

Operation of the Adult Trap at Lower Granite Dam, 2014

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Executive Summary

During 2014, we operated the adult salmonid trap at Lower Granite Dam from 10 March to 11 November. Due to budget constraints, the trap was operated only 5 d/week from 10 March to 7 July. During this period, adult collection began each Sunday at 1500 and ended each Friday at 1500. On 8 July, the trap was forced to close for a 13-day period due to a mechanical breakdown of the trap hoist system. During this time, water temperature at the trap exceeded 70°F, keeping the trap shutdown until 7 August when three extra emergency water pumps were brought in to assist in cooling of the water temperature to below 70°F. From 7 to 31 August, a modified trapping rate of 100% for four hours was used in the morning from 0700 to 1100. From 31 August to 11 November, the trap was operated 7 d/week, with no closures.

We collected and handled 15,749 total steelhead *Oncorhynchus mykiss*, of which we PIT-tagged 5,167 wild steelhead. We collected and handled 12,651 total spring/summer Chinook salmon *O. tshawytscha*, of which we PIT-tagged 4,299 wild spring/summer Chinook. Fin clips were taken from all PIT-tagged steelhead and Chinook salmon for age and genetic analysis. Using the separation-by-code system in the trap, we collected and radio-tagged 18 previously PIT-tagged Lemhi River adult spring Chinook and 101 previously PIT-tagged South Fork Clearwater River steelhead for the Idaho Department of Fish and Game (IDFG) and the Nez Perce Tribe. Blood samples were taken from 369 steelhead by Luara Jenkins, Ph.D candidate, Department of Biological Sciences, University of Idaho. Of the 369 blood samples taken, 178 were considered hatchery origin and 186 were considered wild origin.

We collected and handled a total of 10,154 fall Chinook salmon. Of those fish, 2,427 adults and 598 jacks were transported to Lyons Ferry Hatchery on the Snake River in Washington, and 876 adults and 9 jacks were transported to the Nez Perce Tribal Hatchery on the Clearwater River in Idaho. The remaining 6,244 fall Chinook salmon were passed upstream to continue their migration. Using the separation-by-code system in the trap, 1,806 previously PIT-tagged fall Chinook were collected and had a scale sample taken for NOAA Fisheries. Of these previously PIT-tagged fall Chinook, 575 were gastrically radio-tagged for Washington Department of Fish and Wildlife (WDFW).

Finally, 101 sockeye *O. nerka* were captured in the trap, and we collected genetic samples from 71 of these fish.

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Introduction

Lower Granite Dam, located 695 river kilometers from the mouth of the Columbia River, is the farthest upstream dam on the Snake River with adult fish passage facilities. Since its completion in 1975, adult salmonids have been collected and sampled at Lower Granite Dam using an adult trap built adjacent to the turnpool of the adult ladder (Harmon 2003). Trap operations have been conducted primarily by National Marine Fisheries Service (NMFS/NOAA Fisheries) personnel in cooperation with other agencies.

In recent years, demands on use of the Lower Granite Dam adult trap have increased, and adult sampling needs are expected to continue to increase in the future. To meet this increased demand, the adult trapping facility was revised during winter 1995-1996 and completely remodeled during winter 2006-2007.

At present, the Lower Granite Dam adult trap is used for collection of 1) fall Chinook salmon *Oncorhynchus tshawytscha* for a captive broodstock program, 2) multiple species samples for run-reconstruction monitoring, 3) adults previously tagged with passive integrate transponder (PIT) tags for transportation and life history studies, 4) steelhead *O. mykiss* for adult PIT-tag studies, and 5) adults for radio telemetry studies (with both tagging and tag removal conducted at the adult trap).

Operation of the trap provides the following benefits to listed stocks:

1. Reduces risk to the fall Chinook salmon ESU by improving hatchery practices (i.e., provides hatcheries with the ability to collect and use natural-origin fish for broodstock).
2. Jump-start fall Chinook salmon production in underutilized areas of the Clearwater Basin by providing natural-origin fish.
3. Reduces risks to ESUs from atypical straying of hatchery-origin fish from areas outside the Snake River Basin by facilitating the removal of unusually high numbers of stray fish.
4. Provides information on age-class distribution and hatchery/wild composition of spring/summer and fall Chinook salmon and steelhead returns to improve understanding of ESU status, and provides critical information needed for run-reconstruction of these stocks.
5. Provides critical life history information for fall Chinook salmon (from scale samples) to better manage this stock.

While the adult trap at Lower Granite Dam has been operated by the National Marine Fisheries Service and maintained by the U.S. Army Corps of Engineers since its origin in 1975, the Bonneville Power Administration (BPA) began funding trap operations in mid-2005 (Harmon 2006-2009; Ogden 2010-2014). Here we report on adult trap operations during 2014.

Methods

The adult salmonid trap is located adjacent to the adult fish ladder at Lower Granite Dam on the south shore of the Snake River. A complete description of the adult trap and its operation was reported by Harmon (2003). When the adult trap is in operation, a diversion gate is rotated across the fish ladder to route upstream-migrating fish to an attraction pool. In the attraction pool, adults are induced to jump over a false weir, where they enter pipes fitted with coded wire tag (CWT) and PIT-tag detectors. These pipes transition into flumes, which contain separate diversion gates that can be set at a predetermined rate to sample the run-at-large, sending the sampled adults into a holding area.

Previously tagged fish can also be diverted to the holding area using either the CWT detectors (currently non-functional) or a separation-by-code diversion system based on PIT-tag tag codes. Adults not diverted into the holding area continue through the flumes to the trap exit ladder, from which they re-enter the main adult ladder to continue upstream migration.

Adults in the holding area are processed in small batches each day, generally between 0700 and 1500. As a first step in processing, adults exit the holding area via a gravity-flow dewatering system. This system minimizes stress to fish by allowing them to pass directly from the holding area to an anesthetic tank without being handled. In the anesthetic tank, fish are sedated with Aqui-S 20E¹ and inspected, and sample data are collected and recorded. Fish are then placed either in a freshwater recovery tank for release back to the fish ladder or in holding tanks for eventual transfer to trucks. These trucks are used to transport fish from the trap facility to various hatcheries. Washington Department of Fish and Wildlife (WDFW), Idaho Department of Fish and Game (IDFG), and the Nez Perce Tribe provided the Aqui-S 20E that was used during the 2014 trapping season.

Prior to 2013, the adult trap was generally operated 7 d/week, 24 h/d during the adult migration period, from early March through November each year. The only exception was during summer periods when water temperatures reached 70°F (21°C), the thermal limit for safely handling adult salmonids. However, due to budget constraints, trap operations in 2013 were abridged to 5 d/week during the spring and summer migration periods (4 March to 17 August), and this schedule continued in 2014.

¹ Reference to trade names does not imply endorsement by the National Marine Fisheries Service, NOAA.

During abridged operations, adults were diverted into the holding area from 1500 Sunday to 1500 Friday and processed Monday through Friday. Pacific States Marine Fisheries Commission (PSMFC), who operates and maintains the PIT tag systems at the dam, created a program for the computer operating the adult trap. Their program allowed the trap to be shut down and turned on automatically, ensuring that a full 5 d (120 h) of trapping could be achieved.

Because additional funding (from sources other than BPA) was available during the fall migration period, trap operations were scheduled to run 7 d/week from 18 August to 23 November 2014.

Results and Discussion

Maintenance and Improvements

The Lower Granite Dam adult trap was last remodeled during winter 2006-2007. Work was contracted through the U.S. Army Corps of Engineers (USACE), with funding provided by BPA. Modifications to the trap addressed the need for increased holding capacity for fall Chinook salmon broodstock collection. To increase holding capacity, four additional holding tanks were added, each of which was approximately one and one-half times larger than the original two tanks. The original holding tanks were also modified, but their capacity was not increased. Anesthetic tank capacity was also increased, with an increase in size of the main anesthetic and recovery tanks, and installation of two additional anesthetic tanks.

These modifications provided substantial expansion of the work area, and have made handling feasible for a larger proportion of the adult steelhead and Chinook salmon migrations. Modifications to the trap's gravity-flow water supply in 2009 ensure all anesthetic and holding tanks are usable during the entire trapping season (see Ogden 2014 for details).

Before 2012, data collected at the Lower Granite adult trap were recorded using hand-written data sheets. Each winter, when the trap was closed, the data was transferred to an electronic format. In 2012, in an effort to allow real-time access to all the data being collected, Real Time Research Inc. was contracted to develop a touch-screen data collection system with offsite storage using a database with a cloud platform. Development of this system allowed interested parties to retrieve the data they needed at the end of each day and eliminated the possibility of transcription errors when converting data sheets to electronic form. Fish managers who use data collected at the adult fish trap on a weekly basis were able to get the information they needed to make in-season management decisions.

Operation and Sampling Schedules

During 2014, we operated the trap 5 d/week from 10 March to 17 August, with the exception of a closure from the morning of 8 July to the afternoon of 6 August. This closure was originally due to a mechanical breakdown of the trap, but continued because of high water temperatures exceeding 70°F (21°C); Table 1; Figure 1). During the 5-d/week operating schedule, samples of the run-at-large were taken automatically four times an hour, 24 h/d from 1500 on Sunday to 1500 on Friday.

This sampling schedule resulted in respective daily and overall weekly sample rates of 28 and 20% from 10 March to 14 April and of 15 and 11% from 15 April to 7 July. From 7 to 17 August, the trap was operated only 6 d/week due to warm water temperatures. On the six days the trap was operated during this period (7, 8, 11, 13, 14, and 15 August), operations lasted only 4 h/d, from 0700 to 1100, with a sample rate of 100%.

Table 1. Summary of operations during 2014 at the Lower Granite Adult Trap.

Date range	Trap operating schedule	Trap rate (%)	
		Daily	Overall weekly
10 March-14 April	5 d/week	28	20
15 April-7 July	5 d/week	15	11
8 July-6 August	Closed for repairs and high water temperature		
7 August-17 August	5 d/week (6 of 11 d) 7-8, 11, 13-15 August	100 (0700-1100)	
18 August-31 August	7 d/week (4 of 14 d) 18, 21, 30-31 August	100 (0700-1100)	
1 September-1 October	7 d/week	10	10
2 October-11 November	7 d/week	8	8

During the fall trapping season (which begins on 18 August), we operated the trap 7 d/week, and thus daily and weekly sample rates were the same. However, high water temperatures continued from 18 to 31 August, and the trap was operated on only 4 d during this period (18, 21, 30, and 31 August) using the modified 4 h/d operation described above. Fall sample rates were 10% from 1 September to 1 October and 8% from 2 October to trap closure. Due to unseasonably cold air temperatures, the trap was shut down for the winter on 11 November, 12 days earlier than planned.

In addition to random sampling of the run-at-large, we also used the PIT-tag separation-by-code system at the trap to collect spring, summer, and fall Chinook that had been PIT-tagged as juveniles.

Interruption of Trap Operations

On 7 July 2014, at approximately 1050, there was a failure of the hoist system that lifts the basket in the collection area. As a result, trap operations were temporarily suspended. By 21 July, the hoist system was repaired and the trap was mechanically operational; however, by the time the hoist repair was completed, water temperature had exceeded 21°C (70°F), the upper thermal limit for trap operations.

The trap remained shut down until 7 August, when three emergency water pumps were brought in to assist in cooling the water to below 21°C (70°F; Figure 1). After the three emergency pumps were brought on line, the trap was operated using a modified trapping protocol through 31 August. The modified protocol mandated that when water temperature fell below 21°C (70°F), trapping could proceed for 4 h/d from 0700 to 1100 at a trap rate of 100%. Between 7 July and 31 August, water temperatures averaged 20.9°C (69.7°F), with a high of 22.8°C (73.0°F). Normal fall trapping operations began on 1 September.

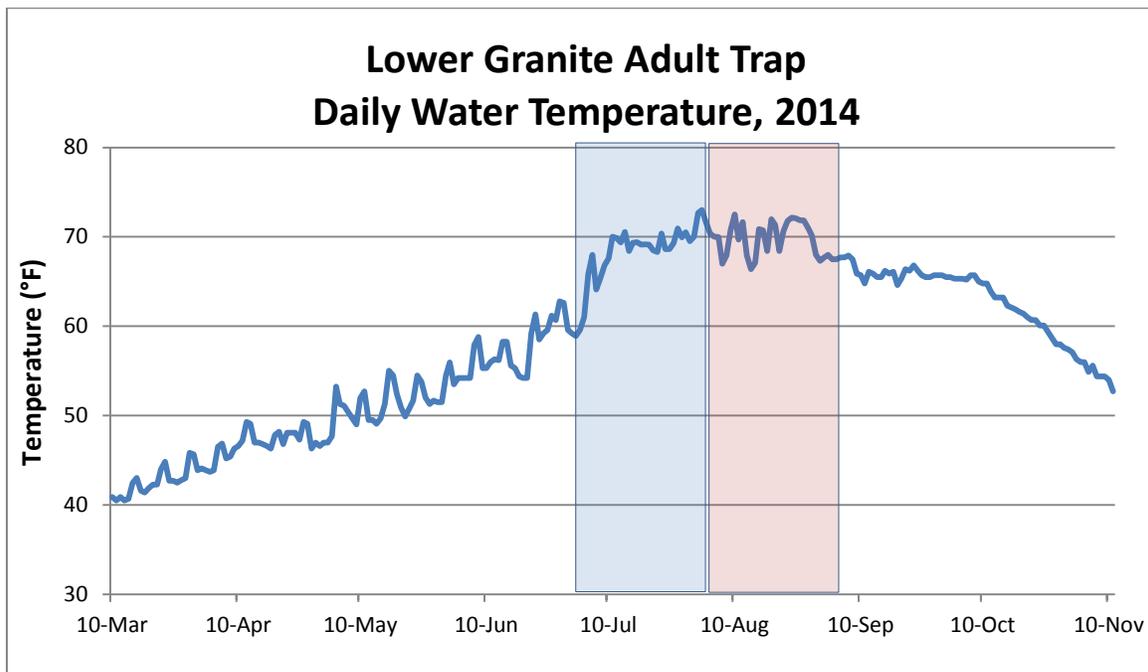


Figure 1. Daily water temperature (°F) at the Lower Granite Dam Adult trap, 2014. Blue shaded area represents interruption of trap operations. Red shaded area represents modified trapping assisted by emergency pumps.

Trapped Fish

All trapped adults were inspected in the holding area for species, length, injuries, brands, visible implant tags, coded-wire tags, PIT tags, external tags, and fin clips. Fall Chinook salmon collected at the trap and transported to hatcheries had their operculi hole-punched for trap rate identification, but no fish were inoculated at the trap in 2014. Data shown in Table 2 is preliminary and will be further analyzed by researchers from the respective agencies for which the data were collected.

Table 2. Number of adult salmonids collected and handled at the Lower Granite Adult trap during 2014.

Species	Number collected	Number PIT-tagged	Number previously PIT-tagged
Spring Chinook	10,630	3,267	397
Summer Chinook	2,021	1,032	95
Fall Chinook	10,154	0	2,710
Steelhead	15,749	5,167	697
Sockeye	101	0	7
Coho	1,789	0	27

Steelhead

A total of 15,749 steelhead were collected and handled at the adult trap during 2014. Of these fish, 1,334 were collected during spring and 14,415 during fall. Of the 1,334 steelhead collected during spring, 611 were of wild origin and received a PIT tag and fin clip (for genetic analysis), and 115 were recaptures of fish that had been previously PIT-tagged. Of the 14,415 steelhead collected during fall, 4,556 were of wild origin and received a PIT tag and fin clip, and 582 were recaptures of previously PIT-tagged fish.

Data taken from these steelhead will be analyzed to evaluate the A- and B-run segments, as well as the hatchery/wild composition of the steelhead run. These data will be analyzed and reported by Idaho Department of Fish and Game (Bill Schrader) and Quantitative Consultants Inc. (Jody White). No freeze-brands were observed during 2014 adult steelhead collections.

Using the separation-by-code capabilities of the trap, we collected 101 South Fork Clearwater River steelhead that had previously been PIT-tagged. These fish were collected and radio-tagged using the gastric implantation method. Data from these fish will help monitor the effectiveness of hatchery supplementation of B-run steelhead in the Clearwater River basin. Specific goals of this study are to:

1. Compare the relative performance of Clearwater River natural, supplementation, and conventional hatchery steelhead.
2. Determine spatial overlap in the spawning distribution of Clearwater B-run natural, supplementation, and conventional adults
3. Verify or refute the believed presence of a velocity barrier (near Golden) to returning steelhead.

These data will be analyzed and reported by Nez Perce Tribe (Jason Vogel) and Idaho Department of Fish and Game (Matt Corsi).

Blood samples were taken from 369 steelhead by the University of Idaho (Luara Jenkins, Ph.D candidate, Department of Biological Sciences). Of the 369 blood samples taken, 178 were considered hatchery origin based on the presence of an adipose fin clip, and 186 were considered wild origin based on the absence of such a clip. Of these fish, those not previously PIT-tagged were given one. This work supported the *Proposal to Evaluate Reproductive Success of Natural-Origin, Hatchery-Origin, and Kelt Steelhead in the Columbia River Basin*. The project studies and evaluates two broad topics with respect to post-spawn steelhead:

1. Assesses reconditioning processes and strategies
2. Measures reproductive success of artificially reconditioned kelt steelhead.

Spring/Summer Chinook Salmon

We collected and handled a total of 10,630 adult spring Chinook salmon and 2,021 adult summer Chinook salmon at the trap during 2014 (Table 2). Of the 10,630 spring Chinook salmon collected, 3,267 were of wild origin and received a PIT tag and fin clip, and 397 were recaptures of previously PIT-tagged fish. Of the 2,021 summer Chinook salmon collected, 1,032 were of wild origin and received a PIT tag and fin clip, and 95 were recaptures of previously PIT-tagged fish. Adult spring Chinook salmon from the Lower Granite Trap were used for the following investigations during 2014:

1. Scale and genetic samples were taken from all fish that were PIT-tagged. These samples will be analyzed by Idaho Department of Fish and Game and Quantitative Consultants Inc. Age structure and genetic stock identification will be determined from these analyses and will be reported by IDFG (Bill Schrader) and QCI (Jody White).
2. Eighteen previously PIT-tagged adult spring Chinook salmon of Lemhi River origin were recaptured using the separation-by-code system and radio-tagged for IDFG as part of the BPA-funded *Integrated Status and Effectiveness Monitoring Program* (ISEMP), which has the following objectives:
 - a) Determine the timing of adult Chinook salmon from Lower Granite Dam to spawning grounds in the Lemhi River watershed
 - b) Identify stream flow and instream migration barriers in the Lemhi River watershed to prioritize future habitat actions.
 - c) Determine the effectiveness of habitat restoration actions taken to reduce fish migration barriers in the Lemhi River watershed.
 - d) Identify staging area habitat in the Lemhi River watershed to prioritize future habitat restoration actions.
 - e) Determine adult Chinook salmon distribution in the Lemhi River watershed.
 - f) Further information about this study is available from IDFG (Mike Biggs) and on the ISEMP web pages (ISEMP 2014).

Fall Chinook Salmon

We collected and handled a total of 10,154 fall Chinook salmon (Table 2). Adults 70 cm FL (fork length) or larger and jacks 69 cm FL or smaller were collected for Lyons Ferry Hatchery on the Snake River in Washington and for the Nez Perce Tribal Hatchery on the Clearwater River in Idaho. Of the 10,154 adult fall Chinook salmon collected, we transported 2,427 adults and 598 jacks to Lyons Ferry Hatchery and 876 adults and 9 jacks to the Nez Perce Tribal Hatchery. The remaining 6,244 fall Chinook salmon were passed upstream to continue their migration. Adult fall Chinook salmon trapped at Lower Granite were used for the following investigations during 2014:

1. Run reconstruction and hatchery data are being analyzed from fall Chinook salmon transported to Lyons Ferry and Nez Perce Tribal Hatcheries. When complete, these analyses will be reported by the Washington Department of Fish and Wildlife (Debbie Milks).

2. Data from scale samples will be used for a study of fall Chinook salmon early life history. Scale samples were taken from the 1,806 PIT-tagged fall Chinook collected using the separation-by-code system at the trap. Information on this study is available from the National Marine Fisheries Service, Northwest Fisheries Science Center in Seattle (Tiffani Marsh).
3. Radio-tag studies to better understand spawner distributions upstream of Lower Granite Dam associated with Lyons Ferry Hatchery subyearling releases. These studies will use the 575 previously PIT-tagged fall Chinook that were radio-tagged using gastric implantation. These radio-tag studies will also be used for estimates of adult return rates and to monitor timing and straying of wild and hatchery-reared fall Chinook salmon adults. When these analyses are complete, results will be made available by the Washington Department of Fish and Wildlife (Debbie Milks).

Sockeye Salmon

We collected genetic samples from 71 of the 101 sockeye captured in the trap. Genetic samples were taken for studies to better understand the age composition of sockeye that survive to the spawning grounds, as well as the rate of PIT tag shedding that is currently not accounted for in run-size estimation procedures. These data will be analyzed and reported by Idaho Department of Fish and Game (Kristen Wright).

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