2022 Annual Fishways Status Report

John Day Dam Project

Brown Pelican Observed in JDA Tailrace on 9/12/22

Eric Grosvenor, Michael Lotspeich,
Laura Ricketts, and Keith Morris

U.S Army Corps of Engineers
John Day Lock & Dam
Rufus, OR 97050
(541) 739-1061

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INTRODUCTION

John Day Dam is located at river mile 216 on the Columbia River and is the third dam upstream from the mouth of the Columbia. The project includes a powerhouse with 16 turbines and 4 skeleton bays (to house additional turbines), a spillway with 20 spill bays (includes 2 top spillway weirs [TSW] located in spill bays 18 and 19), a navigation lock, two fish ladders for upstream migration (North Fish Ladder [NFL], and South Fish Ladder [SFL]), and a complete juvenile bypass system (JBS) with a smolt monitoring facility (SMF) and lab (see figure 1). This document summarizes all fish related activities at John Day Dam in 2022, and all operations were conducted following protocols outlined in the current Fish Passage Plan (see table 1).

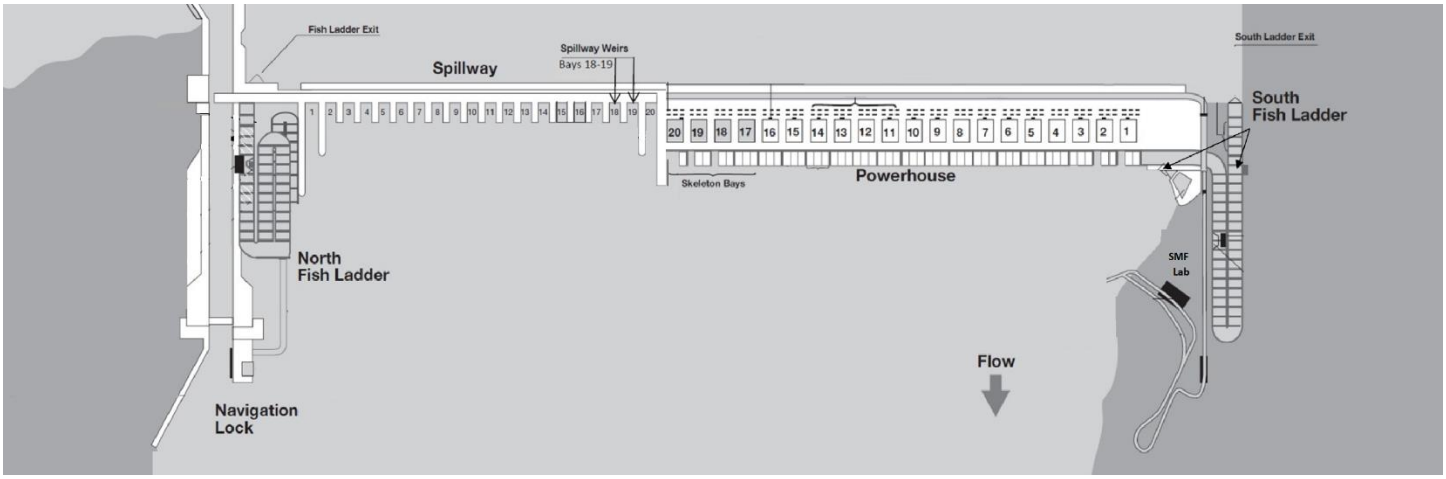


Figure 1: Project layout
An illustration of the John Day project highlighting the location of several fish passage structures.

2022 OPERATING SCHEDULE	
NORTH ADULT FISHWAY	
Regular Operation With AWS	(January 21st – March 4th) & (March 10th - November 28th)
AWS Off Half Day for ROV Inspection	August 1st
On Orifice Flow - No AWS Operation	(March 5th – March 6th)* & (November 29th – November 30th)*
Dewatered for Maintenance	(March 7th - March 9th)* & (December 1st - December 31st)
SOUTH ADULT FISHWAY	
Regular Operation With AWS	(January 1st - January 20th) & (February 28th - December 31st)
AWS Off Half Day for ROV Inspection	August 1st
On Orifice Flow – No AWS Operation	January 21st - February 2nd
Dewatered for Maintenance	February 3rd - February 27th
SMOLT MONITORING FACILITY	
Dewatered for Maintenance	(January 1st – March 16th) & (December 7th - December 31st)
Sampling (Monday-Friday) 7AM-1PM	April 1st – June 15th
Sampling (Monday, Wednesday, Friday) 7AM-1PM	June 16th- July 27th
Limited Sampling (Water Temperature > 70F°)	July 28th - September 15th
Bypass for PIT Detections	September 16th - November 29th
JUVENILE BYPASS SYSTEM	
Normal Operation with STSs Deployed	(March 1st - March 31st units 1-4) & (April 1st - December 15th all units)
SPILLWAY WITH 2 TSWs (bay 18 &19)	
On Seal	(January 1st - April 9th) & (December 1st - December 31st)
Fish Spill Per FPP Schedule	April 10th - August 31st
1.6 KCFS, Bay 2 Only (for NFL Attraction)	September 1st - November 30th
Early TSW Spill (Due to High Flows)	N/A

Table 1: 2022 operating schedule
This table highlights key fishway operations at the project in accordance with the Fish Passage Plan. (*see Appendix A for MOC 22JDA01 for March NFL outage and Appendix B for 22JDA16 for NFL early dewater schedule change).

FISHWAY INSPECTION PROCEDURES

Adult fishways and Juvenile Bypass System (JBS) were inspected twice daily during the adult fish passage season (March 1st - November 30th), and once per day during the winter maintenance season ([January 1st - February 28th] & [December 1st- December 31st]). The Smolt Monitoring Facility (SMF) inspections were conducted bihourly throughout the juvenile sampling season (April 1st - Sept 15th). Any out of criteria (OOC) observations were reported in the weekly status reports (see table 2).

	2019		2020		2021		2022	
	Total #	Total % OOC	Total #	Total % OOC	Total #	Total % OOC	Total #	Total % OOC
Number of Inspections	618	15.7%	633	4.1%	629	13.8%	624	4.3%
	North Fishway							
Exit Differential	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Exit regulating weirs position	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Count station differential	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Weir crest depth	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Entrance differential	**2**	**0.3%**	**2**	**0.3%**	**2**	**0.3%**	0	0.0%
	South Fishway							
Exit differential	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Exit regulating weirs position	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Count station differential	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Weir crest depth	0	0.0%	0	0.0%	0	0.0%	0	0.0%
South entrance differential	**5**	**0.8%**	**1**	**0.2%**	**2**	**0.3%**	**1**	**0.2%**
Entrance weir SE-1	**38**	**6.1%**	**8**	**1.3%**	**2**	**0.3%**	**8**	**1.3%**
Collection channel velocity	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Bay 1 differential	0	0.0%	0	0.0%	0	0.0%	0	0.0%
N. Entrance PH (Bay 19) differential	**12**	**1.9%**	0	0.0%	**3**	**0.5%**	**4**	**0.6%**
Entrance weir NE-1	**31**	**5.0%**	**4**	**0.6%**	**3**	**0.5%**	**7**	**1.1%**
Entrance weir NE-2	**9**	**1.5%**	**5**	**0.8%**	**2**	**0.3%**	**4**	**0.6%**
	Juvenile Passage							
Forebay/bypass conduit differential	0	0.0%	**6**	**0.9%**	**1**	**0.2%**	**3**	**0.5%**
Submersible traveling screens	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Turbine trash rack drawdown	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Vertical barrier screen drawdown	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Spill volume	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Spill pattern	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Turbine unit priority	0	0.0%	0	0.0%	**72**	**11.4%**	0	0.0%
Turbine 1% efficiency	0	0.0%	0	0.0%	0	0.0%	0	0.0%

Table 2: Out of criteria discrepancies
Fishways and the number/percentage of out of criteria (OOC) observations (2019-2022). There were numerous days when the turbine unit priority was out of criteria in 2021, this was due to the line 1-outage that took place October 19th, 2021 – December 16th, 2021.

FISH SALVAGE PROCEDURES

Fishway Dewatering Procedures

Fishways are dewatered following standard operating procedures (SOPs). When fishways are dewatered, fisheries personnel enter and salvage stranded fish. Salvaged fish are transported to either the forebay or tailrace depending on circumstances such as: fish species, dewatering location, age-class, or stress levels. Efforts are made to reduce stress by providing a continuous water supply and following minimal fish handling procedures. Follow-up inspections are performed to account for any overlooked fish. There were no known mortalities in 2022 (See Table 3).

Turbine Dewatering Procedures

When following operational guidelines, turbine dewaterings require minimal fish salvage. If a turbine fails, the operational guidelines cannot always be followed and may result in fish entrainment. Procedures are continually evaluated to determine the best methods to minimize fish stress and mortality. Prior to fish salvage all necessary equipment including nets, fish bags, and transport tanks, is staged. Typically, fish are transported via fish bag. Transport tanks are only used if fish numbers are higher than the two bags can safely handle since tanked fish are released via crane, and therefore require a crane operator on standby. Additionally, JDA has a trailer mounted fish tank. This tank is primarily used to transport high volumes of lamprey, making it easier to release lamprey well upstream of the dam (release site is approximately 2RM upstream), helping to reduce fallback (See Table 3).

2022 John Day Fish Salvage Report

Key; adult=a, juvenile=j, carp=cp, catfish=ct, sculpin=sp, small mouth bass=smb, crappie=cr, whitefish=wf, perch=pr, bluegill=bg, walleye=we, Sturgeon=st, shad-sh, Chinook-Ch, steelhead-STH, coho-co, sockeye-so, lamprey-la Released In Good Conditon=RIGC

Date	Event	CH	STH	SO	CO	LA	Shad	Other	Comments	Mort	PIT	Cause
1/27	JBS Upper/Lower	0	0	0	0	0	0	0	No fish in upper or lower section	0	0	N/A
2/3	SFL Upper/Lower	0	2a, 2j	0	0	0	0	0	(1-14") (2-~7")	0	0	N/A
3/4	MU4 Scrollcase	0	0	0	0	0	0	0	No fish	0	0	N/A
3/4	MU4 Draft tube	0	0	0	0	0	0	0	No fish	0	0	N/A
3/7	NFL Upper	0	2a,1j	0	0	0	0	0	(1-7") (1-10") (1-31") the 10" & 31" clipped. 7" unknown	0	0	N/A
3/8	NFL Lower	0	0	0	0	0	0	0	No fish	0	0	N/A
3/25	MU-12 Scrollcase	0	0	0	0	0	0	0	No fish	0	0	N/A
3/25	MU-12 Draft tube	0	0	0	0	0	0	13	1-st (~16") 12-ct (~14")	0	0	N/A
6/30	MU-3 Draft tube	0	0	0	0	0	0	0	4 st	0	0	N/A
7/22	MU-6 Scroll Case	0	0	0	0	0	0	0	No Fish	0	0	N/A
7/22	MU-6 Draft Tube	0	0	0	0	0	0	6	4-st (6', 4', 22", 14") 3-ct (~14")	0	0	N/A
7/27	MU-11 Scroll Case	0	0	0	0	0	0	0	No Fish	0	0	N/A
7/27	MU-11 Draft Tube	0	0	0	0	0	0	1	1x 4'-st	0	0	N/A
10/3	MU-13 Scroll Case	0	0	0	0	0	0	0	No Fish	0	0	N/A
10/3	MU-13 Draft Tube	0	0	0	0	0	0	5	4-st (~2'-4.5') and 1 ct (18")	0	0	N/A
12/1	NFL Upper	0	2j	0	0	10a	0	1	1 cp	0	0	N/A
12/7	SMF	2j	50a	0	0	70a, 20j	8a, 5j	61	7 cp, 2 st, 10 smb, 10 we, 2 sp, 30 ct	0	0	N/A
12/7	MU-8 Scroll Case	0	0	0	0	0	0	0	No Fish	0	0	N/A
12/8	MU-8 Draft Tube	0	0	0	0	0	0	1	1-st (29")	0	0	N/A
2022 Totals		2j	54a, 5j	0	0	80a, 20j	8a, 5j	88		0	0	N/A

Table 3: Results from fish salvage operations

FISH COUNTING

Fish counting (visual and/or video) occurred April 1st – October 31st during the 2022 adult fish passage season, and all fish count data was posted to the Fish Passage Center (FPC) website (fpc.org). Fish counts were conducted at both the north fish ladder (NFL) and south fish ladder (SFL). Fish counts were conducted, under contract, by Four Peaks Environmental Science & Data Solutions.

Fish Counting Schedule
April 1st – October 31st visual daily counts (0500 - 2100 PST)
June 15th – September 30th nighttime video counts (primarily for lamprey) (2000 - 0400 PST)

Improvements were made to the NFL entrance between 2010 and 2012 to help improve fish passage for salmonids and lamprey. In 2022 the total salmonid counts ranged from 30-46% at the NFL vs. 54-70% at the SFL (see figure 2) and the 13-year averages (see figure 3) at the NFL ranged from 25-60% vs. 40-75% for the SFL. Salmonids are consistently counted more at the SFL vs the NFL. Total sockeye counts (630,888) this season were the highest they have been in ten years and Chinook counts (403,695) were the highest they have been in six years. Coho counts (63,671) were significantly lower than last year but remained the second highest counts in eight years, and steelhead counts (90, 269) have been low the past several years, but this year was the highest return in six years. Lamprey, on the other hand, appear to prefer the NFL over the SFL, this was true again this season with the NFL receiving 70% of the lamprey counts. Lamprey counts (22,306) were the highest they have been in five years.

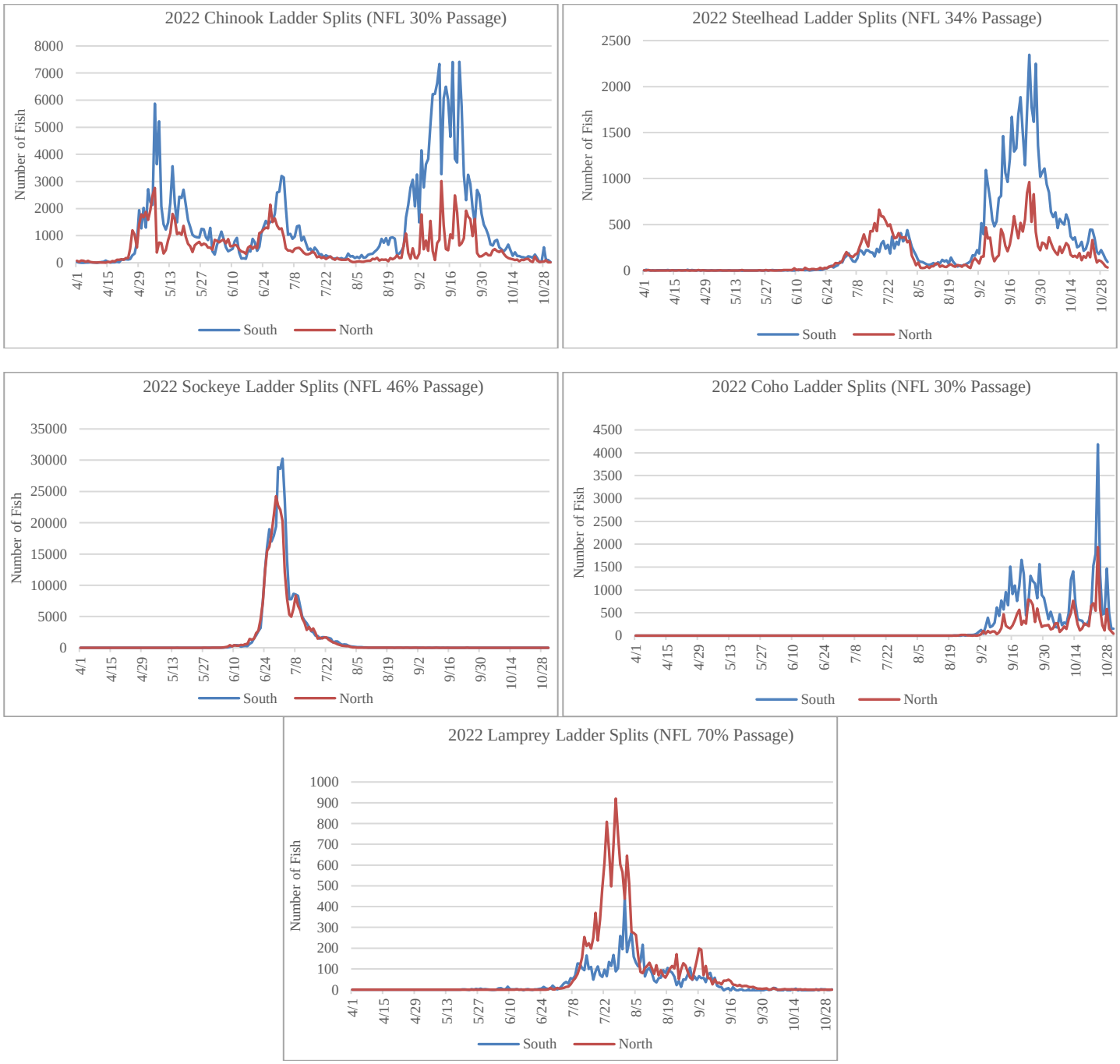


Figure 2: Ladder splits by species

Graphs comparing adult fish counts between fish ladders for 5-different fish species (Chinook, steelhead, sockeye, coho, and lamprey) during the 2022 adult fish count season. There was 1 pink salmon that passed JDA via the NFL on 10/31.

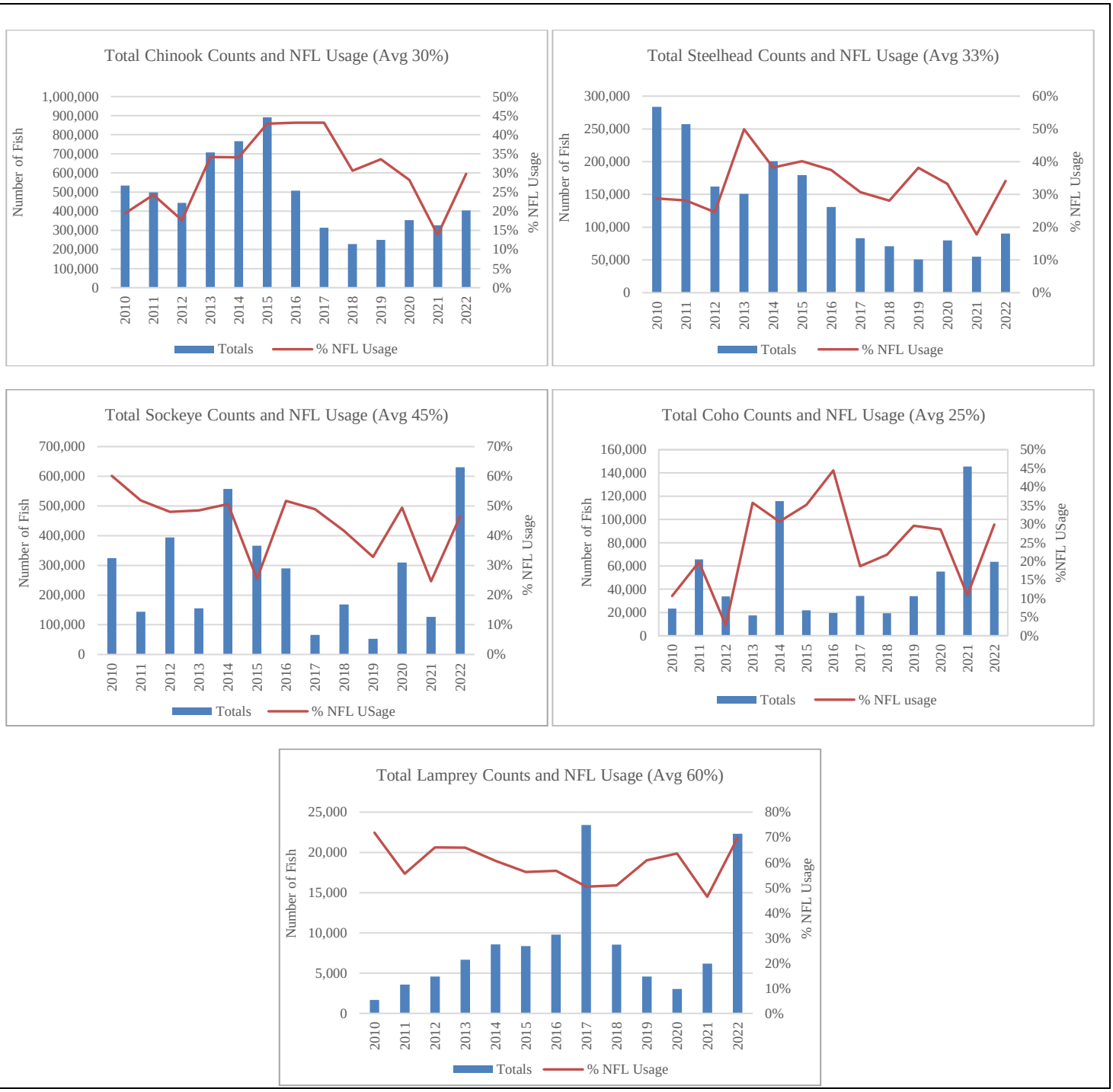


Figure 3: Total fish ladder counts (north and south combined) over a 13-year span (2010-2022) for 5-different fish species (Chinook, steelhead, sockeye, coho, and lamprey), and the percentage that use the north fish ladder.

LAMPREY COLLECTION

JDA collects lamprey from both fish ladders (north and south). The two systems collect fish differently, and collection efficiency varies. The north fish ladder (NFL) has a ramp system that utilizes pumped water to attract lamprey. When lamprey climb the ramp, they drop into a holding tank. This NFL system is primarily accessed by elevator (when operational).

The south fish ladder (SFL) utilizes a trap system. Lamprey navigate the ladder and enter the trap near the counting station. Once there, they swim under grating and are guided into a trap box. This box is lifted by a fixed jib crane for collection. An elevator is not required to access the SFL system.

North Fish Ladder Lamprey Passage System

The NFL lamprey passage system (LPS) is located at the NFL entrance. When lamprey enter the ladder, they navigate a bollard field. This field is used to break up velocity and makes ladder entrance easier. On the north side of the NFL entrance is a ramp fed by pumped water. Lamprey must climb this ramp to reach the holding tank. A rest box is located halfway up the ramp (the box can be flushed pneumatically as needed) to give lamprey a chance to recover during their journey. Once lamprey climb the ramp, they enter an upwelling box. This is where pumped water enters the system. The water percolates through porosity plating, and either down the ramp (for attraction) or into the holding tank (to circulate water in the holding tank). The lamprey travel through the upwelling box, however, porosity plating only allows access the upper portion of the box. Once lamprey navigate the upwelling box, they drop into the holding tank via irrigation piping, and this is where they are recovered by personnel (see figure 4).

Note The only methods to transport collected lamprey are by stairs, elevator, or winch. It is 100-foot climb to the intake deck (access area). It is difficult on personnel, and fish to transport them by stairs. The elevator is outdated and unreliable, so a winch system was created for backup. Access is the most limiting factor for this system.

Figure 4: Images of the NFL LPS

(*Note* the first picture is facing east, and the second picture is facing west): (A) bollard field (B) access ramp (C) resting box (D) ramp entering the upwelling box (E) upwelling box (F) holding tank (G) lamprey pumps (H)water supply line (I) pump location from the 2019 modification (J) pneumatic airlines to flush the rest box.

South Fish Ladder Lamprey Trapping System

The SFL lamprey trapping system (LTS) is located near the SFL count station, lamprey approach this area and enter the system below a grating structure on the deck. Once inside, they travel into a conduit which leads them up a small ramp, and into a trap box. This trap box can then be lifted, by a fixed jib crane, allowing personnel to collect the lamprey (see figure 5). This system generally operates flawlessly, however success is variable. One issue with this area is that lamprey tend to mill in the conduit/ramp area. The flows appear to be ideal in this area, and they may reside there for long periods of time (actual residing times unknown). Every year, during winter maintenance, several lamprey are observed exiting the conduit/ramp area.

Figure 5: Images of the SFL LTS

(A) entrance (B) diversion conduit (C) count station window/crowder (D) trap box guide (E) trap box (with access hatch removed) (F) lamprey entrance port (G) trap hoisting jib crane. *Note* when in operation picketed leads rest atop the LTS entrance (A), and upriver from the trap box guide (D). These picketed leads guide fish to the count station window (D).

Collected Lamprey Data

Adult lamprey collections were conducted from June 6th through September 7th during the 2022 passage season. The Columbia River Inter-Tribal Fish Commission (CRITFC) operated all traps and collected the lamprey. Collected lamprey were translocated in accordance with the Tribal Pacific Lamprey Restoration Plan (TPLRP). In addition to the NFL LPS and SFL LTS, CRITFC utilized three PVC tube traps near the NFL count station between the picketed leads. The PVC tube traps at the NFL are located between the picketed leads because lamprey can go under the picketed leads, this however, is not the case at the SFL. Since lamprey have the ability to go under the picketed leads at the NFL, total counts at the NFL may actually be higher. Lamprey collection efficiency varies annually, and 2022 was the second highest trapping season since 2012, and the SFL trap caught the most lamprey since its inception (see table 4).

Prior to the 2022 lamprey passage season, the grating at the SFL trap entrance was modified in an attempt to improve trapping efficiency. Previously, the grating to the entrance was oriented perpendicular to the flow of the ladder. During dewaterings high sediment volumes accumulated at the entrance. There were concerns that the sediment deterred lamprey from entering the system, so project personnel replaced the grating and oriented it parallel to the ladder flow (see figure 6). It is unknown whether altering the grating's orientation improved the trapping efficiency; however, the project will continue to monitor trapping efficiency. It should be noted that in addition to the 1,349 lamprey collected from the SFL trap in 2022, there were an additional 370 lamprey salvaged from the trap area during the 2023 winter dewatering.

Lamprey Collection Data (2016-2022)							
	2016	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**
Total SFL Counts	4229	11615	4200	1799	1109	3319	6750
Total NFL Counts	5540	11789	4342	2790	1932	2869	15556
SFL Trap	467	125	325	272	140	533	1349
NFL LPS	346	419	1873	3	162	42	624
NFL PVC Trap #1	-	-	-	33	70	152	70
NFL PVC Trap #2	-	-	-	0	60	3	2
NFL PVC Trap #3	-	-	-	183	2	23	18
NFL PVC Trap #4	-	-	-	-	-	13	-
Not Specified	205	227	-	-	-	-	-
Total Handled	**1018**	**771**	**2198**	**491**	**434**	**766**	**2063**

Table 4: Lamprey collection (2016-2022)

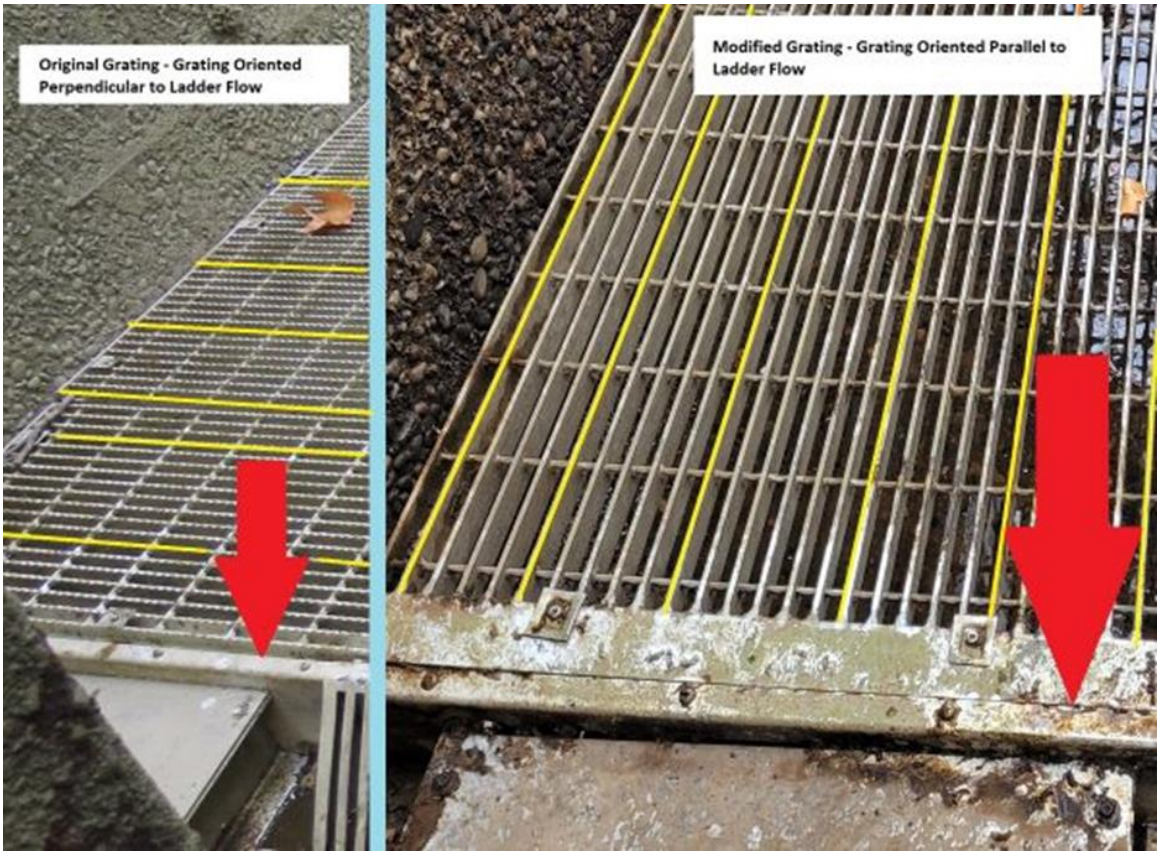


Figure 6: SFL LTS grating
The red arrow indicates the entrance to the lamprey trap, and the yellow line indicates the grating orientation.

NORTHERN PIKEMINNOW DAM ANGLING

The 2022 Northern Pikeminnow (NPM) angling season took place May 19th through September 30th. Angling occurred at the tailrace (powerhouse section) and was performed by a Washington Department of Fish and Wildlife (WDFW) crew.
Since 2016 the NPM catch per effort-hour (NPM/H) has decreased annually (see table 5). In 2022 the average was 0.9 NPM/H, a decrease of 76% from 2016 (3.8 NPM/H). In 2022 the gas cap increased to 125 % saturation, and this may have affected catch rates. No gut analyses were taken during the 2022 NPMP angling season by ODFW.

Northern Pikeminnow Catches at JDA (2016 -2022)			
	Total NPM	**Effort (Hours)**	**NPM/Hour**
2016	3,002	787.25	3.8
2017	3,472	1042.5	3.3
2018	3,089	1199.25	2.6
2019	1,894	760.5	2.5
2020	1,782	743.75	2.4
2021	1,269	785.25	1.6
2022	522	556.5	0.9
Average	**2147**	**839.29**	**2.5**

Table 5: Northern Pikeminnow catches (2016-2022)

Bycatch Data

Dam anglers often collect bycatch while targeting northern pikeminnows (smallmouth bass, walleye, American shad, white sturgeon, channel catfish, suckers, etc.). Some of these fish are piscivorous and target juvenile salmonids. However, they are not included in the NPMP and must be released back into the river. The two most common piscivorous fish released back into the river are smallmouth bass and walleye (see figures 7 and 8). The 10-year average for walleye was 597.2/year and the 10-year catch per hour average (CPUE) was 0.63. The 10-year average for smallmouth bass was 243.7/year and the 10-year CPUE average was 0.26.

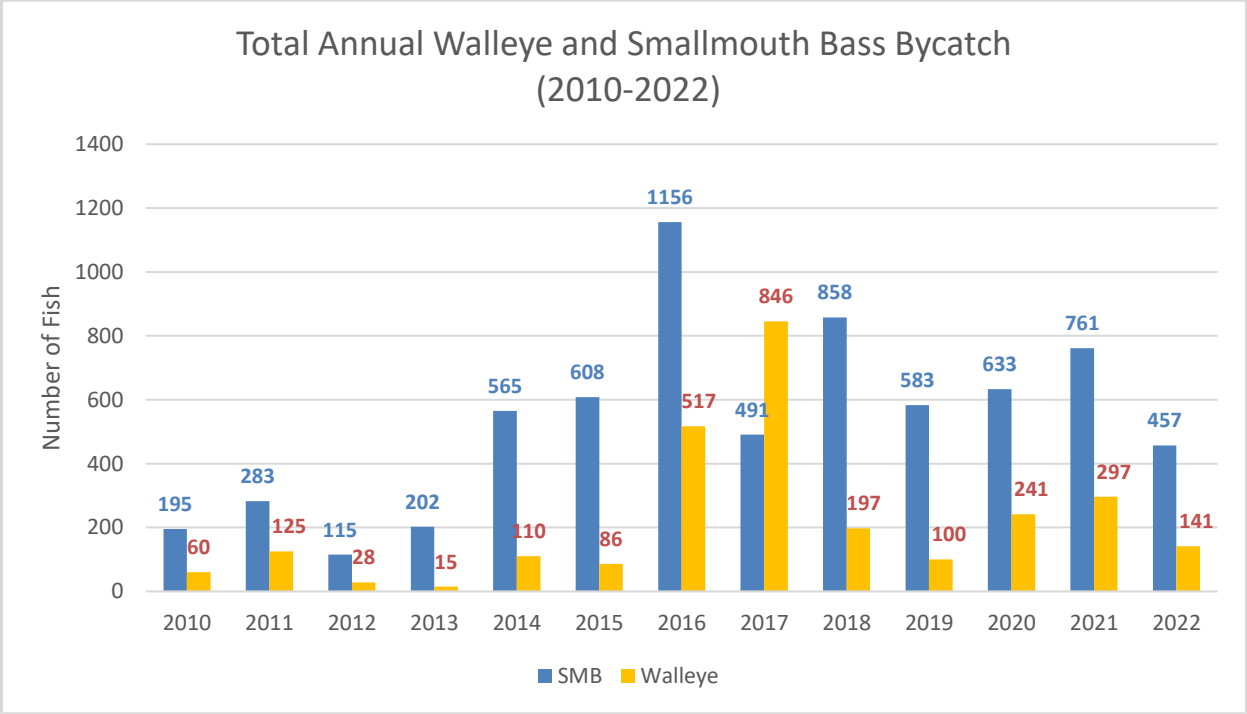


Figure 7: Total annual Walleye and Smallmouth Bass bycatch

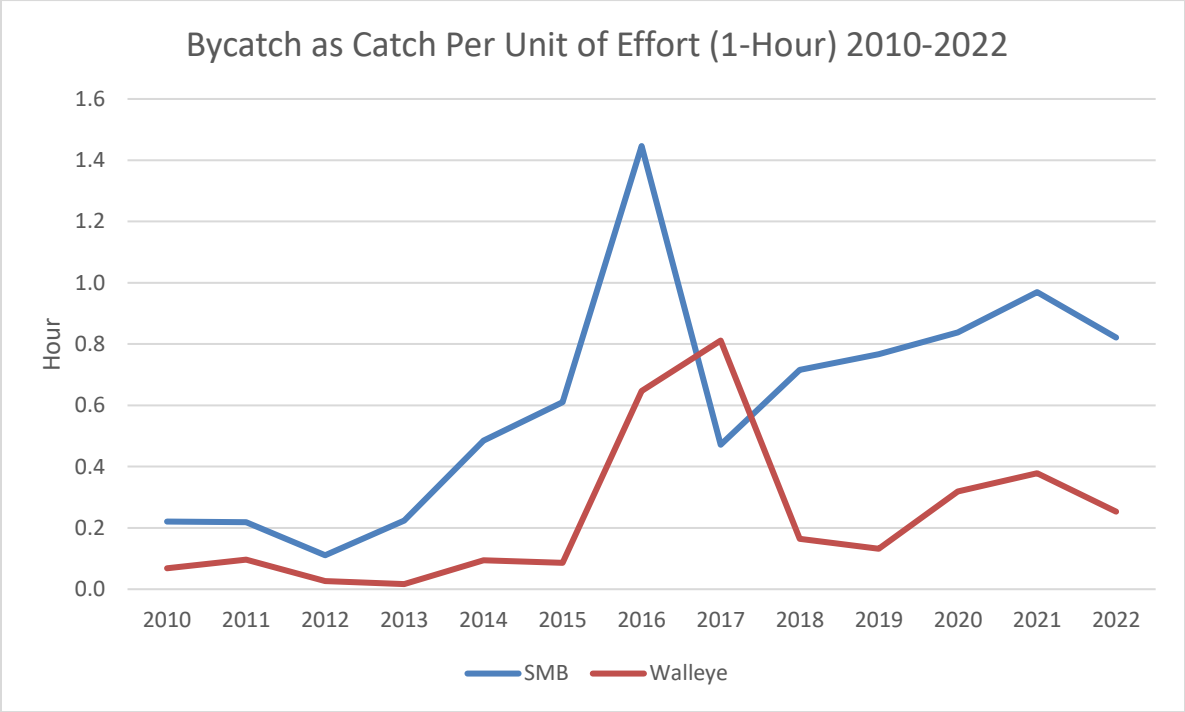


Figure 8: Bycatch as catch per unit effort

AVIAN PREDATOR ABATEMENT

Bypassing smolts through spill and TSWs has been a critical part of fish passage operations since 2006. Unfortunately, piscivorous bird predation on smolts in the tailrace's Boat Restricted Zone (BRZ) has increased during this time. In response, a comprehensive grid of 125 avian lines was installed above the tailrace BRZ in 2010 (see figure 9). The avian lines wore out quicker than expected, and before replacement (in April 2018) 29-lines were missing (23% of the grid). The grid was upgraded from Plasma lines to Vectran™ lines to reduce breakage, and the improved grid has held up well. One avian line (#68 in the spillway) rubbed on a tree branch and snapped in 2020, JDF continues to monitor trees in the area and have them trimmed back as needed. Seven lines were knocked down by contractors conducting the line repair last season, and the contractor replaced the broken lines (#92 and #98-103 in the powerhouse section) on March 29, 2022. Several lines broke this season (#80-85, #87, #90, #96 in the powerhouse section and #59 in the navlock section) and the lines will be repaired in the future; the repair date is to be determined and is currently going through the contracting phase.

In addition to avian lines, supplemental boat hazing (for gulls and cormorants only) by the U.S. Department of Agriculture (USDA) has occurred annually since 2010 (April 16th – July 31st). Hazing occurred 8 hours per day, 7 days a week, with the start and end times of shifts varying to help keep birds from becoming habituated. The hazing is boat based using various pyrotechnics (15mm banger and screamer variants and 15mm extended range rockets). The 125 avian line grid, combined with USDA boat hazing, has helped to reduce gull predation, however gulls have started to habituate to these deterrents and other methods may be warranted.

This was the second year of a three-year Blalock operation to raise the John Day pool to flood low-lying islands in the Blalock Island complex to deter Caspian Terns from nesting there. The operation kept the forebay elevations between 264.5-266.5ft from April 10th – June 1st to flood potential nesting habitat for the birds. The operation was successful, and there were no nesting terns this year or last year on the islands.

This was the first year that Yakama nation conducted gull hazing at Miller Rocks using a combination of falconry and pyrotechnics and they plan to continue their hazing efforts next season as well.

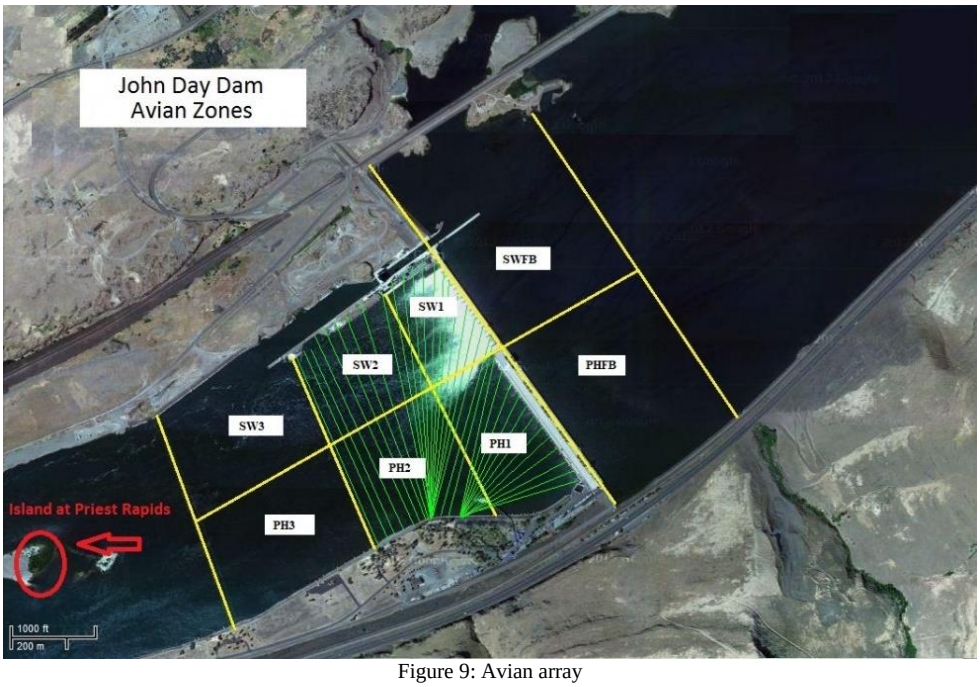


Figure 9: Avian array

An overview of the avian line grid at the JDA tailrace BRZ [powerhouse forebay=PHFB, spillway forebay=SWFB, spillway tailrace zones 1-3 (SWT1-SWT3), powerhouse tailrace zones 1-3 (PHT1-PHT3)]. Red circle indicates Preacher's Island where American white pelicans' loaf between feedings.

AVIAN PREDATION

Bird counts are conducted year-round with two counts daily March 1 – November 30, and 1 count per day December 1 – February 28. Birds are counted from end of the tailrace deck, the southwest corner of the navlock, and the intake deck, depending on which zones are being counted and the best location for visibility that day. Time of day for the counts varies day to day, with one in the morning and one in the afternoon when two counts are conducted per day, and as time allows when counting once a day in the winter. Counts are conducted using Vulture HD 15x56 binoculars or the naked eye depending on the location.

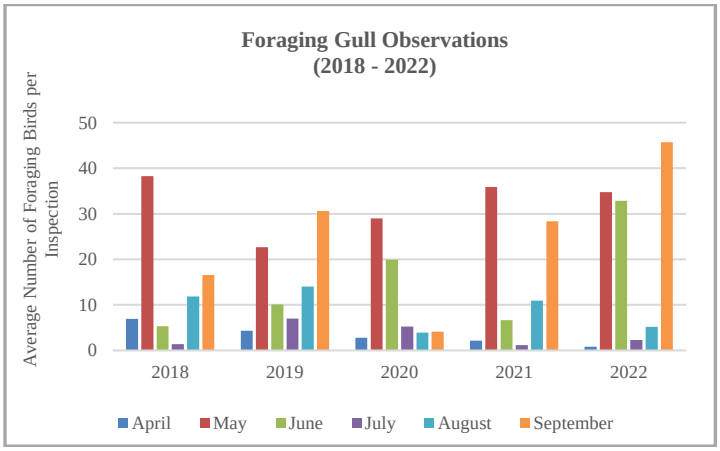
The three main piscivorous birds observed at JDA are gulls (predominantly California and Ring-Billed), American White Pelicans (AWPE) and Double-Crested Cormorants (DCCO), with gulls being the main focus as they are the largest known piscivorous threat to listed fish at JDA. Western Grebes are also present in the PHFB section for most of the smolt outmigration and counts are reported in the weekly report. Caspian Terns are infrequently seen at JDA, and JDF crew rarely see them during their bird counts. USDA hazing crew, having more opportunity for sightings, did see foraging Caspian Terns (max of 7 at a time) over a two-week period June 12th -26th. Other piscivorous birds encountered in small numbers on the project include Bald Eagles (during the winter months), Osprey (mainly April-September), Common Merganser (in the fall) and Great Blue Heron (year-round).

In 2022, gulls started to arrive in the tailrace to forage in late April when outmigrating smolts numbers started to pick up. There were high numbers of foraging gulls in May and June during the height of the outmigration. Gull numbers then decreased in July as juvenile abundance waned and/or the influx of AWPE. Gull numbers then increased in the late summer and fall, coinciding with the end of the hazing season and dispersal of AWPE to feed on the abundance of juvenile shad at that time. Large numbers were seen resting on the wingwall and on the water in SWFB and PHFB throughout the fall and into early winter (see figure 10).

Pelican sightings have increased significantly since 2012 and avian lines do not deter them. Additionally, USDA is not permitted to haze pelicans due to their protected status. Pelicans start arriving in small numbers as early as March, however the biggest influx is June – August which corresponds to the adult shad upstream migration (see figure 11). Most pelicans leave the area in late summer/early fall; however, this was the fourth-year pelicans have overwintered in the area. A couple are seen around the project occasionally and opportunistic sightings occur at the mouth of the Deschutes River when the JDF crew are traveling to and from the project. Despite an influx of pelicans at JDA, predatory impacts on listed fish are not fully known.

Cormorants are present for most of the year except May-July when hazing occurs, and they leave the area during that time. One theory is that they move down to The Dalles Dam to find mates and reproduce during this time. The Dalles sees an increase in cormorants that time of year and have nesting sites on towers at their project. They start to return to the project in August and remain for the rest of the year with small numbers foraging in the tailrace, but mainly seen exhibiting non foraging behavior on the riprap in zone SW2 or roosting on towers in PHFB (see figure 12).

Grebe abundance was mostly confined to zone PHFB and was therefore unaffected by USDA boat hazing. Grebes were seen foraging mainly during the spring and early summer (see figure 13) in zone PHFB. Over the late summer and fall grebe numbers decreased, and they were completely dispersed by winter. Figure 14 shows the breakdown of where all the foraging activity occurs by species and zone.



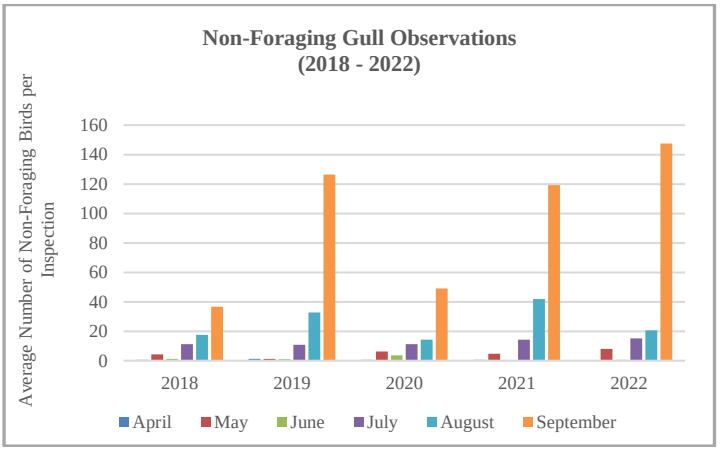
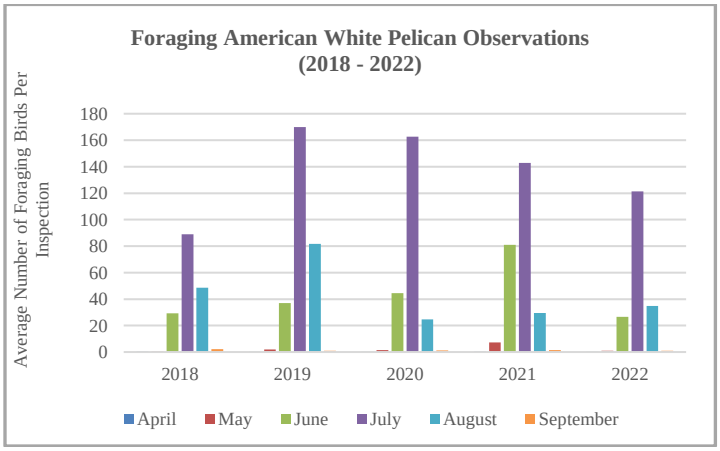


Figure 10: Monthly gull observations
shown as average number of birds per inspection (2-inspections daily) over a five-year period (2018-2022). The left graph represents actively foraging gull observations, and the right chart represents non-foraging gull observations. Gulls are present year-round, however April – September correlates with smolt outmigration at JDA.



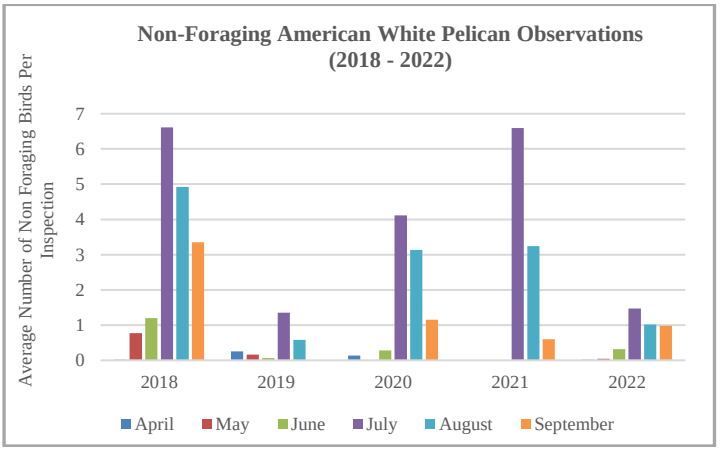


Figure 11: Monthly American White Pelican observations
shown as average number of birds per inspection (2-inspections daily) over a five-year period (2018-2022). The left graph represents actively foraging AWPE observations, and the right chart represents non-foraging AWPE observations. Pelicans linger in small numbers beyond September (fewer than 10) however, April – September correlates with smolt outmigration at JDA.

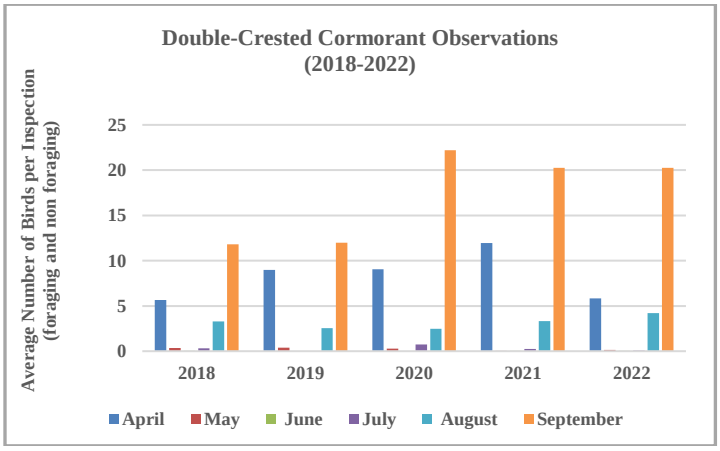


Figure 12: Monthly Double-Crested Cormorant observations
shown as average number of birds per inspection (2-inspections daily) over a five-year period (2018-2022).

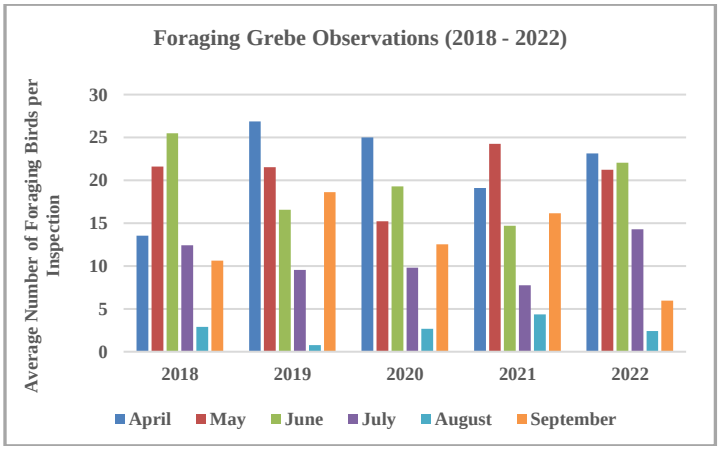


Figure 13: Monthly grebe observations
shown as average number of birds per inspection (2-inspections daily) over a five-year period (2018-2022).

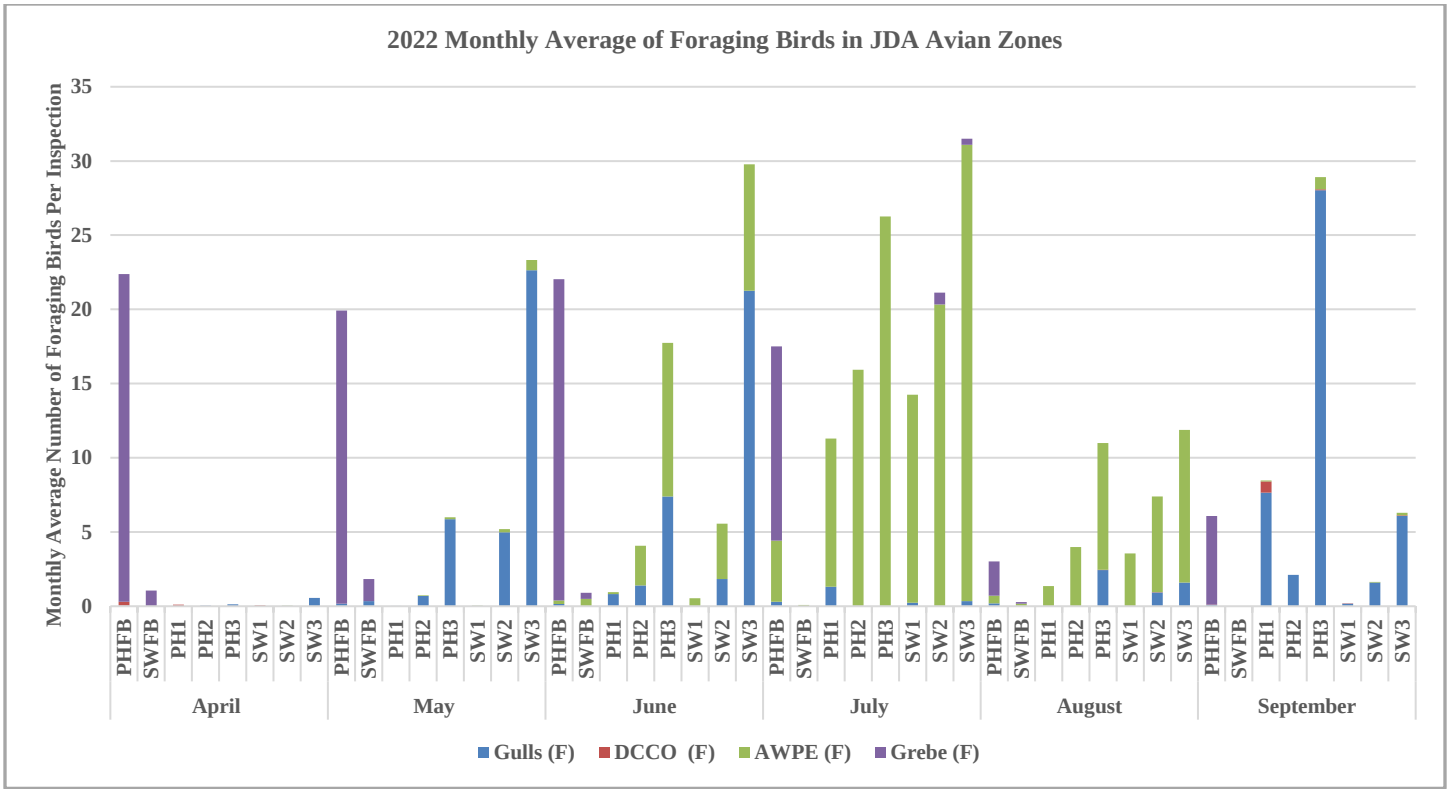


Figure 14: 2022 Monthly average of foraging birds broken down into avian zones

PIT Tag Detections from Preacher's Island

Preacher's island is a dredged material island located approximately 1 mile downstream of John Day Dam. It is a known loafing spot for American white pelicans (AWPE) and other piscivorous birds such as gulls and double-crested cormorants, however AWPE and gulls are the main avian predators on the island during the smolt outmigration. To help better understand predation rates on smolts, John Day Fisheries (JDF) personnel coordinate yearly passive integrated transponder (PIT) tag scans on the island. In total, 1,803 PIT tags have been recovered on Preacher's Island over the course of 4 years (2019-2022). With a high number of recovered PIT tags, JDF submitted a request to the Columbia Basin PIT Tag Information System (PTAGIS) for the island to become a mark, recovery, recapture (MRR) site. The request was approved, and Preacher's Island (JDPI) was implemented as a MRR site in December 2021. All recovered PIT tags have been uploaded and recorded into PTAGIS.

The fourth annual island scan was conducted on October 18, 2022, using Biomark HPR Plus readers. The JDF crew scanned the whole island focusing on areas where birds are known to congregate and recovered 949 unique PIT tags (see figure 15). This year JDF discovered evidence of a Blue Heron colony in the trees, with approximately 14 old nests. There were numerous PIT tag detections directly under these nests (see the clump of yellow dots on figure 15). This was an area that had not been previously scanned due to the thick vegetation and time constraints. JDF will be scanning this area in the future and attempt to monitor the heron colony.

The species breakdown of the 949 unique PIT tags recovered this year are as follows: Steelhead - 621, Chinook - 247, Coho - 29, Sockeye - 14, unknown - 22, Smallmouth Bass - 10, and other - 6. The predominate species of all the PIT tags that have been recovered on JDPI is Steelhead (50%) followed by Chinook (41%) (see figure 16). Figure 17 shows the migration year from all the recovered PIT tags ranging from 1998-2022, with 2021 being the year with the most PIT tags recovered (159-tags).

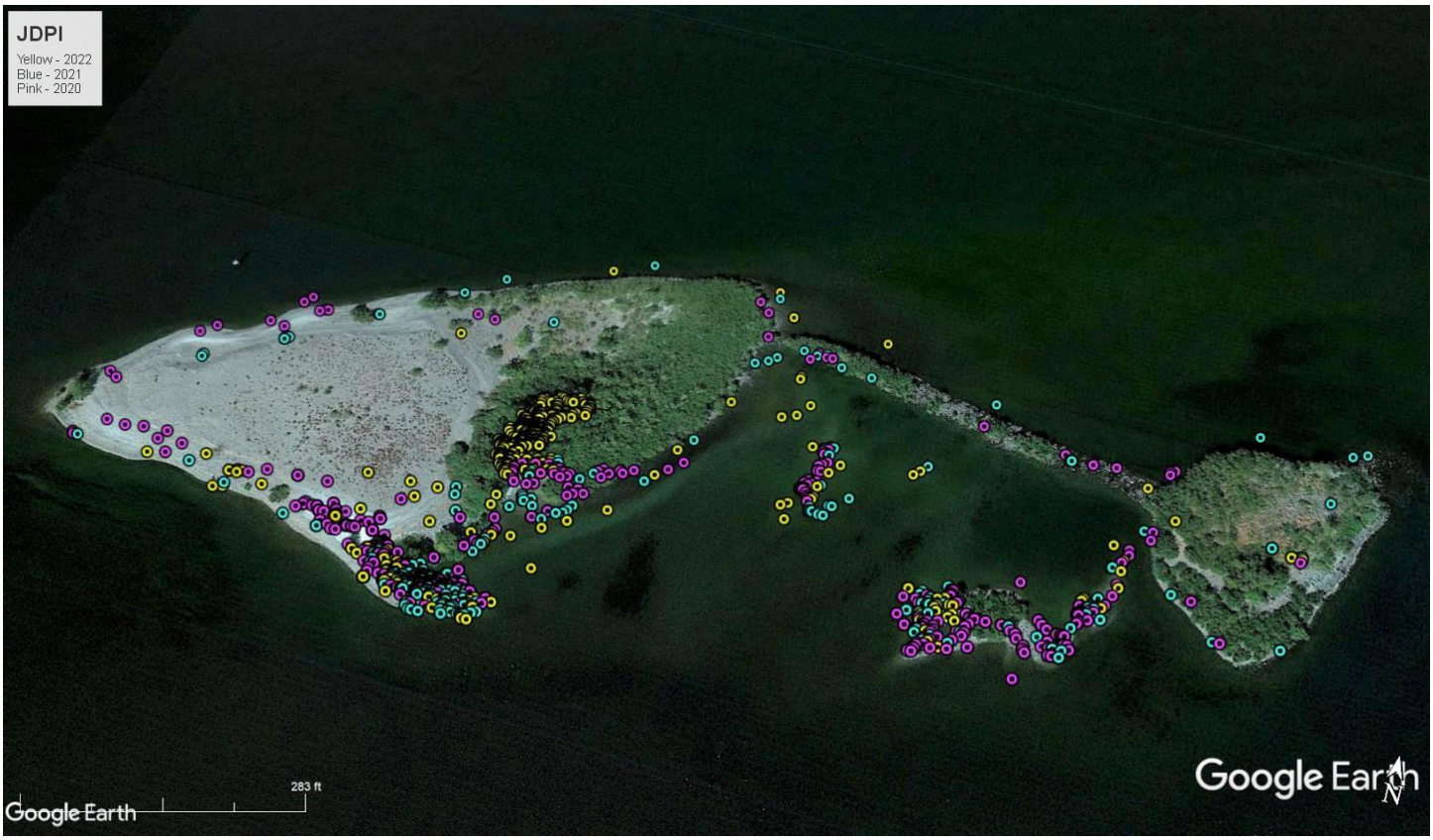


Figure 15: Preacher's Island with recovered PIT tag coordinate locations
Yellow – 2022 locations, Blue - 2021 locations, and Pink - 2020 locations.

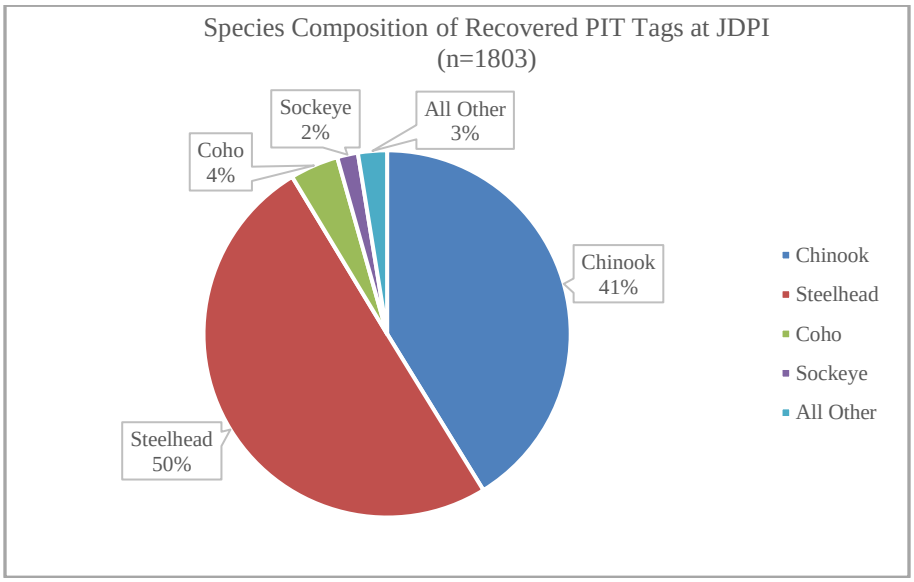


Figure 16: Species composition of all recovered PIT tags from Preacher's Island from all survey years (n=1803). "All Other" category consists of unknown (24), smallmouth bass (13), other (6) American shad (1), pacific lamprey (1), and white sturgeon (1).

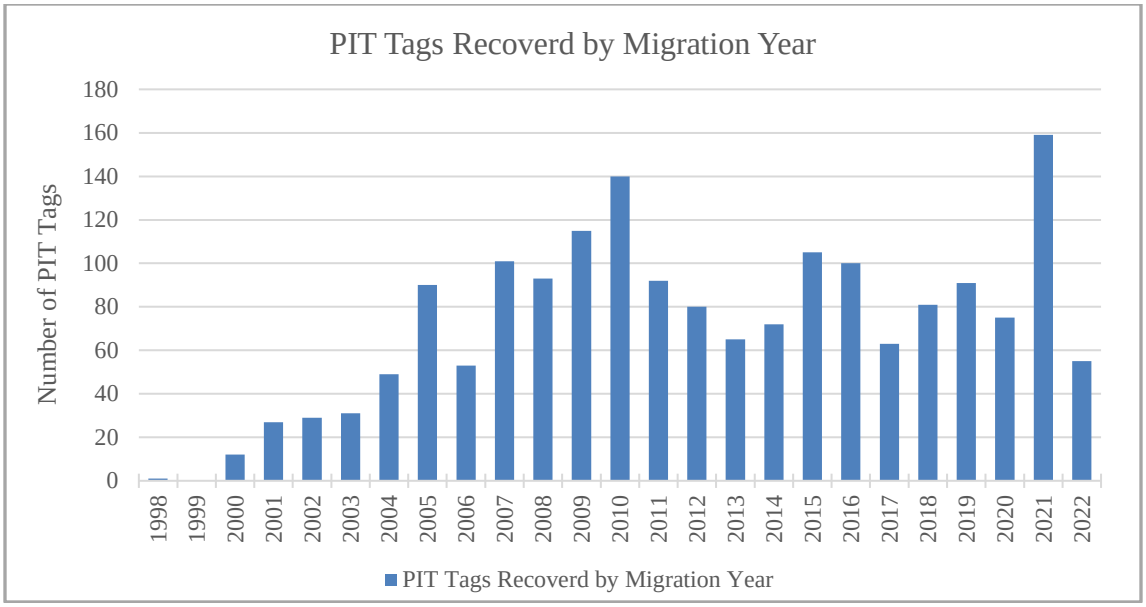


Figure 17: PIT tags recovered by migration year
Total number of PIT tags is 1803.

WATER QUALITY

Forebay Water Temperatures

The JDA forebay water temperatures were obtained from a United States Geological Survey (USGS) temperature sensor (see figure 18). This sensor is located at the upstream end of the navigation lock guide-wall. The USGS forebay temperature probe was deployed from March 29th – September 14th in 2022. The 2022 forebay water temperature was typically lower than the 10-year average until mid-August. Around mid-August temperatures exceeded the 10-year average until the probe was removed.

When JDA forebay water temperatures reach 70°F, JDF switches into 70°F juvenile sampling mode. During this time, condition samples are only taken Mondays and Thursdays, from 7AM – 1PM, this helps reduce stress on outmigrating smolts.

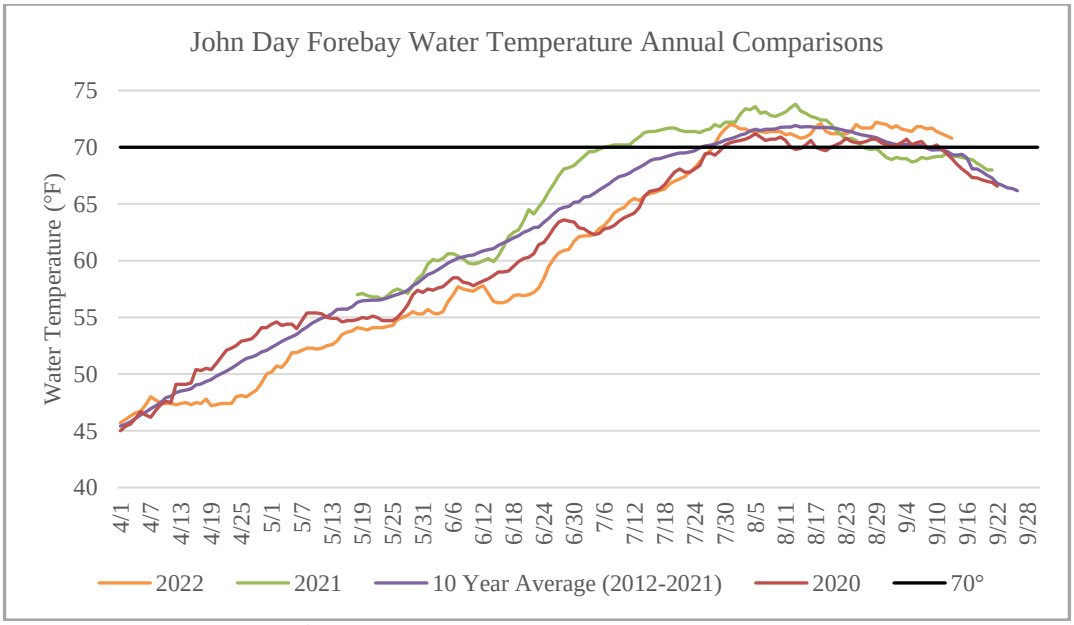


Figure 18: Average daily forebay temperatures (2020-2022) compared to the 10-year average (2012-2021)
The black line represents the 70-degree threshold for juvenile sampling.

In 2022, JDA fisheries installed a forebay temperature string near the SFL exit following the guidelines and location (SS-2) set forth in Lundell et al 2019 (see Appendix C). Onset Hobo temperature probes (model: U22-001) were used at depth intervals of 5, 10, 20, 30, 40, 50, 60, 70, 80, 90, and 100-feet and temperatures were taken hourly from May 6th, 2022 – October 13th, 2022 (See figure 19). The intent was to locate cooling water for the SFL exit. Forebay temperatures reached 70°F from July 24th – September 17th, 2022 (see figure 20). All probes were tested against each other for accuracy by submerging them in a bucket of water for 1-week. The average temperature reading was calculated for each probe, and all probes tested within 0.2°F of each other. This was well within the factory accuracy standards of 0.38°F.

At the time this report is being submitted, there is a draft memorandum that goes into much greater depth discussing the temperature string data as it relates to water cooling efficiency for the SFL (see appendix C).

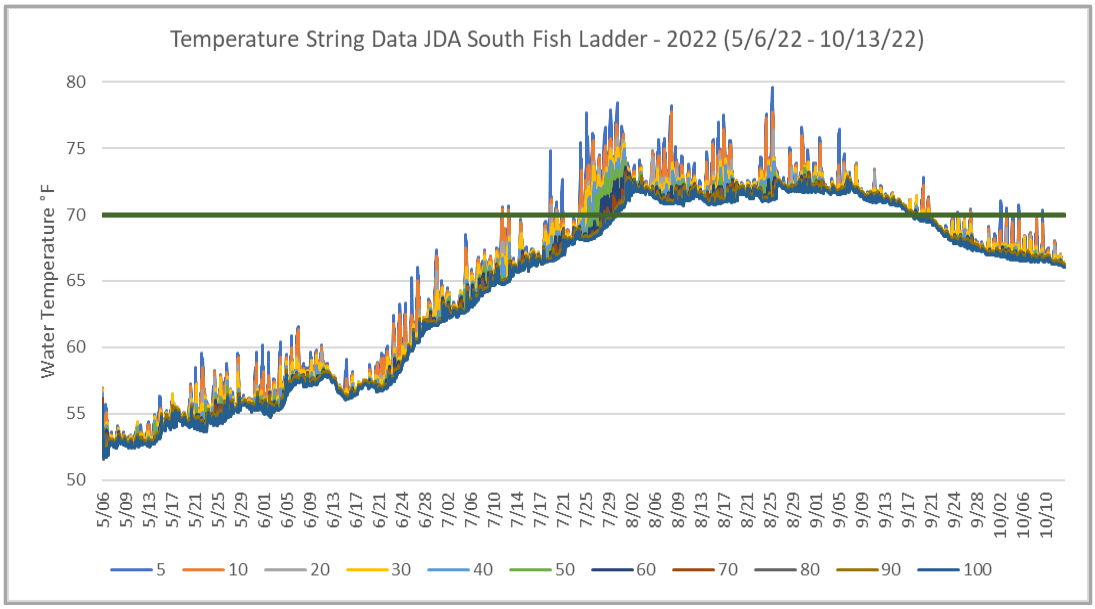


Figure 19: 2022 Forebay temperature string
Temperatures were measured at 5, 10, 20, 30, 40, 50, 60, 70, 80, 90, and 100-feet.
The solid line is to illustrate 70°F water temperature.

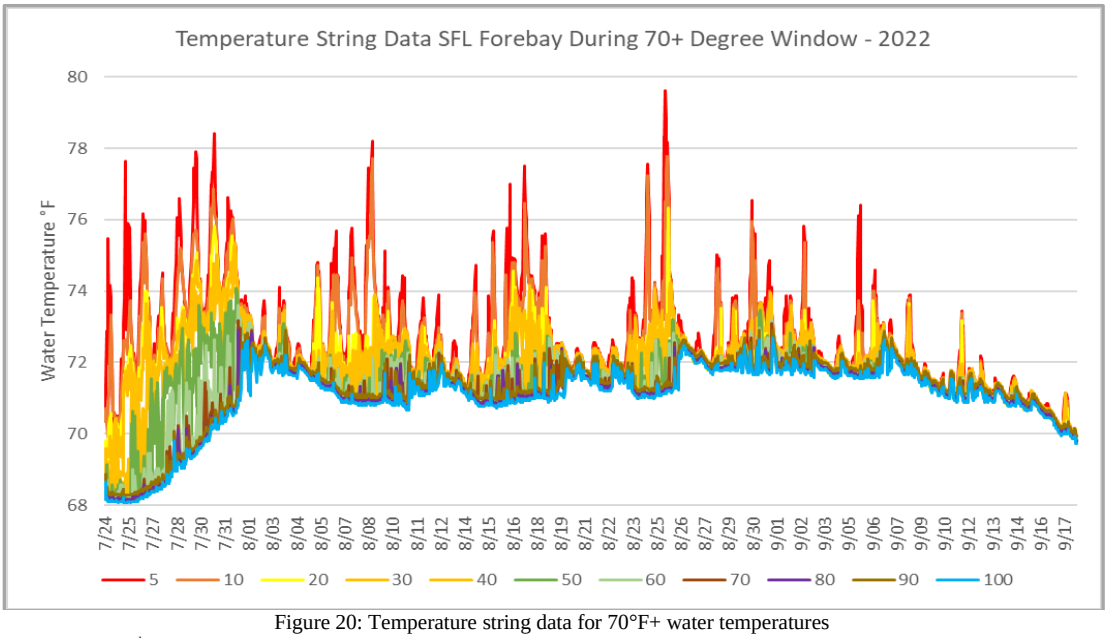


Figure 20: Temperature string data for 70°F+ water temperatures
(July 24th – September 17th, 2022) in the JDA SFL forebay. The data point numbers (5, 10, 20, 30, 40, 50, 60, 70, 80, 90, 100) equal the depth in feet.

Fish Ladder Water Temperatures

John Day fisheries personnel (JDF) record ladder temperatures at the entrance and exit of both fish ladders (north and south). The exit temperatures are recorded upstream of the diffusers, and just downstream of the control sections (modulating weirs). These temperatures are measured using Hobo® (P/N: U22-001) temperature loggers (see figure 21). The temperatures are offloaded weekly (or as time permits) and sent to FPC. These temperatures are also graphed and displayed in the weekly status reports (see figure 22). Similar to forebay water temperatures, the ladder temperatures were below the 10-year average until August. However, by September they were above the 10-year average.

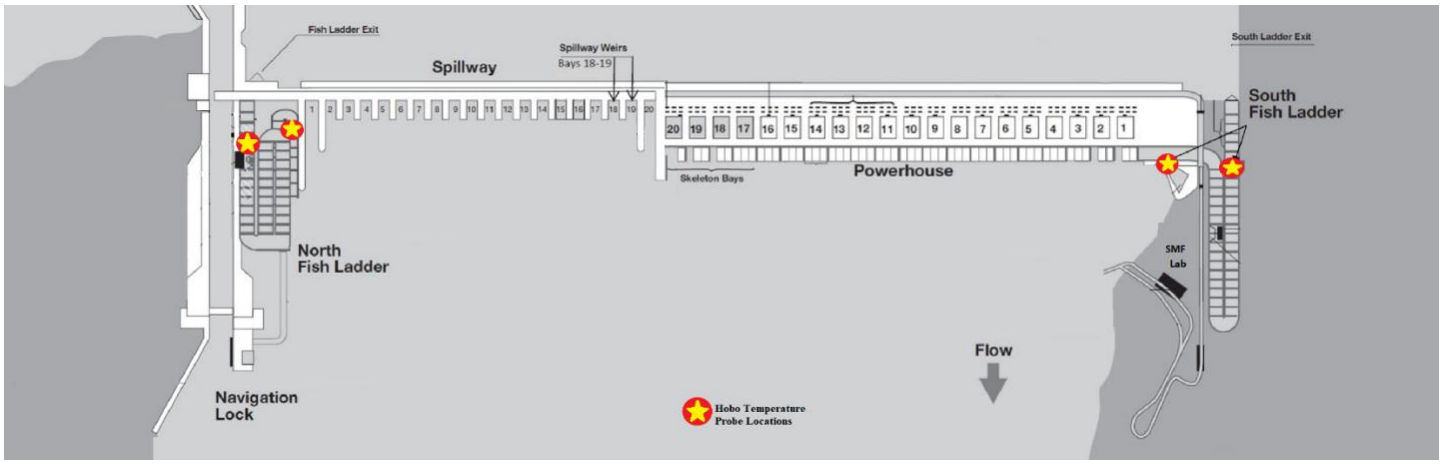


Figure 21: Fish ladder water temperature probe locations

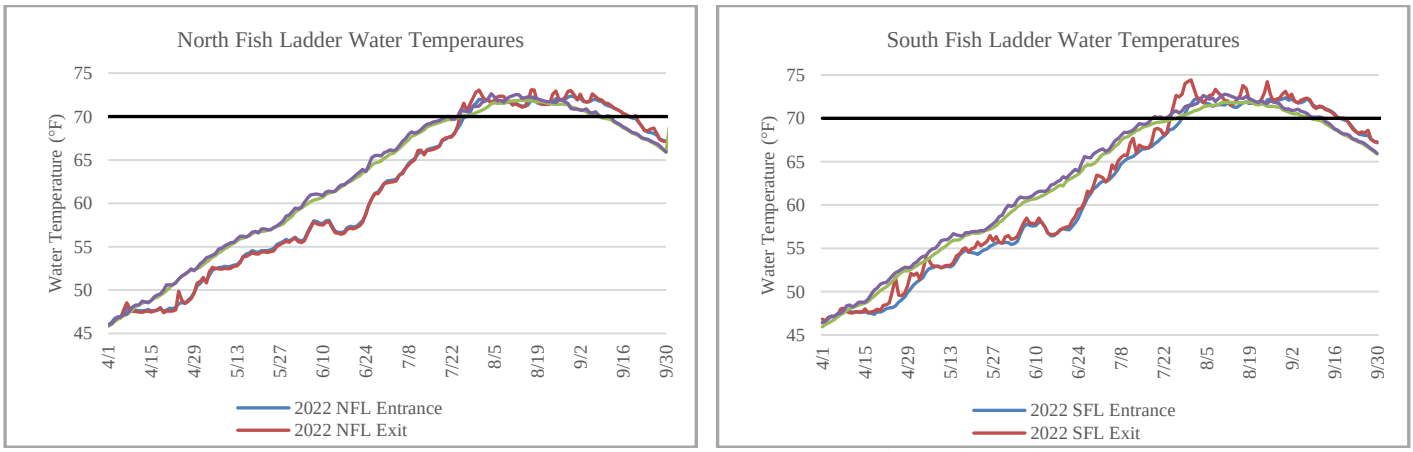


Figure 22: Average daily water temperature and 10-year averages (2012-2021) for both entrance and exit and each ladder

Water Clarity

A Secchi disk was used to measure water clarity at the NFL (just upstream from the count station) (see figure 23). Daily measurements are taken at the NFL (SFL when NFL is down for winter maintenance) for many reasons including ease of access, river conditions, and convenience. Unfortunately, due to water depth, the maximum obtainable measurement is 6-feet. The clarity is typically maxed out at 6-feet except during the spring freshet when sediment washes out from upstream tributaries. Daily and average-weekly clarity readings are reported in the weekly status reports.

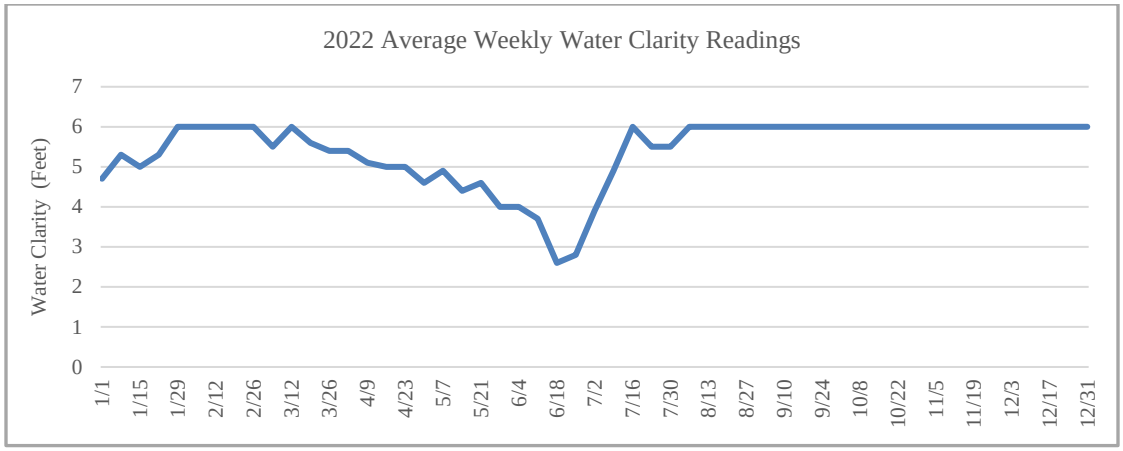


Figure 23: Average weekly water clarity readings

River Flow

Total dissolved gas (TDG) data was obtained from USGS gauges located in the forebay and tailrace (see figure 24). Tailwater TDG was mostly above the 10-year average except for the beginning of April and May. It peaked on June 11th and 12th at 127% saturation, exceeding the gas cap set for the year. Tailwater TDG exceeded the gas cap a total of 12 times this year. Spill and flow data were obtained from the FPC website (see figures 25-26 respectively).

Total river flows were similar to the ten-year average, until mid-March when they dropped below the ten-year average. They stayed below that average until June. The month of June was marked by above average river flows. Flows peaked on June 13th at 446.8 kilo cubic feet per second (kcfs). This was about 60% higher than the 2021 peak river flow (302.7 kcfs).

Spill for juvenile fish passage started April 10th and ended on August 31st. Adult attraction spill for the NFL continued with spill bay 2 open one stop (1.6 kcfs) through November 30th. Spill (kcfs) was mostly higher than the 10-year average (increased gas cap to 125% saturation) and peaked on June 12th at 217.3 kcfs. The highest spill (shown as percent of river flow) peaked on May 7th at 70.5%. Table 6 shows the monthly averages of flow and spill during the spill season.

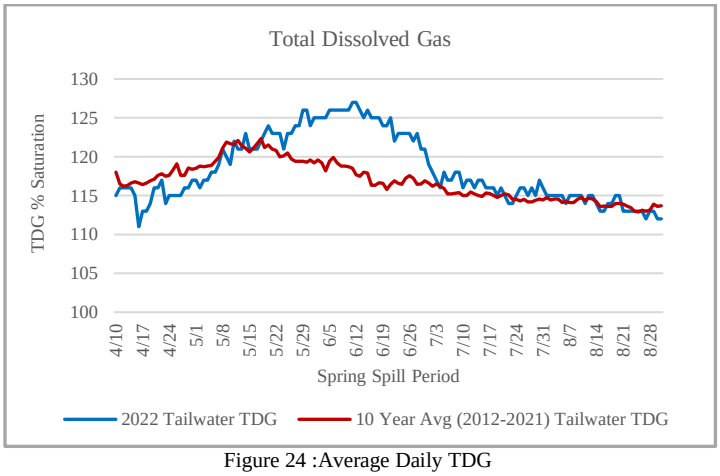


Figure 24 :Average Daily TDG

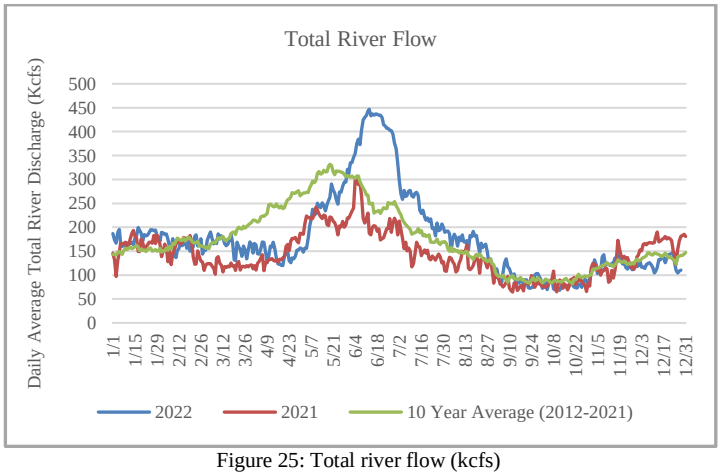


Figure 25: Total river flow (kcfs)

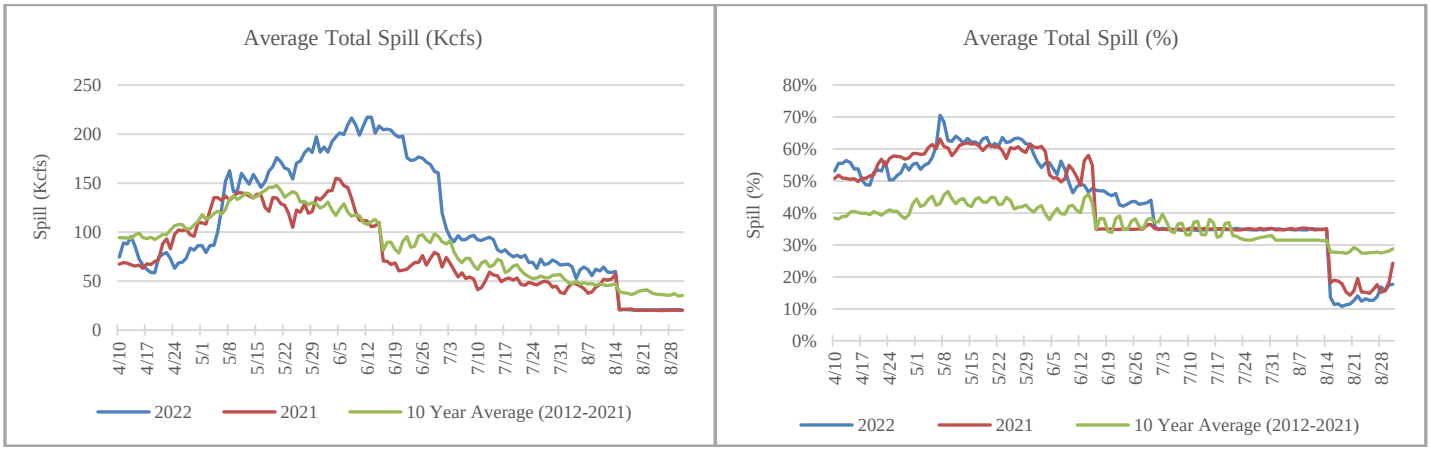


Figure 26: Average daily total spill (kcfs) left and average daily total spill (%) right

2022 Monthly Averages

Month	Total Flow (kcfs)	Powerhouse (kcfs)	Spill (kcfs)	Spill (%)
April	145.02	91.23	52.65	37.16%
May	243.15	91.57	150.40	61.53%
June	404.67	210.41	193.05	47.90%
July	239.26	154.74	83.35	34.83%
August	165.92	125.62	39.07	23.10%
September	95.85	93.30	1.37	1.33%

Table 6: 2022 Monthly total flow averages

South Fish Ladder Collection Channel Velocities

JDF monitors water velocities from the SFL collection channel. Historically velocities were calculated by recording the travel time of floats down the length of the collection channel. The times were recorded at every 2nd monolith, and this revealed velocities along the entire channel. In 2020 JDF began using a General Oceanics (model: 2030) velocity meter to obtain more accurate readings, (see figure 27) and continued using this velocity meter for 2022. Velocities are measured at 2-different locations, for at least 5-minutes, along the collection channel (Bays 4 & 12) (see figure 28). There were no time guidelines included with the meter, the times were established onsite.

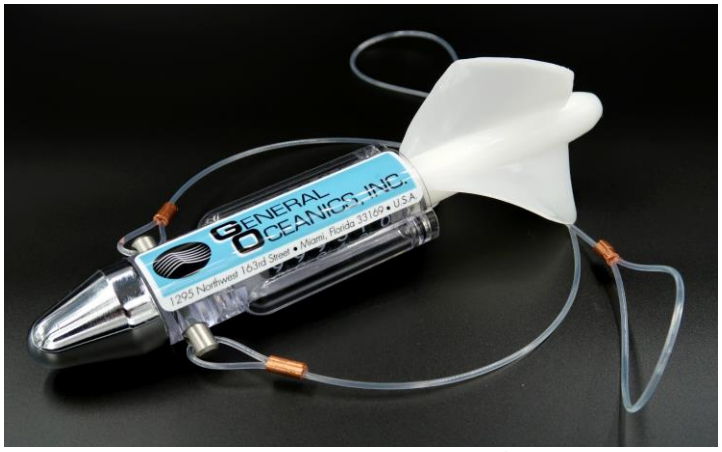


Figure 27: General Oceanics (model:2030) flow meter

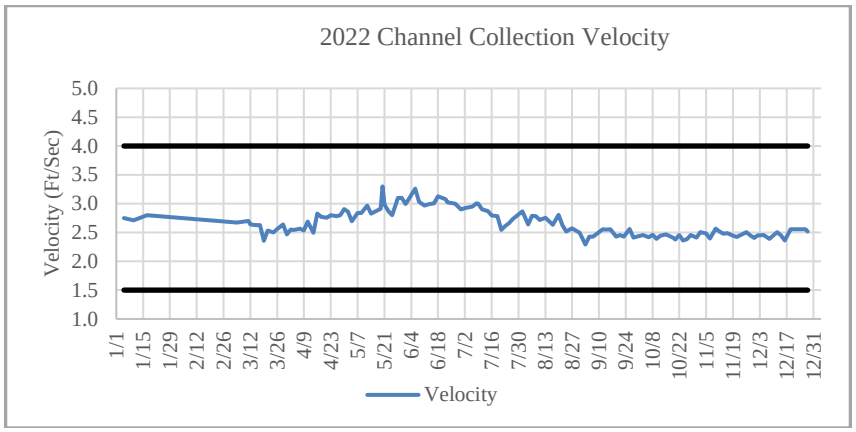


Figure 28: SFL collection channel velocities
Dark black lines represent the FPP criteria range of 1.5 - 4.0 feet per second (Ft/Sec)

ACKNOWLEDGEMENTS

Kudos to all John Day Maintenance, Operations, Electrical, Natural Resources, Administration and Fisheries personnel for their dedication and hard work on improving fish passage at John Day Dam during this difficult year. A special thank you goes to Michael Lotspeich and Laura Ricketts for putting this report together.

RESEARCH

Columbia River Inter-Tribal Fish Commission (CRITFC): Collected adult Pacific lamprey for the Tribal Pacific Lamprey Restoration Plan (TPLRP) and collected genetic samples on outmigrating juvenile lamprey.

Four Peaks Environmental Science & Data Solutions: Conducted fish ladder counts for the USACE Adult Fish Counting Program.

Oregon Department of Fish and Wildlife: Performed the monthly Fish Passage Operations and Maintenance (FPOM) directed inspections of all JDA adult and juvenile fishways (see the FPC's annual report.).

Pacific States Marine Fish Commission (PSMFC): Sampled juvenile salmonids, lamprey, and bycatch at the JDA SMF April 1st through September 15th. Additionally, PSMFC collected PIT tag readings from both fish ladders and the full-flow PIT tag detector.

United States Department of Agriculture (USDA): Performed piscivorous avian hazing below the JDA tailrace.

United States Geological Survey (USGS): Monitored total dissolved gas (TDG). Additionally, monitored forebay and tailrace water temperatures.

Washington Department of Fisheries and Wildlife (WDFW): Performed northern pikeminnow dam angling from the JDA tailrace.

REFERENCES

Lundell et al. 2019. Lower Columbia River dam forebays temperature depth profile study for 2019. U.S. Army Corps of Engineers, Portland District.

ACRONYMS

AWPE: American White Pelican
AWS: Auxiliary Water Supply
FPP: Fish Passage Plan
JBS: Juvenile Bypass System
JDA: John Day Project
JDF: John Day Fisheries
LPS: Lamprey Passage System
LTS: Lamprey Trapping System
NFL: North Fish Ladder
OOC: Out of Criteria
SMF: Smolt Monitoring Facility
SCADA: Supervisory Control and Data Acquisition
SFL: South Fish Ladder
DCCO: Double-Crested Cormorant
BRZ: Boat Restricted Zone
TDG: Total Dissolved Gas
KCFS: Kilo Cubic Feet per Second
NPM: Northern Pikeminnow
PIT: Passive Integrated Transponder
TSW: Top Spillway Weir
USDA: United States Department of Agriculture

Approved by Brett Call, John Day/ Willow Creek Operations Manager

APPENDICES

Appendix A: 22JDA01 Official Coordination Request for Non-Routine Operations and Maintenance for North Fish Ladder 4-Day Outage for Sensor Housing Replacement

OFFICIAL COORDINATION REQUEST FOR NON-ROUTINE OPERATIONS AND MAINTENANCE

COORDINATION TITLE- 22JDA01 North Fish Ladder 4-Day Outage for Sensor Housing Replacement (NFL-Channel) During the Week of March 7th, 2022, **COORDINATION DATE-**
PROJECT- John Day Dam
RESPONSE DATE- 3 March

Description of the problem

At 6AM on Friday February 11th, 2022, John Day Fisheries personnel (JDF) discovered the North Fish Ladder (NFL) was out of criteria (the NFL was in criteria at 4PM the previous day). The PLC showed a differential of 0.0' instead of the FPP required 1-2'. Normally this would indicate an issue with the AWS pumps. However, the same PLC showed all pumps were running at normal levels. An immediate investigation was
performed, and JDF discovered the housing for the NFL channel sensor detached from the wall, fell into the ladder, and left the sensor free-floating in the channel (See figure 1). This ultimately led to incorrect sensor readings. The staff gauges were checked, and the NFL was running within the 1-2' differential criteria. The control room was immediately notified, and the pumps were put in manual mode (3-pumps running at 190 RPMs). The channel sensor is necessary to ensure ladder differentials are kept within FPP requirements 24/7 and should be repaired to avoid any complications during the adult fish passage season.

The NFL has already undergone winter maintenance for the season and was returned to service January 21st, 2022. The remainder of the winter maintenance season will be needed to complete preventive maintenance and repairs on the South Fish Ladder (SFL). Additionally, the navigation lock outage has depleted any personnel that would otherwise be available for fisheries support (mechanics, electricians, crane operators, etc.).
Therefore, JDF is requesting the ability to take the NFL out of service during the week of March 7th, 2022, to repair the channel sensor housing.

By waiting until the week of March 7th JDF will have all necessary personnel available to quickly repair the sensor housing. The week of March 7th also coincides with relatively low fish passage (see figures 1 and 2). The actual sensor housing repair should only take 5-hours. However, the ladder may need to be operated at orifice flow (AWS pumps off)
for 3-days to allow most fish to exit the ladder. This helps reduce fish handling which is less stressful for fish and personnel.

Figure 1: Image of broken NFL channel sensor housing

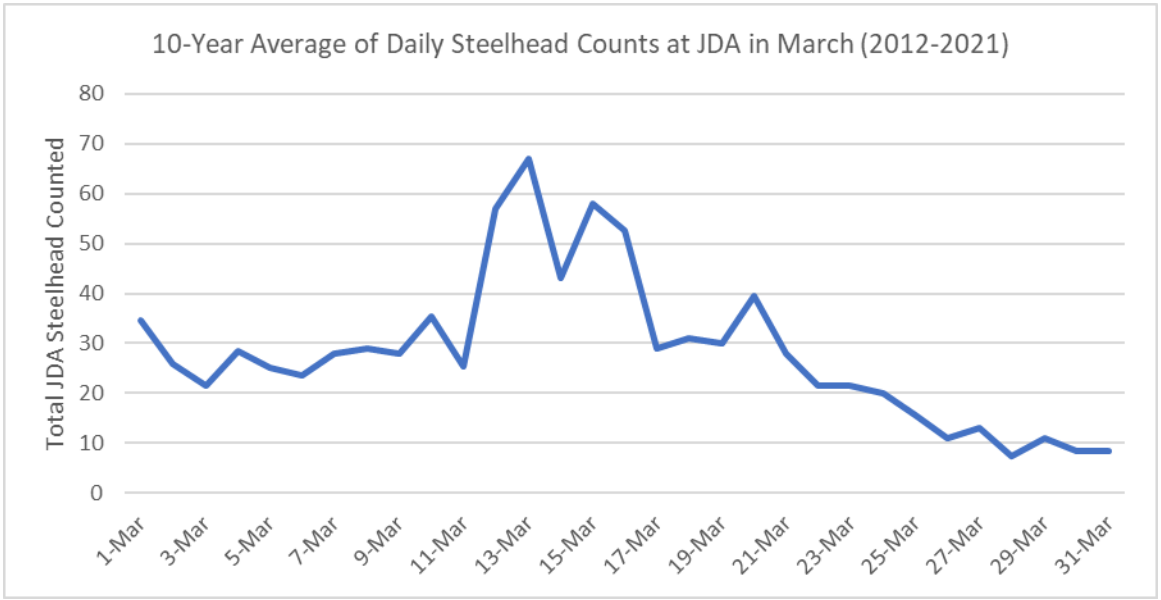


Figure 2: Graph illustrating the average daily steelhead passage at JDA displayed as the 10-year average for the month of March.

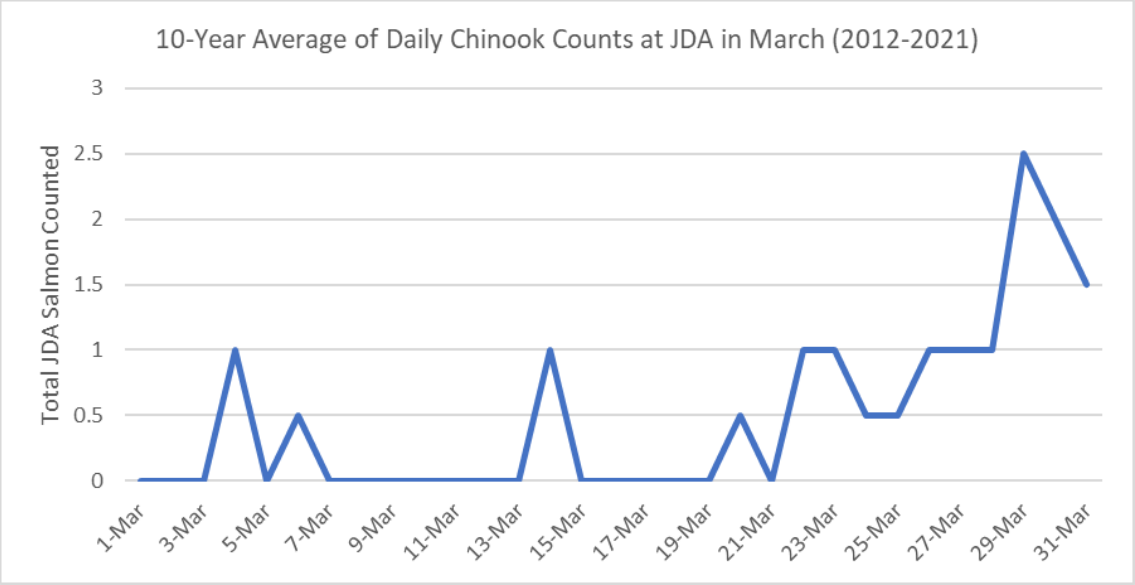


Figure 3: Graph illustrating the average daily Chinook passage at JDA displayed as the 10-year average for the month of March.

Type of outage required

Impact on facility operation This will require the NFL to be OOS for a maximum of 4-days during the week of March 7th, 2022. The SFL will be in service and typically passes the majority of salmonids at the JDA project.

Impact on unit priority this will NOT impact unit priority

Impact on forebay/tailwater operation This will NOT impact forebay/tailwater operations.

Impact on spill This will NOT impact spill operations, nor will it occur during spill season

Dates of impacts/repairs March 7th, 2022 – March 10th, 2022

Length of time for repairs 5-hours

Analysis of potential impacts to fish:
The NFL will be OOS for 4-days so this will have some impacts on fish passage. However, the repairs are taking place during minimal fish passage and the majority of salmonids prefer to pass through the SFL, which will remain in service.

Summary statement - expected impacts on

Downstream migrants PIT data shows an insignificant number of juveniles pass through the NFL ladders. Additionally, this outage will occur before the actual smolt passage season when there have historically been very few outmigrants.

Upstream migrants (including Bull Trout) The ladder will be OOS for 4-days. Any upstream migrants (including Bull Trout) will be able to migrate up the SFL.

Lamprey Adult lamprey typically don't show up at JDA until May so there should be no impacts to adults. Fish ladder use by juvenile lamprey is unknown.

After Action update

The JDA north fish ladder (NFL) was put on orifice flow Saturday March 5th, 2022. The following Monday (March 7th) the ladder was dewatered to tailwater. A fish salvage was performed, and 3-steelhead were recovered, 2-hatchery (10" and 30") and 1-of unknown origin (8"). The fish were salvaged near the entrance of the NFL and released in the tailrace (less stressful than transporting to forebay). All fish were released in good condition. The following morning (Tuesday March 8th) the NFL was dewatered below tailwater. There were no fish in the lower section.

Repairs to the NFL channel sensor housing were performed and completed on March 9th, 2022. Repairs were completed late afternoon (approximately 1600) and did not leave time to water-up. The JDA NFL was watered up and returned to service on March 10th, 2022 @ approximately 0900.

Fisheries personnel immediately performed a calibration and discovered the sensor was out of criteria. A TR was submitted, and electricians quickly calibrated the sensor ensuring the ladder would be in criteria over the weekend.

The replacement appears to be more durable than the previous version. The old housing lasted several years (at least 7-years) and the new housing is made of schedule 80-PVC, has more anchors, and heftier brackets (see Figure 4).

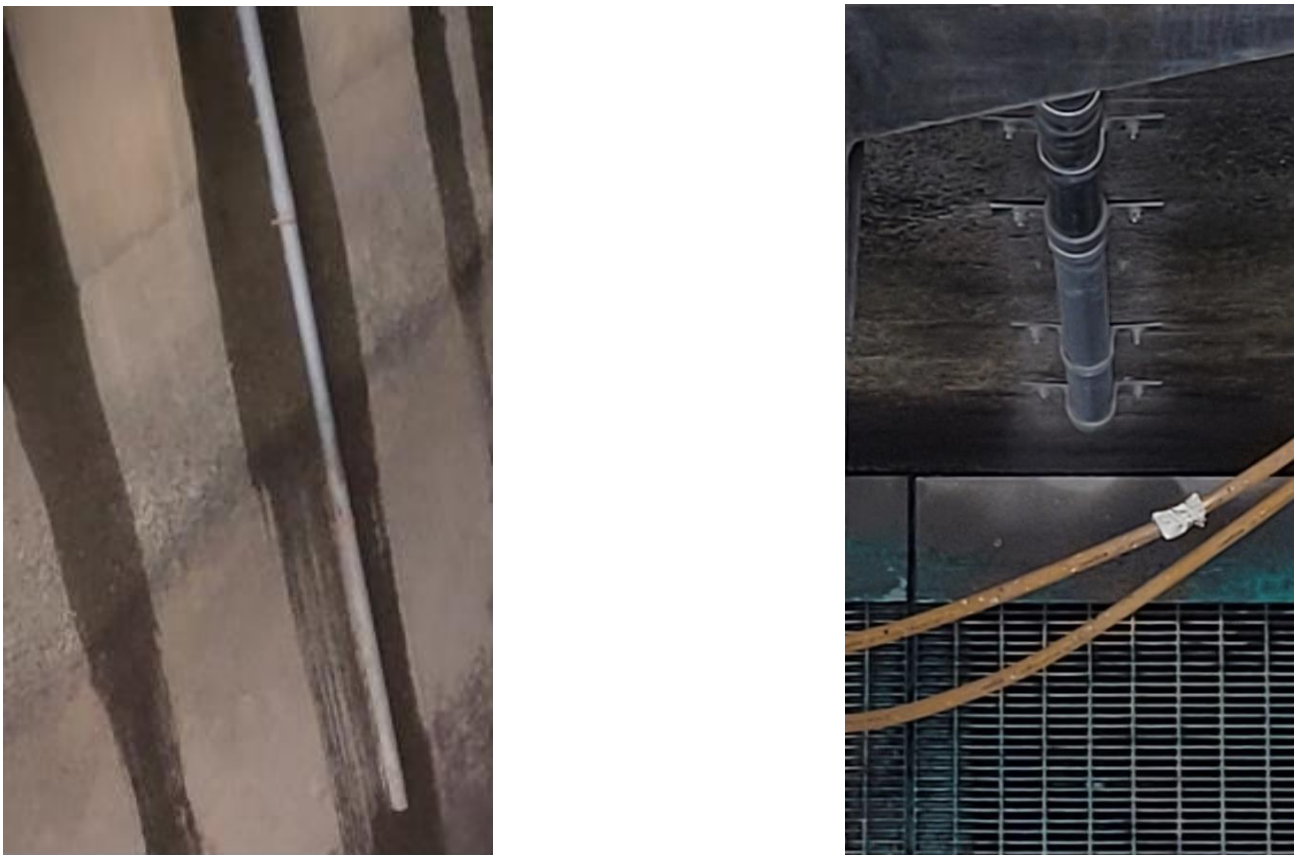


Figure 4: Left photo is of the old housing (taken 12-08-21) and the right photo shows a zoomed-in aerial photo (unable to access the fish ladder for a straight on shot) of the new housing (taken 03-09-22).

Please email or call with questions or concerns. Thank you,

Eric Grosvenor
Interim Chief of Fisheries John Day Dam
Eric.Grosvenor@usace.army.mil

Appendix B: 22JDA16 Official Coordination Request for Non-Routine Operations and Maintenance for North Fish Ladder Early Outage for Winter Maintenance

OFFICIAL COORDINATION REQUEST FOR NON-ROUTINE OPERATIONS AND MAINTENANCE

COORDINATION TITLE- 22JDA16 Early ladder outage for Winter Maintenance
COORDINATION DATE- 27 October 2022
PROJECT- John Day Dam
RESPONSE DATE- 10 November 2022

Description of the problem

The John Day Project is requesting to switch the North Fish Ladder (NFL) to orifice flow (attraction water turned off) on November 29th, 2022 (2-days before the winter maintenance season). The 1st day of winter maintenance (December 1st, 2022) falls on a Thursday, which is the last day of the work week. JDA requires at least 2-days of orifice flow before dewatering any fish ladder.

The current schedule requires personnel to put the ladder in orifice flow over the weekend. On Monday December 5th crews would dewater the upper section of the ladder. This means no work can begin until at least December 6th. By putting the ladder on orifice flow 2-days earlier the ladder could be dewatered on the 1st and crews could begin work almost immediately afterwards. With the new LPS modifications and entrance weir improvements scheduled this year, the more time to work on the NFL the better.

Type of outage required

Impact on facility operation: The NFL would be without attraction water 2-days earlier than scheduled, but the SFL would remain in service.

Impact on unit priority: This will have NO impact on unit priority.

Impact on forebay/tailwater operation: There would be no impact on forebay/tailwater operation.

Impact on spill: The bay #2 attraction flow would be turned off 1-day early to prevent any attraction to the NFL.

Dates of impacts/repairs: November 29th, 2022 – December 1st, 2022

Length of time for repairs: The ladder would be taken down 2-days before the winter maintenance season.

Analysis of potential impacts to fish:

Location	Ladder	Count Date	All Chinook	All Coho	All Steelhead	Sockeye	Chum	Pink
John Day	North	11/24/2018	3	2	4	0	0	0
John Day	North	11/25/2018	5	3	5	0	0	0
John Day	North	11/26/2018	7	5	5	0	0	0
John Day	North	11/27/2018	5	1	2	0	0	0
John Day	North	11/28/2018	1	1	1	0	0	0
John Day	North	11/29/2018	1	0	7	0	0	0
John Day	North	11/30/2018	1	1	5	0	0	0
John Day	North	12/1/2018	2	-1	1	0	0	0
John Day	North	Total	25	12	30	0	0	0

Location	Ladder	Count Date	All Chinook	All Coho	All Steelhead	Sockeye	Chum	Pink
John Day	North	11/24/2013	5	1	16	0	0	0
John Day	North	11/25/2013	1	1	4	0	0	0
John Day	North	11/26/2013	3	0	6	0	0	0
John Day	North	11/27/2013	6	1	4	0	0	0
John Day	North	11/28/2013	0	1	0	0	0	0
John Day	North	11/29/2013	1	1	3	0	0	0
John Day	North	11/30/2013	0	0	1	0	0	0
John Day	North	12/1/2013	0	2	1	0	0	0
John Day	North	Total	16	7	35	0	0	0

Fish counting at JDA concludes on October 31st every year. However, every 5-years counts are performed year round. The most recent year-round count was performed in 2018. Above are the tables for the 2018 and 2013 NFL counts. The areas highlighted yellow are the proposed dates for early orifice flow. As these tables show, there are very few fish migrating up the NFL during the proposed outage. Any upstream migrants would still have the SFL available for passage.

Summary statement - expected impacts on:
Downstream migrants: There are few if any downstream migrants and smolt monitoring concludes September 15th.

Upstream migrants (including Bull Trout). The SFL will be in service and attraction water will be turned off on the NFL. Therefore, minimal impacts to upstream migrants are expected.

Lamprey. There are minimal expected impacts on upstream migrants.

Comments from agencies

Please email or call with questions or concerns. Thank you,

Eric Grosvenor
Chief of Fisheries
John Day Dam
Eric.Grosvenor@usace.army.mil

Appendix C: DRAFT Memorandum for the Record South Fish Ladder Temperatures

CENWP-OD-J **October 18, 2022**

DRAFT: MEMORANDUM FOR THE RECORD

SUBJECT: South Fish Ladder Temperatures

Background:

In 2016, John Day, The Dalles, and Bonneville Dam began monitoring and reporting fish ladder temperatures after high river temperatures during the 2015 migration year contributed to low Sockeye salmon passage and survival. Elevated water temperature differentials between the entrance and exit, in adult fish ladders are associated with altering salmon behavior and potentially slowing adult salmon migration (Caudill et al. 2006; USACE 2004).

In 2018 and 2019, in response to regional concern over entrance-exit temperature differentials throughout the Columbia River System a temperature depth profile study was conducted on the lower Columbia River projects to monitor the vertical thermal profile of the forebays next to fish ladder exits and determine if cooler water existed for cooling of the fish ladders (Lundell et al 2019). The study concluded that although the forebays of The Dalles and Bonneville projects remained well-mixed throughout the summer months, John Day exhibited periods of significant temperature differentials coupled with a stratified reservoir that suggests a potential for fish ladder cooling near the fishway exit. In the 2020 Columbia River System Biological Assessment, the Corps proposed to:

1. Continue monitoring and reporting of all mainstem fish ladder temperatures and identify ladders that have substantial temperatures that have differentials >1.0° C.
2. Where beneficial and feasible, develop and implement operational or structural solutions to address maximum temperatures and temperature differentials in adult fish ladders at mainstem Lower Snake and Columbia River Dams identified as having problems (2020 CRS BA).

This memo directly addresses the Proposed Action by evaluating 2019 and 2022 ladder temperature differentials in the South fish ladder at John Day Dam (JDA) and evaluating an operational alternative (extended shad mode) tested in 2022 to try to reduce entrance-exit thermal gradients during adult passage season.

There were periods of time in the summers of 2019 and 2022 when the water entering the fishway exit from the forebay was several degrees warmer than the water in the (tailrace) fishway entrance, exceeding the 1 deg. C target threshold (Figure 1). During those same periods of time in the summers of 2019 and 2022, deeper water in the forebay at JDA-SS-2 was as much as 5 degrees cooler than the water at the surface (Figure 2).

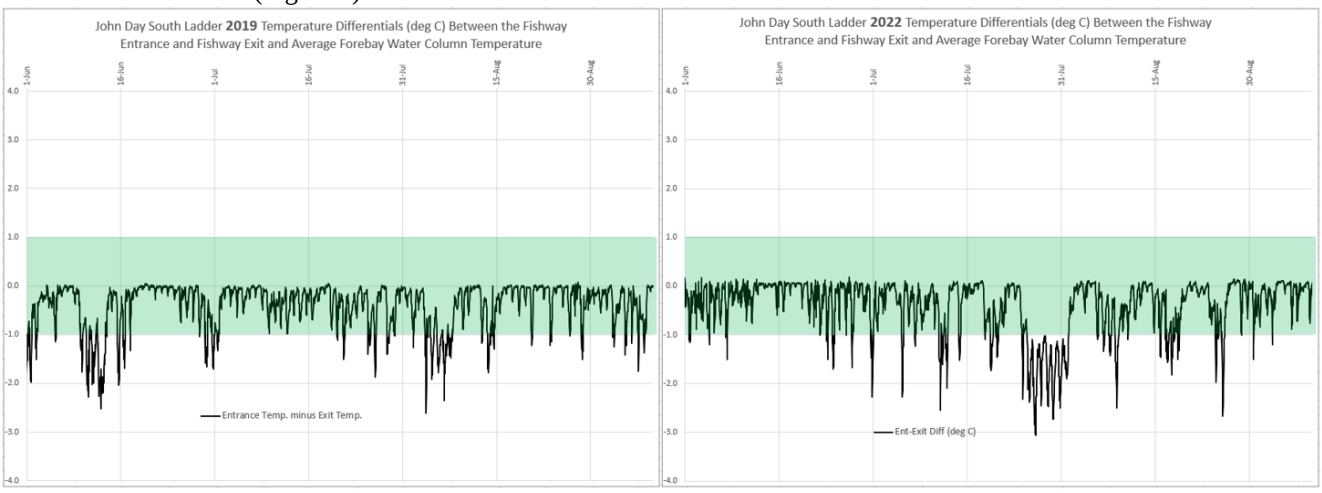


Figure 29: Temperature differentials between the entrance and exits at John Day Dam SFL from June 1 to September 15 in 2019 and 2022.

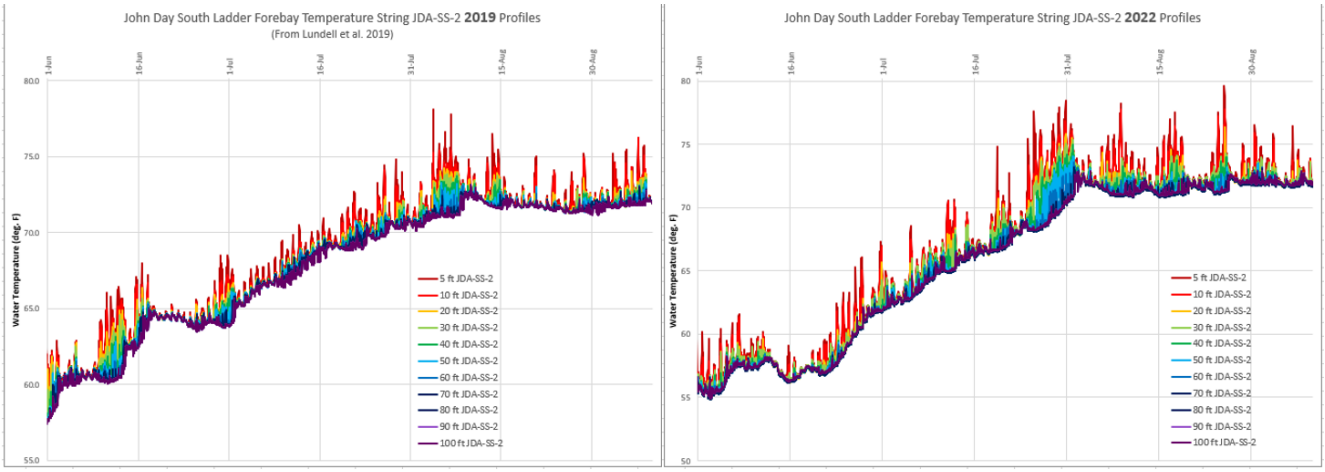


Figure 30: JDA-SS-2 temperatures from June 1 to September 15 in 2019 and 2022. Data shows similar trends in each year.

According to NMFS (2016), the upper incipient lethal temperatures for adult salmonids range from 70 to 72 deg. F. Sustained exposure to temperatures above 68 deg. F can slow adult sockeye migration, warmer temperatures can stop adult sockeye migration completely with fish seeking shelter in tributaries, cold water refuges, or the estuary. In 2019 and 2022, most of the sockeye run had past John Day Dam before the river reached 68 deg. F (Figure 3).

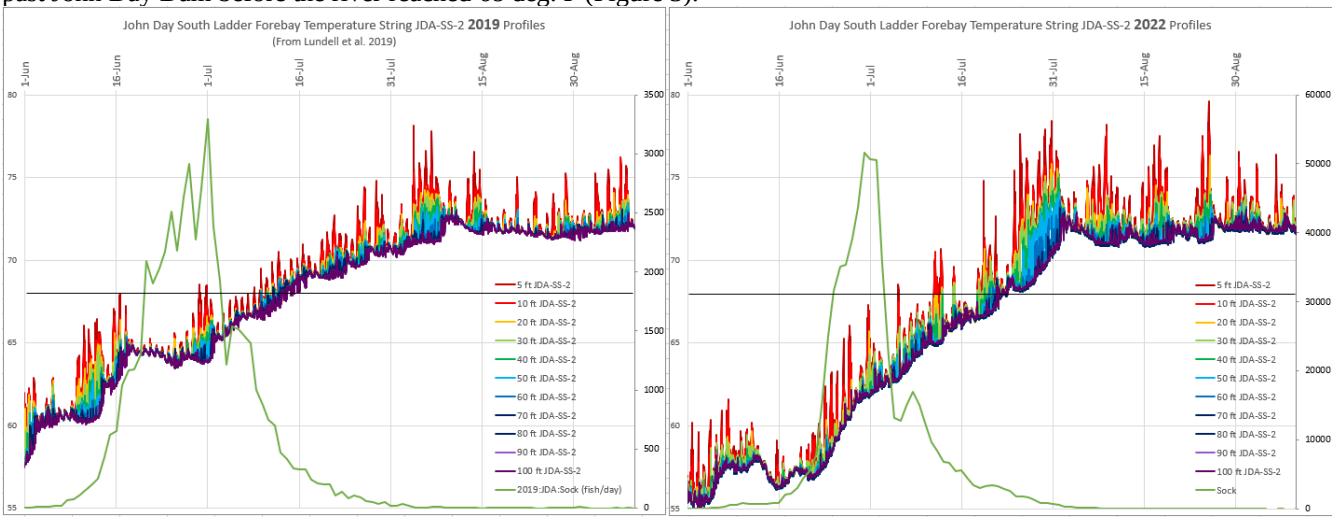


Figure 31: Forebay temperatures (deg. F; left axis) and sockeye passage (fish/day; right axis) for the south fish ladder at John Day Dam in 2019 and 2022.

At temperature differentials of greater than 1°C, Chinook and steelhead have a higher likelihood of entering the ladder multiple times followed by exits back into the tailrace. This movement in the ladder can significantly delay migration, increase thermal exposure, consume energy, and decrease migration success (Keefer and Caudill 2015). Temperature differentials in 2019 and 2020 are shown in Figure 4 with 2022 have a slightly higher occurrence exceeding 1°C.

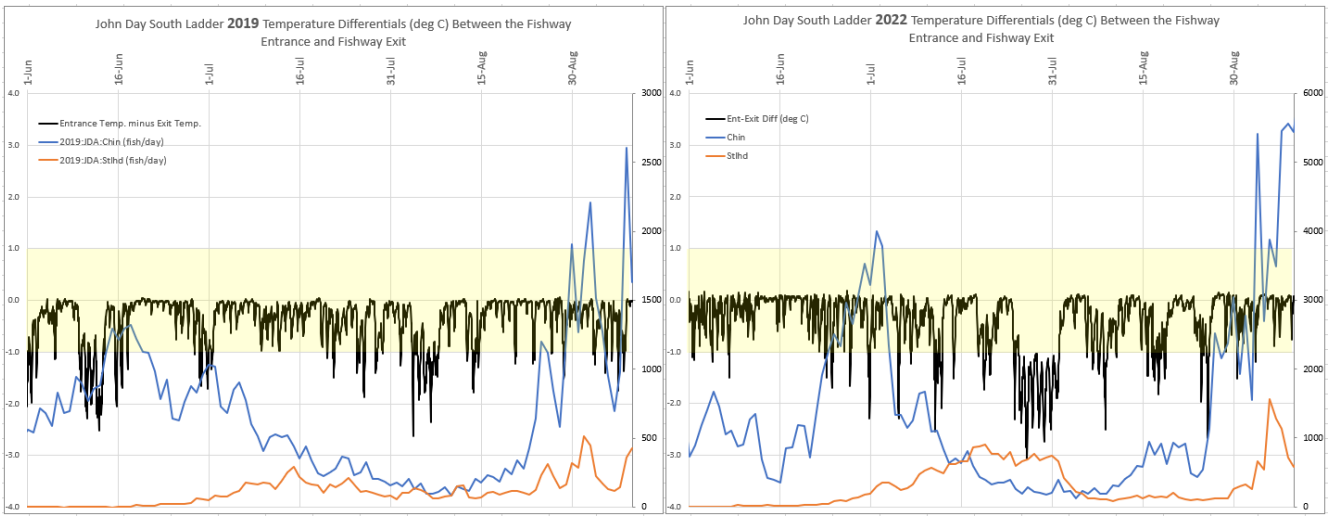


Figure 32: Chinook (blue) and Steelhead (orange) passage (fish/day) for the south fish ladder at John Day Dam in 2019 and 2022.

Method:

Temperature data has been collected from the JDA South Fish Ladder (SFL) entrance and exit sections since 2011 to monitor potential exit/entrance differentials. From 2011 - 2021 the readings were taken from the same locations (See figure 5) and reported to FPOM annually. In 2022 (prior to adult passage season) JDA personnel installed 5-additional temperature probe locations (See figure 5) including a temperature string in the forebay just upstream of the ladder exit (following the methods set forth in Lundell et al. 2019).

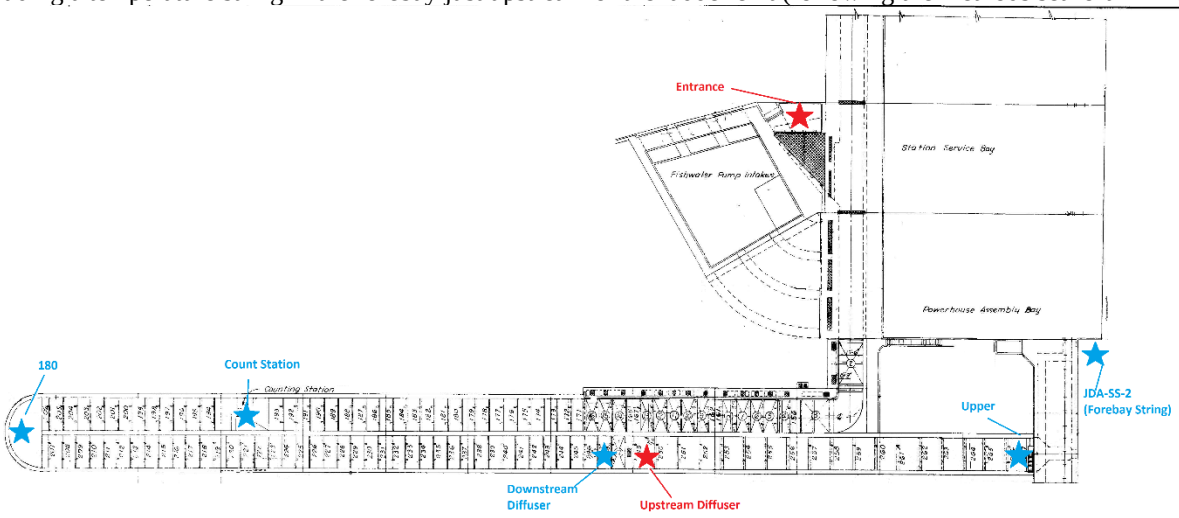


Figure 5**:** Map of the JDA SFL and the temperature probe locations within the ladder. Red stars indicate preexisting temperature probe locations (installed in 2011). The blue stars represent new temperature probes installed prior to the 2022 adult passage season. The red star labeled upstream diffuser is what has been historically referred to as the south fish ladder exit.

For most locations, JDA uses Onset HOBO temperature loggers (Model: U22-001) deployed down 2" PVC pipes mounted to the ladder wall (the pipes are drilled to allow water circulation). The loggers collect data approximately 1-foot from the ladder floor. The count station location uses a Hobo tidbit temperature logger affixed between the picketed leads. Unfortunately, the temperatures at this location cannot be read out until the ladder is dewatered (there are currently plans to install a PVC pipe at this location during the 2022/2023 winter maintenance window to allow in season offloads). The forebay temperature string (referred to as JDA-SS-2) utilizes U22-001 temperature loggers at 11-depths (5, 10, 20, 30, 40, 50, 60, 70, 80, 90, and 100-feet with a base forebay elevation of 262.9-feet).

Temperature loggers are set to record hourly, and data is typically offloaded weekly. Unfortunately, there were times when weekly readouts weren't feasible (short staffed, heavy workloads, malfunctioning equipment, etc.) and blocks of data were lost (See Table 1). Comparing data from these blocks isn't feasible. Therefore, most of the data is displayed as 10-year averages to help offset the lost data.

2022	2021	2020	2019	2018
3/29 - 9/13	(5/18 - 8/21) & (8/30 - 9/21)	5/1 - 9/23	5/1 - 9/16	(5/1 - 6/28) & (9/6 - 9/26)
2017	**2016**	**2015**	**2014**	**2013**
5/1 - 9/27	5/1 - 9/14	5/1 - 9/14	5/1 - 9/14	5/1 - 9/16

Table 1**:** The timeframes when JDA has temperature data available for the SFL and USGS has temperatures available for the forebay.

The SFL exit is typically warmer than the entrance (See Figure 6) and the differentials tend to fluctuate throughout the day (see Figure 7).

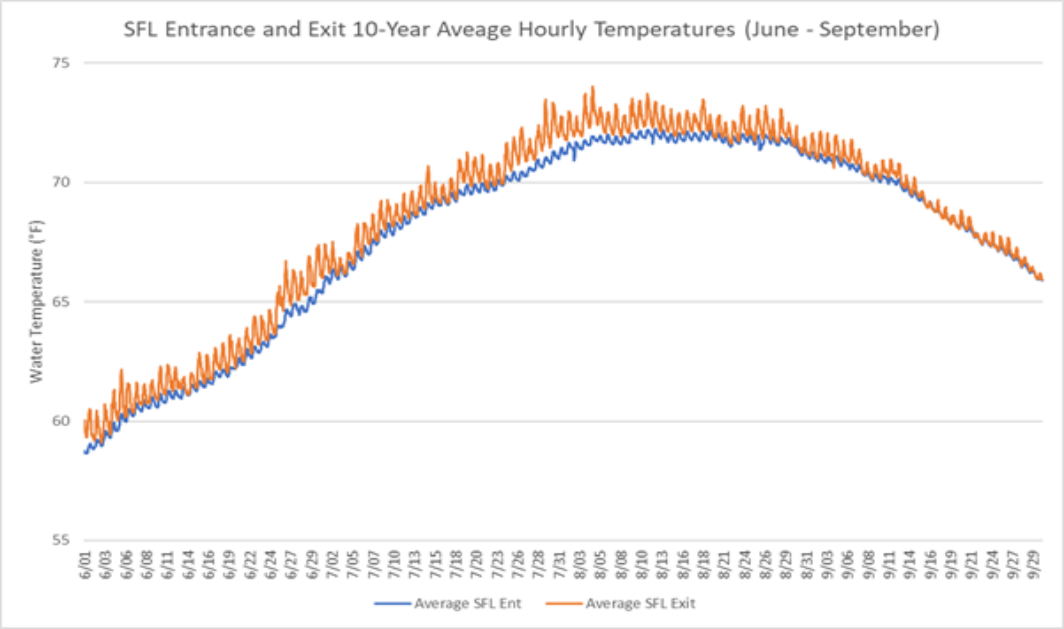


Figure 6**:** The SFL entrance-exit hourly temps shown as a 10-year average (2013-2022) June 1st – September 30th.

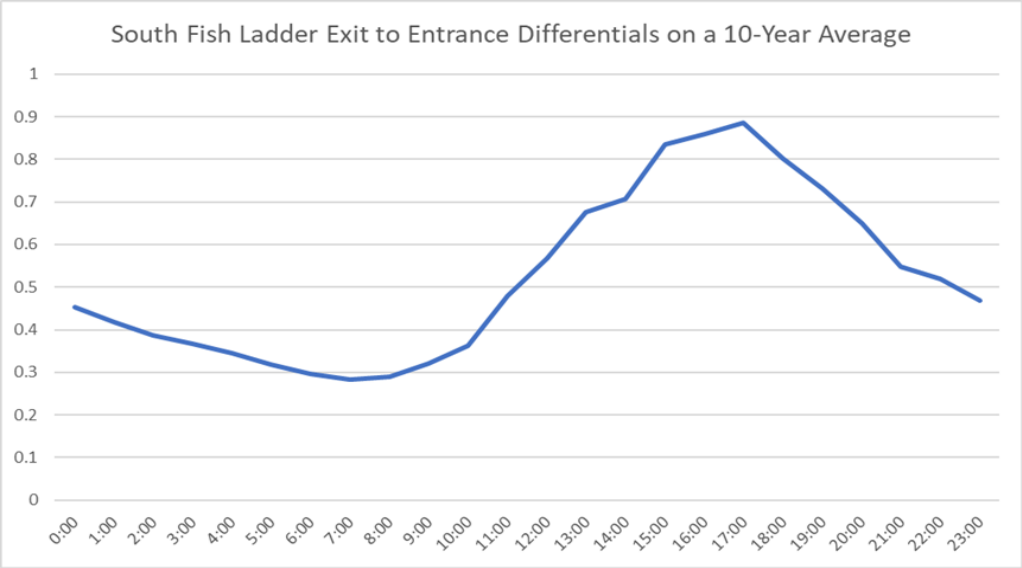


Figure 7**:** Graph illustrating temperature differentials between the SFL exit and the SFL entrance at different times of the day (how many degrees °F the exit is warmer than the entrance). The values are shown as 10-year average temperatures (2012 – 2021) at specific hourly intervals from June 1st – September 30th.

The average 10-year differential between the SFL exit and entrance (when the exit was ≥70°F) was 0.93°F (See Table 2). When the temperature differential is 1°C salmonid passage is negatively impacted. Over the course of 10-years, the differential was ≥1°C (1.8°F) 20.69% of the time (when the exit was ≥70°F). The highest percentage observed was 2015 (30.95%) and the lowest was 2013 (10.17%).

June and July Values								
Year	Hrs SFL Exit ≥ 70°F	Diff. (Exit/Ent) Hrs > 1.8°F	Missing SFL Hours	Hours Compared	% > 1.8°F	Avg Diff Exit ≥ 70°F (°F)	Max Diff (°F)	Date of Max
2021	756	153	0	756	20.24%	0.86	6.84	6/29
2020	171	91	0	171	53.22%	2.12	5.24	7/20
2019	271	30	0	271	11.07%	0.87	3.36	7/26
2018	Missing Data							
2017	360	118	0	360	32.78%	1.34	5.74	6/30
2016	250	93	0	250	37.20%	1.56	4.97	6/27
2015	910	426	0	910	46.81%	1.79	6.60	6/26
2014	267	142	0	267	53.18%	2.02	5.32	7/8
2013	311	63	0	311	20.26%	1.09	4.85	7/9
2012	0	0	0	0	NA	NA	NA	NA
Overall	3296	1116	0	3296	33.86%	1.40	6.84	6/29/21

August and September Values								
Year	Hrs SFL Exit ≥ 70°F	Diff. (Exit/Ent) Hrs > 1.8°F	Missing SFL Hours	Hours Compared	% > 1.8°F	Avg Diff Exit ≥ 70°F (°F)	Max Diff (°F)	Date of Max
2021	554	125	223	554	22.56%	0.97	5.22	8/21
2020	911	203	0	911	22.28%	0.53	3.30	8/5
2019	1168	132	0	1168	11.30%	0.61	4.72	8/13
2018	Missing Data							
2017	1112	190	0	1112	17.09%	0.92	5.59	8/11
2016	892	122	0	892	13.68%	0.72	4.11	8/18
2015	825	111	0	825	13.45%	0.68	4.62	8/1
2014	925	172	0	925	18.59%	0.85	5.27	8/5
2013	1282	99	0	1282	7.72%	0.62	3.98	9/12
2012	421	86	0	421	20.43%	1.06	4.43	8/17
Overall	8090	1240	223	8090	15.33%	0.74	5.59	8/11/17

Combined (June-September)								
Year	Hrs SFL Exit ≥ 70°F	Diff. (Exit/Ent) Hrs > 1.8°F	Missing SFL Hours	Hours Compared	% > 1.8°F	Avg Diff Exit ≥ 70°F (°F)	Max Diff (°F)	Date of Max
2021	1310	278	223	1310	21.22%	0.91	6.84	6/29
2020	1082	294	0	1082	27.17%	0.78	5.24	7/20
2019	1439	162	0	1439	11.26%	0.66	4.72	8/13
2018	Missing Data							
2017	1472	308	0	1472	20.92%	1.03	5.74	6/30
2016	1142	215	0	1142	18.83%	0.90	4.97	6/27
2015	1735	537	0	1735	30.95%	1.26	6.60	6/26
2014	1192	314	0	1192	26.34%	1.12	5.32	7/8
2013	1593	162	0	1593	10.17%	0.71	4.85	7/9
2012	421	86	0	421	20.43%	1.06	4.43	8/17
Overall	11386	2356	223	11386	20.69%	0.93	6.84	6/29/21

Table 2: Table representing the total number of hours the JDA SFL exit was ≥ 70°F and of those hours, the number of hours the SFL exit was ≥ 1°C warmer than the SFL entrance. The percentage represents the time when the SFL exit was ≥ 1°C warmer than the entrance (when the SFL exit was ≥70°F). Tables show a 10-year span and are broken up by; June - July, August – September, and both combined (June – September). There are 2,928 hours between June 1st and September 30th.

Fish run timing varies year to year and species to species at JDA (See Figure 8). When comparing the 10-year average water temperature to the 10-year average salmonid passage (at JDA) the following overlaps are observed. Steelhead have the highest interaction with warmer ladder temperatures at JDA with 45.0% of the total steelhead run passing when ladder temperatures are ≥70 F°. Sockeye passage has the least overlap with 3.0% passing at temperatures of ≥70 F°. (Chinook = 37.0% and Coho = 34.3%).

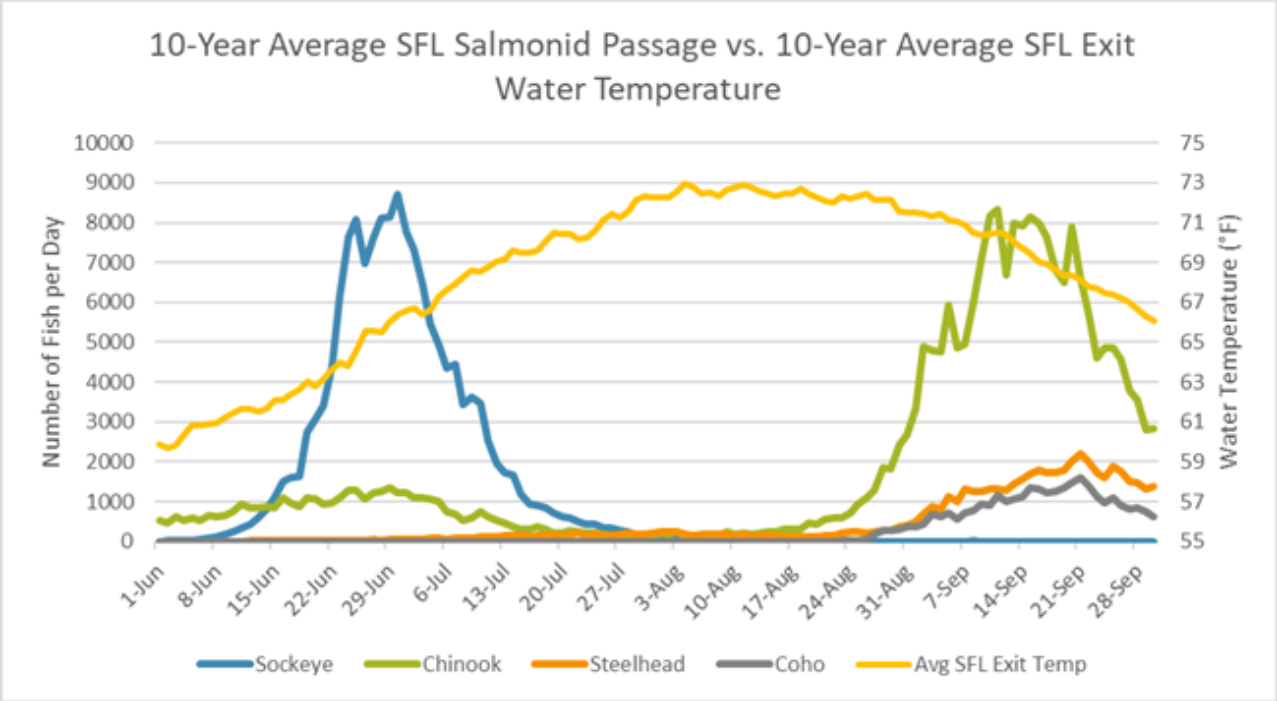


Figure 8: The 10-year average (2013 - 2022) for salmonid passage at the South Fish Ladder of John Day Dam. The secondary axis is the average daily water temperature at the JDA south fish ladder exit.

Post 2022 block-study:

The block-study (MOC: 22JDA07) occurred over a 16-day period (August 2nd – August 17th, 2022) with two-day replicates of "shad mode' and "salmon mode" operations. Temperature differential between the exit and the entrance (Figure 10) were slightly cooler (0.84°F) during the shad mode than during the salmon mode (1.05°F). Ladder exit temperature fluctuated more than the entrance temperatures (Figure 11) during the block study. The average exit temperatures during the block study were 72.27°F during shad mode and 72.53°F during salmon mode and entrance temperatures were slightly higher in salmon mode (71.48°F) than during shad mode (71.43°F). Lamprey passage (Figure 9) during the shad and salmon operation was higher than the ten-year average.

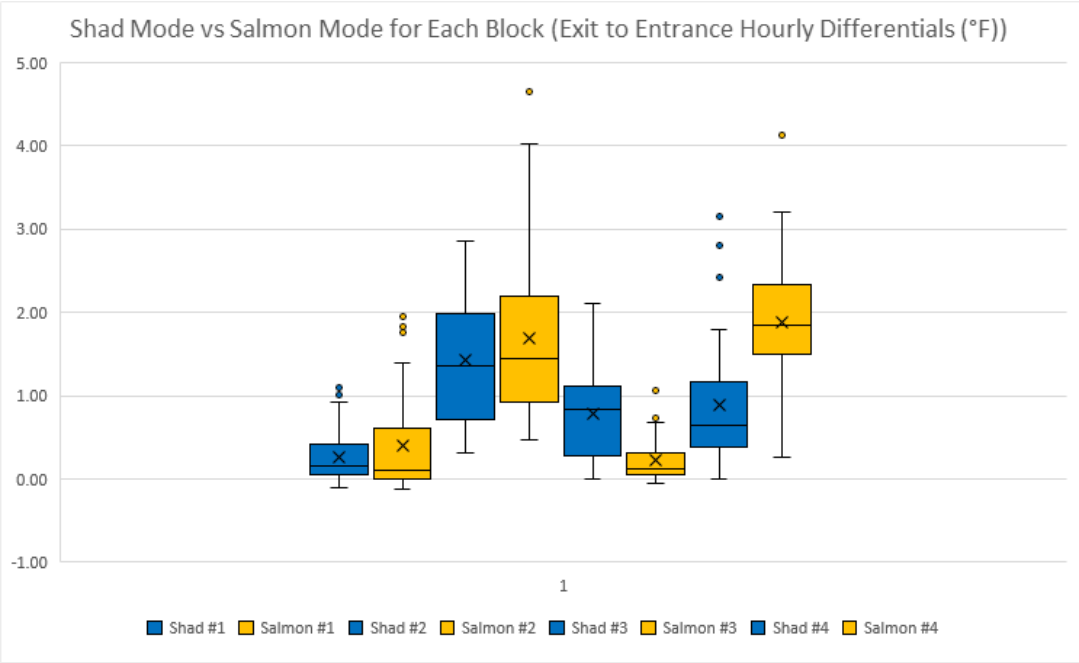


Figure 10: Graph illustrating the exit to entrance differentials during each block of the study. Blue boxes indicate shad mode, while gold boxes indicate salmon mode.

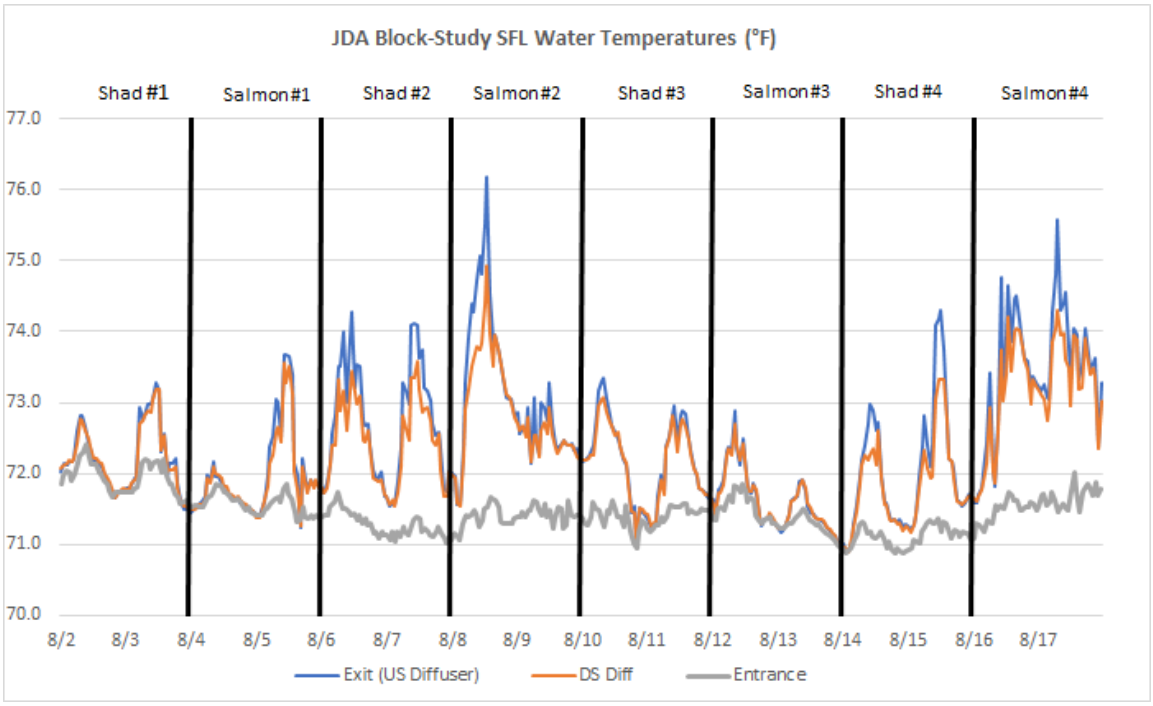


Figure 11: Graph illustrating the recorded hourly temperatures during the block study. The blue line indicates the location just upstream of the diffuser (where the additional water is added in 'shad mode'), the red line temperatures are taken just downstream of the diffuser, and the gray line is the entrance water temperature.

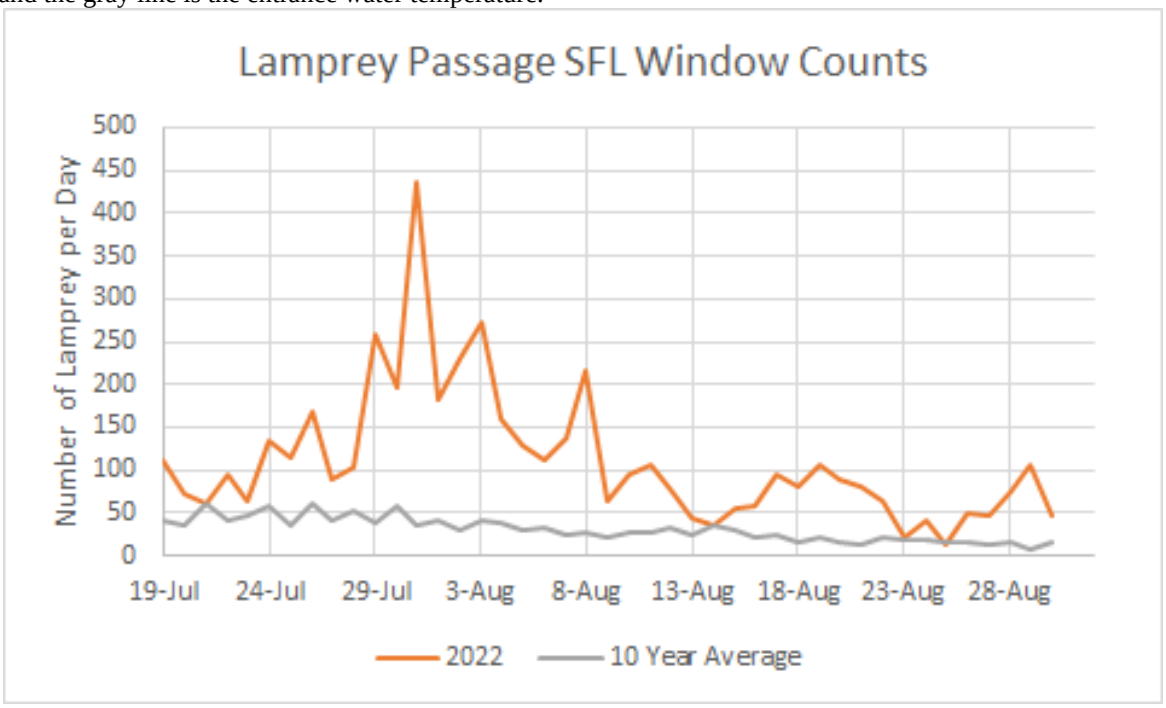


Figure 9: This graph shows 2022 versus the 10 Year Average (2013-2021) of lamprey passage at the South Fish Ladder for two weeks before the start of the block study and two weeks after the block study (8/2-8/16). The number of lamprey per day are from the window counts at the count station. Lamprey passage at the SFL was well above the ten-year average and peaked on July 31st at 436 fish. The CRITFC SFL lamprey trap had their highest catch this year of 1,349 fish.

Ladder Operations:

The John Day Dam South fish ladder uses three Francis turbine pumps to supply attraction water for the SFL (See Figure 12). The turbine pumps are supplied by a 5' penstock located at 200' msl in the forebay of the dam approximately 90-feet north of the fish ladder exit. The turbine drives a gear box that pumps water from a stilling basin on the downstream side of the dam at 90' msl. Normal forebay and tailrace operations at JDA are 262.5' – 266.5' msl and 159' – 162.5'. This water is used for attraction flows at the SFL entrances, collection channel flow between the South and North ends of the powerhouse and diffusion chambers in the lower overflow weirs above the transition pool at the base of ladder.

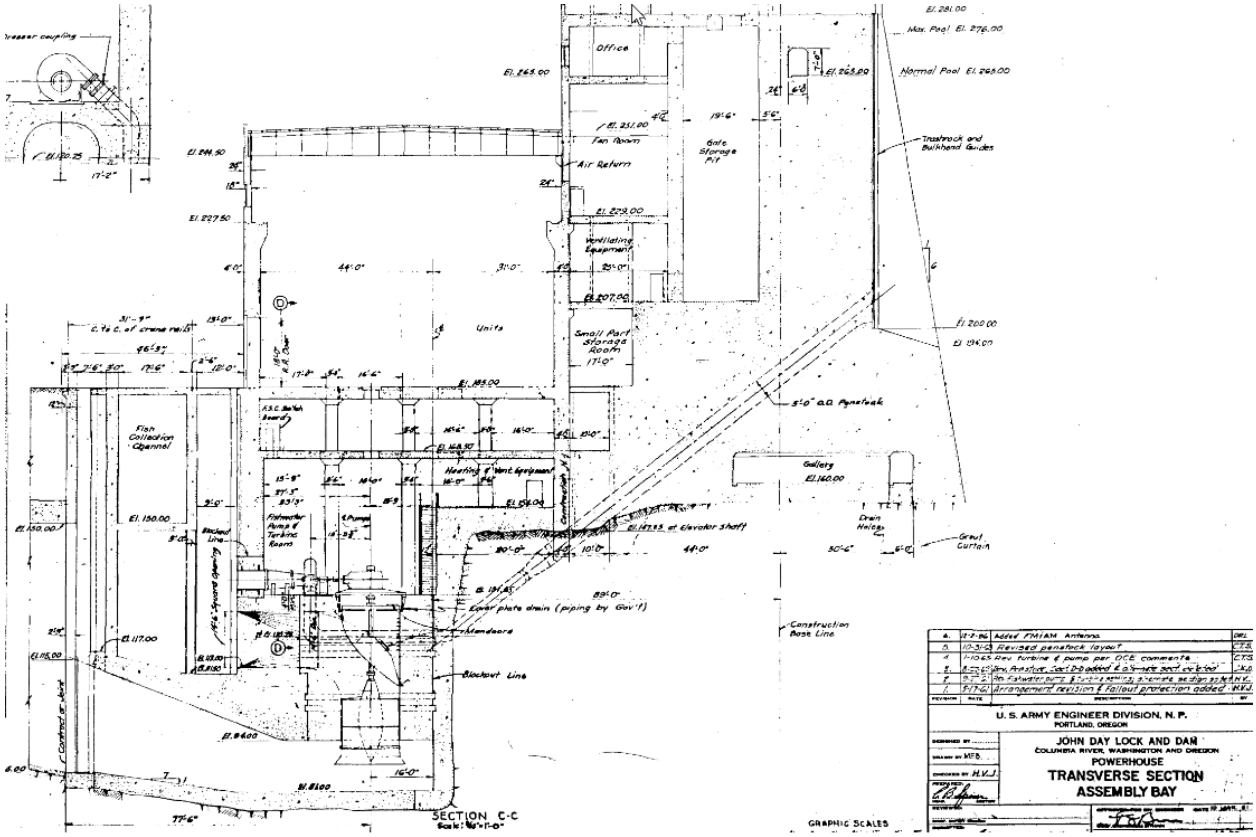


Figure 12: Transverse cross section of assembly bay showing SFL fish turbine penstock intake and discharge and pump assembly intake and discharge.

Additionally, water is added to the SFL from diffuser #5 above weir 248 which is the last overflow weir before the start of the exit control section (See Figure 13). The diffuser is fed from two 24" supply lines from a forebay intake at 238' msl. Actuated butterfly valves automatically adjust flow to the diffuser keeping 1'- 1.3' of water over the overflow weirs depending on the ladder setting. The level is monitored and adjusted from readings taken between weirs 193 and 194 at the SFL count station. Water flows from diffuser #5 range from 5.5 – 88.1 cfs and vary based on operational setting and forebay elevations (See Table 3). Between June 10th and September 9th, 2019, water temperatures at the diffuser were on average ~0.5°F cooler than surface water temperatures (measured at ~5' of depth) (Lundell et al. 2019).

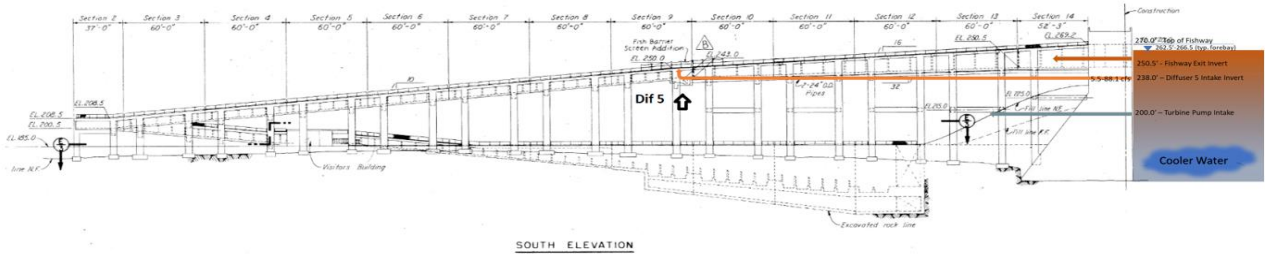


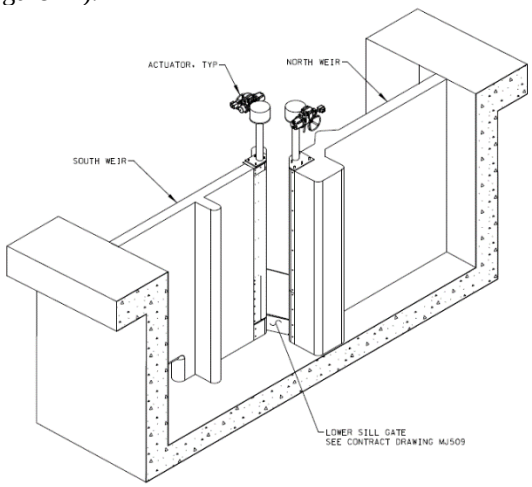
Figure 13: General layout of elevation sections including views of Diffuser #5 and 24" supply lines from forebay intake at 238'msl.

Ladder flow at 1 foot =		**85** cfs		*assumed same as JDA North*		
	Exit channel Flow			Diffuser 5 Flow		
	Sill Settings			Sill Settings		
Forebay	low	medium	high	low	medium	high
257	32.7			52.3		
258	39.2			45.8		
259	45.9			39.1		
260	54.1			30.9		
261	61.6			23.4		
262	68.6	45.7		16.4	39.3	
263	73.2	54.1		11.8	30.9	
264		61.9			23.1	
265		67.6			17.4	
266		74.1	65.7		10.9	19.3
267		79.5	70.9		5.5	14.1
268		88.1	79.5			5.5

Ladder flow at 1.3 feet =		**113.4** cfs		*assumed same as JDA North*		
	Exit channel Flow			Diffuser 5 Flow		
	Sill Settings			Sill Settings		
Forebay	low	medium	high	low	medium	high
257	32.7			80.7		
258	39.2			74.2		
259	45.9			67.5		
260	54.1			59.3		
261	61.6			51.8		
262	68.6	45.7		44.8	67.7	
263	73.2	54.1		40.2	59.3	
264		61.9			51.5	
265		67.6			45.8	
266		74.1	65.7		39.3	47.7
267		79.5	70.9		33.9	42.5
268		88.1	79.5			33.9

Table 3: Ladder flows based on forebay elevation and corresponding sill setting and diffuser flow.

Ladder flow starts in the forebay as water passes through the exit into the upper control section of the ladder. The control section is of a vertical slot weir configuration with a 1:32 slope. Adjustable actuated sill gates on weirs 256 – 267 modulate gravity flow from the forebay based on water elevation (See Figure 14).



NORTH AND SOUTH WEIRS OF LADDER – ISOMETRIC VIEW

Figure 14: Vertical slot weir with actuated sill gates and orifice in the SFL exit control section.

Operational changes are made to ladder flows during the annual American Shad (shad) run at JDA. Shad have difficulty ascending the ladders through submerged orifices. Once shad passage at Bonneville Dam exceeds 5,000 per day, fish ladders at JDA increase the

ladder flow through diffuser #5 at the SFL to 1.3’ over the overflow weirs to aid shad in their passage. The 10year average of shad operation at JDA is 54 days and ranged from 22 May to 4 August (See Table 4).

Shad Mode Timeframes		
Year	Start	End
2012	6-Jun	11-Jul
2013	22-May	8-Jul
2014	22-May	16-Jul
2015	26-May	15-Jul
2016	1-Jun	18-Jul
2017	5-Jun	20-Jul
2018	24-May	23-Jul
2019	30-May	29-Jul
2020	4-Jun	4-Aug
2021	3-Jun	20-Jul
2022	31-May	21-Jul
AVG	29-May	19-Jul

Table 4: Operating range of fish ladders at JDA for American Shad at 1.3’ over weirs.

Conclusion:

Between June and September, the JDA SFL experiences frequent warm water periods (≥70°F at the SFL exit). During this time the SFL exit is typically warmer than the entrance and differentials >6.5°F have been observed. Figure 15 compares the entrance-exit temperature differentials observed in 2019 and 2022 to temperature differentials between the entrance and deeper parts of the forebay, suggesting water from different depths in the forebay could help to temper variations in entrance-exit differentials when the forebay is stratified.

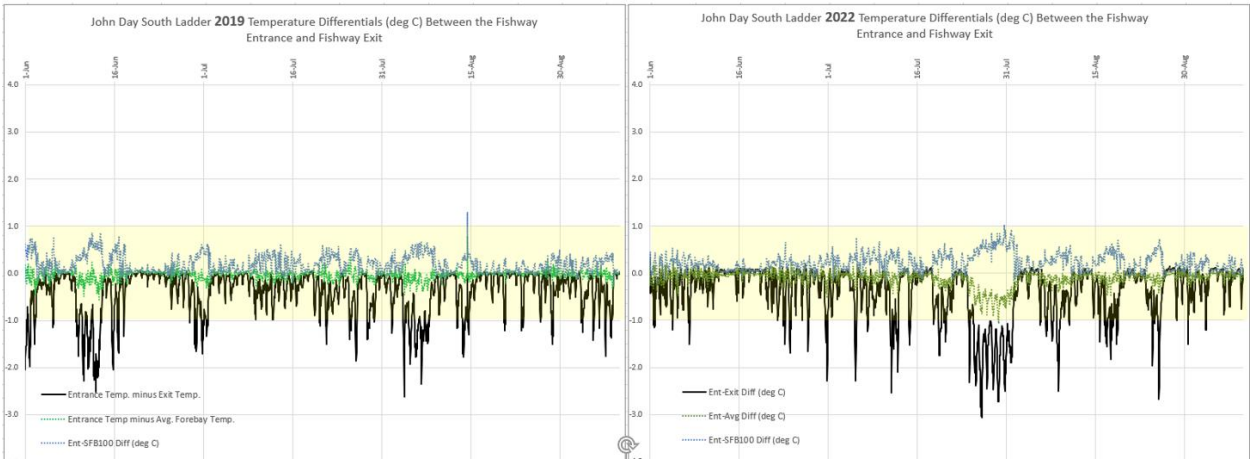


Figure 15 33*: Comparison of entrance: exit, entrance: forebay@100', and entrance: forebay avg. temperature differentials for JDA south ladder in 2019 and 2022. Blue dotted lines: If all the water entering the JDA South fish exit came from a depth of 100 feet in 2019 and 2022, the exit temperature may have been consistently cooler than the entrance temperature. Green dotted lines: If all the water entering the JDA South fish exit came from a depth of 40-50 feet deep, or the forebay water column at the JDA South fish exit was well-mixed (homogenous temperature top-to-bottom), in 2019 and 2022, we may have seen fewer occurrences of differentials >1 degree C.*

Adult salmonids migrating above JDA typically experience different ladder operations between June and July than those migrating between August and September. Within warm water periods, ladder temperature differentials ≥1°C are typically observed more frequently between August and September (exceptions being 2015 and 2021). The exact impacts this has on SFL salmonid passage are unknown.

Temperature differentials between the exit and entrance of the South Fish Ladder at John Day Dam have been documented in 2018 and 2019. In 2022, JDA personnel deployed a forebay temperature string at JDA-SS-2 (same location as the 2018 and 2019 Lundell study) and deployed additional temperature probes within the SFL. Temperature differentials again were observed exceeding 1.0°C between the exit and entrance in 2022. The forebay string also indicated stratification near the ladder exit with cooler water below the 70’ depth.

Recommendations:

The USACE recommends proceeding with the USACE design process and initiating an Engineering Documentation Report (EDR) to evaluate alternatives for cooling the SFL exit. Some key questions heading into the EDR development:

- How much cool water exists at depth in the JDA forebay to help cool the ladder exit, and what is the temporal availability relative to adult run timing?
- What is the expected year-to-year variability of the success of a ladder cooling structure (i.e., in the critical hot and/or dry years)?

The available data does not suggest the thermal gradients and maximum temperatures observed in the SFL at JDA are resulting in a passage problem. While we recognize the temperature differentials between the entrance and the exit, we do recommend additional analysis of fish passage at JDA while alternatives are being evaluated during the EDR process.

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