

Operation of the Adult Trap at Lower Granite Dam 2013

Darren A. Ogden

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



July 2014

EXECUTIVE SUMMARY

During 2013, we operated the adult salmonid trap at Lower Granite Dam from 4 March to 23 November. Due to budget constraints, the trap was operated only 5 d/week from 4 March to 10 July. During this period, adult collection began each Sunday at 1500 and ended each Friday at 1500. The trap was forced to close on 3 July for a one-day period due to high water temperatures (exceeding 70°F). On 10 July, the trap was again forced to close due to high water temperatures. This second closure continued until 23 September, when water temperatures dropped below 70°F. From 23 September to 23 November, the trap was operated 7 d/week, with no closures.

We collected and handled 14,323 total steelhead *Oncorhynchus mykiss*, of which we PIT-tagged 4,138 wild steelhead. We collected and handled 11,541 total spring/summer Chinook salmon *O. tshawytscha*, of which we PIT-tagged 2,611 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 14 previously PIT-tagged Lemhi River adult spring Chinook and 68 previously PIT-tagged South Fork Clearwater River steelhead for the Idaho Department of Fish and Game (IDFG) and the Nez Perce Tribe.

We collected and handled a total of 6,434 fall Chinook salmon. Of those fish, 1,295 adults and 522 jacks were transported to Lyons Ferry Hatchery on the Snake River in Washington, and 458 adults and 48 jacks were transported to the Nez Perce Tribal Hatchery on the Clearwater River in Idaho. The remaining 4,111 fall Chinook salmon were passed upstream to continue their migration. Using the separation-by-code system in the trap, 709 previously PIT-tagged fall Chinook were collected and had a scale sample taken for NOAA Fisheries. Of these previously PIT tagged fall Chinook, 105 were gastrically radio-tagged for Washington Department of Fish and Wildlife (WDFW).

Finally, 48 sockeye *O. nerka* were captured in the trap, and we collected genetic samples from 44 of these fish.

CONTENTS

EXECUTIVE SUMMARY	iii
INTRODUCTION	1
METHODS	2
RESULTS AND DISCUSSION	3
Maintenance and Improvements	3
Operation and Sampling Schedules	4
Interruption of Trap Operations	5
Trapped Fish	6
Steelhead	7
Spring/Summer Chinook Salmon	7
Fall Chinook Salmon	8
Sockeye Salmon	9
ACKNOWLEDGMENTS	10
REFERENCES	11

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 the completion of Lower Granite Dam in 1975, adult salmonids have been collected and sampled 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. Demands on use of the Lower Granite Dam adult trap have increased in recent years and are expected to continue to increase. 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 Lower Granite Dam adult 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 2010-2013). Here we report on adult trap operations during 2013.

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 divert upstream-migrating fish to an 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. The pipes transition into flumes which contain diversion gates that can be set at a predetermined rate to sample the run-at-large, sending the sampled adults into a holding area.

In addition, previously tagged fish can also be diverted to the holding area using either the CWT detectors (currently non-functional) or a PIT tag separation-by-code system (for PIT-tagged fish, only those selected by tag code are diverted to holding). 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 the trap is operated, generally between 06:00 and 15:00. Adults exit the holding area via a gravity-flow dewatering system, which 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 to be hauled from the 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 2013 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, except during periods in the summer when water temperatures reach 70°F, the thermal limit for safely handling adult salmonids. Due to budget constraints, trap operations in 2013 were changed to 5 d/week during the spring and summer migration periods (4 March to 17 August).

During these 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

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

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 planned to run 7 d/week from 18 August to 23 November.

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. Holding capacity was increased by adding four additional holding tanks, which are 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 capacity was also increased, with an increase in size of the main anesthetic and recovery tanks, and installation of two additional anesthetic tanks. The modifications also provided substantial expansion of the work area. These modifications now make it feasible to handle a larger proportion of the adult steelhead and Chinook salmon migrations.

The adult trap was designed to operate with a gravity-flow water system supplying sufficient water pressure to operate the adult trap at all forebay operating levels. However, it was found that when the Lower Granite forebay is at minimum operating level, as it is during late summer, there is only enough water available to use three of the four new holding tanks. Throughout the 2009 season, the USACE worked to increase the water supply so that all tanks could be used.

In mid-August 2009, while the trap was shut down due to high water temperatures, a remotely operated camera was run through the water supply pipes to check for debris blockage. Nothing was found in the water supply pipes that would obstruct flow. The USACE decided to replace a butterfly valve on the water supply pipe at the end of the 2009 season (mid-November). During testing the following day, we were able to run the adult trap at full capacity, with all six holding tanks operating. Further testing was done throughout the 2010 season to verify the improvement in water

supply during normal trap operations. The trap was able to run at full capacity during the 2010 season without any problems with water supply.

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 2013, we operated the trap 5 d/week from 4 March to 10 July, with the exception of a closure from the morning of 3 July to the morning of 4 July due to high water temperatures (exceeding 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 a daily and overall weekly sample rates of 21 and 18%, respectively, from 4 March to 23 April and 25 and 20%, respectively, from 24 April to 10 July.

Table 1. Summary of operations during 2013 at the Lower Granite Adult Trap.

Date range	Trap operating schedule	Daily sample rate (%)	Overall weekly sample rate (%)
4 March-23 April	5 d/week	21	18
24 April-10 July	5 d/week	25	20
23 September-2 October	7 d/week	12	12
3-8 October	7 d/week	15	15
9 October-23 November	7 d/week	20	20

During fall, we operated the trap 7 d/week, and thus daily and weekly sample rates were the same. Fall sample rates were 12% from 23 September to 2 October, 15% from 3-8 October, and 20% from 9 October to 23 November. After 23 November, the trap was shut down for the winter.

In addition to the periodic samples 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. Note that the trap was closed from the afternoon of 10 July to the morning of 23 September due to water temperatures that exceeded 70°F (discussed below).

Interruption of Trap Operations

On 10 July 2013, water temperature exceeded 70°F, forcing a shutdown of the trap that lasted until 23 September when the water temperature decreased below 70°F (Figure 1). During the 75 d during which the trap was shut down, water temperature averaged 70.4°F with a high of 73.2°F.

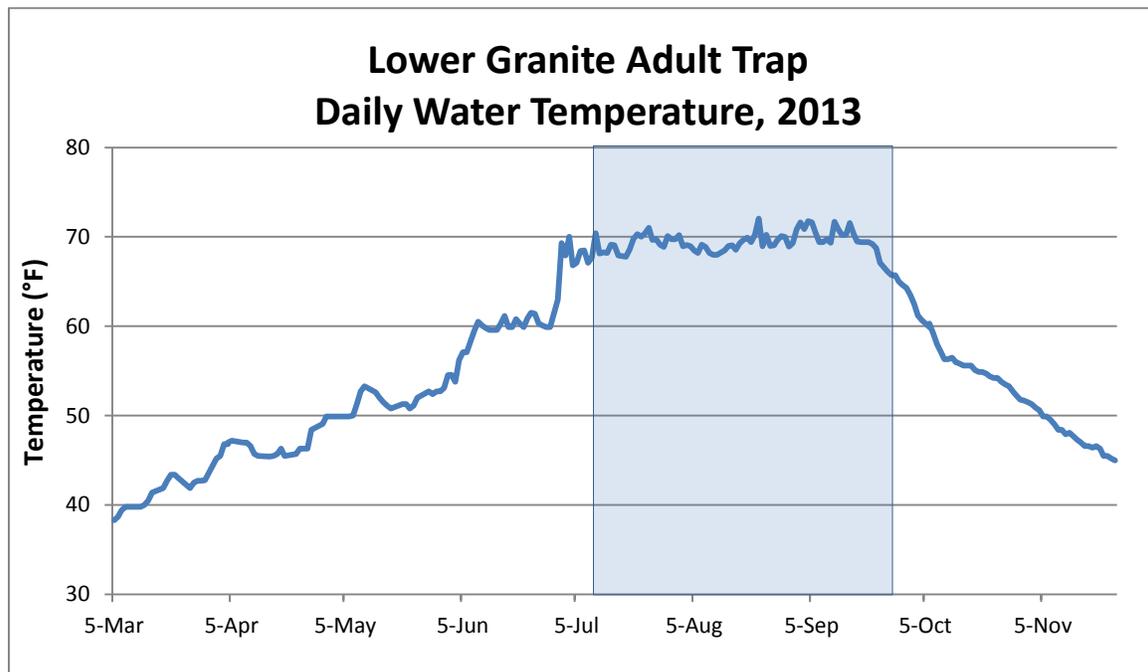


Figure 1. Daily water temperature (°F) at the Lower Granite Dam Adult trap, 2013. Shaded area represents interruption of trap operations.

On 25 July 2013, while the trap was shut down due to high water temperature, Idaho Department of Fish and Game requested an emergency trap-and-haul of sockeye salmon. The trap was watered up and put into trapping mode at approximately 1500 PDT. However, on the morning of 26 July, water pressure was not strong enough to induce adults to jump over the false weir. As a result, no sockeye were trapped during this time, and the trapping effort was immediately stopped to investigate the situation.

During this warm-water event, the USACE attempted to cool water temperature in the adult ladder using deep water from the reservoir (Lower Granite Lake). To draw cooler water into the ladder, they used two auxiliary pumps, which had been originally installed to draw deep water from the reservoir during an experimental drawdown of Lower Granite Lake in 1992. Auxiliary pump 1 terminates at the exit pool of the adult ladder, and auxiliary pump 2 terminates in the chamber of diffuser 14, which provides water to the adult trap. Unfortunately, turning both pumps on caused the automatic valve in diffuser 14 to restrict attraction flow to the false weir to an unacceptably low level. Repeated efforts to circumvent the automatic valve failed, and trapping effort was stopped. A temporary fix is being investigated for 2014 and 2015, with a permanent fix scheduled for 2016.

Trapped Fish

All adults in the holding area were inspected 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 2013. 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 2013.

Species	Number collected	Number PIT tagged	Number previously PIT tagged
Spring Chinook	9,566	1,842	535
Summer Chinook	1,975	769	206
Fall Chinook	6,434	0	1,542
Steelhead	14,323	4,138	276
Sockeye	48	0	7
Coho	589	0	18

Steelhead

A total of 14,323 steelhead were collected and handled at the adult trap during 2013. Of these fish, 1,137 were collected during spring and 13,186 during fall. Of the 1,137 steelhead collected during spring, 448 were of wild origin and received a PIT tag and fin clip (for genetic analysis); 33 were recaptures of fish that had been previously PIT tagged. Of the 13,186 steelhead collected during the fall, 3,690 were of wild origin and received a PIT tag and fin clip, and 243 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 2013 adult steelhead collections.

Using the separation-by-code capabilities of the trap, 68 previously PIT tagged South Fork Clearwater River steelhead were collected and radio tagged using the gastric method. These data will help monitor the effectiveness of B-run steelhead hatchery supplementation 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).

Spring/Summer Chinook Salmon

We collected and handled a total of 9,566 adult spring Chinook salmon and 1,975 adult summer Chinook salmon at the trap during 2013 (Table 2). Of the 9,566 spring Chinook salmon collected, 1,842 were of wild origin and received a PIT tag and fin clip; 535 were recaptures of previously PIT tagged fish. Of the 1,975 summer Chinook salmon collected, 769 were of wild origin and received a PIT tag and fin clip, and 206 were recaptures of previously PIT tagged fish. Adult spring Chinook salmon from the Lower Granite Trap were used for the following investigations during 2013:

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. Fourteen 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 for the Lemhi River watershed:
 - a) Determine the timing of adult Chinook salmon from Lower Granite Dam to spawning grounds
 - b) Identify stream flow and instream migration barriers to prioritize future habitat actions.
 - c) Determine the effectiveness of habitat restoration actions taken to reduce fish migration barriers.
 - d) Identify staging area habitat to prioritize future habitat restoration actions.
 - e) Determine adult Chinook salmon distribution.
 - 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 6,434 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 Nez Perce Tribal Hatchery on the Clearwater River in Idaho. Of the 6,434 adult fall Chinook salmon collected, we transported 1,295 adults and 522 jacks to Lyons Ferry Hatchery and 458 adults and 48 jacks to the Nez Perce Tribal Hatchery. The remaining 4,111 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 2013:

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

2. Scale samples were taken from the 709 PIT-tagged fall Chinook collected using the separation-by-code system at the trap. Data from these scales will be used for a study of fall Chinook salmon early life history. Information on this study is available from the National Marine Fisheries Service Northwest Fisheries Science Center in Seattle (Tiffani Marsh).
3. Using the gastric method, 105 previously PIT tagged fall Chinook were radio tagged in an attempt to better understand spawner distribution upstream of Lower Granite Dam associated with Lyons Ferry Hatchery subyearling releases. 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 44 of the 48 sockeye captured in the trap. Genetic samples were taken to 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).

ACKNOWLEDGMENTS

We thank the U.S. Army Corps of Engineers for providing maintenance on the Lower Granite Dam adult trap and to the Bonneville Power Administration for providing funding for its operation. Janine Fetke, Ken McIntyre, Neil Paasch of NOAA Fisheries and Viki Brenner of Ocean Associates, Inc. assisted with sampling at the trap. We thank Troy Humphrey of PSMFC for writing 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 (June 2014)
- 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).