2018 JUVENILE SAMPLE AND BYPASS REPORT
MCNARY PROJECT JUVENILE FISH FACILITY

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United States Army Corps of Engineers
McNary Lock and Dam
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ESBS – extended-length submersible bar screen
COE-Corps of Engineers
FPP-Fish Passage Plan
GBT – gas bubble trauma
JCC – Juvenile Collection Channel
JFF – Juvenile Fish Facility
OOS– out of service
PIT – Passive Integrated Transponder
PLC– programmable logic controllers
PNNL-Pacific Northwest National Laborites
PSMFC – Pacific States Marine Fisheries Commission
TMT-Technical Management Team
TSW-Top-over Spill Weir
USDA-WS-United States Department of Agriculture-Wildlife Services
VBS – vertical barrier screen

SUMMARY

This report summarizes the juvenile bypass and sample collection operations of McNary Project. New this year: Separator adult fallbacks have been moved to the Adult Report., and juvenile Pacific lamprey now have their own section. Tables related to sampling now contain averages.

FACILITY INTRODUCTION AND DESCRIPTION

McNary Dam is located at river mile 292 on the Columbia River and is the first dam downstream of the confluence of the Snake and Columbia Rivers. McNary has 14 turbine units. To bypass the turbines, the juvenile system begins with trash racks, extended length submersible bar screens (ESBS) and vertical barrier screens (VBS). When fish enter the turbines' intake, they are diverted into the gatewell slots. Each unit has three gatewell slots. Each gatewell slot has two orifices with one being open. The fish pass through these twelve-inch orifices to the juvenile collection channel.

The channel flow runs from north to south. The dewatering structure and associated equipment are at the southern end of the powerhouse. Here there are the two side-dewatering valves, which regulate the channel elevation. There is also a set of three floor-dewatering valves, which remove excess water. Finally, there is the 48-inch juvenile facility supply line. All flow is gravity fed.

Bar screen in the side and on the floor of the channel retains fish and allows the excess water to be removed. The screen is kept cleaned by the side, rectangular and transition brushes. All systems are controlled by a program logic controller. In the transition area, the channel funnels down to the full flow transport flume/pipe where the fish and debris exit. The transport flume takes the fish to the facility or returns them to the river. Just upstream for the separator is the primary bypass gate. This gate is used during fish passage season to switch between primary (fish go directly back to the river) and secondary bypass (a percentage of fish are sampled fish with the remainder returned to the full flow pipe and river).

During secondary bypass, a cohort of fish are sampled for smolt indexing and condition evaluation during the fish passage season. Sampling is conducted every other day at the Juvenile Fish Facility (JFF). The separator sorts the fish by size with the small smolts exiting down the A flume and the large smolts going down the B flume. Adult salmonids and other miscellaneous fish are released at the separator's return to river line into the full flow pipe/flume. (Adult fish passing through the separator are summarized in a separate adult report.) The outfall pipe terminates in the tailwater approximately 1,100 feet downstream of the McNary Project in the center of the river channel. The sample gates divert 0.5% to 25% of the passing fish in the A and B lines into holding tanks where they are held for up to 24 hours before being enumerated and examined for injury and disease. The percentage of fish sampled is adjusted to achieve at least 100 individuals of the predominant salmonid smolt species passing through the JFF. An estimation of the number

and condition of the bypassing population is calculated from the sampled cohort. The sampled smolts are then held temporarily in a recovery raceway before being released to the tailrace via lines that tie back into the outfall pipe.

Downstream of the separator in the A and B flumes are the passive integrated transponder (PIT) tag gates, the sample gates and the secondary bypass gates (which tie the A and B lines back into the full flow flume/pipe). The A and B sides each have a set of sample and PIT tag systems. Inside the building is the wet lab where the sample is examined. The full flow flume/pipe, adult return line and all facility lines have PIT tag detectors with the remainder of the PIT system inside the building.

Finally, in spillbays 19 and 20, there are top spillway weirs (TSW). In the spring, the TSWs improve fish passage through the spillway.

FACILITY MODIFICATIONS/MAINTENANCE & IMPROVEMENTS

Maintenance and improvements for the winter of 2017-2018 made to enhanced system performance over previous seasons are listed:

Juvenile collection channel (JCC) contract:

1. Side screen cleaning brush rehabilitated. Main feature was new electrical cord carrier.
2. Rectangular screen cleaning brush rehabilitated.
3. Transition screen cleaning brush rehabilitated. Main feature was new drive system.
4. Transition screen air burst zones 5 and 6 added. Zone 6 was removed due to location.
5. Airline system desiccant drier.
6. Actuators replaced on all three floor valve drains.
7. Control room annunciation improved.
8. Control system modified/improved.
9. Two bridge crane supports protected.
10. One hoist installed on bridge crane.
11. The two orifice traps at units 4 and 5 removed.
12. Four forebay debris shields reinstalled.

Collection channel/powerhouse:

1. Airline bleeders improved.
2. Still wells for temperature probes installed.
3. Three orifice covers reconditioned.
4. Water elevation meter brackets and shroud rehabilitated.
5. Wiring, motors and gearboxes were replaced on ESBSs as needed.
6. VBS rehabilitation continued.
7. Orifice attraction lighting, orifice operators and area lighting replaced/repaired as needed.
8. Digital thermometer, which later failed, was installed in the cooling water line at unit 1.

Juvenile Fish Facility/full flow pipe:

1. Camera inspection of flume flow pipe/flume. No major problems found.
2. Three access hatches in flow pipe in underground section secured properly.
3. Sample and PIT tag systems rehabilitated as needed.
4. Flume gaskets replaced as needed.
5. Airline leaks repaired as needed.
6. Truck loading line leak repaired.
7. Slope of gas bubble trauma (GBT) line from separator to wet lab adjusted.
8. Still wells for temperature probes installed.
9. New heat pump was installed in the separator observation building.
10. Sample tank crowding devices rehabilitated as needed.
11. Sample tank gaskets replaced.
12. New sample tank netting installed.
13. Minor sample system improvements.
14. Unused equipment removed from the wet lab.
15. Wet lab trough painted.

Other maintenance items during the year were:

1. New temperature station installed at facility.
2. Wet lab floor waxed and sealed as needed.
3. GBT monitoring station improved.
4. Barge loading line flex hose leak repaired.
5. Flume gaskets trimmed as needed.
6. Facility roof tear repaired.
7. Winterization drain on "A" side add in line repaired.
8. GBT line to wet lab repaired.
9. Walkway grating retaining clips installed as needed.
10. New drive gear installed on "B" side sample tank crowding screen.
11. Avian spikes installed on top of the navigation lock wing wall light fixtures.
12. Orifice attraction lights and operator air leaks were replaced and/or repaired as needed.
13. Separator upwell supply valve rehabilitation began and should conclude February, 2019.
14. New cooling water strainers and environmental friendly lubricant installed in units.
15. Station service upgrades continued, which will improve electrical reliability to systems.

Miscellaneous maintenance and winterization occurred as needed. Other maintenance issues may be covered in the remaining text of this report. During all dewatering and maintenance, no invasive mussels were observed.

RIVER CONDITIONS

River Flow

Daily average total river flow, powerhouse flow, and spill were compiled from April 3 to September 30. The average included hourly values collected from 0700 hours of the previous day to 0700 hours of the current day. Figure 1, below, shows river flow was above the 10-year average until the end of May and mostly below the 10-year average through

September. The 2018 maximum daily average for total river flow was 504.7 kilo cubic feet per second (kcfs) recorded on May 25. Maximum daily average for powerhouse flow was 169.7 kcfs on April 9 and for spill was 371.8 kcfs on May 16. Minimum daily average for total river flow was 67.5 kcfs on September 24, and minimum daily average for powerhouse flow was 51.7 kcfs on June 15. Minimum daily average for spill, when spill occurred, was 29.0 kcfs on April 3. Spill was discontinued at 2400 hours on August 31. Tables 1 and 2, below, summarize river flow for the 2018 season.

Figure 1. Total River Flow April 3 to September 30, 2018 and 10-Year Average.

Table 1. Average Monthly River Flows, 2018.

Month	Total Flow (kcfs)	Powerhouse (kcfs)	Spill (kcfs)
April	267.1	109.6	153.0
May	441.9	149.4	288.1
June	283.5	126.6	152.4
July	182.6	86.5	91.4
August	144.6	67.4	72.5
September	92.0	85.9	1.3

Table 2. Season Start, End, Seasonal Average, Maximum, and Minimum River Flows, 2018.

	Total Flow (kcfs)	Powerhouse (kcfs)	Spill (kcfs)
Season Start (April 3)	184.9	151.5	29.0
Season End (September 30)	76.0	71.3	0.0
Season Average	235.3	104.1	126.6
Maximum (Date)	504.7 (25-May)	169.7 (9-Apr)	371.8 (16-May)

	Total Flow (kcfs)	Powerhouse (kcfs)	Spill (kcfs)
Minimum	67.5	51.7	29.0
(Date)	(24-Sep)	(15-Jun)	(3-Apr)*

Note: *Minimum spill only considered for dates when spill occurred.

River Temperatures

River temperature was recorded at 0700 hours daily in Sample Tank "B" at the JFF from April 3 to September 30. The maximum temperature was 71.5 °F on August 10. The minimum temperature was 43.8°F on April 3. Tables 3 and 4, below, summarize river temperatures. The water temperature monitoring program is summarized in a separate annual report.

Table 3. Average Monthly River Temperatures, 2018.

Month	River Temperature (°F)
April	47.1
May	54.3
June	61.0
July	67.9
August	70.1
September	66.5

Table 4. Season Start, End, Average, Maximum, and Minimum River Temperatures, 2018.

Date	River Temperature (°F)
Season Start (April 3)	43.8
Season End (September 30)	63.4
Season Average	61.3
Maximum (Date)	71.5 (10-Aug)
Minimum (Date)	43.8 (3-Apr)

JUVENILES BYPASS

Migration, Sampling and Bypass of Juvenile Salmonids

Some of the smolts entering the powerhouse are diverted to a juvenile bypass system, from which a subset of smolts are sampled. Bypass numbers represent the estimated number of smolts navigating the dam, calculated from the number of smolts in the sample, mortality and the corresponding sample rate. Smolt enumeration occurred every other day when in secondary bypass during the season. Bypass totals do not include smolts passing during primary bypass or other operations.

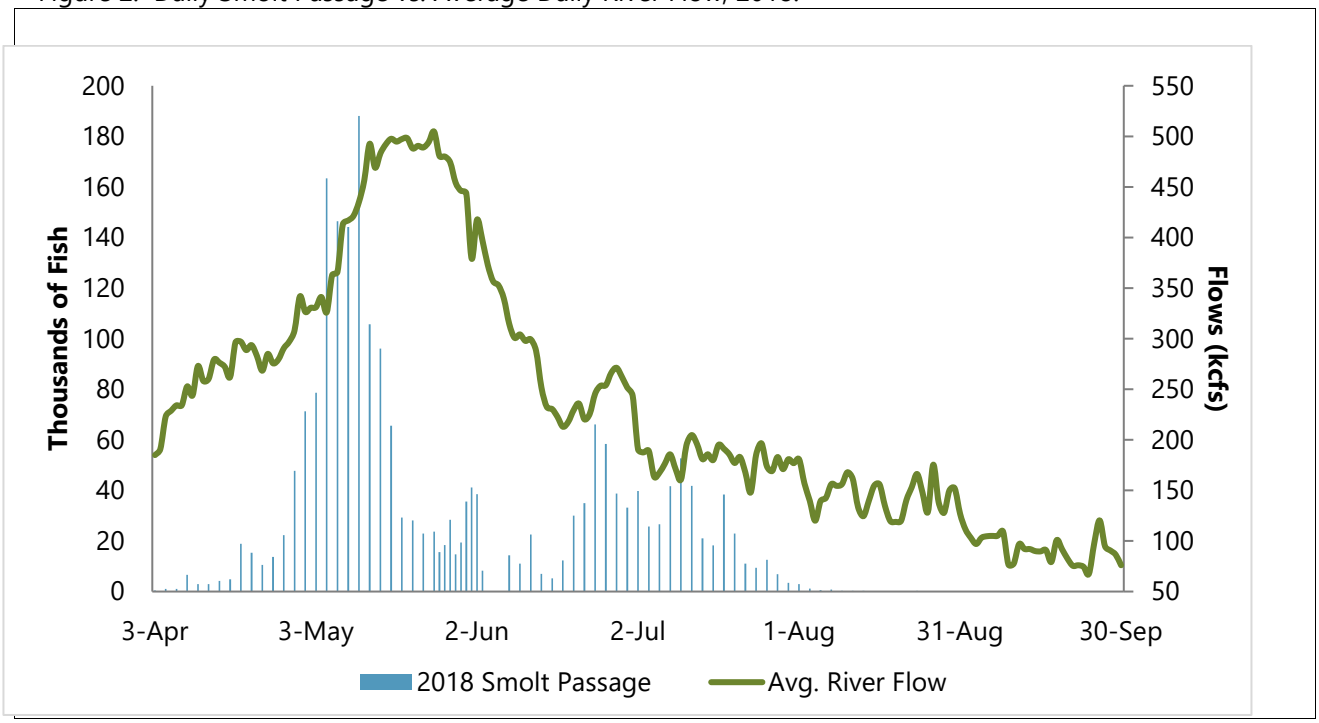
The JFF bypassed 2,249,776 smolts during the 2018 season. The estimated number of smolts passing during the 2018 season was lower than the 5-year average (Table 5, below). Figure 2, below, compares total salmonid smolts bypassed to the river flow.

Bypass operations are in the Operations and Maintenance Section below.

Table 5. Bypassed Smolts by Species and Clip Type, 2018-2014 and 5-Year Average.

Bypassed											
	Yearling Chinook		Subyearling Chinook		Steelhead		Coho		Sockeye		Total
Year	Clip	Unclip	Clip	Unclip	Clip	Unclip	Clip	Unclip	Clip	Unclip	
2018	441,979	115,619	342,099	631,648	70,293	20,273	37,342	44,674	5,367	540,482	2,249,776
2017	421,423	147,964	301,890	835,622	125,516	39,738	6,975	24,595	700	55,533	1,959,956
2016	946,054	276,893	615,476	1,540,617	323,425	88,826	7,346	81,863	5,249	489,026	4,374,775
2015	622,939	164,455	221,314	552,241	212,435	55,098	8,104	30,780	2,300	73,506	1,943,172
2014	705,468	298,186	784,179	1,622,410	230,028	66,388	7,825	61,134	3,350	682,999	4,461,967
5 YR AVG	627,573	200,623	452,992	1,036,508	192,339	54,065	13,518	48,609	3,393	368,309	2,997,929

Figure 2. Daily Smolt Passage vs. Average Daily River Flow, 2018.



The predominant species collected in 2018 was Chinook salmon (43.3% subyearling Chinook salmon and 24.8% yearling Chinook salmon). Table 6, below, summarizes the number of juvenile salmonids collected by species and clip type for 2018 and a 5-year comparison.

Table 6. Collected Smolts by Species and Clip Type, 2018-2014 and 5-Year Average.

Collected											
	Yearling Chinook		Subyearling Chinook		Steelhead		Coho		Sockeye		Total
Year	Clip	Unclip	Clip	Unclip	Clip	Unclip	Clip	Unclip	Clip	Unclip	
2018	442,017	115,631	342,127	631,747	70,299	20,275	37,344	44,677	5,368	540,514	2,249,999
2017	421,455	147,973	301,905	835,722	125,531	39,744	6,975	24,595	701	55,538	1,960,139
2016	946,286	277,020	615,504	1,540,736	323,457	88,842	7,346	81,881	5,250	489,121	4,375,443
2015	622,962	164,467	221,778	552,880	212,457	55,104	8,105	30,781	2,300	73,513	1,944,347
2014	706,087	298,509	784,430	1,622,853	230,095	66,411	7,825	61,157	3,350	683,687	4,464,404
5 YR AVG	627,761	200,720	453,149	1,036,788	192,368	54,075	13,519	48,618	3,394	368,475	2,998,866

Juvenile salmonids exhibit a wide range of migration strategies that vary in their seasonal timing and age at migration onset. At McNary Project, this translates into two semi-distinct peaks in the number of smolts, one in the spring and one in the summer, though annual variation exists. The spring migration is typically dominated by yearling Chinook salmon, steelhead, sockeye salmon, and coho salmon smolts. Subyearling Chinook salmon fry are also present. The summer migration is primarily subyearling Chinook salmon smolts. The spring bypass peak occurred on May 11, and comprised 65.5% sockeye salmon, 25.4% yearling Chinook salmon, 4.7% coho salmon, 3.3% subyearling Chinook salmon, and 1.1% steelhead. The summer bypass peak occurred on June 24, and comprised 99.4% subyearling Chinook salmon, 0.3% yearling Chinook salmon, and 0.3% steelhead. Collection peaks for each species are summarized in Table 7, below.

Table 7. Peak Collection Dates by Species and Clip Type, 2018-2014.

Peak Collection Dates									
Year	Yearling Chinook	Subyearling Chinook	Clipped Steelhead	Unclipped Steelhead	Coho	Clipped Sockeye	Unclipped Sockeye	Total Smolts	Juvenile Lamprey
2018	5-May 75,552	24-Jun 65,697	5-May 8,500	5-May 2,650	5-May 11,750	25-May 1,000	11-May 123,200	11-May 188,101	19-May 40,400
2017	3-May 49,480	2-Jul 8,100	27-Apr 19,632	29-Apr 3,200	19-May 3,500	19-May 275	29-May 7,200	2-Jul 81,200	15-May 6,800
2016	3-May 163,307	28-Jun 478,503	1-May 46,205	1-May 9,000	13-May 9,002	25-May 1,950	11-May 72,606	28-Jun 478,503	17-Apr 3,200
2015	5-May 155,901	6-Jul 151,601	5-May 29,203	9-May 5,000	23-May 4,000	23-May 800	25-May 9,600	5-May 195,504	8-June/24-June 800
2014	11-May 194,300	2-Jul 264064	1-May 36,600	11-May 7,800	21-May 9,204	23-May 2,200	19-May 110,059	11-May 300,558	4-Jun 6,350

Sampling for smolt migration indexing and condition evaluation was conducted every other day from April 3 to September 30, 2018. (The sample was collected the day before.) The sample rate was adjusted to allow at least 100 individuals of each of the predominant salmonid species to be sampled. There were 27,919 smolts sampled, comprising 34.1% yearling Chinook salmon, 29.5% subyearling Chinook salmon, 22.8% sockeye salmon, 9.0%% steelhead, and 4.7% coho salmon. The number of sampled fish is listed by species and clip type in Table 8, below.

Table 8. Sampled Smolts by Species and Clip Type, 218-2014.

Sampled											
	Yearling Chinook		Subyearling Chinook		Steelhead		Coho		Sockeye		Total
Year	Clip	Unclip	Clip	Unclip	Clip	Unclip	Clip	Unclip	Clip	Unclip	
2018	6,789	2,719	2,447	5,783	1,922	578	428	882	124	6,247	27,919
2017	3,675	1,823	2,121	8,724	1,524	490	70	304	22	483	19,236
2016	5,744	2,485	2,204	9,564	2,549	1,120	57	668	94	2,820	27,305
2015	5,065	2,134	1,085	4,423	2,044	513	46	417	12	637	16,376
2014	4,055	2,273	4,522	12,423	1,588	610	57	510	27	4,151	30,216
5 YR AVG	5,066	2,287	2,476	8,183	1,925	662	132	556	56	2,868	24,210

The average sample rate for the season was 8.9%. Table 9, below, summarizes average monthly and seasonal sample rates. Sampling issues and sample rates set to support PNNL research are in the JFF Sample System Section below.

Table 9. Average Monthly and Seasonal Sample Rate, 2018.

Month	Rate (%)
April	10.8%
May	1.6%
June	0.9%
July	0.6%
August	21.6%
September	19.0%
Season Average	8.9%

Migration, Sampling and Bypass of Juvenile Lamprey

Due to an increased interest in lamprey populations in more recent years, lamprey data is being collected more thoroughly. In previous years, lamprey were found in the incidentals section of the annual report. Lamprey identification largely depends on the number, position and structure of the teeth found within the mouth. The primary species found at McNary Project is the Pacific lamprey.

Downstream migrating lamprey metamorphosis from the larvae stage (ammocoetes) to the juvenile stage (macropthalmia) generally occurs over several months as they develop eyes, teeth and become free swimming. It is the macropthalmia stage that is primarily sampled at the JFF. Collected, sampled and mortality for Pacific lamprey juvenile life stages are presented in Table 10, below. In addition, the 5-year average of collected, sampled and mortality are also presented. Mortality includes sample tank mortality only.

Table 10. Pacific Lamprey Collected, Sampled, and Mortality, 2018.

Year	2018	2017	2016	2015	2014	5 YR AVG
Collected	226,628	33,257	34,791	9,027	59,953	72,731
Sampled	2,024	408	378	213	985	802
Mortality	35	11	19	7	22	19

Incidental Species Sampled (Including Adults)

Non-target fish and invertebrates are sampled with target species. They were weighed, measured, and counted at the time as the every-other-day smolt sampling. Juvenile American shad were the most prevalent incidental species encountered in 2018, followed by Pacific lamprey macropthalmia (*Entosphenus tridentatus*) and smallmouth bass (*Micropterus dolomieu*). Juvenile American shad were first sampled on July 16. Their numbers were manually counted until the population became too high to make it feasible. From August 5 to September 30 they were enumerated using a weighing technique. Seven Siberian prawn (*Exopalaemon modestus)* were encountered in the sample and euthanized throughout the sampling period. All other incidental species sampled were passed to the tailrace. Table 11, below, summarizes incidental species sampled for the 2018 season as well as 2014-2017 seasons.

Table 11. Incidental Species Sampled, 2108-2014.

Incidental Species						
Common Name	**Species**	**2018**	**2017**	**2016**	**2015**	**2014**
Pacific Lamprey (Adult)	*Entosphenus tridentatus*	6	14	9	8	3
Pacific Lamprey (Macropthalmia)	*E. tridentatus*	2,021	406	378	213	985
Pacific Lamprey (Ammocoete)	*E. tridentatus*	3	2	0	0	1
American Shad (Adult)	*Alosa sapidissimia*	10	4	1	2	6
American Shad (Juvenile)	*Alosa sapidissimia*	336,798	137,630	85,598	40,316	143,599
Bluegill/Pumpkin Seed	*Lepomis spp.*	29	158	18	184	3
Bullhead	*Ameiurus spp.*	22	1	6	13	4
Common Carp	*Cyprinus carpio*	3	97	3	3	7
Channel Catfish	*Ictalurus punctatus*	21	4	11	9	8
Chinook salmon (Mini-jack)	*Oncorhynchus tshawytscha*	0	0	4	2	0
Chiselmouth	*Acrocheilus alutaceus*	0	0	0	0	1
Crappie	*Pomoxis spp.*	3	7	7	7	0
Crayfish	*Pacifastacus spp.*	3	1	3	25	7
Banded Killifish	*Fundulus diaphanus*	56	87	7	0	0
Kokanee	*O. nerka*	1	1	0	0	0
Longnose Dace	*Rhinichthys cataractae*	2	9	6	13	12
Speckled Dace	*R. osculus*	2	0	0	0	0
Umatilla Dace	*R. umatilla*	0	1	0	0	0
Northern Pikeminnow	*Esoxlucius* Linnaeus	0	2	0	0	0
Mountain Whitefish	*Prosopium williamsoni*	9	23	3	3	7
Mountain Sucker	*C. platyrhynchus*	1	1	0	0	0
Peamouth	*Mylochelius caurinus*	0	14	8	58	22
Redside Shiner	*Richardsonius balteatus*	0	0	0	0	2
Sculpin	*Cottus spp.*	0	0	7	6	1
Sandroller	*Percopsis transmontana*	0	0	0	2	0
Siberian Prawn	*Exopalaemon modestus*	7	2	21	120	5
Largemouth Bass	*Micropterus salmoides*	0	2	0	1	0
Smallmouth Bass	*Micropterus dolomieu*	78	224	148	60	68
Clipped Steelhead Kelt	*O. mykiss*	0	1	0	0	0
Unclipped Steelhead Kelt	*O. mykiss*	1	1	0	4	1
Sturgeon	*Acipenser spp.*	0	0	1	0	0
Sucker	*Catostomus spp.*	0	0	2	1	1
Bridgelip Sucker	*Catostomus columbianus*	0	2	0	0	0
Three-spine Stickleback	*Gasterosteus aculeatus*	22	33	91	275	161
Tench	*Tinca tinca*	0	3	0	0	0
Walleye	*Stizostedion vitreum*	20	3	3	11	1
Yellow Perch	*Perca flavescens*	33	12	5	6	1
Totals		339,151	138,745	86,340	41,342	144,906

Separator Efficiency

The separator is designed with varying bar spacing to allow some separation of juvenile fish by size and to separate juvenile fish from adult fish. Smaller fish can divert through either

narrowly spaced bars in the upstream "A" section of the separator, or wider spaced bars of the downstream "B" section. Larger juvenile fish must divert through the wider spaced bars. Adult fish that are too large to pass through the bars are manually released from the separator to the tailrace. After separation, the smolts are either bypassed to the tailrace via the JFF flume system to the outfall pipe or the smolts are sampled and held for up to 24 hours, examined, then released to the tailrace after recuperating in the recovery raceway. The separator efficiency measures the percentage of sampled smolts segregated into the desired sample holding tank. The seasonal separator efficiency is summarized in Table 12, below.

Table 12. Separator Efficiency, 2018.

	Yearling Chinook	Subyearling Chinook	Steelhead	Sockeye	Coho
Desired Sample Tank	A	A	B	A	A
Efficiency (%)	26.2%	38.3%	85.2%	11.5%	17.4%

FISH CONDITION

Descaling

All sampled salmonid smolts greater than 60 millimeters in total length were examined for descaling. A smolt with descaling greater than or equal to 20% of the area on one side of its body was recorded as descaled. The descaling rate for all species combined was 3.2% for the 2018 season. The highest monthly descaling rate for all salmonid species combined (6.9%) was recorded in September. Total descaling rates for all juvenile salmonid species and clip type are summarized in Table 13, below.

Table 13. Percentage Weekly Descaling and Count of Descaled Smolts Sampled, 2018-2014.

Weekly Descaling in Percent and Actual Count of Descaled Fish Sampled																	
2018 Week Ending Date	Current YR	Yearling Chinook		Subyearling Chinook		Clipped Steelhead		Unclipped Steelhead		Coho		Clipped Sockeye		Unclipped Sockeye		Total	
Week Number	4 YR AVG (2014-2017)	# Count	% Descaled	# Count	% Descaled	# Count	% Descaled	# Count	% Descaled	# Count	% Descaled	# Count	% Descaled	# Count	% Descaled	# Count	% Descaled
5-Apr	2018	11	4.4%	--	--	1	10.0%	4	8.2%	0	0.0%	0	0.0%	0	0.0%	16	4.6%
1	AVG	10	3.4%			8	6.8%	3	3.6%	1	2.7%	--	--	1	11.1%	21	4.2%
12-Apr	2018	33	2.0%	--	--	30	10.0%	5	3.3%	5	6.3%	0	0.0%	2	7.4%	75	3.4%
2	AVG	22	2.7%			17	6.5%	3	2.0%	2	3.3%	--	--	2	5.3%	44	3.5%
19-Apr	2018	45	4.2%	--	--	36	5.3%	3	3.9%	1	3.6%	--	--	3	9.7%	88	4.7%
3	AVG	27	2.9%			15	3.6%	3	3.3%	1	2.1%			4	3.0%	49	3.1%
26-Apr	2018	36	6.9%	--	--	22	9.3%	2	6.5%	4	5.9%	--	--	0	0.0%	64	7.3%
4	AVG	27	3.0%	0	0.0%	8	3.1%	1	2.1%	1	2.8%	0	0.00%	6	3.7%	42	3.0%
3-May	2018	31	2.0%	--	--	17	4.7%	1	1.3%	4	2.6%	--	--	6	1.0%	59	2.2%
5	AVG	53	3.3%	0	0.0%	15	3.6%	3	3.6%	0	0.7%	0	0.00%	12	5.8%	83	3.5%
10-May	2018	67	4.6%	0	0.0%	15	8.5%	3	5.9%	9	4.9%	--	--	42	2.3%	136	3.7%
6	AVG	55	4.6%	0	0.0%	10	5.4%	2	3.2%	1	2.1%	0	0.00%	49	9.4%	116	5.8%
17-May	2018	30	2.0%	0	0.0%	10	16.9%	2	4.2%	9	2.7%	0	0.00%	47	2.0%	98	2.3%
7	AVG	23	3.8%	1	1.9%	6	4.9%	2	4.8%	5	4.6%	0	0.0%	58	10.5%	94	6.4%
24-May	2018	69	5.8%	2	1.2%	12	17.6%	7	11.3%	15	4.9%	6	8	45	4.2%	156	5.3%
8	AVG	10	3.7%	3	1.1%	7	9.2%	4	6.2%	3	3.0%	2	8.0%	29	12.6%	57	5.6%
31-May	2018	3	1.3%	8	0.9%	2	13.3%	3	10.3%	2	2.2%	4	10	11	3.6%	33	2.1%
9	AVG	8	4.9%	9	2.2%	3	8.2%	2	4.7%	5	5.0%	2	12.5%	19	12.2%	47	5.2%
7-Jun	2018	2	6.1%	2	0.6%	1	33.3%	--	--	1	8.3%	0	0	0	0.0%	6	1.4%
10	AVG	3	4.0%	19	2.9%	3	8.1%	1	3.3%	1	2.6%	0	0	3	12.5%	29	3.4%
14-Jun	2018	0	0.0%	9	2.1%	2	40.0%	0	0.0%	1	7.1%	--	--	0	0.0%	12	2.6%
11	AVG	1	6.0%	16	1.9%	1	10.3%	0	10.0%	0	0.0%			2	34.8%	20	2.3%
21-Jun	2018	0	0.0%	23	2.6%	1	20.0%	0	0.0%	0	0.0%	--	--	0	0.0%	24	2.7%
12	AVG	0	0.0%	18	1.3%	1	13.6%	1	40.0%	0	14.3%			0	0.0%	20	1.5%
28-Jun	2018	0	0.0%	13	1.1%	0	0.0%	--	--	0	0.0%	--	--	--	--	13	1.1%
13	AVG	1	20.0%	17	0.8%	1	16.7%	0	0.0%	0	16.7%			1	28.6%	20	1.0%
5-Jul	2018	--	--	8	1.6%	--	--	--	--	--	--	--	--	--	--	9	1.8%
14	AVG	1	50.0%	19	1.4%	0	0.0%							1	33.3%	20	1.5%
12-Jul	2018	--	--	7	0.9%	--	--	--	--	--	--	0	0.0%	1	100.0%	8	1.0%
15	AVG			10	1.3%			0	0.0%			--	--	0	0.0%	10	1.3%
19-Jul	2018	--	--	10	2.6%	--	--	--	--	--	--	--	--	--	--	10	2.6%
16	AVG			10	1.8%	1	25.0%							0	0.0%	10	1.8%
26-Jul	2018	--	--	2	0.5%	--	--	--	--	--	--	--	--	--	--	2	0.5%
17	AVG			11	1.9%	0	0.0%			1	100.0%			0	0.0%	12	2.1%
2-Aug	2018	--	--	12	4.8%	--	--	--	--	--	--	--	--	--	--	12	4.8%
18	AVG			7	1.2%	0	0.0%							0	0.0%	7	1.1%
9-Aug	2018	--	--	15	4.0%	--	--	--	--	--	--	--	--	--	--	15	4.0%
19	AVG			8	2.5%	0	0.0%							0	0.0%	8	2.5%
16-Aug	2018	--	--	11	6.6%	--	--	--	--	--	--	--	--	0	0.0%	11	6.5%
20	AVG			6	2.6%	0	0.0%							0	0.0%	6	2.6%
23-Aug	2018	--	--	3	1.9%	--	--	--	--	--	--	--	--	--	--	3	1.9%
21	AVG			5	4.3%	0	0.0%									5	4.2%
30-Aug	2018	--	--	5	5.6%	--	--	--	--	--	--	--	--	--	--	5	5.6%
22	AVG			4	2.0%	0	0.0%							0	0.0%	4	1.9%
6-Sep	2018	--	--	7	5.6%	--	--	--	--	--	--	--	--	--	--	7	5.6%
23	AVG			5	5.9%									0	0.0%	5	5.8%
13-Sep	2018	--	--	3	6.0%	--	--	--	--	--	--	--	--	--	--	3	6.0%
24	AVG			0	0.5%									0	0.0%	0	0.5%
20-Sep	2018	--	--	2	5.9%	--	--	--	--	--	--	--	--	--	--	2	5.9%
25	AVG			1	3.6%			0	0.0%					1	50.0%	2	5.0%
27-Sep	2018	--	--	2	28.6%	--	--	--	--	--	--	--	--	--	--	2	28.6%
26	AVG			1	4.1%	1	0.0%									1	3.9%

Other Injury and Disease

Sub-samples of up to 100 smolts per species from the daily sample were examined for conditions including injuries, diseases, and predator marks. All individuals of a species were examined from the sample if 100 or fewer individuals were present. Injuries included recently acquired damage to the head, eyes, body, and fins possibly attributable to dam operations. Diseases included fungus, columnaris, bacterial kidney disease, parasites, and deformities of the spine, operculum, or other body parts. Predator marks included injury or marks consistent with scratches or bites from birds, fish, or lamprey. Conditions reported here do not include descaling since descaling was calculated separately for all sampled smolts.

Out of 11,701 smolts examined in the sub-sample, 7.6% were observed with at least one condition and less than 1% had multiple conditions. Table 14, below, summarizes the prevalence of conditions in examined fish for 2018. Disease was present in 5.0% of fish examined. The trematode parasite responsible for blackspot, the most common disease noted, affected 4.1% of smolts examined. Blackspot was most predominant in subyearling Chinook salmon (472 fish), but it was also observed in steelhead (3 fish) and coho salmon (1 fish). Table 15, below, summarizes the number and percentage of smolts observed with disease by species. Injuries were observed in 1.6% of smolts. Yearling Chinook salmon experienced the highest injury rate at 2.7% followed by coho salmon (1.7%), steelhead (1.5%), subyearling Chinook salmon (1.2%), and sockeye salmon (1.1%). Table 16, below, summarizes the numbers and percentage of injuries by species. Predator marks were present in 1.3% of smolts, with bird marks being the most prevalent predator mark observed. Steelhead were observed to have the highest rate of predator marks of all species examined at 4.2%, largely attributed to bird marks. Table 17, below, summarizes the number and type of predator mark sustained by species in 2018.

Table 14. Summary of Smolt Conditions Excluding Descaling in Subsample, 2018.

	Yearling Chinook				Subyearling Chinook				Steelhead				Coho				Sockeye				Total	
	Clip		Unclip		Clip		Unclip		Clip		Unclip		Clip		Unclip		Clip		Unclip			
	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%
Total Conditions	104	—	50	—	51	—	542	—	88	—	23	—	8	—	32	—	4	—	26	—	928	—
	Yearling Chinook				Subyearling Chinook				Steelhead				Coho				Sockeye					
	#		%		#		%		#		%		#		%		#		%			
	154		—		593		—		111		—		40		—		30		—			
Smolts with Conditions	99	5.0%	47	5.7%	51	4.2%	526	16.5%	81	6.7%	22	5.3%	8	2.0%	28	3.7%	4	6.1%	26	1.5%	892	7.6%
	Yearling Chinook				Subyearling Chinook				Steelhead				Coho				Sockeye					
	#		%		#		%		#		%		#		%		#		%			
	146		5.2%		577		13.1%		103		6.4%		36		3.1%		30		1.7%			
Total Smolts Examined	Yearling Chinook				Subyearling Chinook				Steelhead				Coho				Sockeye					
	Clip		Unclip		Clip		Unclip		Clip		Unclip		Clip		Unclip		Clip		Unclip			
	1,962		823		1,213		3,181		1,207		415		391		757		66		1,686		11,701	
	Yearling Chinook				Subyearling Chinook				Steelhead				Coho				Sockeye					
	2,785				4,394				1,622				1,148				1,752					

Table 15. Number and Percentage of Smolts Observed with Disease in the Subsample, 2018.

	Yearling Chinook				Subyearling Chinook				Steelhead				Coho				Sockeye				Total	
	Clip		Unclip		Clip		Unclip		Clip		Unclip		Clip		Unclip		Clip		Unclip			
	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%
Total	38	1.9%	6	0.7%	38	3.1%	465	14.6%	13	1.1%	6	1.4%	4	1%	9	1.2%	1	1.5%	3	0.2%	583	5.0%
	Yearling Chinook				Subyearling Chinook				Steelhead				Coho				Sockeye					
	#		%		#		%		#		%		#		%		#		%			
	44		1.6%		503		11.4%		19		1.2%		13		1.1%		4		0.2%			

Table 16. Number and Percentage of Smolts Observed with Injury in the Subsample, 2018.

	Yearling Chinook				Subyearling Chinook				Steelhead				Coho				Sockeye				Total	
	Clip		Unclip		Clip		Unclip		Clip		Unclip		Clip		Unclip		Clip		Unclip			
	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%
Total	40	2.0%	36	4.4%	11	0.9%	42	1.3%	19	1.6%	5	1.2%	4	1.0%	15	2.0%	2	3.0%	18	1.1%	192	1.6%
	Yearling Chinook				Subyearling Chinook				Steelhead				Coho				Sockeye					
	#		%		#		%		#		%		#		%		#		%			
	76		2.7%		53		1.2%		24		1.5%		19		1.7%		20		1.1%			

Table 17. Number and Percentage of Smolts Observed with Predator Marks in the Subsample, 2018.

Predator Mark	Yearling Chinook				Subyearling Chinook				Steelhead				Coho				Sockeye				Total	
	Clip		Unclip		Clip		Unclip		Clip		Unclip		Clip		Unclip		Clip		Unclip			
	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%
Bird	12	0.6%	4	0.5%	1	0.1%	6	0.2%	54	4.5%	10	2.4%	0	0.0%	8	1.1%	1	1.5%	1	0.1%	97	0.8%
Fish	6	0.3%	4	0.5%	0	0.0%	15	0.5%	2	0.2%	2	0.5%	0	0.0%	0	0.0%	0	0.0%	3	0.2%	32	0.3%
Lamprey	6	0.3%	0	0.0%	1	0.1%	11	0.3%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	1	0.1%	19	0.2%
Total	Yearling Chinook				Subyearling Chinook				Steelhead				Coho				Sockeye				Total	
	#		%		#		%		#		%		#		%		#		%			
	24	1.2%	8	1.0%	2	0.2%	32	1.0%	56	4.6%	12	2.9%	0	0.0%	8	1.1%	1	1.5%	5	0.3%	148	1.3%
	32		1.1%		34		0.8%		68		4.2%		8		0.7%		4		0.3%			

Mortality

Total facility mortality comprises mortalities found in the separator, sample tanks, and the sample recovery raceway, and is expressed as the rate of mortality of the bypassed population. Total facility mortality for all species combined was <0.1% in 2018. August and September both had the highest monthly total mortality rate of 0.1%. Table 18, below, summarizes monthly and annual total facility mortality for 2018.

Table 18. Monthly and Total Facility Mortality, 2018.

Monthly and Total Facility Mortality																						
Month	Yearling Chinook				Subyearling Chinook						Steelhead				Coho				Sockeye				Total	
	Clip		Unclip		Clip		Unclip		Fry		Clip		Unclip		Clip		Unclip		Clip		Unclip			
	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%
April	15	<0.1%	5	<0.1%	--	--	--	--	6	0.3%	2	<0.1%	1	<0.1%	0	0.0%	0	0.0%	0	0.0%	1	<0.1%	30	<0.1%
May	23	<0.1%	7	<0.1%	3	<0.1%	6	<0.1%	36	<0.1%	3	<0.1%	0	0.0%	2	<0.1%	2	<0.1%	1	<0.1%	31	<0.1%	114	<0.1%
June	0	0.0%	0	0.0%	18	<0.1%	14	<0.1%	1	<0.1%	1	0.1%	1	0.2%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	35	<0.1%
July	0	0.0%	--	--	7	<0.1%	27	<0.1%	--	--	0	0.0%	--	--	--	--	1	0.5%	0	0.0%	0	0.0%	35	<0.1%
August	--	--	--	--	0	0.0%	8	0.1%	--	--	--	--	--	--	--	--	--	--	--	--	0	0.0%	8	0.1%
September	--	--	--	--	--	--	1	0.1%	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1	0.1%
Total	38	<0.1%	12	<0.1%	28	<0.1%	56	<0.1%	43	<0.1%	6	<0.1%	2	<0.1%	2	<0.1%	3	<0.1%	1	<0.1%	32	<0.1%	223	<0.1%
	50		0.0%		127		0.0%				8		0.0%		5		0.0%		33		0.0%			

Sample mortalities comprise mortalities found in the sample tank only and is expressed as the rate of mortality of the sample population. Therefore, sample tank mortality is considered a better indicator of system issues than facility mortality since McNary is a bypass only project. Sample mortality for all species combined was 0.5% in 2018. Subyearling Chinook salmon had the highest sample mortality rate of 1.0% for the season. May, July, and August all had the highest monthly sample mortality rates at 0.6%. Table 19, below, summarizes monthly and annual sample mortality for 2018. Table 20, below, compares the weekly sample tank mortality from 2014 to 2018 and the actual number of mortalities in the sample, all listed by species and clip type.

Unusual mortality in the JCC or at the JFF are described in the Operations and Maintenance Section below.

Table 19. Monthly and Total Sample Tank Mortality, 2018.

Monthly and Total Sample Tank Mortality																						
Month	Yearling Chinook				Subyearling Chinook						Steelhead				Coho				Sockeye				Total	
	Clip		Unclip		Clip		Unclip		Fry		Clip		Unclip		Clip		Unclip		Clip		Unclip			
	#	%	#	%	#	%	#	%	--	--	#	%	#	%	#	%	#	%	#	%	#	%	#	%
April	7	0.3%	4	0.2%	--	--	--	--	6	10.5%	1	0.1%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	1	0.3%	19	0.3%
May	10	0.2%	5	0.6%	3	0.6%	5	0.8%	36	3.9%	3	0.6%	0	0.0%	1	0.3%	2	0.3%	0	0.0%	22	0.4%	87	0.6%
June	0	0.0%	0	0.0%	10	0.6%	5	0.4%	1	3.2%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	16	0.5%
July	0	0.0%	--	--	0	0.0%	12	0.7%	--	--	--	--	--	--	--	--	1	100.0%	0	0.0%	0	0.0%	13	0.6%
August	--	--	--	--	0	0.0%	6	0.6%	--	--	--	--	--	--	--	--	--	--	--	--	0	0.0%	6	0.6%
September	--	--	--	--	--	--	1	0.5%	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1	0.5%
Total	17	0.3%	9	0.3%	13	0.5%	29	0.6%	43	4.2%	4	0.2%	0	0.0%	1	0.2%	3	0.3%	0	0.0%	23	0.4%	142	0.5%
	26		0.3%		85		1.0%				4		0.2%		4		0.3%		23		0.4%			

Table 20. Weekly Mortality in Percentages and Count of Sample Tank Mortality, 2018-2014.

Weekly Mortality in Percent and Actual Count of Sample Tank Mortality																	
2018 Week Ending Date	Current YR	Yearling Chinook		Subyearling Chinook		Clipped Steelhead		Unclipped Steelhead		Coho		Clipped Sockeye		Unclipped Sockeye		Total	
Week Number	4 YR AVG (2014-2017)	# Count	% Mortality	# Count	% Mortality	# Count	% Mortality	# Count	% Mortality	# Count	% Mortality	# Count	% Mortality	# Count	% Mortality	# Count	% Mortality
5-Apr	2018	3	1.2%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	3	0.8%
1	AVG	1	0.4%	3	3.9%	0	0.0%	0	0.0%	0	0.0%	--	--	0	0.0%	4	0.7%
12-Apr	2018	2	0.1%	2	18.2%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	4	0.2%
2	AVG	2	0.3%	1	0.3%	1	0.4%	0	0.0%	0	0.0%	--	--	0	0.0%	4	0.3%
19-Apr	2018	3	0.3%	1	7.7%	1	0.1%	0	0.0%	0	0.0%	--	--	0	0.0%	5	0.3%
3	AVG	4	0.4%	0	0.0%	2	0.5%	0	0.0%	0	0.0%	--	--	2	1.7%	8	0.4%
26-Apr	2018	2	0.4%	1	6.7%	0	0.0%	0	0.0%	0	0.0%	--	--	0	0.0%	3	0.3%
4	AVG	6	0.7%	0	0.0%	1	0.4%	1	1.7%	0	0.0%	--	--	1	0.6%	9	0.6%
3-May	2018	4	0.3%	2	9.1%	1	0.3%	0	0.0%	0	0.0%	--	--	2	0.3%	9	0.3%
5	AVG	5	0.3%	0	0.0%	2	0.5%	1	1.2%	0	0.0%	--	--	1	0.5%	9	0.4%
10-May	2018	4	0.3%	0	0.0%	1	0.6%	0	0.0%	0	0.0%	--	--	5	0.3%	10	0.3%
6	AVG	7	0.6%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	--	--	3	0.6%	10	0.5%
17-May	2018	4	0.3%	18	3.6%	0	0.0%	0	0.0%	3	0.9%	0	0.0%	10	0.4%	35	0.7%
7	AVG	3	0.5%	1	1.4%	0	0.0%	0	0.0%	1	1.0%	0	0.0%	3	0.5%	8	0.5%
24-May	2018	2	0.2%	16	3.9%	1	1.4%	0	0.0%	0	0.0%	0	0.0%	4	0.4%	23	0.7%
8	AVG	1	0.4%	1	0.3%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	2	0.9%	4	0.4%
31-May	2018	2	0.8%	10	1.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	2	0.6%	14	0.8%
9	AVG	2	1.3%	3	0.7%	1	2.4%	0	0.0%	0	0.0%	0	0.0%	3	1.9%	9	0.9%
7-Jun	2018	0	0.0%	1	0.3%	0	0.0%	--	--	0	0.0%	0	0	0	0.0%	1	0.2%
10	AVG	3	3.7%	4	0.6%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	1	5.0%	8	0.9%
14-Jun	2018	0	0.0%	1	0.2%	0	0.0%	0	0.0%	0	0.0%	--	--	0	0.0%	1	0.2%
11	AVG	0	0.0%	4	0.5%	0	0.0%	0	0.0%	0	0.0%	--	--	0	0.0%	4	0.5%
21-Jun	2018	0	0.0%	8	0.9%	0	0.0%	0	0.0%	0	0.0%	--	--	0	0.0%	8	0.9%
12	AVG	0	0.0%	18	1.3%	0	0.0%	0	0.0%	0	0.0%	--	--	0	0.0%	18	1.3%
28-Jun	2018	0	0.0%	5	0.4%	0	0.0%	--	--	0	0.0%	--	--	--	--	5	0.4%
13	AVG	0	0.0%	10	0.5%	0	0.0%	--	--	0	0.0%	--	--	0	0.0%	10	0.5%
5-Jul	2018	0	0.0%	3	0.6%	--	--	--	--	--	--	--	--	--	--	3	0.6%
14	AVG	--	--	23	1.7%	0	0.0%	--	--	--	--	--	--	0	0.0%	23	1.7%
12-Jul	2018	--	--	1	0.1%	--	--	--	--	--	--	0	0.0%	0	0.0%	1	0.1%
15	AVG	--	--	12	1.5%	--	--	0	0.0%	--	--	--	--	--	--	12	1.5%
19-Jul	2018	--	--	4	1.0%					1	100.0%	--	--	--	--	5	1.3%
16	AVG	--	--	5	0.9%	0	0.0%	--	--	--	--	--	--	0	0.0%	5	0.9%
26-Jul	2018	--	--	3	0.8%	--	--	--	--	--	--	--	--	--	--	3	0.8%
17	AVG	--	--	5	0.9%	0	0.0%	--	--	--	--	--	--	0	0.0%	5	0.9%
2-Aug	2018	--	--	4	1.6%	--	--	--	--	--	--	--	--	--	--	4	1.6%
18	AVG	--	--	12	1.9%	0	0.0%	--	--	--	--	--	--	0	0.0%	12	1.9%
9-Aug	2018	--	--	3	0.8%	--	--	--	--	--	--	--	--	--	--	3	0.8%
19	AVG	--	--	3	1.0%	--	--	--	--	--	--	--	--	--	--	3	1.0%
16-Aug	2018	--	--	1	0.6%	--	--	--	--	--	--	--	--	0	0.0%	1	0.6%
20	AVG	--	--	1	0.5%	--	--	--	--	--	--	--	--	--	--	1	0.5%
23-Aug	2018	--	--	0	0.0%	--	--	--	--	--	--	--	--	--	--	0	0.0%
21	AVG	--	--	1	0.8%	--	--	--	--	--	--	--	--	--	--	1	0.8%
30-Aug	2018	--	--	0	0.0%	--	--	--	--	--	--	--	--	--	--	0	0.0%
22	AVG	--	--	1	0.6%	0	0.0%	--	--	--	--	--	--	0	0.0%	1	0.6%
6-Sep	2018	--	--	1	0.8%	--	--	--	--	--	--	--	--	--	--	1	0.8%
23	AVG	--	--	10	11.1%	--	--	--	--	--	--	--	--	0	0.0%	10	11.0%
13-Sep	2018	--	--	0	0.0%	--	--	--	--	--	--	--	--	--	--	0	0.0%
24	AVG	--	--	0	0.0%	--	--	--	--	--	--	--	--	--	--	0	0.0%
20-Sep	2018	--	--	0	0.0%	--	--	--	--	--	--	--	--	--	--	0	0.0%
25	AVG	--	--	0	0.0%	--	--	--	--	--	--	--	--	0	0.0%	0	0.0%
27-Sep	2018	--	--	0	0.0%	--	--	--	--	--	--	--	--	--	--	0	0.0%
26	AVG	--	--	1	5.3%	--	--	--	--	--	--	--	--	--	--	1	5.3%

RESEARCH

Gas Bubble Trauma Monitoring

PSMFC conducted Gas Bubble Trauma (GBT) monitoring as part of the Smolt Monitoring Program from April 10 to August 8. Twice per week, a combination of up to 100 juvenile Chinook salmon and steelhead were collected from the separator and inspected for GBT.

There were a few exceptions to the biweekly GBT examinations. Between June 1 and 7 only 1 day of GBT examination occurred due to a collection channel brush failure. Three GBT examination days occurred between June 8 and 14, with one of the examinations replacing the previously missed examination. GBT examinations were reduced to once per week after July 20 due to high water temperatures and concluded early due to a lack of fish. Related details can be found in the Operations and Maintenance Section below.

In 2018, 3,161 smolts were examined for GBT. Signs of GBT were present in 12 smolts: 6 clipped yearling Chinook salmon, 4 clipped steelhead, 1 unclipped yearling Chinook salmon, and 1 clipped subyearling Chinook salmon. These smolts were examined on April 25 (1 clipped yearling Chinook salmon), May 11 (1 clipped steelhead), May 21 (2 clipped yearling Chinook salmon and 1 clipped steelhead), May 23 (2 clipped yearling Chinook salmon), May 30 (1 clipped yearling Chinook salmon and 1 clipped subyearling Chinook salmon), June 2 (1 clipped steelhead), June 10 (1 unclipped yearling Chinook salmon), and June 26 (1 clipped steelhead). Table 21 summarizes fish examined for GBT for the year.

Table 21. Total Smolts Examined for GBT, 2018.

	Yearling Chinook		Subyearling Chinook		Steelhead		
	Clip	Unclip	Clip	Unclip	Clip	Unclip	Total
Collected	863	240	622	1,018	328	90	3,161
GBT Signs	6	1	1	0	4	0	12

Pacific Northwest Laboratories (PNNL)

PNNL acquired 1,163 juvenile salmonids from the samples between April 23 and May 23, 2018. Most of the fish were acquired from the sample. However, there was also some fish used from the GBT sample. The research collection comprised 455 clipped steelhead, 409 clipped yearling Chinook salmon, 168 unclipped steelhead, and 131 unclipped yearling Chinook salmon. The smolts were the subject of an off-site acoustic telemetry study examining system survival from Lower Granite Dam to Bonneville Dam.

PNNL also acquired 7,333 juvenile American shad from the sample between September 18 and 28, 2018. The fish were the subject of an off-site study to develop a model to study the effects of barotrauma exposure. This model will be used to assess the environmental impact of hydropower turbine design.

The Sample rates for PNNL are recorded in the JFF Sample System Section below.

Yakima Nation Tribal Research

The Yakima Tribe acquired 111 Pacific lamprey macropthalmia from the samples between April 27 and May 13. The fish were the subject of an off-site acoustic telemetry project in the lower Yakima and mainstem Columbia Rivers in coordination with USGS Biological Service.

OPERATIONS AND MAINTENANCE

Bypass Operations

After winter maintenance, primary bypass began March 26. All systems were watered up, tested and cleaned. The channel systems were fully functional. The facility systems remained out of service until April 2. The facility was switched in and out of secondary bypass three times on March 29 in a 30 minute span for training. The system remained in primary bypass until April 2 at 0700 hours, at which time secondary bypass began. The season consisted of 24 hour alternating days of primary and secondary bypass. During secondary bypass, fish condition samples were collected. For the season, the sample gates were only on during sample collection.

Listed below are deviations outside the alternating schedule:

1. The facility was switched into and out of secondary bypass once for 14 minutes for training on April 5. Also, that day, over a span of 21 minutes the system was in and out of secondary bypass multiple times to test, lubricate and replace the airlines on the primary/secondary bypass gate. Sample gates were off.
2. The system remained in primary bypass for 63 minutes to insure hydraulic fluid in a gatewell slot was contained on April 16. Six samples were missed.
3. The system was in secondary bypass twice for a total of six minutes to examine a water leak at the B side PIT tag slide gate on May 9, which could be repaired next winter. Sample gates were off.
4. The system was switched to primary bypass due to side screen brush failure on June 2, at 1535 hours. From that time to June 6, at 0700 hours, daily sampling was missed. (Daily sampling was scheduled to run from May 24 to June 5.) After the side brush was repaired, every other day sampling resumed on schedule on June 7, at 0700 hours.
5. The facility was in primary bypass due to low water flows caused by a collection channel power outage on July 19, from 1131 to 1231 hours. With a sample rate of 0.5 percent, two samples were missed.
6. In order to maintain a staff member in the collection channel while the rectangular screen brush was being repaired on July 23, from 0700 to 1700 hours, the system remained in primary bypass instead of switching to secondary bypass for sample collection. Ten hours of sampling were missed.
7. Alternating days of secondary bypass for sample collection concluded on September 30 at 0700 hours. Facility systems were removed from service. Fish were evacuated. Maintenance and winterization began.

The juvenile system was switched from primary to emergency bypass as ESBS removal began on December 10. The facility was dewatered and the channel systems were removed from service. Channel maintenance began.

With all ESBSs raised, the channel orifices were closed for the season on December 19. Fish evacuated form the channel were approximately 18 adult steelhead, one steelhead smolt, two adult sturgeon, two walleye, one pike minnow, three channel catfish, one sculpin,

five adult shad (two mortalities) six smallmouth bass and a couple of dozen juvenile shad (with some mortalities). Steelhead were not examined for clips. There was one clipped subyearling Chinook mortality.

Turbine Operations

The one percent hard criteria for unit operation ran from April 1 to October 31, inclusive. There are no records of units running outside the constraint for long periods of time. Only a short test runs of units returning to service along with slight variances which occurred during the season.

The Technical Management Team (TMT) requested a reduction in spill in order to reduce the dissolved gas levels at McNary, from May 16 to June 1. This request allowed units to operate throughout the entire one percent range, and hold reserves above one percent. No significant excursions outside the one percent criteria occurred during this request.

Headgates in the down position continued to appear to be advantageous: reducing the turbine boil in the gatewell slots resulting in less mortality observed in the slots, in trash rack debris and on the VBSs when cleaning or when performing other operations.

During the soft one percent criterion in January to March, November and December, the project ran units outside the constraint at the BPA's request.

In order to reduce heat stress, the saw tooth pattern (an alternating pattern of units on/off) was in effect from July 12 to August 31, inclusive. No heat stress mortality was noted this year. Temperature monitoring by the smolt monitoring contractor occurred from June 15 to August 31, inclusive. The smolt monitoring staff published the results in a separate report.

Spill Operations

Before the spill season, spill in excess of powerhouse capacity occurred as required. Issues with the spillgate hoist in bay 9 were resolved by April 6. The spring spill program, which was spill to gas cap, occurred from April 10 to June 15, inclusively. It was noted in the Fish Passage Plan (FPP) that MCN Table 7 required expansion for the flows that were occurring on May 12. The control room received an expanded table on May 15. The TMT request for reduced spill is described above. The summer spill program, with 50 percent of flow being spilled, was from June 16 to August 31, inclusively. However, high spill volumes did occur. No spill in excess of powerhouse capacity happened in the fall and winter. During this time, spillway hoist and crane maintenance was performed. Slight spill may have occurred during hoist or crane testing.

With the second spillway crane (crane 6) out of service, there was no crane available to adjust the spillgate in bay 2. The solution was to dog the gate at four stops, which occurred on April 9. For this, the other crane (crane 7) attached to the TSW was used and disconnect from the TSW for 26 minutes. The spill pattern was adjusted for the bay 2 issue. Crane 6 hoist repairs were completed in April, then the hoist was load tested and returned to service on May 22. That day, crane 6 was attached to the TSW in bay 19. Crane 7 was moved back to bay 2 and attached to the spillgate. The control room received an expanded spill table, which included bay 2 being functional on May 24.

In order to repair the electrical box for Washington ladder entrance weir W3 in a safe environment, spillbay 1 was closed on May 31 from 0718 to 1338 hours.

It was noted that spillbay 20 was not opening and closing properly on July 18. The spillgate was disconnected from crane 6. Due to the spill pattern at the time, the bay was already closed. It was determined the crane's gear box required repairs, which were immediately begun. After the repairs were completed and the limits set on the crane, the crane and spillgate returned to service on July 19. The spill pattern at the time called for the gate to be open, which it was. During approximately 33 hours the bay was closed, there were 19 hours when the bay should have been opened 2 stops. Spillgate manipulation for forebay debris removal will be discussed in the Forebay Debris Section below.

This year, one unclipped yearling Chinook mortality was found by spillbay 1 and 22, respectively.

TSWs

TSW installation was completed on March 31. The TSWs in bay 19 and 20 are attached to a crane and spillgate hoist, respectively. Limit adjustments were made as required. The TSWs were opened on April 9. After the crane exchange mentioned above in the Spill Operations Section, The TSW in bay 19 was closed so the lower limits could be set on crane 6 on May 23, from 1350 to 1430 hours.

TSW removal was scheduled for June 11. Project management asked for an extension so the TSWs could continue to help dissipate forebay debris. The TSWs were closed on June 18.

However, two problems were causing difficulties in installing the standard spill leaf in each bay on June 21. First, the hoist used in bay 19 would not properly attach to the spillgate. Secondly, the crane used at bay 20 had brake issues. These two issues and setting the limits for the crane and hoist could not be resolved by the close of business. With June 22 being a non-work day, district biologists were consulted to see if completion of the work could be done on June 25. It was agreed to finalize the work on June 25. The proper spill pattern was used before, during and after TSW removal.

Forebay Debris

During the winter, the powerhouse debris load was light to heavy, as new debris arrived in January. Wind direction changes moved the debris from the powerhouse to the Oregon shoreline and back repeatedly.

For the season, wind directional changes continued to move tumbleweeds, woody material and aquatic vegetation across the forebay. Tumbleweeds occurred mostly in the spring. Woody material was throughout the season. Aquatic vegetation began in the summer and ran through late fall. Along the Washington and the Oregon shorelines, the debris varied between minimal and heavy. Powerhouse and spillway debris loads for the season are recorded in Table 22, below. When the spill was closed the night of August 31, the debris there migrated to the powerhouse.

Table 22. Forebay Debris Loads, 2018.

Month	Powerhouse	New Debris	Spillway	New Debris
March	Moderate-heavy	Minimal-light	Minimal	Minimal
April	Minimal-heavy	Minimal-light	Minimal	Minimal
May	Minimal-moderate	Minimal-heavy	Minimal-moderate	Minimal-heavy
June	Minimal-moderate	Minimal-light	Minimal-heavy	Minimal-light
July	Minimal-moderate	Minimal	Very light-heavy	Minimal
August	Minimal-light	Minimal	Very light-light	Minimal
September	Minimal-light	Minimal	Minimal-light	Minimal
October	Minimal-moderate	Minimal	Minimal	Minimal
November	Light-moderate	Minimal	Minimal	Minimal
December	Very light-moderate	Minimal	Minimal	Minimal

Forebay Debris Removal

Along the Washington shoreline, much of the debris was flushed down the navigation lock as needed.

When TSWs were in place, or trash racks were cleaned, or wind direction would change and/or project operations were altered, some forebay debris would pass downstream and be removed. For example, when the spring spill program began, much of the existing debris at that time was passed.

Two debris spills occurred this season. The project staff used spillbays 2, 4 and 5 operated in split leaf mode on May 30, which expedited debris removal from bays 2 through 5. Bays 2 through 6 were closed and opened in a rotating fashion, which drew the debris to one of the three split leaf bays and passed it to the tailwater. When open, each leaf was raised to approximately 14 feet and passed approximately 23 kcfs. The operation began at 1330 hours and concluded at 1633 hours. Spillway gates settings were visually verified by 1730 hours.

A fairly large amount of floating woody material had accumulated in the forebay near spillbays 18 through 21. The project staff manipulated spillbay 18 into and out of spilt leaf mode from 1438 to 1513 hours on July 9. However, an extra spillgate leaf stored upstream of the spillgate made that bay unfeasible to use for debris removal. Spillbay 16 was successfully operated in split leaf mode on July 10, from 0951 to 1117 hours. Bays 17 through 21 were opened and closed as need to help maneuver the debris to bay 16, where the debris was passed to the tailwater.

Trash Racks

During the winter, trash rack differentials were checked twice a week. No problems were observed. After the trash rake was repaired on January 23, five slots were test cleaned with less than ten yards of debris removed. No fish mortalities were noted.

Just before the ESBSs were installed, on March 21 to 23 and 27 to 28, all trash racks were cleaned, which removed 227 yards of woody material and tumbleweeds. Again, no fish mortalities were noted.
For the season, trash differentials were monitored daily. The trash racks were cleaned at units 1, 6, 9 and 14, on April 20. There was 29 yards of woody material and tumbleweeds were removed. The trash rack cleaning at units 4 through 11 removed 90 yards of debris, which was mostly woody material and tumbleweeds on May 16 and 17. The trash racks were cleaned in slots 2A, 2B, 3A, 12A and 13A on June 20. Six yards of debris were removed. During all cleanings, no fish were observed in the debris.

Gatewells

During the winter outage, a small amount of oil was removed from slots 2B and 5B with absorbent pads and booms. Also, gatewell slots were check twice a week.

During the season, gatewell slots were checked daily. Small amounts of woody material were removed as required. No large accumulations of woody material were noted. Oil and hydraulic fluid in the slots is recorded in Table 23, below. Generally, absorbent pads and booms are used to remove the oil. For the fluid in slot 13C, a pump and oil skimmer was also used for removal, which was completed on April 24.

Table 23. Gatewell Slot Oil and Hydraulic Fluid, 2018.

Date	Type	Location	Amount	Source/Solution
22-Mar	Hydraulic	9A slot	8 ounces	Headgate line bleeder/Replaced
8-Apr	Hydraulic	2B slot	8 ounces	Headgate line fitting/Repaired
16-Apr	Hydraulic	13C slot	162 to 210 gallons	Headgate line O-ring/Replaced
13-Dec	ESBS oil	9B slot	< 1 ounce	Gearbox oil/Maintenance
23-Dec	Hydraulic	9A	8 ounces	Headgate line fitting/Repaired

Extended-Length Submersible Bar Screens

A change in the FPP has allowed more flexibility in ESBS installation and removal. ESBSs were installed in all units, from April 2 to 5 and 9 through 11. The brush cycle time for all ESBSs was set at 60 minutes. All ESBSs were raised for winter maintenance from December 10 through 13 and 17 to 18. No ESBSs were raised on December 12 due to crane issues.

The fisheries staff performed underwater camera inspections from May 8 to November 13. Due to issues with the primary and backup cameras, inspections were somewhat limited this year. The primary camera was sent to the factory twice due to cable issues. The backup camera also had cables issues. A new camera will be ordered for next season. Camera inspection results are recorded in Table 24, below.

Table 24. ESBS Camera Inspection Results, 2018.

Date	Location	Issues	Camera Used
8-May	3B & 3C slots	None/Camera issues	Backup
15-May	Units 13 & 14	None	Backup
22-May	Unit 4	None	Backup
29-May	Units 11 & 12	11C brush cycling wrong direction/Fixed on May 30 and 31	Backup
26-Jun	Units 9 & 10	None	Backup
3-Jul	Units 7 & 8	None	Backup
10-Jul	Units 5 & 6	None	Backup
17-Jul	Units 3 & 4	None	Primary
24-Jul	Units 2 & 11	None	Primary
31-Jul	Units 10 & 12	None	Primary
7-Aug	Units 6 & 7	None	Primary
14-Aug	Units 2, 8 & 14	None	Primary
21-Aug	Units 1, 4 & 13	None	Primary
28-Aug	Units 3, 5 & 9	None	Primary
4-Sep	Units 10, 11 & 12	None	Primary
11-Sep	Units 7 & 8	None	Primary
18-Sep	Units 13 & 14	None/Camera cable drum brake repaired	Primary
25-Sep	Units 1, 2 and 6	None	Primary
2-Oct	Units 3, 4 & 5	None	Primary
9-Oct	Units 9, 10 & 11	None	Primary
16-Oct	Units 7, 8 & 12	None/Brush cycle for unit 8 ESBSs had to be reset before inspection	Primary
23-Oct	Units 13 & 14	None	Primary
30-Oct	Units 1 & 2 6A & 6B slots	None/Unit 6 was out of service, C slot could not be examined.	Primary
6-Nov	Units 3, 4 & 5	None	Primary
13-Nov	Units 9, 10 & 11	None/Camera failed along with backup	Primary

After the ESBSs were raised, an inspection revealed all screens to be clean and only juvenile shad were noted on top of each brush.

During the season, ESBS problems were due to proximity switch failures, programming and electrical issues. Gearbox, motor, brush drive or coupler issues were less frequent only one unit having to go out of service for ESBS replacement. No fish mortalities were noted during ESBS issues, which are recorded in Table 25, below.

Table 25. ESBS Issues, 2018.

Slot(s)	Date(s)	Issue
10A	5-Apr	Brush mechanism failed. ESBS was replaced.
3A & 3B	11-Apr	Brushes found in manual mode. Switched to automatic mode.
1C	12-Apr	After multiple alarms, brush cycle switched to timer mode.
1C	12-Apr-30-Jun	Brush cycle in timer mode, switched to automatic Jun 30. (May 30-31, briefly in automatic mode.)
2A	15-Apr-26-Apr	Brush cycle was incomplete. Cycle was reset on Apr 20. Brush cycle to timer mode on Apr 26.
2B	15-Apr-23-Apr	Brush cycle was incomplete. Electricians resolved issue.
2A	23-Apr-4-Jun	Brush cycle in timer mode, switched to automatic Jun 4.
2A	27-Apr-2-May	Brush cycle was incomplete 18 times. Program examined Apr 30. No further issues.
2B	30-Apr - 1-May	Brush cycle was incomplete twice. No further issues.
Units 1 & 2	30-May-31-May	Brush cycles reset after power switching.
14C	25-Jun	After multiple alarms, brush cycle switched to timer mode.
14C	25-Jun-30-Jun	Brush cycle in timer mode, switched to automatic Jun 30.
10A	28-Jun	Brush cycle tripped an alarm and was reset.
4A	29-Jun	Brush cycle tripped an alarm and was reset.
14C	21-Jul	After multiple alarms, brush cycle switched to timer mode.
14C	21-Jul-21-Aug	Brush cycle in timer mode, switched to automatic Aug 21.
Unit 3	23-Aug	Brush cycles in timer mode, returned to automatic. Program converted back to timer mode.
Unit 3	23-Aug-27-Aug	Brush cycles remained in timer mode due to blown fuse.
3A	27-Aug	Electrical cable and proximity failed, blew controller fuse.
		Issues resolved. Brush cycle remained in timer mode.
3B & 3C	27-Aug	Brush cycles returned to automatic mode.
3C	29-Aug	After multiple alarms, brush cycle switched to timer mode.
3A	23-Aug-10-Dec	Brush cycle remained in timer mode until ESBS was raised.
3C	29-Aug-10-Dec	Brush cycle remained in timer mode until ESBS was raised.
4A	8-Sep	After multiple alarms, brush cycle switched to timer mode.
4A	8-Sep- 10-Dec	Brush cycle remained in timer mode until ESBS was raised.
Unit 6	11-Sep	Control system not communicating to brushes. Resolved.
Unit 4	4-Nov- 5-Nov	Brushes not cycling in automatic mode. Operator cycled brushes manually. Issue resolved.
9B	12-Nov-13-Nov	Brush not cycling fully. Cycle switched to timer mode. Issue resolved. Cycle returned to automatic mode.
Unit 1	13-Nov	All brush cycles in timer mode. No reason recorded.
1A & 1B	13-Nov-25-Nov	Brush cycle in timer mode, switched to automatic Nov 25. Unit 1 issues resolved. (1A brush cycle reset Nov 16.)
1C	13-Nov-18-Dec	Brush cycle remained in timer mode until ESBS was raised.
1A	16-Nov	Brush not cycling fully. Cycle reset.
2B	16-Nov-18-Nov	Brush cycled intermittently. Reset multiple times and switched in and out of timer mode.

Table 25. ESBS Issues, 2018 (cont).

Slot(s)	Date(s)	Issue
2B	18-Nov-19-Nov	ESBS brush failed. Unit out of service. Issue resolved.
2B	19-Nov-29-Nov	Brush cycled intermittently. Reset multiple times. Switched in and out of timer mode. Examined Nov 20. Operators monitored and cycled brush manually.
2B	30-Nov-8-Dec	Brush cycled intermittently. Reset multiple times. In timer mode. Operators monitored and cycled brush.
2A	6-Dec	Brush not cycling fully. Cycle reset.
Unit 4	7-Dec-8-Dec	PLC not communicating with ESBSs. Reboot PLC.
2B	8-Dec	Brush failed. Unit out of service. ESBSs raised Dec 10.
1A	9-Dec & 12-Dec	Brush not cycling fully. Cycle reset.
13A	9-Dec	Brush tripped an alarm. Cycle switched to timer mode.
13A	9-Dec-17-Dec	Brush cycle remained in timer mode until ESBS was raised.
9B	10-Dec	Brush tripped an alarm. Cycle switched to timer mode.
9B	10-Dec-13-Dec	Brush cycled intermittently. Reset multiple times. Operators monitored and cycled brush. In timer mode until ESBS was raised.
6A & 6C	11-Dec	Brush cycles reset before ESBSs raised.

Vertical Barrier Screens

VBS rehabilitation continued over the winter and after a VBS was replaced. Replacement includes cleaning. The VBSs in slots 9B and 10A were replaced on July 18 and 19, respectively. Five subyearling Chinook mortalities were recorded from under the VBS mesh in slot 9B. Four other subyearling Chinook mortalities washed off the VBSs during removal. The prototype VBS in slot 4C was moved to slot 4A on August 20. The standard VBS was then moved to slot 4C. This will reduce VBS cleaning and moving the large slot cover in slot 4A. The other prototype VBS remains in slot 4B.

Daily VBS head differential monitoring began with ESBS installation, which is discussed in the ESBS section above. The first VBS was cleaned on May 9, with the last one being cleaned on December 13. In August, the back of the screens were cleaned, as needed; to help remove fresh water sponges. VBSs cleaned by month and mortalities noted are recorded in Table 26, below. In many cases, VBSs were cleaned as a preventative measure.

Table 26. VBS Cleaning by Month, Debris Removal Only, 2018.

Month	Days	VBSs Cleaned	Measured 1.5 Feet or More	Lamprey Mortality	Live Lamprey	Smolt Mortality
March	0	0	0	0	0	0
April	0	0	0	0	0	0
May	6	13	0	0	0	47
June	8	21	0	0	0	1
July	5	19	1	0	0	30
August	2	11	0	0	0	2
September	5	33	0	0	0	0
October	6	20	0	0	0	0
November	9	18	0	0	0	0
December	9	3	1	0	0	0
Total	50	138	2	0	0	80

Retaining taps were welded on the screen guides in slot 2A on July 25. The high differential recorded in December occurred when the unit was running at 78 megawatts.

VBS inspections, which includes cleaning, are recorded in Table 27, below. With cleaning and inspection, every VBS was examined at least once this year.

Table 27. VBS Inspections by Month, 2018.

Month	Days	VBSs Inspected	Lamprey Mortality	Live Lamprey	Smolt Mortality
March	0	0	0	0	0
April	0	0	0	0	0
May	4	17	1	0	7
June	1	7	0	0	3
July	3	5	0	0	0
August	0	0	0	0	0
September	0	0	0	0	0
October	0	0	0	0	0
November	1	1	0	0	0
December	0	0	0	0	0
Total	9	30	1	0	10

VBS differential monitoring and inspections concluded when all ESBSs had been raised as described in the ESBS section above. During cleaning or inspection, mesh retaining clips were replaced as required.

JCC Orifices and Collection Channel

After the JCC rehabilitation contractor was done, the channel systems required testing. At unit 8 on March 12, from 1130 to 1337 hours, which was out of service, six orifices were opened to test fill the juvenile channel. The water elevation was held to a point so no water went done the full flow bypass pipe. The channel was left to set overnight with no orifice open. The same orifices were opened for testing of the brushes, the side dewatering valves, the alarms and the system programmable logic on March 13, from 0726 to 1530. From

1230 to 1500 hours, two orifices from unit 7 were opened to improve flow conditions for the side dewatering valve testing. During testing, one issue was found. The south side dewatering valve was not communicating properly with the system program. On March 19, this issue was resolved. After the channel had drained down overnight on March 14, seven Chinook and two steelhead smolts along with two juvenile lamprey, one juvenile shad and two juvenile bluegills were rescued from the side screen pool. One white crappie mortality was also removed. Six five gallon buckets of concrete chips were also removed from the side screen pool area. The concrete "cream" on the channel floor in this area was damaged by exposure to winter air temperatures and moisture. Finally, the three rectangular screen floor drain valves were calibrated.

District personnel inspected the supply line to the new transition screen air zone on March 19, which was labeled number 6. It was determined the line protruded into the water flow to far. The line was removed the next day. Rerouting or not installing the supply line to zone 6 will be determined next winter.

The season began with 42 orifices opened on March 26. One possible smolt mortality was noted during water up. The orifice count remained consistent all year. Brief orifice exchanges occurred for trash rack cleaning, VBS cleaning, VBS exchanges or forebay debris removal. With installation of the airline system desiccant drier, water was no longer noted in the orifice operators supply airline. Orifice attraction lights and area lighting along with operator air leaks were replaced and repaired as required. The fisheries staff monitored the JCC when the JFF was in primary bypass or on day shift when in secondary bypass, when cleaning or replacing VBSs or trash racks and during forebay debris removal along with the spillway closure. Issues with the JCC system are listed in sections below.

In September, walkway grating retaining clips were installed as required.

No orifice blockages occurred this year. Only one stick, which was removed from the orifice immediately, was observed all season. No harm to fish was noted. At times, orifice adjustments and cycling resulted in brief high/low water alarms, which quickly reset. After each incident, orifice cycling protocols were reviewed. Orifice issues are listed in Table 28, below.

Table 28. Orifice Issues, 2018.

Date	Issue	Result	Comment
29-Mar	Closed orifice 2A slot.	Closed 5.5 hours.	No fish issues.
16-Apr-25-Apr	Hydraulic fluid isolated in 13C slot.	Unit 13 orifices closed.	Make up orifices opened in unit 14. Fluid removed.
14-Sep	VBS cleaning make up orifice left open.	43 orifices.	Extra orifice closed.
12-Oct	Closed orifice 12B slot.	Closed 5.5 hours.	No fish issues.

Orifice were closed during the switched from primary to emergency bypass on December 10. All other systems were removed from services. Orifices were closed for the season and channel maintenance began on December 19. A second JCC contractor mobilized on December 26. They will rehabilitate and paint the drain valve pit at the south end of the JCC. The contract will be completed in February, 2019.

Before the watering up or dewatering the JCC, with station service unit 1 out of service and dewatered, the deck fire water, which is river water, was used to flush the full flow pipe.

JCC Mortalities

No adult salmonid mortalities were found on the walkway grating this season. However, two unclipped steelhead smolt mortalities did occur on the side screen brush access platform. The jump guards were repositioned and netting was installed on the hand rail.

JCC Power Outages

All power outages are related to the station service upgrades. These outages do raise questions about the channel system program.

Electrical switching resulted in two very brief power outages in the channel on May 30. The one adverse effect was each outage reset the brushes operational sequence to the beginning, resulting in the screen cleaning brushes not operating in automatic mode for 8 hours. There were two brief power outages for repair of the side screen brush, which had no adverse effect on the channel on June 6. A brief power outage occurred on June 28, at 1336 and 1712 hours. After the first outage, the side screen brush tripped an alarm. After the brush was reset, the brush cycle sequence appeared to "find" itself and return to normal. After the second outage, no alarms occurred. However, the brush cycle sequence again had to "find" itself. The power was removed from the channel control system so the transition screen cleaning brush B zone limit switch could be replaced on July 19, from 1055 to 1138 hours. A brief power outage occurred on September 18, at 0700 hours. Two alarms came in, which the biologist reset. Also, the program reset the brushes cycle sequence. Another power outage occurred on September 19, at 1005 hours. During this outage, the side screen brush was operating. When power was restored, the side brush did not continue its cleaning cycle. The biologist used the position switches to park the brush. However, the other two brushes did complete the cycle sequence, which did not reset this time and no alarms occurred either.

JCC Primary Dewatering Structure (PDS)-Program and Alarms

The JCC contractor verified the channel control program and system alarms on March 26 and 27. The new system was monitored closely all year. It was noted that brushes location sensors were not very useful in the channel environment. Also, the east floor drain valve level indicator seemed to fluctuate. The two side dewatering valves seemed to run more frequently and slightly warmer. However, this did not develop into a problem. Programing and alarm issues are reflected in this report in JCC sections above and below. There are concerns with the control program, the biggest of which is having the brushes cycle starts

tied into the rectangular screen air burst cycle. Another interesting example, on December 6, all three screen cleaners were noted to have an alarm when examining the PLC panel view but no alarms were recorded on the alarm screen or elsewhere. There was no explanation for this observation. These issues will need to be addressed once the warranty expires.

The channel's water elevation meter had no problems this year. The channel systems were operational in automatic mode from March 26 to December 10. Scheduled maintenance was performed on all JCC systems described below.

JCC PDS-Rectangular/Transition Screens Air Burst System

The air burst system has five zones. (Zones 5 and 6 are associated with the transition screen.) One zone runs every eight minutes for about 30 seconds. A full cycle is completed when every zone has run. Though not functional zone 6 is still in the cycle. The brushes were programmed to run in sequence (first side screen, next rectangular screen and last transition screen) once a set number of air cycles were completed. For example, most of the season, the brushes were set to cycle after three air zone cycles (1 through 6). The brushes would run approximately every three hours. During the year, the brush cycle was set to run after 2 to 4 air cycles. This cycle timing was changed six times and was dependent on debris loads and brush reliability.

Scheduled maintenance was performed on the systems back up compressor on July 12.

During screen cleaning brush failures, the air burst system was instrumental in keep the screens clean.

JCC PDS-Hoist

Scheduled maintenance was performed on the JCC hoist on July 17 and October 17. Before installing the emergency bypass stoplogs, On December 10, the hoist pendant had to be repaired. The hoist was again found not functional on December 26. It was repaired on December 31. This is the hoist install by the JCC contractor and is still under warranty.

JCC PDS-Rectangular Dewatering Screen Cleaning Brush

One of the rectangular screen cleaning brush proximity switches was adjusted on March 26. The rectangular and transition screens brushes cycles overlap, thus, both report sections refer to each brush. The program does not allow them to run at the same time. With current programming, when a "did not operate in sequence" alarm came in for the transition brush, the rectangular brush missed one cleaning cycle. Issues with the rectangular screen cleaning device are recorded in Table 29, below. After rehabilitation, the rectangular screen brush had far few issues than in past years.

Table 29. Rectangular Screen Cleaning Mechanism Issues, 2018.

Date(s)	Problem	Resolution
2-Apr	Tripped alarm. Transition brush not parked correctly.	Transition brush parked. Rectangular brush functional.
5-Apr	Program test. Will brush run with other two brushes off.	Yes, functional with other two brushes off.
22-Jul-23-Jul	Brush failed. Electrical bracket came off & cable entangled, electrical short.	Electrical staff repaired. Fisheries staff monitored JCC.
12-Nov	Timing alarm tripped. Possible debris jam. Alarm only recorded on PLC.	Brush self-cleared debris. Concern over program.

JCC PDS-Side Dewatering Screen Cleaning Brush

Issues with the side screen cleaning device are recorded in Table 30, below. All problems were related to new components. The brush was out of service during most repairs. Scheduled maintenance was performed on the side brush on July 2.

Table 30. Side Screen Cleaning Mechanism Issues, 2018.

Date	Problem	Resolution
2-Apr	Lower drive sprocket loose. (Drives brush upstream and back.)	Mechanics tightened set screws.
4-Apr	Lower drive sprocket loose.	Mechanics tightened and cemented set screws.
12-Apr	Lower drive sprocket.	Tightened fasteners and drive chain.
2-Jun-6-Jun	Brush tripped alarm. Would not reset. Electrician count not repair. Brush cycle sequence off. Concern about program.	Staff ran brushes. Operate side brush in hand mode. Rectangular brush not always cycling in auto mode.
6-Jun	Contractor found upstream magnetic limit switch failed.	Replaced and repositioned switch. Brushes to auto mode.
18-Nov-19-Nov	Lower drive sprocket slipped. Brush was functional.	Cycle sequence time increased. New set screws installed.

JCC PDS-Transition Dewatering Screen Cleaning Brush

Issues with the transition screen cleaning device are recorded in Table 31, below. When the brush was out of service, the air burst system kept the screen relatively clean. All problems were related to new components. The all-weather magnetic limit switches appeared to have issues after rain storms.

Table 31. Transition Cleaning Mechanism Issues, 2018.

Date	Problem	Resolution
1-Apr-12-Apr	Tripped alarm. One motor was caught on electrical cord of the other motor. Brush turned off.	Parked properly Apr 2. Contractor resolved issue. Returned to automatic mode.
9-May-15-May	Tripped alarm. Cycle not complete. Went past proximity switch, program "lost" brush. Brush turned off.	Hoist brakes and magnetic proximity switches. Extra metal added to beams. Tested.
16-May	Parked in wrong location. Tripped rectangular alarm. Also, brush parked hard.	Transition brush parked properly. Switch concerns. Brush remained out.
16-May–6-Jun	Brush parks hard.	Contractor moved limit switch. Brush to automatic. Timing returned.
	Brushes timing sequence lost.	
18-Jun-21-Jun	Stalled in C zone. B zone limit switch failed.	Brush out of service. Test B limit switch Jun 20. Limit dry. Ran brush once a day.
21-Jun	Downstream limit failed, brush in water.	Brush raised from water. Tripped downstream limit & parked brush, allowing rectangular brush to run.
	Upper limit on, rectangular brush will not run.	
21-Jun-19-Jul	Downstream limit issue. (Two alarms.) (Assume someone tried to operate brush.)	Brush out of service. Contractor repaired limit, installed stop, checked program & test brush.
25-Jun		
19-Jul	B zone limit switch failed.	Contractor replaced limit & installed "splash" guards over B and D zone limits. Brush to auto.
22-Jul-23-Jul	Rectangular brush required repair.	Transition brush out of service.

JCC PDS-Side Screen Dewatering Valves (2)

During winter maintenance, no new problems were found. These valve were tied into the new JCC programming. For the season, both side dewatering valves were functional, in automatic mode and operated well. These valve control the JCC water elevation.

During the winter of 2018-2019, at the south side dewatering valve, the discharge conduit leak will be repaired.

JCC PDS-Floor Screen Dewatering Valves (3)

After the contractor installed new actuators on all three valves and the level indicators were calibrated, there were no problems during winter maintenance. During the season, these valves are opened and turn turned off as they only function as drains. The east and west floor valves were opened an additional inch in order to reduce the percentage opening of the side dewatering valves on June 20.

Full Flow Bypass Flume and Pipe

There are still reports of interference at PIT tag detector number 4 in the full flow pipe. This issue will continue to be investigated.

It was noted that handrail missing from the outfall pipe walkway on June 1. Due to high flows cresting over the outfall pipe, there was concerned about the condition of the outfall pipe, access walkway and avian hazing sprinkler system. The Chief of Operations, the Project Manager and a project engineer accessed the outfall walkway on June 4. They estimated the last fifth of the walkway was not safe to use. The walkway and avian sprinkler system had both been damaged with sections of each missing. Project and district engineers used a boat to examine the outfall walkway and sprinkler system further on June 6 and August 1. They found the walkway had structural support damage and the sprinkler system was missing two of five sprinklers. Cleaning and repairing some the damage will be contracted for the winter of 2018 and 2019. Replacement of systems will be a long term discussion.

JUVENILE FISH FACILITY (JFF) ISSUES

The adult flush line supply valve, which is trigger to open and close with the primary bypass gate (open during secondary bypass), was found making an unusual noise on April 5. The valve was operated manually from April 6 to 8, which appears to have resolved the over torque issue, which had caused the motor to overheat. After electricians examined the valve, it was returned to automatic operation on April 9.

A water leak at the B side PIT tag slide gate was examined and plugged on May 14. With the gate not being used, the leak will be repaired next winter. A flume gasket just upstream of the gate was trimmed on May 17.

Daily sampling was scheduled in order to monitor fish condition better during the high flow conditions associated with spilling to the gas cap from May 24 to June 5. However, due to failure of the side dewatering screen brush in the JCC, the system was switched to primary bypass on June 2. There were 87.4 hours of secondary bypass with sampling missed.

As requested by district biologists, on June 21, for the first time since 1998, adult incidental fish released from the separator were recorded. Recording these fish will return as a routine separator technician duty. Project operations have changed greatly since 1998 so recording the incidentals is a task that can now be accomplished quite easily.

The facility was in primary bypass due to low water flows caused by a collection channel power outage on July 19. Two samples were missed.

Again, in September, juvenile shad become the predominant species. No smolts were observed in the sample on September 24, 28 and 30.

Flow into the separator is depended on collection channel changes and debris blockage on the perforated plate just upstream of the separator. High flows were generally due to debris

on the perforated plate, which technicians cleaned. During the spill program, project operations, juvenile channel adjustments and other issues described in this report, the separator can experience fairly severe fluctuations at times. However, the new channel program did appear to reduce these fluctuations somewhat. Regularly tapping and back flushing the separator up well did improve flow. The end of the spill program had no significant effect on separator debris loads.

Debris issues as describe elsewhere in this report affected the separator and facility when operational. Also, at the facility, algae was removed as needed.

With fall primary bypass season, the system remained watered up to help avoid frozen pipes. In December, with the facility dewatered, winterization was completed and maintenance began. Other facility issues are outlined in the other sections of this report.

JFF Mortalities

For the year, facility mortality records were within normal ranges. The one unusual location was the primary/secondary bypass gate, where a couple of juvenile lamprey were removed in April.

Another unusual event occurred on May 5. Approximately four clipped yearling Chinook and six unclipped sockeye smolt mortalities were found under the weir boards in the sample recovery raceway after the sample was released. It was determined the weir boards were improperly reinstalled after winter maintenance. After trying different alternatives, it was determined the best solution was to permanently fasten the bottom weir board to the raceway with angle iron on the downstream side of the weir, which occurred on May 7 and 8. No other mortalities were observed in this location.

JFF Power Outages

Electrical switching resulted in two brief power outages on May 30, from 1212 to 1226 hours and 1607 to 1610 hours. With sample gates off, one sample may have been missed. A brief power outage occurred due to the station service testing on June 28, at 1336 and 1712 hours. Neither outage affected the facility as it was a primary bypass day. Electrical switching resulted in a one minute power outage on October 22nd when the system was in primary bypass.

JFF Sample System (A & B)

The sampling season consisted of alternating days of primary and secondary bypass with the switch occurring every morning at 0700 hours. On April 2, at that time, the sample gates were turned on for the first day of secondary bypass. The sample gates were activated only during secondary bypass. The sample system was shut down for the year on September 30 at 0700. Turning the sample gates on and off during other events are also recorded in the Bypass Operations and JFF Power Outages sections of this report. During the season, the sampling system operated well. However, system issues are recorded in Table 32, below.

Table 32. Sample System Issues, 2018.

Date	Issue	Resolution
3-Apr	Chiller not functioning properly. Sample delayed 30 minutes.	Mechanic resolved issue. Chiller had been examined preseason.
9-Apr	Chiller not functioning properly. Sample delayed till 1030 hours.	Chiller pump foot valve replaced. Chiller operations reviewed.
16-Apr	Sample gates off 30 minutes. Four samples missed.	Mechanics repaired a water supply line to research tanks.
14-Jun	Circulation pump failed. Sample delayed one hour.	Pump replaced.

For smolt monitoring purposes, when needed, the sample rates were changed on the data days at 0700 hours. However, as request by Pacific Northwest National Laboratory (PNNL) personnel, sample rates were also changed to insure PNNL collected enough fish for tagging. PNNL had collected, tagged and released yearling Chinook and steelhead smolts at McNary as part of the spill to gas cap evaluation study. The sample rate changes are recorded in Table 33, below.

Table 33. Sample Rate Changes in 2018 for PNNL.

Date/Time	Previous Rate	New Rate
22-Apr/1330 hours	1.0 percent both gates.	5.0 percent both gates.
26-Apr/0700 hours	2.0 percent both gates.	4.0 percent B gate.
30-Apr/0700 hours	1.0 percent both gates.	2.0 percent B gate.
4-May/0700 hours	0.5 percent both gates.	2.0 percent B gate.
12-May/0700 hours	0.5 percent both gates.	4.0 percent B gate.
16-May/0700 hours	0.5 percent both gates.	4.0 percent B gate.
20-May/0700 hours	0.5 percent both gates.	10.0 percent B gate.
22-May/0700 hours	0.5 percent both gates.	10.0 percent B gate.

There were no issues to report with the sample recovery raceway or sample release line.

JFF PIT Tag System (Primary (A & B) & Secondary (C & D))

During the bypass season, the primary PIT tag gates were not used. All PIT tagged fish were still detected in the full flow flume during primary bypass and at the facility including the return to river lines during secondary bypass so no data was lost and these bypass routes are preferred over the smaller PIT tag release lines system. Also, the PIT tag count tanks delay fish. The primary PIT system received scheduled inspection.

The secondary bypass slide gates, which also can serve as a PIT tag diversion system (C gate is on the A side and D gate is on the B side) have not been used in a PIT tag study for several years. These gates received no preseason or in season adjustments. They are left off and open.

JFF Secondary Bypass Lines (A & B)

There were no problems to report with the secondary bypass lines. Inspections and blind ice block checks continued with nothing to report.

JFF Operations Related to Gas Bubble Trauma (GBT) Examinations/Research

GBT examinations occurred twice a week (report week/Friday through Thursday) from April 10 to July 19. Because of issues with the sample recovery raceway weir boards, the GBT monitoring scheduled for May 6 was move to May 10. In June, due to the system being in primary bypass, one examination date was moved to the next week. With high water temperatures, examinations were reduced to once a week from July 20 to August 9. After this, GBT monitoring was suspended due to lack of fish. During the season, twelve smolts were reported with signs of GBT. Finally, GBT examined smolts were allowed to recover in the sample recovery raceway before being released by the project biologists.

For the spill to gas cap study, PNNL removed steelhead smolts from the GBT sample on three occasions. The fisheries staff monitored the holding tanks used by PNNL.

In late April and early May, the Yakima Nation removed juvenile lamprey from the smolt monitoring sample on six occasions for off sight tagging.

In September, on two occasions, PNNL collected juvenile shad from the smolt monitoring sample for off sight barometric trauma testing.

These monitors/researchers publish their results in separate reports.

JUVENILE FISH SALVAGE/COOLING WATER STRAINERS

Juvenile fish salvage for the juvenile passage system is recorded in various sections of this report. Fish salvage from both ladders and turbine units will be recorded in the adult report since adult fish are mainly found in these location. The other location that juvenile salmonids were recovered from was navigation lock tainter valve #3. (Valve #1 had no fish.) The estimate was 500 to 600 smolts in tainter valve #3. Most fish appeared to be yearling Chinook with some steelhead and other species mixed in. Approximately 10 smolt mortalities occurred when the dewatering pumps were installed. The estimate was 15 more mortalities occurred during fish rescue along with an estimated 25 smolts that were highly stressed. The remainder of the fish were returned to the river unharmed.

Cooling Water Strainers

Table 34, below reflects the results of this year's main unit cooling water strainer examinations. Due to a change in the FPP, the strainers do not need to be examined year round.

Table 34. Cooling Water Strainer Results, 2018.

Month	Lamprey Mortality	Live Lamprey	Smolt Mortality	Live Smolts
January	11	1	0	0
February	19	0	0	0
March	52	0	0	0
April	14	0	0	0
May	1	0	0	0
June	6	0	4	0
July	1	3	18	0
December	0	0	0	0

All smolts were subyearling Chinook. Sixteen were unclipped. In addition, on February 26, during strainer repairs at unit 6, six live juvenile lamprey were removed.

AVIAN PREDATION

From January to February, bald eagles, pelicans, great blue herons and grebes were occasional observed around project. Gulls and cormorants were the species most commonly seen. In March, before avian observations began, gulls, cormorants, blue herons and osprey were the species noted.

Daily bird counts occurred from April 1 to September 27. There are four zones: bypass outfall, spill, powerhouse (these three zones make up the tailwater area) and forebay. All zones are counted once a day, usually in the morning. There are five species of interest: gulls, pelicans, terns, cormorants (these four are primarily in the tailwater area) and grebes (which are primarily in the forebay zone). Bird numbers fluctuated with smolt, juvenile lamprey and shad outmigration peaks. Pelicans appear to arrive with the adult shad migration. Avian numbers also appeared to be affect by the birds own migration patterns.

For the tailwater area, the technicians or biologists performed the counts from the separator building using binoculars. (Gulls and terns are difficult to distinguish with binoculars. Cormorants are difficult to observe unless they are roosting.) For the forebay zone, bird counts were performed with the unaided eye while doing gatewell observations. All daily counts were reported in the Endangered Species Act (ESA) weekly reports.

The avian hazing program was based on the ten year smolt passage average. The hazing season this year was from April 15 to July 28. The avian graphs below will be for species abundance during the hazing season(s). The hazing seasons for previous years used in the average were longer than 2018. The longest hazing season was in 2014, April 1 to August 1. This is the time frame used in the tailwater area and forebay zone graphs below.

Avian Predation-Tailwater Area

In the tailwater zones, from April 1 to 14, a small number of gulls and cormorants were observed. All four bird species were observed from July 29 to September 27. However, the main prey specie was shad, both adult and juvenile. Pelican and tern numbers began to decrease throughout the summer and by September, both species were essentially gone. After the spill closure, gulls moved from the spillway to the powerhouse to feed and roosted all around the project. Cormorants continued to roost on the navigation lock wing wall and a few other locations. Both species feed at the outfall.

After avian counting concluded, from September 28 to December 31, casual observations of birds were made and reported. Gulls and cormorants remained well into December feeding on juvenile shad and roosting in the same locations as late September. A few bald eagles and pelicans were also noted.

During the hazing season, April 15 to July 28, with high flows, pelicans and gulls would roost outside the counting zones. Gulls observed near the outfall may have actually been feeding in the spill flow. Also, gulls appeared to be feeding later in the day. As flows decreased, bird numbers in the outfall and spillway zones increased. Pelicans prefer the shorelines and outfall. Gulls and terns prefer the spillway and outfall. Cormorants were observed roosting on the navigation lock wing wall and were observed feeding at the outfall. After the outfall sprinklers and bird wire washed out, gulls were noted roosting on the outfall pipe. Osprey began to feed on adult shad toward the end of the hazing season.

The figures below reflect the primary species (pelicans, gulls, cormorants and terns) in the primary zones, outfall, Figure 3-6 and spillway, Figure 7-10. There will be no figures for the powerhouse zone as this area is lightly used.

Figure 3. Pelicans at Outfall, Hazing Season 2018 and 4-Year Average 2017-2014.

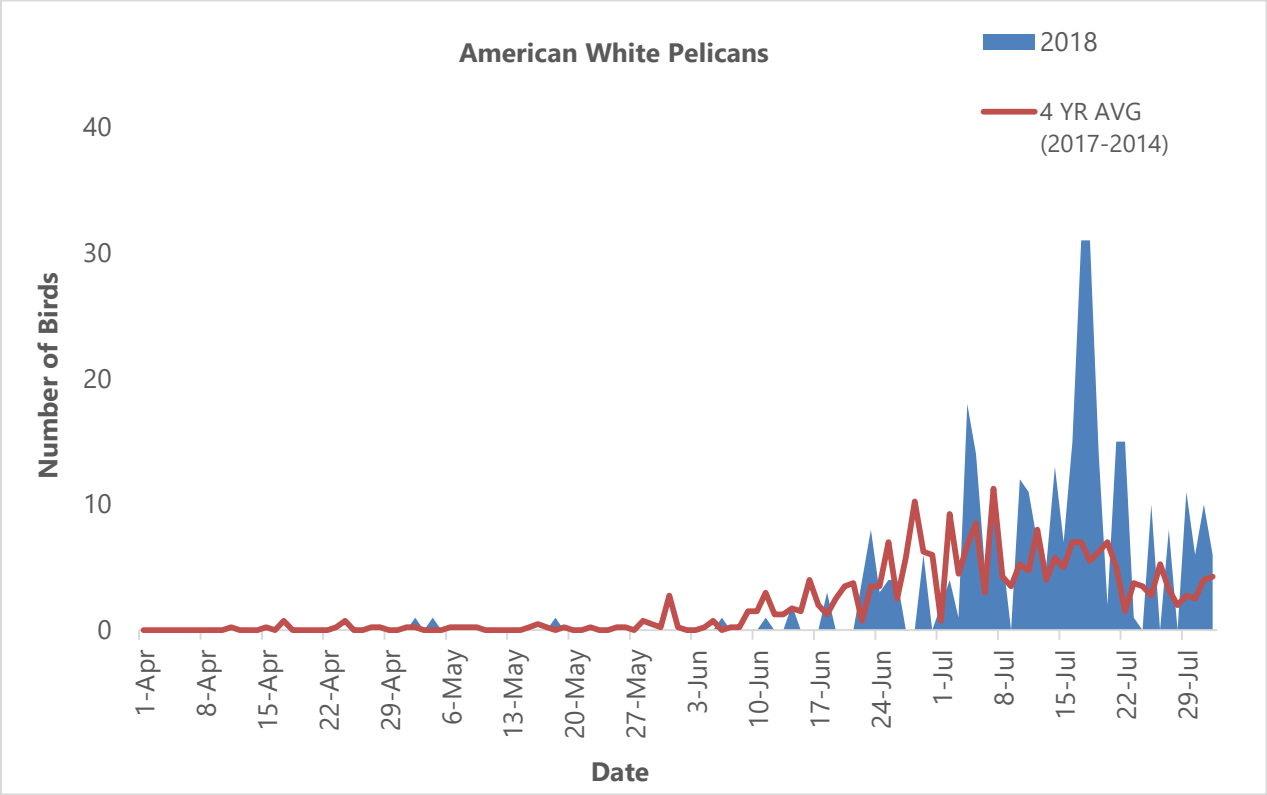


Figure 4. Gulls at Outfall, Hazing Season 2018 and 4-Year Average 2017-2014.

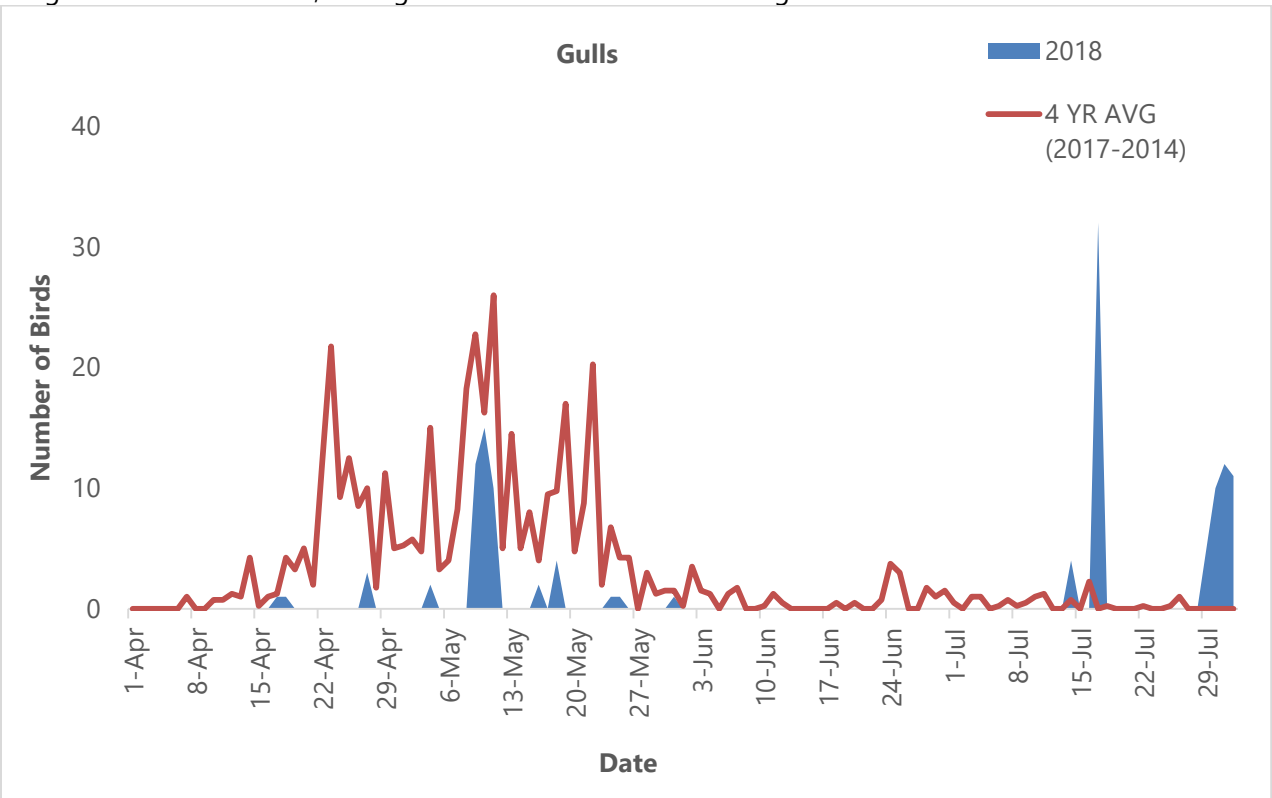


Figure 5. Terns at Outfall, Hazing Season 2018 and 4-Year Average 2017-2014.

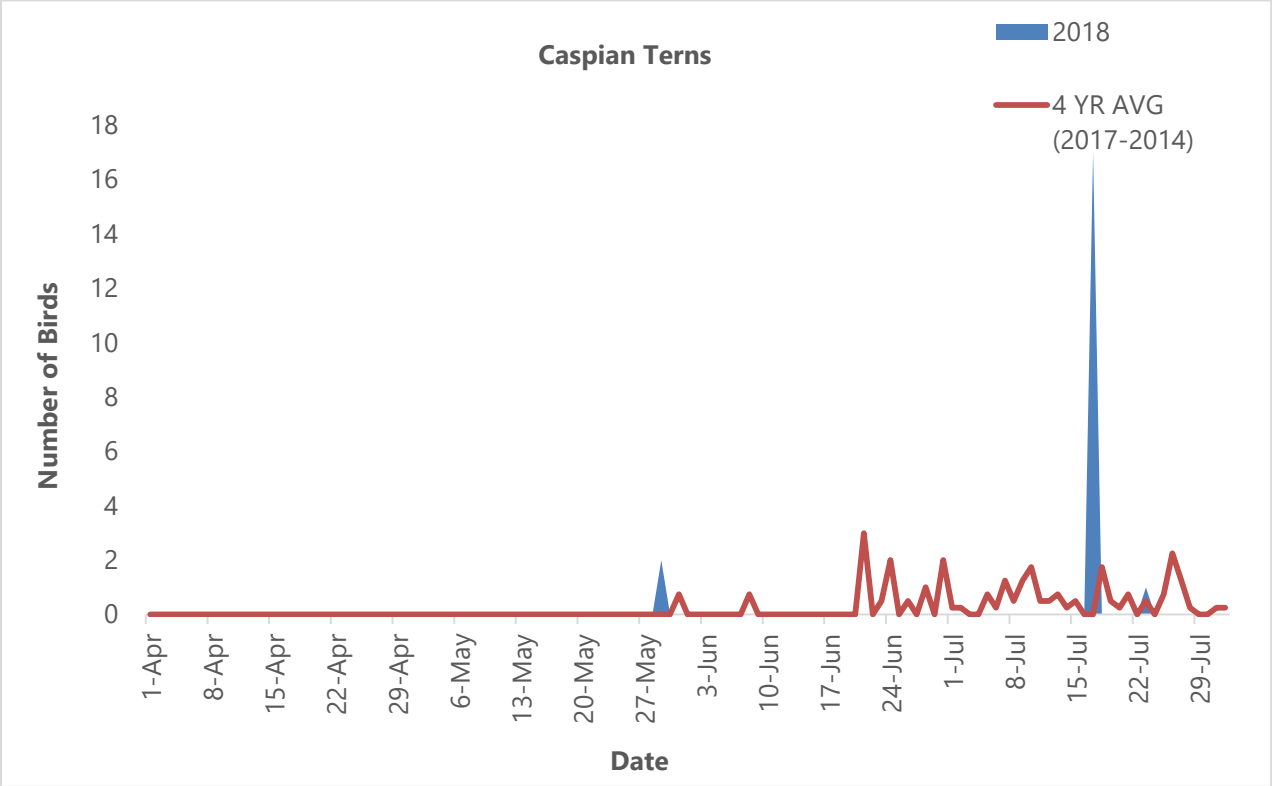


Figure 6. Cormorants at Outfall, Hazing Season 2018 and 4-Year Average 2017-2014.

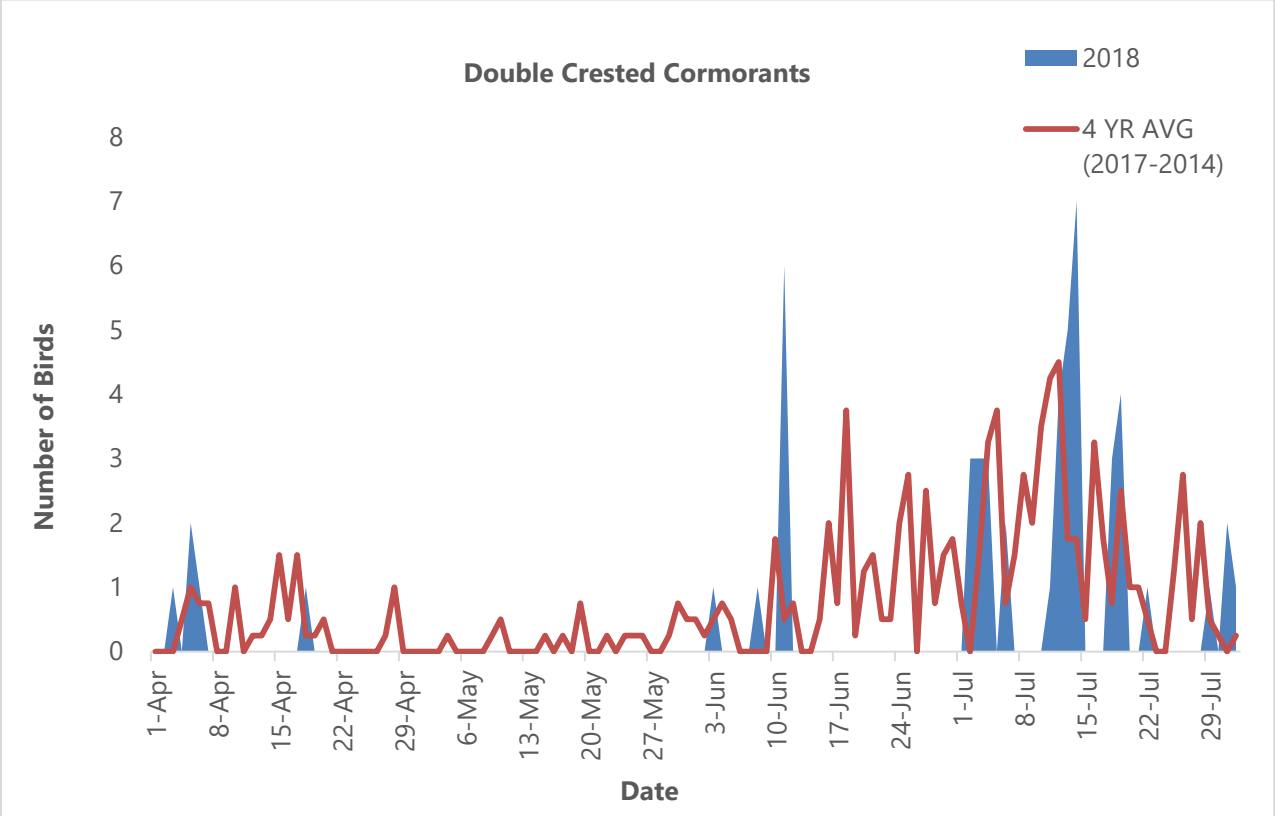


Figure 7. Pelicans in the Spillway, Hazing Season 2018 and 4-Year Average 2017-2014.

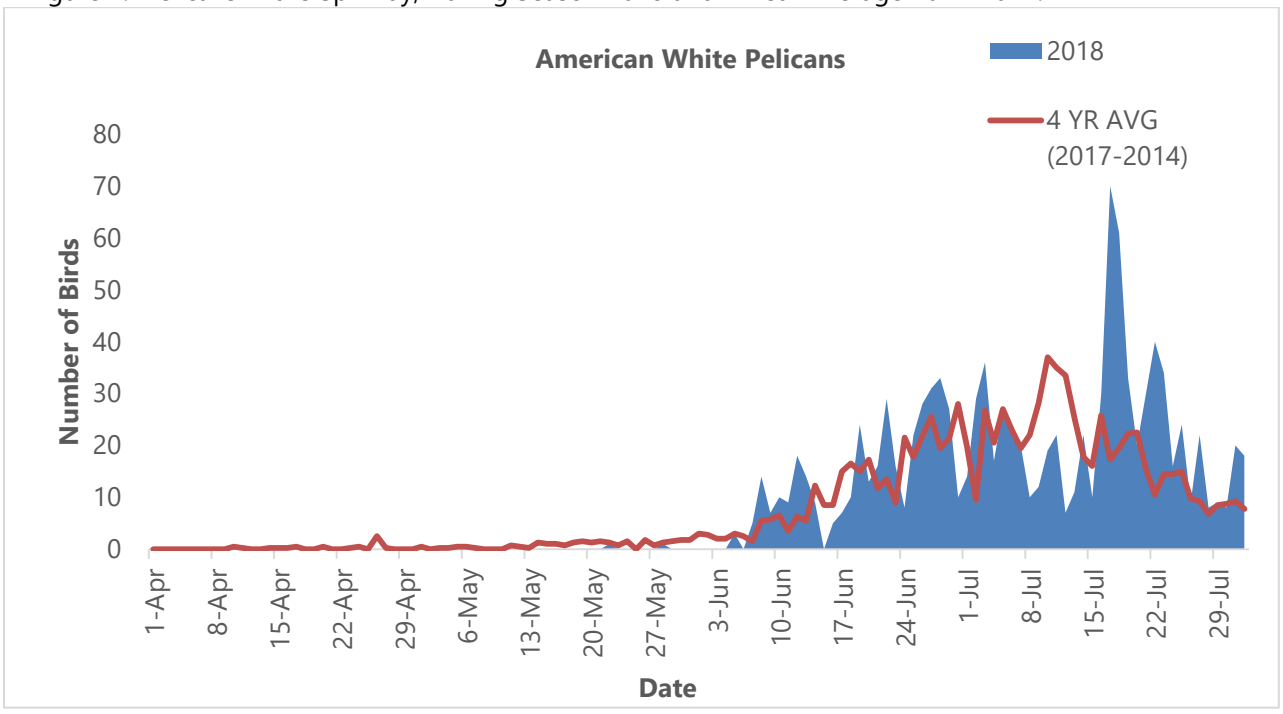


Figure 8. Gulls in the Spillway, Hazing Season 2018 and 4-Year Average 2017-2014.

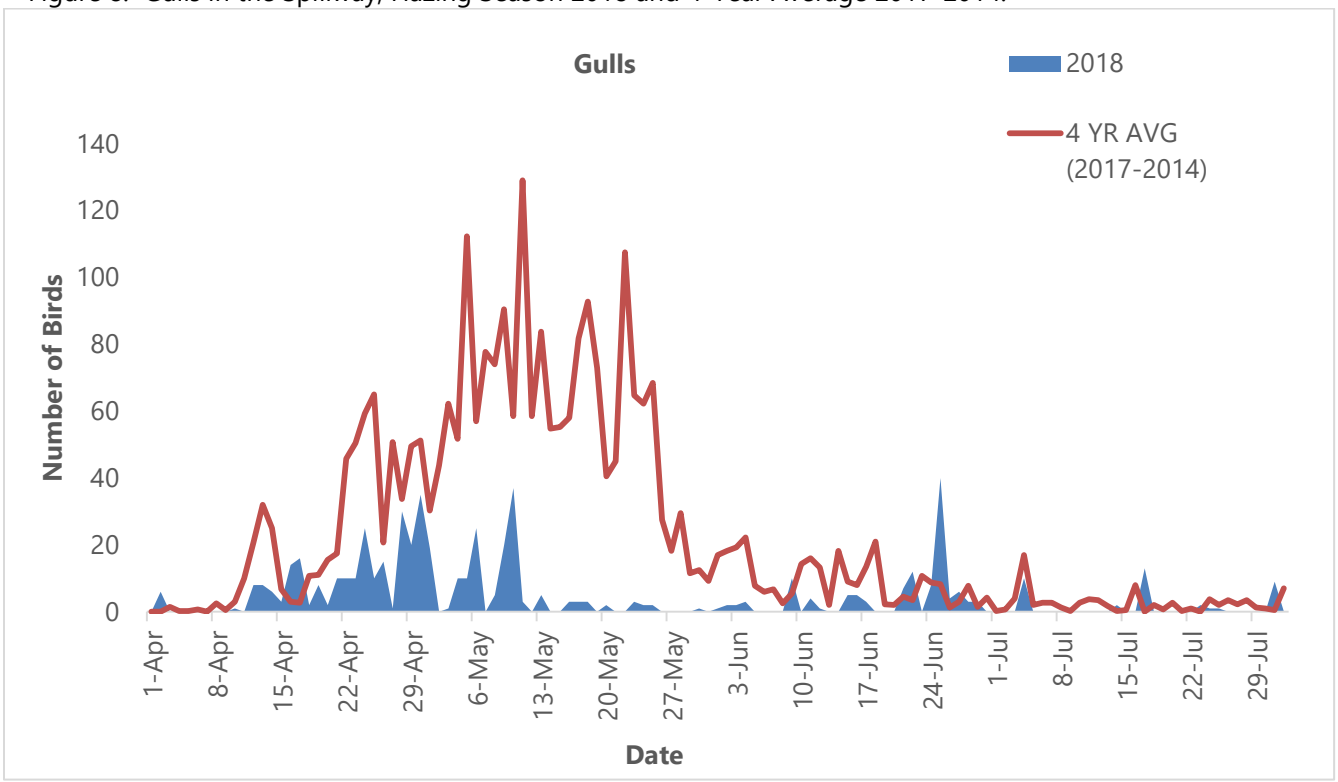


Figure 9. Terns in the Spillway, Hazing Season 2018 and 4-Year Average 2017-2014.

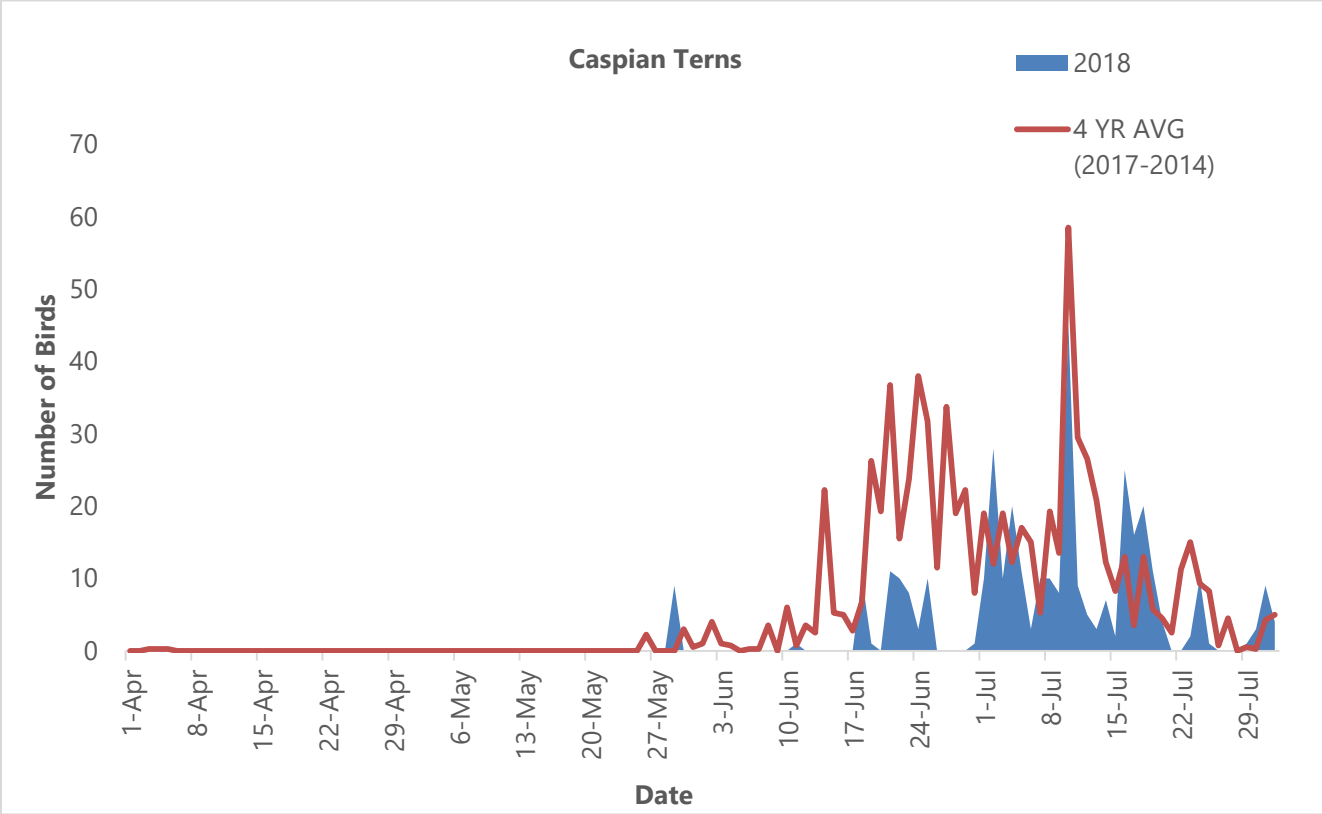
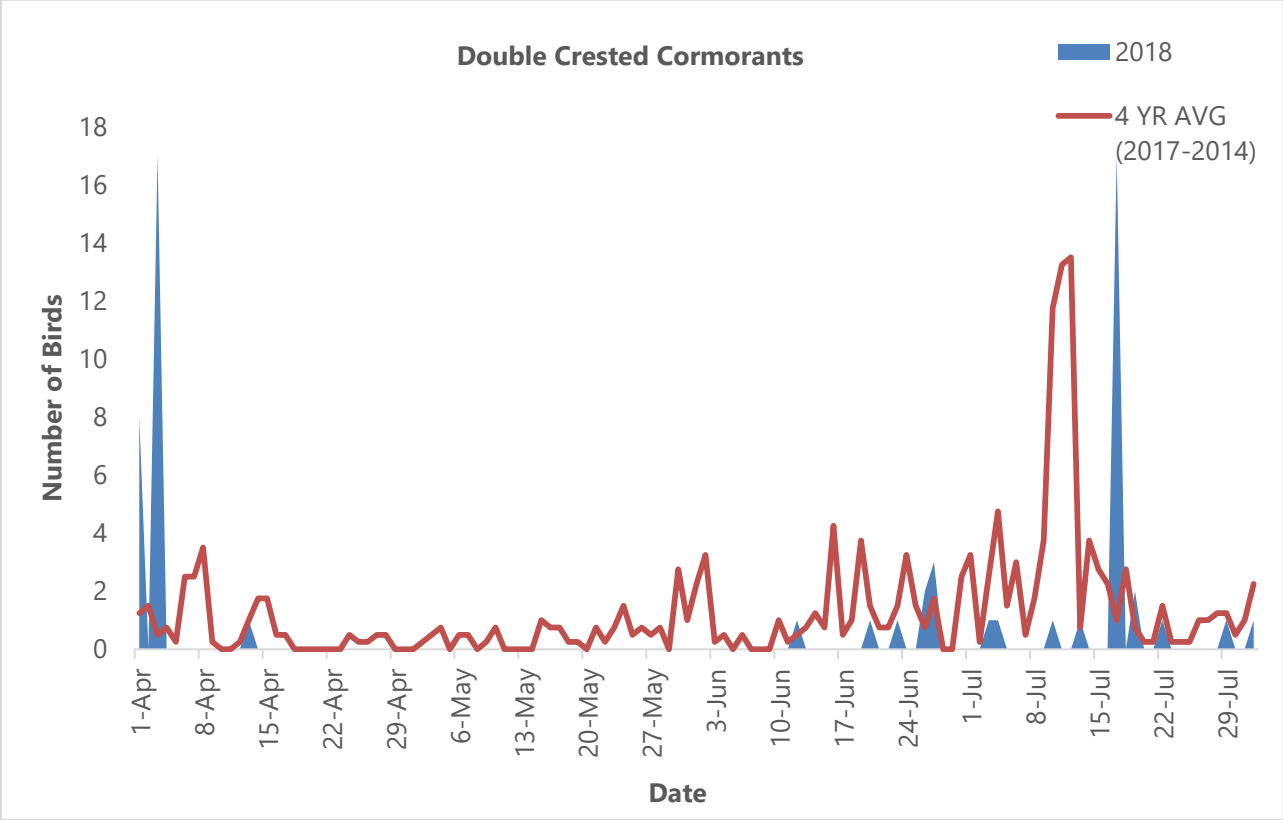


Figure 10. Cormorants in the Spillway, Hazing Season 2018 and 4-Year Average 2017-2014.



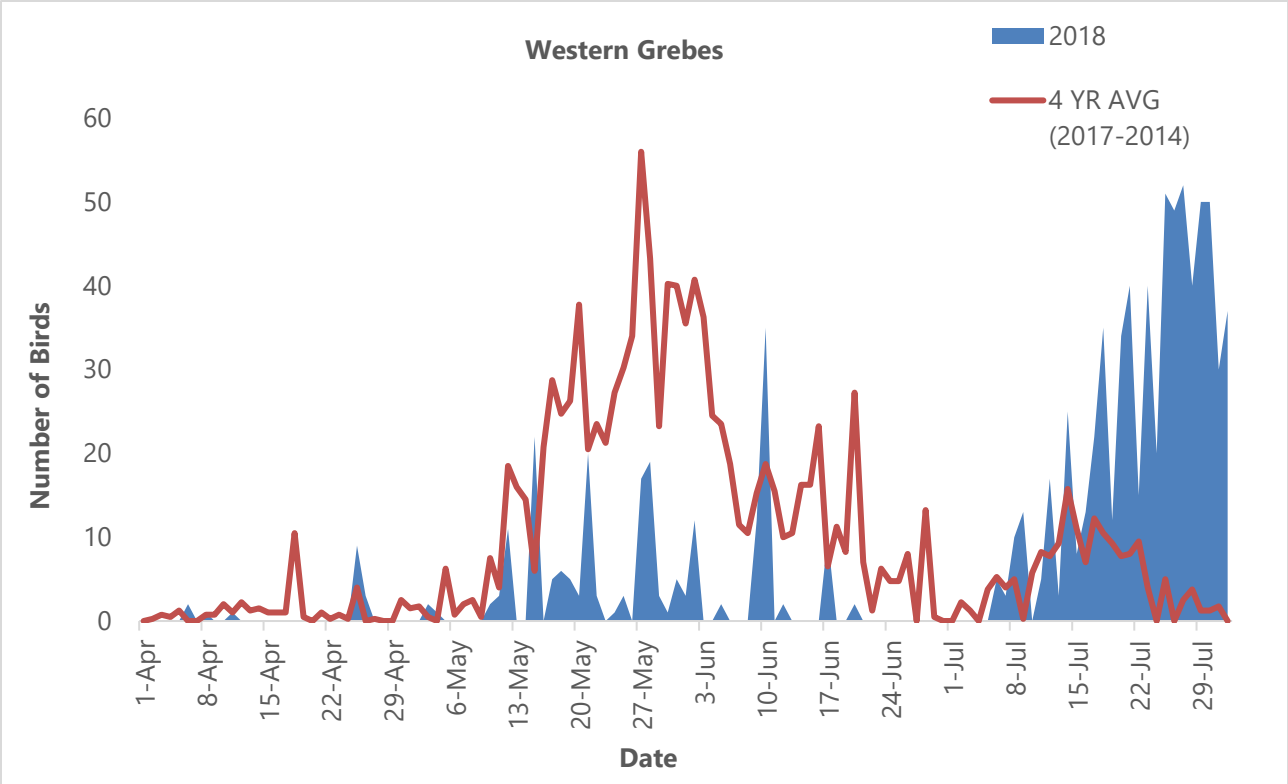
Avian Predation-Forebay Zone

In the forebay zone, from April 1 to 14, osprey, gulls, cormorants, great blue herons and grebes were observed in low numbers. From July 29 to September 27, the same species were observed in the same locations just in gradually decreasing numbers as the hazing season described below.

After avian counting concluded, from September 28 to December 31, casual observations of birds were made and reported. Occasionally, a gull or roosting gull flock, grebe or grebe flock, cormorant, great blue heron, kingfisher, loon, pelican, bald eagle or merganser was observed. Gulls and cormorants occasionally roosted on the rocks by the Washington shore boat dock.

During the hazing season, April 15 to July 28, the graph below reflects the primary species in the forebay zone, which is grebes. Osprey, gulls, cormorants, great blue herons along with a roosting gull flock, a pelican flock, loons, kingfishers and terns were observed but the number or frequency of occurrence does not warrant a graph. The roosting rocks by the Washington shore boat dock were visited by pelicans, gulls, cormorants and terns. Starting in July, scavenging juvenile gulls made up a part of the count. Occasionally, pelicans and cormorants were noted outside the Oregon ladder exit. Figure 11, below, represent the data collected from grebe counts in the forebay during hazing season.

Figure 11. Grebes in the Forebay, Hazing Season 2018 and 4-Year Average 2017-2014.



Avian Predation-Grebes in Gatewell Slots

Grebe observations and counts are difficult due to their behavior, the various locations they appeared and system operations. There is no accurate way to enumerate grebes. From May 31 to June 18, four grebes entered the gatewells slots. Two were removed and two passed to the JCC. One grebe was removed from the JCC and the other passed out of the system during primary bypass.

Avian Predation-Pelican Observations

For the second year, Pacific States Marine Fisheries Commission (PSMFC) smolt monitoring personnel observed pelican activity at the bypass outfall with the aid of a spotting scope. This year, the observations were done from June 30 to September 3. They intended to continue later into the year to see how pelicans respond when juvenile shad are the size of subyearling Chinook. However, due to a lack of pelicans the observations were suspended.

Avian Hazing-Bypass Outfall Sprinklers

On March 22, the hazing water sprinklers were turned on. A combination of big gun and/or inverted sprinklers can be used depending on flow conditions and avian response to the sprinklers. On May 8, the sprinklers were turned off due to high flows cresting over the outfall. On May 16, a new sprinkler water supply pump was installed. On June 1, it was determined part of the sprinkler supply line and some of the sprinkler heads were missing. As mentioned in the Full Flow Flume and Bypass Pipe section, the high river flows had damaged much of the structure at the end of the outfall. The outfall structure and sprinkler system will require a major contract(s) to repair/replace. During the winter of 2019, a contractor will remove damaged structure and repair supports as needed. Replacement of the walkway, sprinkler system, bird wire and other items will require future discussion. The purchase and use of a green light laser to cover the outfall area is being considered for the 2019 season.

Avian Hazing-Distress Calls

The distress call stations include three species of gulls and double creasted cormorants. On April 5, the calls were deployed along the navigation lock wing wall where birds in the past roosted in large numbers. The call frequency was adjusted weekly. During smolt passage season, the calls were very effective. On July 24, a second distress call system was deployed on the outfall walkway in order to help compensate for the loss of the sprinkler system. In August when the juvenile shad outmigration began, the distress calls were not as effective. The call systems were removed on October 4.

Avian Hazing-Bird Wires/Spikes

Bird wires remain across the powerhouse tailrace, around the barge dock and on the outfall bypass pipe. Avian spikes are used on outfall bypass pipe and barge dock as well as on the handrails of the outfall, navigation lock wing wall, powerhouse and ice/trash sluiceway walkways. Some of the outfall avian wire was lost during the high flows mentioned above. These wires will be replaced once a solution to the walkway damage has been developed. Hopefully, the green light laser test in 2019 will help with this issue. On May 10, spikes were added to the light fixtures along the navigation lock wing wall.

Avian Hazing-United States Department of Agriculture-Wildlife Services (UDSA-WS)

The USDA-WS hazing program is outlined in Table 35 below. Deck and boat hazers worked eight hours shifts including travel time. The boat was in the tailwater area for approximately six hours each trip. Early in the season, the boat remained below the bypass outfall due to high flows. Later in the season, the boat was able to move slightly upstream of the outfall pipe. In response to bird activity some afternoon boat hazing occurred. When boat trips were missed, they were immediately made up the next working day. When weather conditions did not allow the boat crew to go out, they would haze from the shoreline. From the boat, USDA-WS personnel lethally took 21 cormorants and 92 gulls. On July 20 and 23 through 26, due to the large number of birds, additional boat trips occurred.

Table 35. Avian Hazing Program Schedule, 2018.

Personnel	Days	Dates	Shift
Deck hazer	Mon - Fri	15-Apr–28-Jul	Day
Deck hazer	Sat & Sun	15-Apr–28-Jul	Day
Deck hazer	Mon - Fri	29-Apr–14-Jul	Swing
Deck hazer	Sat & Sun	29-Apr–14-Jul	Swing
Boat captain & hazer	4-days, Mon - Fri	29-Apr –7-Jul	Day

On July 24 to 26 and August 30 to 31, USDA-WS personnel tested a drone in the tailwater area. The use of a drone appears to have potential. Hazing of pelicans is prohibited at this time. Hazing grebes from the forebay deck was very effective as long as USDA-WS personnel were persistent.

RECOMMENDATIONS

1. Clear brush along shore line near JFF.
2. Install new plugs in experimental orifices in JCC.
3. Paint inside (joints) and outside (erosion) of new section of full flow bypass pipe.
4. Concrete path for access to JFF valves.
5. Refinish JCC floor and walls.
6. Rehabilitate, paint and deal with moisture in JCC drain area.
7. Address inside erosion in old section of full flow flume above separator.
8. Repaint sections of JFF.
9. Install new JFF heating and cooling system.
10. Mothball or remove JFF transport systems.
11. Install larger PIT tag shields around detectors to reduce debris blockages in JFF flumes.
12. Install emergency truck release site at junction box at JFF.
13. Install a new JFF separator.
14. Rehabilitate the separator supply valves.
15. Purchase new boom for forebay debris removal.
16. Repair outfall walkway and sprinkler system.

17. Reprogram JCC control PLC.
18. Adapt TSWs so installation and removal are improved.
19. Improve fish crowding devices in both JFF sample holding tanks.

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APPENDIX