

Operation of the Adult Trap at Lower Granite Dam, 2018

Darren A. Ogden, Amber L. Barenberg, and Ross M. Gleason

Fish Ecology Division
Northwest Fisheries Science Center
National Marine Fisheries Service
National Oceanic and Atmospheric Administration
2725 Montlake Boulevard East
Seattle, Washington 98112-2097

Report of research for

Division of Fish and Wildlife
Bonneville Power Administration
U.S. Department of Energy
P.O. Box 3621
Portland, Oregon 97208-3621
Contract 44314, Project 200500200



August 2019

Executive Summary

During 2018, we operated the adult salmonid trap at Lower Granite Dam as scheduled from 8 March to 18 November. From 8 March to 17 August, the trap was operated 5 d/week from 1500 on Sunday to 1500 on Friday, with samples taken from the run-at-large four times an hour, 24 h/d. From 18 August to 18 November, the trap was operated 7 d/week.

We collected and handled a total of 11,643 wild and hatchery steelhead *Oncorhynchus mykiss*. Among these fish, we tagged 2,464 wild steelhead with passive integrated transponder (PIT) tags. We collected and handled a total of 8,463 wild and hatchery spring/summer Chinook salmon *O. tshawytscha*, and from these fish, we PIT-tagged 2,099 wild adults. Fins clips were taken from all PIT-tagged steelhead and Chinook salmon for age determination and genetic analysis.

Using the separation-by-code system in the trap, we also collected previously PIT-tagged fish for radio tagging studies. We radio-tagged 14 previously PIT-tagged Lemhi River adult spring Chinook for the Idaho Department of Fish and Game and one previously PIT-tagged South Fork Clearwater River steelhead for the Nez Perce Tribe.

In addition, we collected and handled a total of 6,684 fall Chinook salmon. Of those fish, 1,784 adults and 511 jacks were transported to Lyons Ferry Hatchery on the Snake River in Washington, and 966 adults and 14 jacks were transported to the Nez Perce Tribal Hatchery on the Clearwater River in Idaho. The remaining 3,509 fall Chinook were passed upstream to continue their migration.

Scale and genetic samples were also taken from 72 sockeye salmon *O. nerka* captured in the trap. No sockeye were transported in 2018.

We collected and handled a total of 829 coho salmon *O. kisutch*. Of these fish, 478 were transported by the Nez Perce Tribe to the Kooskia National Fish Hatchery. The remaining 351 coho salmon were passed upstream to continue their migration.

One bull trout was captured in the trap in 2018. This bull trout was PIT tagged and a genetic sample taken before the fish was released back to the fish ladder.

Contents

Executive Summary	iii
Introduction.....	1
Methods	3
Results and Discussion	5
Maintenance and Improvements.....	5
Operation and Sampling Schedules.....	6
Interruption of Trap Operations.....	7
Trapped Fish.....	8
Steelhead.....	9
Spring/Summer Chinook Salmon	9
Fall Chinook Salmon.....	10
Sockeye Salmon.....	11
Coho Salmon.....	11
Bull Trout	11
Acknowledgements	12
References.....	13

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 personnel from the National Marine Fisheries Service (NMFS/NOAA Fisheries) in cooperation with staff from 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 increasing demand, the adult trapping facility was modified during winter 1995-1996 and completely remodeled during winter 2006-2007.

At present, the Lower Granite Dam adult trap is used for collection of adult salmon targeted for the following studies and programs:

- 1) Fall Chinook salmon *Oncorhynchus tshawytscha* for a captive broodstock program
- 2) Multiple species samples for run-reconstruction monitoring
- 3) Multiple species previously tagged with passive integrate transponder (PIT) tags for transportation and life history studies
- 4) Steelhead *O. mykiss* for adult PIT-tag studies
- 5) Multiple species 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. Provides natural-origin fish to boost fall Chinook salmon production in underutilized areas of the Clearwater Basin.
3. Facilitates removal of unusually high numbers of stray fish to reduce risks to multiple ESUs from atypical straying of hatchery fish from areas outside the Snake River Basin.

4. Provides information on age-class distribution and hatchery/wild composition of returning adult spring/summer and fall Chinook salmon and steelhead to improve understanding of ESU status and provide 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 multiple ESA-listed stocks in years when extreme environmental conditions threaten the survival of an entire age class.

Since its origin 1975, 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. In mid-2005, the Bonneville Power Administration (BPA) began funding trap operations, and BPA support has continued since then, allowing substantial improvement and expansion of trap operations (Harmon 2006-2009; Ogden 2010-2016). Here we report on adult trap operations during 2018.

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 trap and its operation was reported by Harmon (2003). When the adult trap is operating, 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 CWT detectors (not functional at present) or a separation-by-code diversion system based on PIT-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 into 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 prior to release back to the fish ladder or in a holding tank for 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 helped provide the Aqui-S 20E used during the 2018 trapping season.

Prior to 2013, the adult trap was generally operated 7 d/week, 24 h/d during the adult migration period each year, from early March through November. 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). This schedule has continued from 2014 to the present.

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 only 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 turned on or shut down 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, we were able to schedule trap operations to run 7 d/week from 18 August to 19 November 2018.

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. Four additional holding tanks were added, each of which was approximately one and one-half times larger than the original two tanks. Original holding tanks were also modified, but their capacity was not increased. Anesthetic tank capacity was also increased, with enlargement of the main anesthetic and recovery tanks and installation of two additional anesthetic tanks.

These modifications provided substantial expansion of the work area and made handling feasible for a larger proportion of the adult steelhead and Chinook salmon migrations. The gravity-flow water supply was modified in 2009 to ensure that 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, data were transferred to an electronic format. In an effort to allow real-time access to all data collected, Real Time Research Inc. was contracted in 2012 to develop a touch-screen data collection system with an offsite, cloud-based database. The new system eliminates the possibility of transcription errors when converting data sheets to electronic form.

In fall 2017, the touch-screen data collection system was upgraded to utilize new technologies and provide additional features. The system now allows managers and other interested parties to retrieve data they need at the end of each day. Fish managers who used data collected at the adult fish trap on a weekly basis are now able to get the information they need daily to inform in-season management decisions.

Operation and Sampling Schedules

In 2018, we operated the trap 5 d/week from 8 March to 18 November, and there was no interruption during this period 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 28 and 20% from 8 March to 17 August.

During the fall trapping period (which begins on 18 August), we operated the trap 7 d/week, and thus daily and weekly sample rates were the same. In an effort to increase numbers of larger unmarked adults for broodstock, the trap rate was set to 70% from 18 August to 6 September. On 7 September, the trap rate was returned to 20% until the end of the fall trapping period, as agreed upon by regional co-managers. Normal operations continued until the trap closed for the winter on 18 November.

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

Table 1. Summary of operations during 2018 at the Lower Granite Adult Trap.

Date range	Trap operating schedule	Trap rate (%)	
		Daily	Overall weekly
8 March-17 August	5 d/week	28	20
Fall trapping			
18 August-6 September	7 d/week	70	70
7 September-18 November	7 d/week	20	20

Interruption of Trap Operations

In early spring 2016, the USACE installed two large vertical structures, called chimneys, on the upstream face of Lower Granite Dam. These intake chimneys provided a permanent way to pull cooler, deep water from the reservoir into both the Diffuser 14 pipe and the pump intake. As a result, water from a depth of approximately 70 ft in the forebay is now used to cool both the fish ladder and adult trap flows during hot summer months. This cooling system allowed the adult trap to run uninterrupted for the entire 2018 trapping season. Further information on these deep-water cooling structures is available from the U.S. Army Corps of Engineers Walla Walla District.

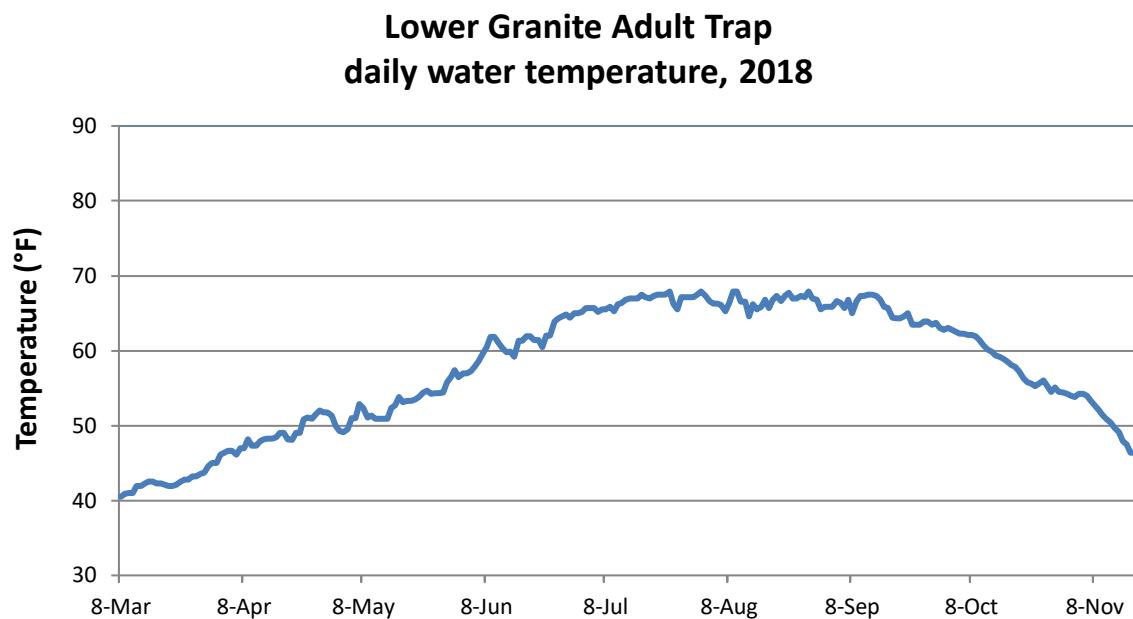


Figure 1. Daily water temperature (°F) at the Lower Granite Dam Adult trap, 2018.

Trapped Fish

All trapped adults were inspected in the holding area to determine species, measure length, and assess injuries. Fish were also examined for brands, visible implanted 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 2018. Data shown in Table 2 is preliminary; further analyses will be conducted by researchers from the respective agencies for which these data were collected.

Table 2. Number of adult salmonids collected and handled at the Lower Granite Adult trap during 2018.

Species	Number collected	Number PIT-tagged	Number previously PIT-tagged
Spring Chinook	7,022	1,494	325
Summer Chinook	1,441	605	79
Fall Chinook	6,684	0	249
Steelhead	11,643	2,464	381
Sockeye	72	0	16
Coho	829	0	20
Bull Trout	3	1	2

Steelhead

A total of 11,643 steelhead were collected and handled at the adult trap during 2018 (Table 2). Of these fish, 927 were collected during spring and 10,716 during fall. Of the 927 steelhead collected during spring, 219 were of wild origin and received a PIT tag and fin clip for genetic analysis; 57 were recaptures of fish that had been previously PIT-tagged. Of the 10,716 steelhead collected during fall, 2,245 were of wild origin and received a PIT tag and fin clip, and 324 were recaptures of previously PIT-tagged fish.

Data taken from trapped steelhead will be analyzed to evaluate the A- vs. B-run segments and hatchery vs. wild composition of the steelhead run. Personnel from the Idaho Department of Fish and Game will conduct these analyses (Bill Schrader, Kathrine Lawry, and Marika Dobos). No freeze-brands were observed during adult steelhead collections in 2018.

Using the separation-by-code capabilities of the trap, we collected one South Fork Clearwater River steelhead that had previously been PIT-tagged. This fish was 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 natural, supplementation hatchery, and conventional hatchery steelhead
2. Determine spatial overlap in the spawning distribution of B-run natural, supplementation, and conventional adults
3. Verify or refute the believed presence of a velocity barrier to returning steelhead (near Golden)

Personnel from the Nez Perce Tribe (Jason Vogel) and Idaho Department of Fish and Game (Marika Dobos) will conduct these analyses.

Spring/Summer Chinook Salmon

We collected and handled a total of 7,022 spring and 1,441 summer Chinook salmon adults at the trap during 2018 (Table 2). Of the 7,022 spring Chinook collected, 1,494 were of wild origin and received a PIT tag and fin clip and 325 were recaptures of previously PIT-tagged fish. Of the 1,441 summer Chinook salmon collected, 605 were of wild origin and received a PIT tag and fin clip; 79 were recaptures of previously PIT-tagged fish. Adult spring Chinook salmon from the Lower Granite Trap were used for the following investigations during 2018:

1. Age structure and genetic stock identification: Scale and tissue samples were taken from all PIT-tagged fish. Idaho Department of Fish and Game staff will analyze scale samples, and staff of Quantitative Consultants Inc., will perform genetic analysis of tissues. Determinations from these analyses and will be reported by IDFG (Bill Schrader and Marika Dobos).
2. *Integrated Status and Effectiveness Monitoring Program* (ISEMP): We recaptured 14 previously PIT-tagged adult spring Chinook salmon of Lemhi River origin using the separation-by-code system. These fish were radio-tagged for IDFG as part of the BPA-funded ISEMP for the following objectives:
 - a) Determine travel time 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 from ISEMP program reports (ISEMP 2015, 2018).

Fall Chinook Salmon

We collected and handled a total of 6,684 fall Chinook salmon (Table 2). For hatcheries, we collected adults 70 cm FL (fork length) or larger and jacks 69 cm FL or smaller with coded wire tags. Of the 6,684 adult fall Chinook salmon collected, we transported 1,784 adults and 511 jacks to Lyons Ferry Hatchery on the Snake River in Washington. From this same total, we transported 866 adults and 14 jacks to the Nez Perce Tribal Hatchery on the Clearwater River in Idaho. The remaining 3,509 fall Chinook salmon were passed upstream to continue their migration.

Adult fall Chinook salmon trapped at Lower Granite in 2018 were used for run reconstruction and hatchery data analyses of fall Chinook salmon transported to Lyons Ferry and Nez Perce Tribal Hatcheries. Staff of the Washington Department of Fish and Wildlife will complete these analyses (Afton Oakerman).

Sockeye Salmon

We collected scale and genetic samples from 72 sockeye salmon. 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, which is not presently accounted for in run-size estimation procedures. Staff of the Idaho Department of Fish and Game will conduct these analyses (John Powell). No sockeye were transported in 2018.

Coho Salmon

In 2018, the Nez Perce Tribe requested that we collect any coho salmon adult of at least 52 cm fork length for transport to the Kooskia National Fish Hatchery. These coho salmon were collected for broodstock to assist the Nez Perce Tribe *Clearwater River Basin Coho Restoration Project*. We collected and handled a total of 829 coho (Table 2). Of these 829 fish, 478 were transported to Kooskia National Fish Hatchery by Nez Perce Tribe personnel. The remaining 351 were passed upstream to continue their migration.

Bull Trout

A collaborative study of bull trout between NOAA Fisheries and the U.S. Fish and Wildlife Service was started in 2016. One bull trout was captured in the adult trap in 2018, and this fish was PIT tagged and sampled for genetic analysis. Data collected from bull trout will be used to investigate the origin and migration patterns of juvenile and adult bull trout encountered at Lower Granite Dam.

Acknowledgements

We thank the U.S. Army Corps of Engineers for maintaining the Lower Granite Dam adult trap and the Bonneville Power Administration for funding for its operation. Thanks also to Ken McIntyre of NOAA Fisheries, and Allen Bartels, Randy Bunce, Lela Work, and Kris Snyder of Ocean Associates, Inc. for assistance with sampling at the trap. Troy Humphrey of PSMFC wrote the software that allowed the automated beginning and end of the sampling system at the adult trap during 5 d/week operations. Thanks also to Don Warf, his supervisor, and the rest of the PSMFC field staff for their support. We thank Nicole Tancreto of PSMFC for her assistance with the separation-by-code system.

References

- Harmon, J. R. 2003. A trap for handling adult anadromous salmonids at Lower Granite Dam on the Snake River Washington. North American Journal of Fisheries Management 23:989-992 (doi: 10.1577/M02-035).
- Harmon, J. R. 2006. Operation of the Lower Granite Dam Adult Trap, 2005. Report of the National Marine Fisheries Service to the Bonneville Power Administration Division of Fish and Wildlife. Portland, Oregon. Available from www.cbfish.org (June 2014).
- Harmon, J. R. 2007. Operation of the Lower Granite Dam Adult Trap, 2006. Report of the National Marine Fisheries Service to the Bonneville Power Administration. Portland, Oregon. Available at www.cbfish.org (June 2014).
- Harmon, J. R. 2008. Operation of the Lower Granite Dam Adult Trap, 2007. Report of the National Marine Fisheries Service to the Bonneville Power Administration. Portland, Oregon. Available at www.cbfish.org (June 2014).
- Harmon, J. R. 2009. Operation of the Lower Granite Dam Adult Trap, 2008. Report of the National Marine Fisheries Service to the Bonneville Power Administration. Portland, Oregon. Available at www.cbfish.org (June 2014).
- ISEMP (Integrated Status and Effectiveness Monitoring Program). 2014. Columbia River Habitat Monitoring Program (CHaMP) and the Integrated Status and Effectiveness Monitoring Program (ISEMP). Project website available at www.nwfsc.noaa.gov/research/divisions/cbd/mathbio/isemp/index.cfm (September 2014)
- ISEMP (Integrated Status and Effectiveness Monitoring Program). 2018. Integrated Status and Effectiveness Monitoring Program (BPA Project 2003-017-00) and Columbia Habitat Monitoring Program (BPA Project 2011-006-00) Final Technical Report for Bonneville Power Administration. Available at isemp.org/documents/publications-outreach/ (September 2019).
- Ogden, D. A. 2010. Operation of the Lower Granite Dam Adult Trap, 2009. Report of the National Marine Fisheries Service to the Bonneville Power Administration. Portland, Oregon. Available at www.cbfish.org (June 2014).
- Ogden, D. A. 2011. Operation of the Lower Granite Dam Adult Trap, 2010. Report of the National Marine Fisheries Service to the Bonneville Power Administration. Portland, Oregon. Available at www.cbfish.org (June 2014).

- Ogden, D. A. 2012. Operation of the Lower Granite Dam Adult Trap, 2011. Report of the National Marine Fisheries Service to the Bonneville Power Administration. Portland, Oregon. Available at www.cbfish.org (June 2014).
- Ogden, D. A. 2013. Operation of the Lower Granite Dam Adult Trap, 2012. Report of the National Marine Fisheries Service to the Bonneville Power Administration. Portland, Oregon. Available at www.cbfish.org (June 2014).
- Ogden, D. A. 2014. Operation of the Lower Granite Dam Adult Trap, 2013. Report of the National Marine Fisheries Service to the Bonneville Power Administration. Portland, Oregon. Available at www.cbfish.org (June 2014).
- Ogden, D. A. 2016. Operation of the Lower Granite Dam Adult Trap, 2014. Report of the National Marine Fisheries Service to the Bonneville Power Administration. Portland, Oregon. Available at www.cbfish.org (January 2016).
- Ogden, D. A. 2016. Operation of the Lower Granite Dam Adult Trap, 2015. Report of the National Marine Fisheries Service to the Bonneville Power Administration. Portland, Oregon. Available at www.cbfish.org (April 2016).
- Ogden, D. A. 2018. Operation of the Lower Granite Dam Adult Trap, 2016. Report of the National Marine Fisheries Service to the Bonneville Power Administration. Portland, Oregon. Available at www.cbfish.org (May 2018).
- Ogden, D. A. 2019. Operation of the Lower Granite Dam Adult Trap, 2017. Report of the National Marine Fisheries Service to the Bonneville Power Administration. Portland, Oregon. Available at www.cbfish.org (April 2019).