



NOAA Contract Report NMFS-NWFSC-CR-2023-07

<https://doi.org/10.25923/pppq-6988>

Operation of the Adult Trap at Lower Granite Dam, 2020

Contract **BPA 44314**, Project **200500200**

August 2023

U.S. DEPARTMENT OF COMMERCE

National Oceanic and Atmospheric Administration
National Marine Fisheries Service
Northwest Fisheries Science Center

NOAA Contract Report Series NMFS-NWFSC-CR

The Northwest Fisheries Science Center of NOAA's National Marine Fisheries Service uses the NOAA Contract Report NMFS-NWFSC-CR series to disseminate information only. Manuscripts have not been peer-reviewed and may be unedited. Documents within this series represent sound professional work, but do not constitute formal publications. They should only be footnoted as a source of information, and may not be cited as formal scientific literature. The data and any conclusions herein are provisional, and may be formally published elsewhere after appropriate review, augmentation, and editing.

NWFSC Contract Reports are available from the NOAA Institutional Repository, <https://repository.library.noaa.gov>.

Mention throughout this document to trade names or commercial companies is for identification purposes only and does not imply endorsement by the National Marine Fisheries Service, NOAA.

Recommended citation:

(Ogden et al. 2023)¹

¹ Ogden, D. A., A. L. Barenberg, and R. M. Gleason. 2023. Operation of the Adult Trap at Lower Granite Dam, 2020. U.S. Department of Commerce, NOAA Contract Report NMFS-NWFSC-CR-2023-07.

<https://doi.org/10.25923/pppq-6988>



NOAA
FISHERIES

Operation of the Adult Trap at Lower Granite Dam, 2020

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

<https://doi.org/10.25923/pppq-6988>

August 2023

Fish Ecology Division
Northwest Fisheries Science Center
2725 Montlake Boulevard East
Seattle, Washington 98112

U.S. DEPARTMENT OF COMMERCE

National Oceanic and Atmospheric Administration
National Marine Fisheries Service
Northwest Fisheries Science Center

Executive Summary

In 2020 the Lower Granite Dam adult trap began operations as scheduled on Monday, 2 March. Operations at the trap were suspended on the morning of 24 March 2020 due to restrictions in response to the COVID-19 virus pandemic. Trapping resumed on 2 July at a 5-d/week operating schedule, with samples of the run-at-large taken automatically four times an hour, 24 h/d from 1500 Sunday to 1500 on Friday. From 18 August to 12 November, trap operations were increased to 7-d/week and ran without interruption until closure of the trap.

We collected and handled a total of 11,641 wild and hatchery steelhead *Oncorhynchus mykiss* using the adult trap during 2020. Among these fish, we injected 2,635 with passive integrated transponder (PIT) tags. All tagged hatchery steelhead had adipose fins intact.

For an additional 2,065 steelhead, T-bar tags were externally attached near the dorsal fin. Of these fish, 918 were of wild origin and 1,147 were of hatchery origin.

No spring-run adult Chinook *O. tshawytscha* were trapped due to the trap closure resulting from COVID-19 virus pandemic restrictions. We collected and handled a total of 1,337 wild and hatchery summer-run adult Chinook salmon during 2020. No PIT tagging, scale, or genetic sampling occurred for spring/summer Chinook in 2020, again due restrictions related to the pandemic.

We also collected and handled a total of 9,928 fall Chinook salmon. Of these fish, 1,978 adults and 500 jacks were transported to Lyons Ferry Hatchery on the Snake River in Washington, and 889 adults and 19 jacks were transported the Nez Perce Tribal Hatchery on the Clearwater River in Idaho. The remaining 6,542 fall Chinook were passed upstream to continue their migration.

A total of 210 adult sockeye *O. nerka* were also captured and released in 2020. Genetic samples were taken from all adults. Of the 2,308 coho salmon *O. kitsutch* captured in the trap, 634 were transported by Nez Perce Tribal staff to the Kooskia National Fish Hatchery. The remaining 1,674 were passed upstream to continue their migration.

Finally, there were 5,306 fish captured as bycatch in the adult trap at Lower Granite Dam during 2020. Bycatch was composed of 13 fish species, with the most abundant being American shad *Alosa sapidissima* (1,830) followed by sucker

Catostomus spp. (1,339) and peamouth *Mylocheilus caurinus* (1,010). The Idaho Department of Fish and Game lethally sampled all 45 walleye *Sander vitreus* captured in the trap. Data collected from these samples will help define the demographic characteristics of walleye captured at the Lower Granite adult fish trap and will provide needed information for fisheries biologist to prepare a management plan should walleye become more prevalent in the Snake River Basin.

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	8
Spring/Summer Chinook Salmon	9
Fall Chinook Salmon	9
Sockeye Salmon.....	9
Coho Salmon.....	10
Bull Trout.....	10
Bycatch	10
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 Pacific salmonids *Oncorhynchus* spp. 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 in 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 2020.

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 provided 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 local time. 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 2020 trapping season.

Prior to 2013, the adult trap was generally operated 7 d/week, 24 h/d during the adult migration periods 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 abridged 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 12 November 2020.

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. (Bend, Oregon) 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 2020 the Lower Granite Dam adult trap began operations as scheduled on Monday, 2 March. We operated the trap 5 d/week from 2 to 24 March (Table 1). Operations at the trap were suspended on the morning of 24 March 2020 due to restrictions based on the COVID-19 virus pandemic. Trapping resumed (5-d/week) on 2 July 2020 under the guidance of USACE and IDFG personnel, with WDFW personnel beginning work on 18 August. However, COVID-19 restrictions prevented NOAA Fisheries personnel from returning to the trap until 26 August. During 5-d/week operations, the sampling schedule resulted in respective daily and overall weekly sample rates of 25 and 18%.

Fall operations (7-d/week) began on 18 August and continued without interruption until trap closure on 12 November. From 18 August through 1 September 2020, the trap was operated at an 80% sample rate. We then dropped to an 18% sample rate from 2 September to closure on 12 November. Using the higher trap rate (80%) early in the fall Chinook run, and then dropping to a lower trap rate (18%) allowed us to achieve fall Chinook broodstock collection goals while minimizing impacts on steelhead.

Table 1. Summary of operations during 2020 at the Lower Granite Adult Trap.

Date range	Trap operating schedule	Trapping rate (%)	
		Daily	Overall weekly
<i>Early spring/summer</i>			
2 March-24 March	5 d/week	28	20
25 March-1 July	Trap closed		
2 July-31 July	5 d/week	28	20
3 August-17 August	5 d/week	25	18
<i>Fall</i>			
18 August-1 September	7 d/week	80	80
2 September-12 November	7 d/week	18	18

Interruption of Trap Operations

In early spring 2016, the USACE installed two large vertical structures called intake chimneys, on the upstream face of Lower Granite Dam. These chimneys provided a permanent way to pull cooler, deep water from the reservoir into both the diffuser 14 pipe and the pump intake. Water from a depth of approximately 70 ft in the forebay is now used to cool flows in both the fish ladder and adult trap during hot summer months.

This cooling system enabled the adult trap to run uninterrupted during the entire trapping seasons of 2016-2018. A brief 6-d interruption occurred in 2019, when water temperatures exceeded 21°C (70°F); however, there were no interruptions due to warm water temperatures in 2020. Further information on these deep-water cooling structures is available from the U.S. Army Corps of Engineers Walla Walla District.

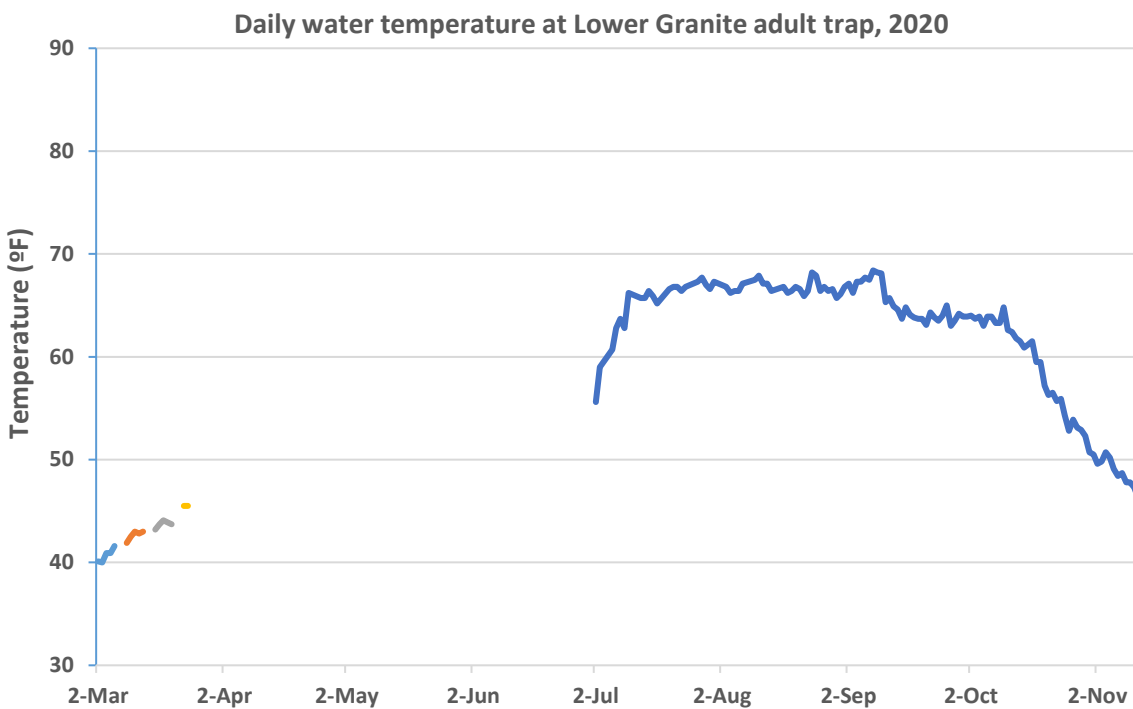


Figure 1. Daily water temperature (°F) at the Lower Granite Dam adult trap, 2020.

Trapped Fish

During processing, all trapped adults were inspected 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. For fall Chinook salmon collected at the trap and transported to hatcheries, we punched small holes in the operculum to identify trap rate, but no fish were inoculated at the trap in 2020. Data shown in Table 2 are preliminary; further analyses will be conducted by researchers from the respective agencies for which these fish were collected.

Table 2. Number of adult salmonids collected and handled at the Lower Granite adult trap during 2020.

Species	Number collected	Number PIT-tagged	Number previously PIT-tagged
Spring Chinook	0	0	0
Summer Chinook	1,337	0	38
Fall Chinook	11,265	0	157
Steelhead	11,641	2,635	171
Sockeye	210	0	2
Coho	2,308	0	29
Bull trout	0	0	0

Steelhead

A total of 11,641 steelhead were collected and handled at the adult trap during 2020 (Table 2). Of these fish, 251 were collected during spring and 11,390 during fall. Of the 251 steelhead collected during spring, 86 were injected with a PIT tag, scale-sampled, and fin-clipped to provide a tissue sample for genetic analysis. Twelve fish captured in the spring had been previously PIT-tagged. Of the 11,390 steelhead collected during fall, 2,635 were injected with a PIT tag, scale-sampled, and fin-clipped. One hundred and fifty nine fish captured in the fall had been previously PIT-tagged. All tagged hatchery steelhead had adipose fins intact.

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 and Marika Dobos, IDFG, personal communication).

We attached external T-bar tags near the dorsal fins of 2,065 steelhead (Reward Orange, Floy Tag Inc., Seattle). This tagging effort supported the University of Idaho study, *Encounter Rates and Catch-and-Release Mortality of Steelhead* (Will Lubenau, University of Idaho Department of Fish and Wildlife Sciences, personal communication). Of the 2,065 externally tagged steelhead, 918 were wild and 1,147 were of hatchery origin.

Spring/Summer Chinook Salmon

Because the trap was shut down due to COVID-19 restrictions during the adult migration of spring-run Chinook, no adult spring Chinook were trapped in 2020. We collected and handled a total of 1,337 summer-run adult Chinook at the trap during 2020 (Table 2). As a result of both the mandatory trap closure and COVID-19-related restrictions on the number of staff available for trap operations, no PIT tagging and no fin or scale sampling were conducted for spring and summer Chinook during 2020.

Fall Chinook Salmon

We collected and handled a total of 9,928 fall Chinook salmon (Table 2). For hatcheries, we collected adults of 70 cm FL (fork length) or larger and jacks of 69 cm FL or smaller with coded wire tags. Of the 9,928 fall Chinook salmon collected, we transported 1,978 adults and 500 jacks to Lyons Ferry Hatchery in Washington on the Snake River. We also transported 889 adults and 19 jacks to the Nez Perce Tribal Hatchery on the Clearwater River in Idaho. The remaining 6,542 fall Chinook salmon were passed upstream to continue their migration.

Fall Chinook salmon trapped at Lower Granite in 2020 were used for run reconstruction and hatchery data analyses of fall Chinook salmon released as juveniles from the Lyons Ferry and Nez Perce Tribal Hatcheries. Staff of the Washington Department of Fish and Wildlife will complete these analyses (Joe Bumgarner, WDFW, personal communication).

Sockeye Salmon

We collected tissue samples from all 210 sockeye trapped in 2020. Tissue samples were taken for genetics studies. Objectives of these studies are 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 estimates. Staff of the Idaho Department of Fish and Game will conduct these analyses (John Powell, IDFG, personal communication). No sockeye were transported in 2020.

Coho Salmon

In 2020, the Nez Perce Tribe requested that we collect any adult coho of at least 55 cm fork length for transport to the Kooskia National Fish Hatchery. These coho salmon were needed for broodstock to assist the Nez Perce Tribe *Clearwater River Basin Coho Restoration Project*. We collected a total of 2,308 coho (Table 2). Of these 2,308 fish, 634 were transported to Kooskia National Fish Hatchery by Nez Perce Tribal personnel. The remaining 1,674 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. 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. No bull trout were captured in the trap in 2020.

Bycatch

We define bycatch for the trap as any fish captured in the trap that is outside the intended species and/or age range needed for the various projects collecting fish at the trap. In 2020, there were 5,306 individual fish and 13 species captured in the trap as bycatch (Table 3).

Including bull trout, which is deliberately sampled using the trap at present, many of these same 13 species have been incidentally captured at the trap over many years (Table 4). Bycatch numbers in general have increased since 2013. For some species, an increase in bycatch numbers may have been related to longer periods of uninterrupted trap operations or higher trapping rates. However, further investigation will be needed to evaluate this trend. Decreases in bycatch numbers for 2020 were likely due to the trap being closed from 25 March to 1 July.

In 2020, IDFG started lethally sampling any walleye captured in the trap. Along with morphometric measurements, otoliths, stomach, spine, and genetic fin clip samples were also collected. Data from these samples will help define the demographic characteristics of walleye captured at the Lower Granite adult fish trap and will provide needed information for fisheries biologists to prepare a management plan should walleye become more prevalent in the Snake River Basin (Nolan Smith, IDFG, personnel communication).

Table 3. Bycatch species trapped in 2020.

Species common name	Scientific name	Number collected	Average length (cm)
American shad	<i>Alosa sapidissima</i>	1,830	37
Chiselmouth	<i>Acrocheilus alutaceus</i>	19	27
Common carp	<i>Cyprinus carpio</i>	72	62
Chinook smolt	<i>O. tshawytscha</i>	750	24
Coho smolt	<i>O. kisutch</i>	1	25
Mountain whitefish	<i>Prosopium williamsoni</i>	13	27
Northern pikeminnow	<i>Ptychocheilus oregonensis</i>	85	33
Pacific Lamprey	<i>Entosphenus tridentatus</i>	1	68
Peamouth	<i>Mylocheilus caurinus</i>	1,010	27
Smallmouth bass	<i>Micropterus dolomieu</i>	139	30
Steelhead smolt	<i>O. mykiss</i>	2	27
Large scale sucker	<i>Catostomus macrocheilus</i>	1,339	41
Walleye	<i>Sander vetreus</i>	45	44
Total		5,306	33

Table 4. Historical bycatch trapped by year, 2013-2020.

Species	2013	2014	2015	2016	2017	2018	2019	2020
American shad	51	32	1,345	8,497	5,842	11,218	3,426	1,830
Bull trout*	4	1		na	na	na	na	na
Channel catfish	1						3	
Chiselmouth	90	42	76	104	172	81	109	19
Common carp	50	24	4	5	25	136	56	72
Juvenile Chinook	3				91	602	450	750
Juvenile coho						1	1	1
Largemouth bass		1	4				2	
Mountain whitefish	34	29	8	17	20	28	65	13
Northern pikeminnow	119	36	47	244	122	308	112	85
Pacific lamprey				4	18	16	4	1
Peamouth	2,809	1,251	1,860	2,681	2,943	3,753	3,048	1,010
Smallmouth bass	76	61	55	93	40	234	290	139
Steelhead smolt				1	1	13	21	2
Sucker	3,555	1,554	1,915	4,214	3,348	7,316	5,455	1,339
Walleye				2	11	49	20	45
Total	6,792	3,031	5,314	15,862	12,633	23,755	13,062	5,306

* Considered bycatch prior to 2016; beginning in 2016, bull trout were targeted for studies of the origin and migration patterns of juvenile and adults.

Acknowledgements

We thank the U.S. Army Corps of Engineers for maintaining the Lower Granite Dam adult trap. We are also grateful to the Bonneville Power Administration for continuing funding of annual trap operations. In particular, we thank Allen Bartels of NOAA Fisheries and Lela Work, Kris Synder, and Randy Bunce of Stillwater Sciences for assistance with sampling at the trap. Much gratitude is owed to Troy Humphrey, formerly of Pacific States Marine Fisheries Commission, who wrote the software that allowed automated starting and ending of the trap sampling system during 5d/week operations. Thanks also to Don Warf, his supervisor, and all PSMFC field staff for their support. We especially 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. 2017. 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).
- Ogden, D. A. 2019. Operation of the Lower Granite Dam Adult Trap, 2018. Report of the National Marine Fisheries Service to the Bonneville Power Administration. Portland, Oregon. Available at www.cbfish.org (August 2019).
- Ogden, D.A. 2021. Operation of the Lower Granite Dam Adult Trap, 2019. Report of the National Marine Fisheries Service to the Bonneville Power Administration. Portland, Oregon. Available at www.cbfish.org (February 2021).



U.S. Secretary of Commerce
Gina M. Raimondo

Under Secretary of Commerce for
Oceans and Atmosphere
Dr. Richard W. Spinrad

Assistant Administrator for Fisheries
Janet Coit

August 2023

fisheries.noaa.gov

OFFICIAL BUSINESS

National Marine
Fisheries Service
Northwest Fisheries Science Center
2725 Montlake Boulevard East
Seattle, Washington 98112