

# Operation of the Adult Trap at Lower Granite Dam, 2015

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# Executive Summary

During 2015, we operated the adult salmonid trap at Lower Granite Dam from 10 March to 22 November. With the exception of a closure from the morning of 20 June to 12 July due to water temperatures that exceeded 21°C (70°F), the trap was operated 5d/week from 10 March to 17 August. During this period, adult collection began each Sunday at 1500 and ended each Friday at 1500 PDT. From 13 July to 17 August, the trap was operated under modified protocols. Operations lasted only 4h/d, from 0700 to 1100 PDT, with a sample rate of 100%. Modified trapping protocols continued from 18 to 30 August. From 31 August to trap closure on 22 November, the trap was operated 7 d/week.

We collected and handled 17,351 total steelhead *Oncorhynchus mykiss*, of which we PIT-tagged 4,807 wild steelhead. We collected and handled 12,848 total spring/summer Chinook salmon *O. tshawytscha*, of which we PIT-tagged 3,046 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 15 previously PIT-tagged Lemhi River adult spring Chinook and 162 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 386 steelhead by Luara Jenkins, Ph.D candidate, Department of Biological Sciences, University of Idaho. Of the 386 blood samples taken, 189 were considered hatchery origin and 197 were considered wild origin.

We collected and handled a total of 10,125 fall Chinook salmon. Of those fish, 1,817 adults and 405 jacks were transported to Lyons Ferry Hatchery on the Snake River in Washington, and 850 adults and 16 jacks were transported to the Nez Perce Tribal Hatchery on the Clearwater River in Idaho. The remaining 7,037 fall Chinook salmon were passed upstream to continue their migration. Using the separation-by-code system in the trap, 1,061 previously PIT-tagged fall Chinook were collected and had a scale sample taken for NOAA Fisheries. Of these previously PIT-tagged fall Chinook, 244 were gastrically radio-tagged for Washington Department of Fish and Wildlife (WDFW).

On 13 July 2015, an emergency trap-and-haul operation was initiated at the Lower Granite Dam adult fish trap. From 13 July to 17 August, adult sockeye salmon for broodstock were trapped daily and hauled to the IDFG Eagle Fish Hatchery in southern

Idaho. Of 51 total adult sockeye salmon transported to Eagle Fish Hatchery, 47 were collected from the adult trap and four were captured on the Lower Granite Dam juvenile fish separator by U.S. Army Corp of Engineers personnel. From 18 August to close of trap on 22 November, an additional 8 sockeye salmon were captured in the trap and were passed upstream to continue their migration.

Due to the low numbers of coho salmon returning to Lower Granite Dam in 2015, the Nez Perce Tribe requested NOAA personnel place any trapped coho in a holding tank for transportation to the Kooskia National Fish Hatchery. Collection of coho salmon broodstock assists the Nez Perce Tribe Clearwater River Basin Coho Restoration Project. We collected and handled a total of 138 coho salmon. Of the 138 coho salmon collected, the Nez Perce Tribe transported 113 to Kooskia National Fish Hatchery. The remaining 25 coho salmon were passed upstream to continue their migration.

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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. For example the trap provides hatcheries with the ability to collect and use natural-origin fish for broodstock.
2. Jump-starts 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 from scale samples of fall Chinook salmon to better manage this stock.

6. Provides an emergency collection point for ESA-listed stocks when environmental conditions are extreme enough to threaten the survival of whole age classes.

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 2010-2016). Here we report on adult trap operations during 2015.

## 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 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 PDT. 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 20E<sup>1</sup> 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 Nez Perce Tribe provided the Aqui-S 20E that was used during the 2015 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 21°C (70°F), 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 (1 March to 17 August), and this schedule continued in 2014 and 2015.

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<sup>1</sup> 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) operates and maintains PIT-tag systems at the dam. In 2015, PSMFC 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 22 November 2015.

# 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 gravity-flow water supply in 2009 ensure all anesthetic and holding tanks are usable during the entire trapping season (Ogden 2014).

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 2015, we operated the trap 5d/week from 10 March to 17 August, with the exception of a closure from the morning of 20 June to 12 July due to water temperatures exceeding 21°C (70°F); (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 11 and 8% from 10 March to 14 April and of 15 and 11% from 15 April to 19 June.

On 13 July 2015, an emergency trap-and-haul operation was initiated at the adult trap for sockeye salmon broodstock. Due to low adult passage counts, low river flows, and water temperatures exceeding 70°F in the Snake River, the Idaho Department of Fish and Game and NOAA Fisheries declared an adult Snake River sockeye salmon passage emergency.

From 13 July to 17 August, adult sockeye salmon were trapped and hauled daily to the IDFG Eagle Fish Hatchery in southern Idaho. Between 0700 and 1100 on 12 of those days (13-17, 20, 30, 31 July, 3, 13, 14, 17 August), the trap was opened only when a sockeye salmon was observed passing the fish count window, and was left open until the sockeye was captured. During the other 14 days, operations followed established modified protocols of 4h/d, from 0700 to 1100, with a sample rate of 100%.

Table 1. Summary of operations during 2015 at the Lower Granite Adult Trap.

Date range	Trap operating schedule	Trap rate (%)	
		Daily	Overall weekly
10 March-14 April	5 d/week	11	8
15 April-19 June	5 d/week	15	11
20 June-12 July	Closed for high water temperature		
13 July-17 August	5 d/week (0700-1100) 13-17, 20, 30, 31 July 3, 13, 14, 17 August	100	Trap open only when adult sockeye observed in viewing window
<b>Fall trapping</b>			
18 August-30 August	7 d/week (0700-1100) 22, 27, 28, 30 August	100	
31 August-22 November	7 d/week	12	12

During the fall trapping season (which begins on 18 August), we operated the trap 7d/week, and thus daily and weekly sample rates were the same. However, high water temperatures continued from 18 to 30 August, and the trap was operated on only 4 d during this period (22, 27, 28, 30 August) using the modified 4 h/d operation described above. The fall sample rate was 12% from 31 August to trap closure on 22 November.

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 the afternoon of 21 June 2015, there was a spike in water temperature that exceeded 21°C (70°F; Figure 1) in the main fish ladder. This temperature spike caused a die-off of American shad, which plugged both the turnpool fish diversion gate and the fish screens to the adult trap. As a result, trap operations were temporarily suspended.

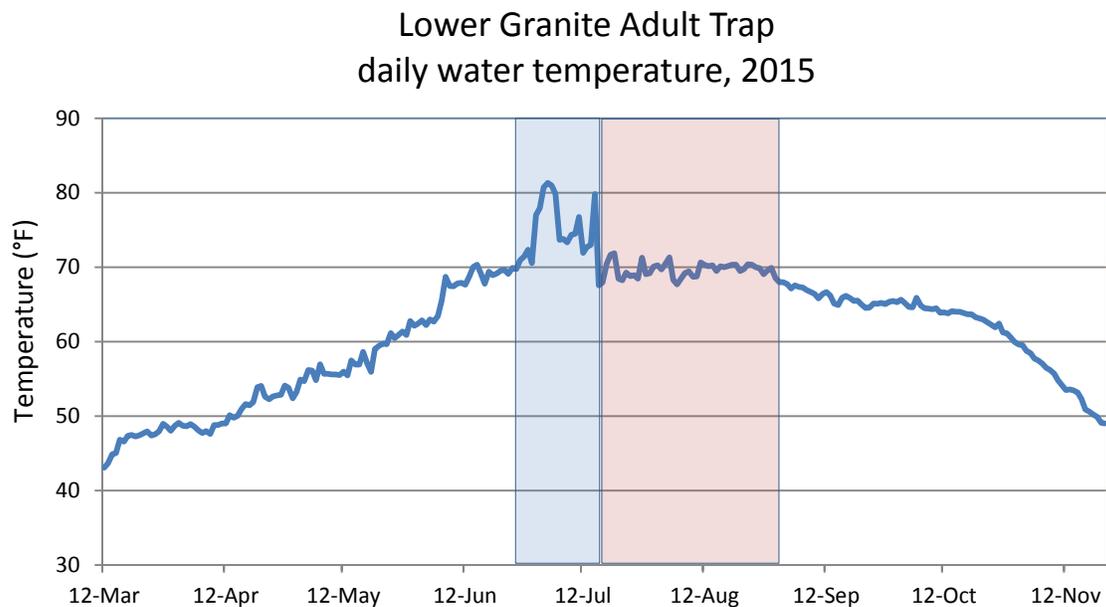


Figure 1. Daily water temperature (°F) at the Lower Granite Dam Adult trap, 2015. Blue shaded area represents interruption period of trap operations. Red shaded area represents period of modified trapping assisted by emergency pumps.

On 25 June, three emergency pumps were brought on line to assist in cooling the fish ladder water to below 21°C (70°F). However, over the next 19 days, the water temperature averaged 23.8°C (74.9°F) and reached a maximum of 27.4°C (81.3°F). Temperatures during this period were too high to resume trapping operations.

Between 13 July and 17 August, we resumed operations under either a modified trapping protocol or an emergency protocol specifically designed to capture sockeye adults for hauling to an IDFG hatchery. 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%. When water temperatures did not allow for the modified trapping procedures, the trap was opened only long enough to capture any sockeye salmon passing the count window during periods from 0700 to 1100 PDT.

From 18-30 August, the trap was operated on only 4 d using the modified trapping protocols. Between 21 June and 30 August, water temperatures averaged 21.0°C (69.9°F) and reached a maximum of 26.6°C (79.8°F). Normal fall trapping operations began on 31 August.

## 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 2015. 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 2015.

Species	Number collected	Number PIT-tagged	Number previously PIT-tagged
Spring Chinook	11,872	2,634	311
Summer Chinook	976	412	28
Fall Chinook	10,125	0	1,404
Steelhead	17,351	4,807	768
Sockeye	59	0	4
Coho	138	0	10

## Steelhead

A total of 17,351 steelhead were collected and handled at the adult trap during 2015. Of these fish, 520 were collected during spring and 16,831 during fall. Of the 520 steelhead collected during spring, 270 were of wild origin and received a PIT tag and fin clip for genetic analysis, and 25 were recaptures of fish that had been previously PIT-tagged. Of the 16,831 steelhead collected during fall, 4,537 were of wild origin and received a PIT tag and fin clip, and 743 were recaptures of previously PIT-tagged fish.

Data taken from trapped 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 adult steelhead collections in 2015.

Using the separation-by-code capabilities of the trap, we collected 162 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 relative performance among Clearwater River natural, supplementation hatchery, 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 to returning steelhead (near Golden)

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 386 steelhead by the University of Idaho (Luara Jenkins, Ph.D candidate, Department of Biological Sciences). Of the 386 blood samples taken, 189 were considered to be from hatchery fish based on the presence of an adipose fin clip, and 197 were considered to be from wild fish based on the absence of such a clip. Of these 386 fish, we PIT-tagged any that had not been previously PIT-tagged.

This sampling and tagging effort 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. Assess reconditioning processes and strategies, and 2. Measure reproductive success of artificially reconditioned kelt steelhead.

## Spring/Summer Chinook Salmon

We collected and handled a total of 11,872 spring Chinook and 976 summer Chinook salmon adults at the trap during 2015 (Table 2). Of the 11,872 spring Chinook salmon collected, 2,634 were of wild origin and received a PIT tag and fin clip, and 311 were recaptures of previously PIT-tagged fish. Of the 976 summer Chinook salmon collected, 412 were of wild origin and received a PIT tag and fin clip, and 28 were recaptures of previously PIT-tagged fish. Adult spring Chinook salmon from the Lower Granite Trap were used for the following investigations during 2015:

1. Scale and tissue samples were taken from all fish that were PIT-tagged. Scale samples will be analyzed by Idaho Department of Fish and Game and genetic analysis of tissues by 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. Fifteen 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). The ISEMP 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.

Further information about this study is available from IDFG (Mike Biggs) and on the ISEMP web pages (ISEMP 2015).

## Fall Chinook Salmon

We collected and handled a total of 10,125 fall Chinook salmon (Table 2). Adults 70 cm FL (fork length) or larger and jacks 69 cm FL or smaller were collected for hatcheries. Of the 10,125 adult fall Chinook salmon collected, we transported 1,817 adults and 405 jacks to Lyons Ferry Hatchery on the Snake River in Washington. From this same total, we transported 850 adults and 16 jacks to the Nez Perce Tribal Hatchery on the Clearwater River in Idaho. The remaining 7,037 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 2015:

1. Run reconstruction and hatchery data analyses 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 1,061 PIT-tagged fall Chinook collected using the separation-by-code system at the trap. Information on this study is available from the NMFS 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 244 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

On 13 July 2015, an emergency trap-and-haul was initiated at the adult trap for sockeye salmon hatchery broodstock. With low adult passage counts, low river flows and water temperatures exceeding 21°C (70°F) in the Snake River, a fish passage emergency was declared by IDFG for adult Snake River sockeye salmon. From 13 July to 17 August, adult sockeye were trapped and hauled daily to the IDFG Eagle Fish Hatchery in southern Idaho. Of 51 total adult sockeye transported to Eagle Fish Hatchery, 47 were collected from the adult trap. The remaining four fish were captured on the Lower Granite Dam juvenile fish separator by U.S. Army Corp of Engineers personnel. From 18 August to close of trap on 22 November, an additional 8 adult sockeye were captured in the trap and passed upstream to continue their migration.

## Coho Salmon

Due to low numbers of coho salmon returning to Lower Granite Dam in 2015, the Nez Perce Tribe requested NOAA personnel place any coho trapped in a holding tank for transportation to the Kooskia National Fish Hatchery. Collection of coho salmon for broodstock assists the Nez Perce Tribe *Clearwater River Basin Coho Restoration Project*. We collected and handled a total of 138 coho salmon. Of these 138 coho, the Nez Perce Tribe transported 113 to Kooskia National Fish Hatchery. The remaining 25 coho salmon were passed upstream to continue their migration.

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