMP; BPA Project 2003-017-00) spearhead PIT tagging of adults at LGR, have been integral in the development and maintenance of IPTDS infrastructure throughout the Snake River, and developed the Bayesian patchwork occupancy model to estimate population-level estimates of abundance. Idaho Steelhead Monitoring and Evaluation Studies (ISMES; BPA Project 1990-055-00) and the Idaho Natural Production Monitoring and Evaluation Program (NPM; BPA Project 1991-073-00) coordinate biological sampling of adults at LGR and provide length, age, and passage timing data. The Snake River Genetic Stock Identification (BPA Project 2010-026-00) provides SNP genotype data for population-level genetic diversity and structure analysis. Trapping at LGR is coordinated by National Marine Fisheries Service (NMFS; BPA Project 2005-002-00; Harmon 2003; Ogden 2010, 2011). The Bureau of Reclamation and Lewiston

Orchards Irrigation District support the maintenance of PIT tag arrays in Lapwai, Mission, Sweetwater, and Webb creeks.

**Adult Detections**

Adult PIT tag detections at IPTDS within Lapwai Creek were summarized for detections occurring July 1, 2016 through June 30, 2017. First and last adult steelhead detections in Lapwai Creek ranged from February 5, 2017 through May 23, 2017 (Table 1). Adult coho salmon, fall Chinook salmon, were also detected during this reporting period (Table 1), but were influence by brood stock collections at a weir downstream of the arrays.

Table 1. Date of first and last adult PIT tag observation by species at in-stream PIT tag arrays within Lapwai Creek during the period of July 1, 2016 through June 30, 2017. Most coho and fall Chinook were trapped for brood stock at a weir downstream of the array.

| Species | First Observation Date | Last Observation Date |
|---|---|---|
| Coho | 10/27/2016 | 11/29/2016 |
| Fall Chinook | 11/16/2016 | 11/17/2016 |
| Steelhead | 2/5/2017 | 5/23/2017 |

A total of 78 unique PIT tagged adults were detected between the Lapwai (LAP), Mission (MIS), Sweetwater (SWT), and Webb (WEB) creek in-stream PIT tag arrays (Table 2). Both hatchery and wild/natural steelhead adults were detected within Lapwai Creek from 11 different release locations (Table 2). Of these, 52 were wild/natural (adipose intact), six were of hatchery origin (adipose clip), and four were of unknown origin (Table 2).

Table 2. Number of unique PIT tagged adults detected at Lapwai Creek in-stream PIT tag arrays between July 1, 2016 through June 30, 2017 by species, rear type (wild, hatchery, and unknown) and by release site.

| Release Site | Steelhead | | | Chinook | Coho | Total |
|---|---|---|---|---|---|---|
| | Hatchery | UnKnown | Wild | Hatchery | Hatchery | |
| Bonneville Adult | | 3 | | | | 3 |
| Kooskia Hatchery | | | | | 9 | 9 |
| Lapwai Creek | | | | | 6 | 6 |
| LGR Adult Trap | 3 | | 46 | | | 49 |
| LGR Juvenile Barge | | | 2 | | | 2 |
| LGR Juvenile In-River | | | 1 | | | 1 |
| LGR Juvenile Release in Tailrace | | 1 | | | | 1 |
| Lyons Ferry Hatchery | | | | 1 | | 1 |
| Meadow Creek | 1 | | | | | 1 |
| Mission Creek | | | 1 | | | 1 |
| Touchet River | 1 | | | | | 1 |
| Tucannon River | 1 | | 1 | | | 2 |
| Webb Creek | | | 1 | | | 1 |
| Total | 6 | 4 | 52 | 1 | 15 | 78 |

### Adult Steelhead Detections

A total of 49 adult steelhead that were PIT tagged as adults at Lower Granite Dam adult trap (LGRLDR) were detected within Lapwai Creek for spawn year 2017 (Table 2). Of these, 46 were wild/natural (adipose intact) and three of hatchery origin (Table 2). Of the 46 wild adults, two were repeat spawners that previously spawned in Lapwai Creek in 2016. The three hatchery adults tagged at LGRLDR were adipose intact fish, and determined to be hatchery-origin through genetic analysis (IDFG unpublished data). In addition, there was a PIT tag detected at MIS during high spring flows from an adult that spawned in 2014. Unassociated PIT tags either shed from a live fish or released into the environment through a mortality event is a common occurrence at other PIT tag arrays within the region.

Under normal adult trapping operations, PIT tags from LGRLDR tag group are a representative sample of wild/natural steelhead adults passing Lower Granite Dam and therefore can be used to assess and make inference to the wild/natural run of steelhead into Lapwai Creek that includes estimates of arrival timing at Lower Granite Dam, arrival timing into Lapwai Creek, travel time, residency time, and dip-in behavior.

Of the PIT tags from the LGRLDR tag group, seven of the 45 tags (18% of the total tags) were observed at the Mission Creek array, fourteen (31%) of the tags were observed passing the Sweetwater Creek array, and five PIT tagged wild/natural adult steelhead (11%) were observed crossing the Webb Creek arrays (Table 3).

*Arrival Timing*--Based on the LGRLDR adult PIT tags, the wild/natural adult steelhead that entered Lapwai creek arrived at Lower Granite Dam beginning June 26, 2016 through April 20, 2017 (Figure 1). Thirty-five percent of Lapwai Creek steelhead crossed Lower Granite Dam in September, 2016 with approximately 15 percent crossing Lower Granite Dam in the spring of 2017 (Figure 1). The first wild adult steelhead arrivals into Lapwai Creek began in February, 2017. In addition, 72 percent of wild adult steelhead arrived in Lapwai Creek during February (Figure 1). Detections during April and May at the Lapwai Creek array were dominated by downstream passages indicating post spawn adults (Figure 2).

*Residency Time and Dip-In Behavior*--The detection probability for all PIT tagged adult steelhead moving upstream at the Lapwai Creek array was 0.896 and 0.50 at the Mission Creek array. The detection probability for PIT tagged adult steelhead at the Sweetwater and Webb creek arrays was calculated to be 1.0. However, the operational status and operational time periods for the Sweetwater and Webb creek arrays were not assessed. It was assumed that the Sweetwater and Webb creek arrays operated normally and continuously over the entire time period of assessment. A violation of this assumption would result in an underestimate of PIT tagged adults entering Sweetwater and Webb creeks. The detection probability of downstream passages was not calculated but likely less than 1.0, therefore the number of dip-ins and post spawn adults may be underestimated. However, the available data suggest that 45 PIT tagged ad-intact steelhead adults from the tagging effort at LGRLDR entered and remained in Lapwai Creek.

*Travel Time Between Arrays*--The Mission Creek PIT tag array (MIS) detected 7 PIT tagged adult steelhead that were also detected at the LAP PIT tag array (LAP). The Travel time between these arrays ranged between 7 to 24 days with a mean travel time of 17 days.

The Sweetwater Creek PIT tag array (SWT) detected a total of 17 PIT tagged adult steelhead that were also detected at Lapwai Creek Array (LAP). The travel time between these arrays ranged between 1 to 45 days with a mean travel time of 14.9 days. The adult steelhead with a 45 day travel time was first detected at the Mission Creek PIT tag array (MIS) 10 days after the initial LAP detection but only resided in Mission Creek for 1 day and therefore was excluded from the MIS travel time estimate. This particular adult steelhead then took an additional 35 days to enter Sweetwater Creek. When excluding this fish from the SWT estimate, the mean travel time between LAP and SWT averaged 13 days.

Webb Creek PIT tag array (WEB) detected 7 PIT tagged adult steelhead that were also detected at SWT. The run timing range between these arrays was 2 to 9 days with a mean travel time of 5 days.

Table 3. The number of wild/natural Lower Granite Dam PIT tagged adult steelhead by array site detected moving upstream, the number leaving the site prior to spawning (dip-ins), and the final number remaining upstream to spawn.

| Site | Upstream | Dip-ins | Final Upstream |
|---|---|---|---|
| Lapwai Creek Total | 45 | 0 | 45 |
| Mission Creek | 8 | 1 | 7 |
| Sweetwater Creek | 14 | 0 | 14 |
| Webb Creek | 5 | 0 | 5 |

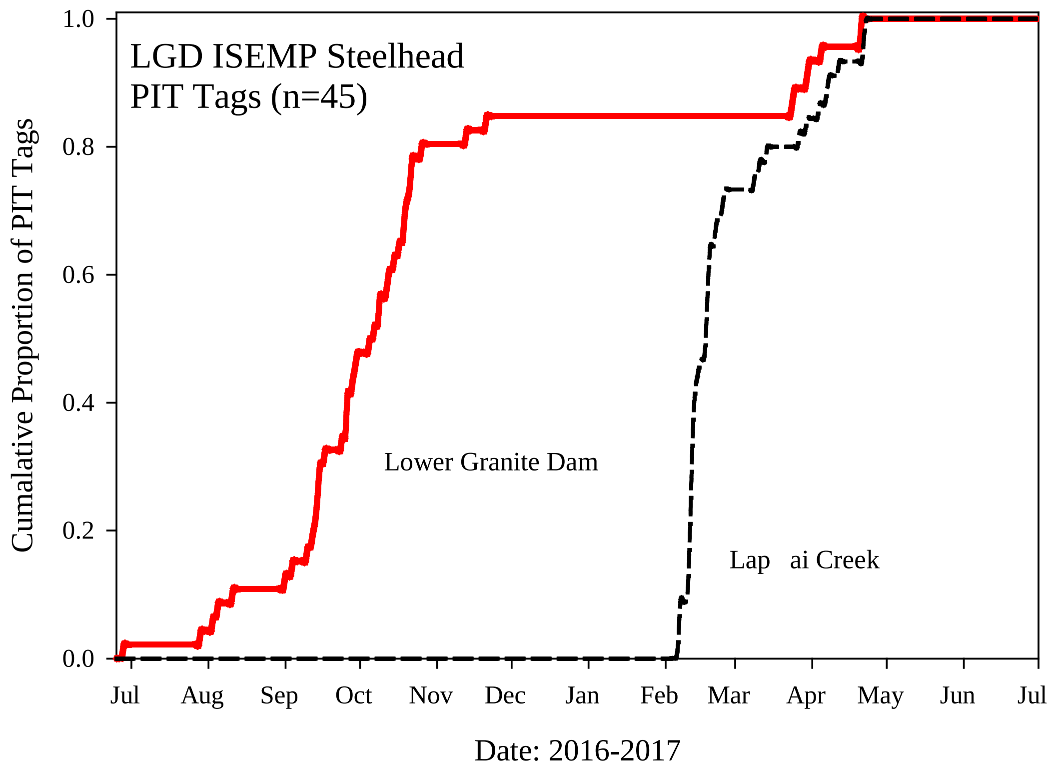



Figure 1. The cumulative proportion of Lower Granite Dam PIT tagged wild/natural adult steelhead by arrival date at the Lapwai Creek in-stream PIT tag array (dashed black line) and the date tagged and released at Lower Granite Dam (solid red line).

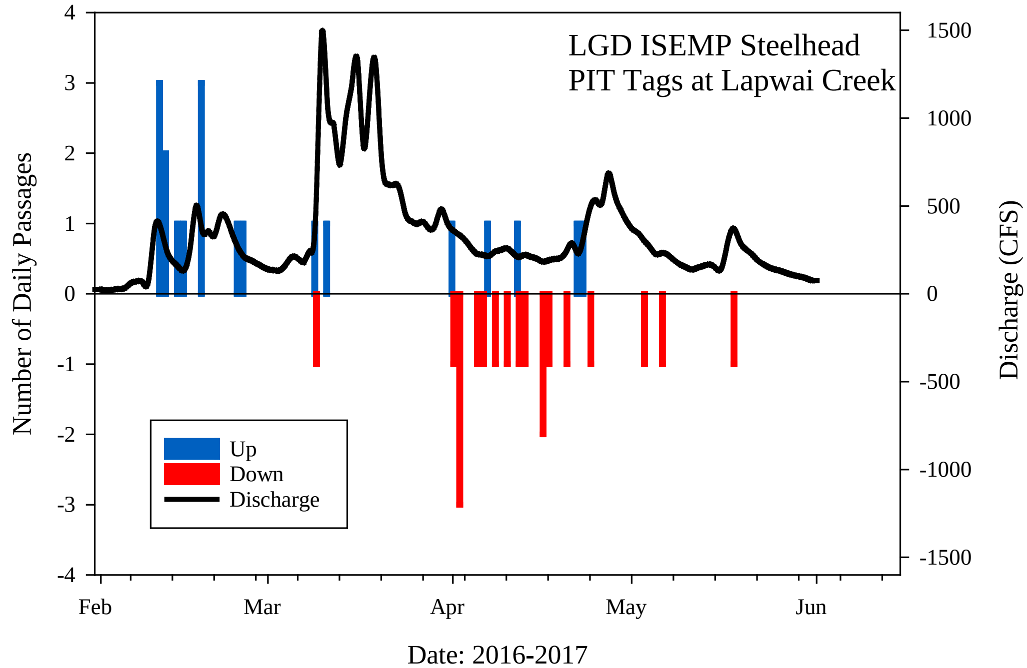



Figure 2. The number of observed upstream (positive blue bars) and downstream (negative red bars) daily passages of Lower Granite Dam PIT tagged wild/natural adult steelhead at the Lapwai Creek in-stream PIT tag array for spawn year 2017. Also shown is the Lapwai Creek discharge (USGS Gage 13342450, cubic feet per second, solid black line).

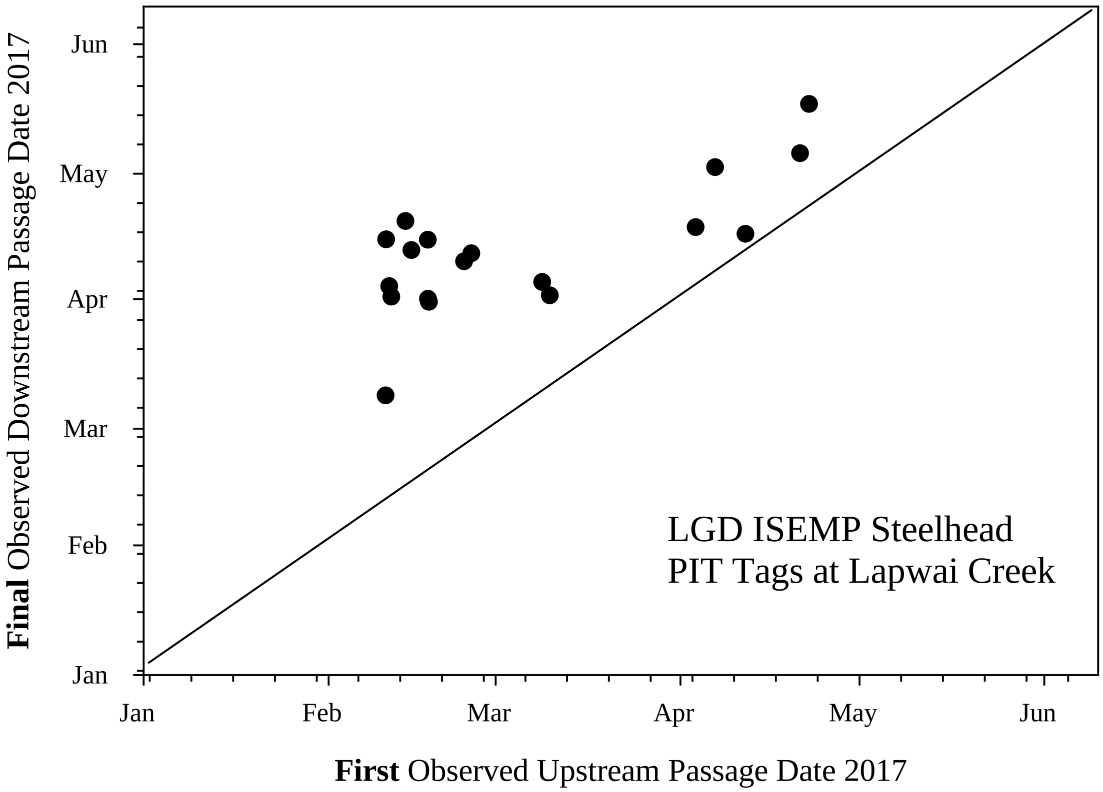



Figure 3. The first observed upstream passage (x-axis) and the final observed downstream passage (y-axis) of Lower Granite Dam PIT tagged wild/natural adult steelhead at the Lapwai Creek in-stream PIT tag array showing post spawn adults (above 1:1 line) and dip-ins (on or near the 1:1 line).

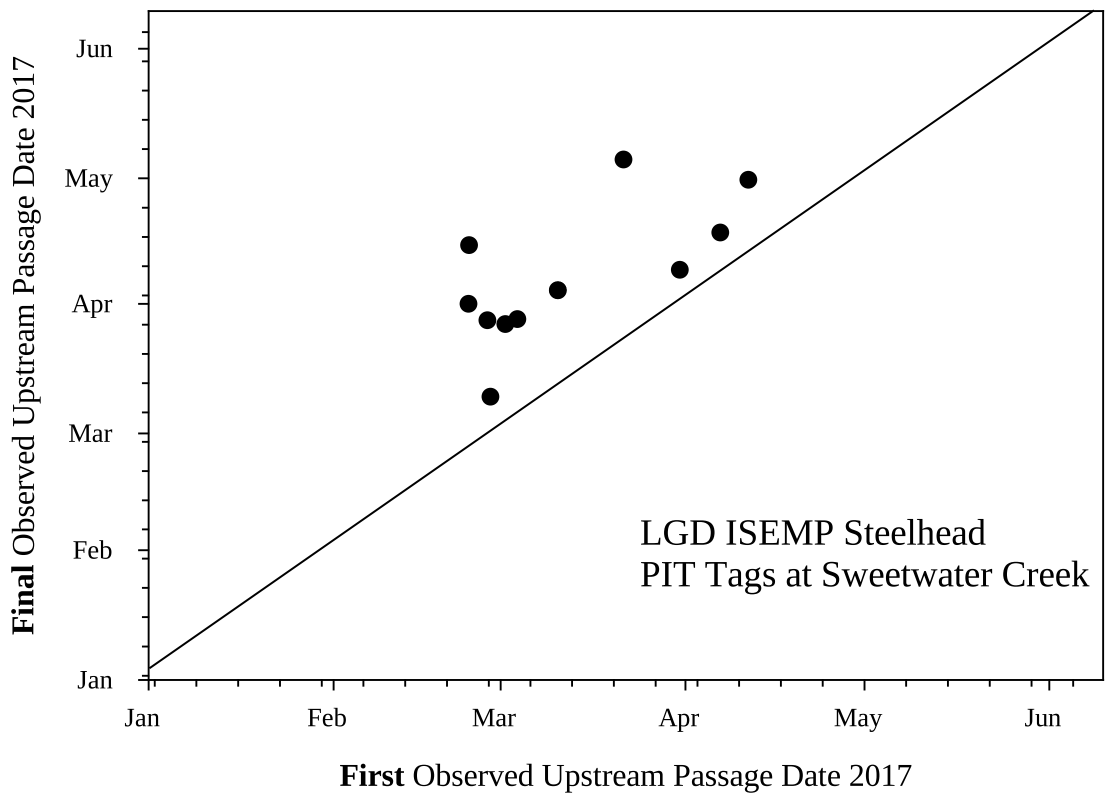



Figure 4. The first observed upstream passage (x-axis) and the final observed downstream passage (y-axis) of Lower Granite Dam PIT tagged wild/natural adult steelhead at the Sweetwater Creek in-stream PIT tag array showing post spawn adults (above 1:1 line) and dip-ins (on or near the 1:1 line).

**Wild Steelhead Adult Abundance Estimates**

Results of the Integrated Status and Effectiveness Monitoring Project's (ISEMP; BPA Project 2003-017-00) Bayesian patchwork occupancy model are presented in Tables 4 through 7. In 2017, a total estimated abundance of 218 wild/natural adults spawned within Lapwai Creek (Table 4) (Orme and Kinzer 2018). The estimated abundance within Mission Creek was 58 wild/natural adults (Table 5), 45 wild/natural adults within Sweetwater Creek (Table 6), and 19 of the 45 wild/natural adults within Webb Creek (Table 7) (Orme and Kinzer 2018).

Table 4. Lapwai Creek wild adult steelhead abundance estimates. The Lapwai Creek array (LAP) was not functional for spawn year 2012. Abundance estimates 2010-2015 (See et. all 2016). Abundance estimates 2016, and 2017 (Orme and Kinzer 2018).

| Spawn Year | Abundance | Lower 95% CI | Upper 95% CI | CV |
|---|---|---|---|---|
| 2010 | 481 | 409 | 564 | 0.084 |
| 2011 | 233 | 194 | 279 | 0.095 |
| 2012 | - | - | - | - |
| 2013 | 328 | 281 | 390 | 0.089 |
| 2014 | 367 | 301 | 440 | 0.103 |
| 2015 | 580 | 489 | 690 | 0.091 |
| 2016 | 590 | 507 | 690 | 0.079 |
| 2017 | 218 | 183 | 262 | 0.093 |

Table 5. Mission Creek wild adult steelhead abundance estimates. Abundance estimates 2010-2015 (See et. all 2016). Abundance estimates 2016, and 2017 (Orme and Kinzer 2018).

| Spawn Year | Abundance | Lower 95% CI | Upper 95% CI | CV |
|---|---|---|---|---|
| 2010 | - | - | - | - |
| 2011 | 106 | 60 | 157 | 0.239 |
| 2012 | 124 | 83 | 176 | 0.189 |
| 2013 | 123 | 78 | 175 | 0.202 |
| 2014 | 141 | 78 | 208 | 0.236 |
| 2015 | 135 | 72 | 213 | 0.268 |
| 2016 | 154 | 97 | 224 | 0.205 |
| 2017 | 58 | 30 | 89.1 | 0.266 |

Table 6. Sweetwater Creek wild adult steelhead abundance estimates. Abundance estimates 2010-2015 (See et. all 2016). Abundance estimates 2016, and 2017 (Orme and Kinzer 2018).

| Spawn Year | Abundance | Lower 95% CI | Upper 95% CI | CV |
|---|---|---|---|---|
| 2010 | 166 | 105 | 223 | 0.187 |
| 2011 | 33 | 7 | 66 | 0.488 |
| 2012 | 59 | 24 | 99 | 0.328 |
| 2013 | 50 | 21 | 87 | 0.338 |
| 2014 | 112 | 62 | 165 | 0.238 |
| 2015 | 177 | 109 | 261 | 0.220 |
| 2016 | 162 | 94 | 225 | 0.206 |
| 2017 | 45 | 16 | 21 | 0.331 |

Table 7. Webb Creek wild adult steelhead abundance estimates. Abundance estimates 2010-2015 (See et. all 2016). Abundance estimates 2016, and 2017 (Orme and Kinzer 2018).

| Spawn Year | Abundance | Lower 95% CI | Upper 95% CI | CV |
|---|---|---|---|---|
| 2010 | - | - | - | - |
| 2011 | 13 | 1 | 9 | 0.753 |
| 2012 | 30 | 7 | 22 | 0.488 |
| 2013 | 19 | 2 | 14 | 0.618 |
| 2014 | 37 | 8 | 35 | 0.452 |
| 2015 | 48 | 12 | 36 | 0.452 |
| 2016 | 57 | 22 | 101 | 0.368 |
| 2017 | 19 | 5 | 41 | 0.496 |

**Array Maintenance**

The Mission Creek array (MIS) antenna C2 was ripped out of the stream from high spring flows in March, 2017. Antenna C1 at MIS lost current during the same time period and continued to function at low current (reduced read range) through 2017. On October 25, 2017 both antennas were replaced. Antenna C2 was placed 10 feet upstream of the prior location in the stream bed with a previously used 20 ft. PVC antenna acquired from BOR. Antenna C1 was replaced with an identical 20 ft. PVC antenna approximately 30 feet upstream from its original configuration.  Both antennas were armored with large substrate found on site.

The Lapwai Creek PIT tag array (LAP) operated continuously without disruption during the period of July 2016 through June of 2017.  The Mission Creek array (MIS) had zero downtime during the same time period, however PIT tag detections recorded were compromised from losing antenna C2 and low current to antenna C1 during March 2017.

**References**

See, K., R. Kinzer, M.W. Ackerman. 2016.  PIT Tag Based Escapement Estimates to Snake Basin Populations.  Integrated Status and Effectiveness Monitoring Program. BPA Project # 2003-017-00.

Orme, R. and R. Kinzer.  2018.  Integrated In-stream PIT Tag Detection System Operations and Maintenance; PIT Tag Based Adult Escapement Estimates for Spawn Years 2016 and Integrated Status and Effectiveness Monitoring Program. BPA Project # 2018-002-00.