FINAL
2020 Annual Report
April 2021

Hatchery and Supplementation Program

Lewis River Hydroelectric Projects

FERC Project Nos. 935, 2071, 2111, 2213

PACIFICORP
A BERKSHIRE HATHAWAY ENERGY COMPANY

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1.0 INTRODUCTION

This report documents results from monitoring and evaluation activities associated with implementing the Hatchery and Supplementation (H&S) program in 2020. The format of this report follows the objectives as presented in the 2020 Annual Operating Plan (AOP) (ATS 2020). Development of monitoring objectives in the AOP are guided by general monitoring objectives presented in the Hatchery and Supplementation Plan (PacifiCorp and Cowlitz County PUD 2014)[1]. Evaluation methods to answer specific H&S plan objectives are developed through a collaborative effort of the Aquatic and Technical Subgroup (ATS) and documented within the AOP.

The following key activities were completed as part of the 2020 AOP:

1. Transport of adult late winter steelhead, spring Chinook and coho salmon adult returns upstream of Swift Dam
2. Production of late winter steelhead smolts using NOR broodstock
3. Abundance and distribution estimates of spawning adults downstream of Merwin Dam.
4. Hatchery production of trout and salmon as stipulated in Section 8 of the Lewis River Settlement Agreement.
5. Ongoing spring Chinook rearing, release and precocity evaluations.
6. A final H&S plan (3rd revision) was submitted to the FERC in December 2020.

This report is required by Section 8.2.4 of the Lewis River Settlement Agreement (PacifiCorp and Cowlitz County PUD 2004) that states:

"On an annual basis, the Licensees shall provide to the ACC for review and comment a report compiling all information gathered pursuant to implementation of the Hatchery and Supplementation Plan. The report also will include recommendations for ongoing management of the Hatchery and Supplementation Program. The ACC shall have 60 days to comment on the annual report. Within 60 days of the close of the comment period, the Licensees shall finalize the report after consideration of all comments. The Licensees shall also provide the comprehensive periodic review undertaken pursuant to Section 8.2.6 below to the ACC. The Licensees shall provide final annual reports and the comprehensive periodic review to the Services during the development of any required ESA permit or authorization for hatchery operations, including NOAA Fisheries' HGMP process. The report may be included as part of the detailed annual reports of the ACC activities required by Section 14.2.6."

[1] A revised H&S Plan was submitted to the FERC for approval in December 2020. Thus, the 2021 Annual Operating Report (AOR) will include substantial reformatting to remain consistent with the revised H&S plan and 2021 AOP.

2.0 LATE WINTER STEELHEAD

In 2020, the North Fork Lewis River supported three stocks of winter running steelhead:

1. A hatchery produced winter steelhead stock derived from Chambers Creek (Puget Sound) with a peak spawn time of December
2. An endemic natural stock with a peak spawn time in April
3. A fully integrated stock derived from the endemic population but spawned and reared in the hatchery (program or supplementation stock).

The primary goal of the fully integrated program is to produce adult returns that are genetically identical to the late winter steelhead endemic stocks to be used for upstream supplementation.

This program has three main components:

- Collection of broodstock at traps and through in-river netting.
- Spawning and rearing at Merwin Hatchery.
- Transport of returning adults upstream of Swift Dam.

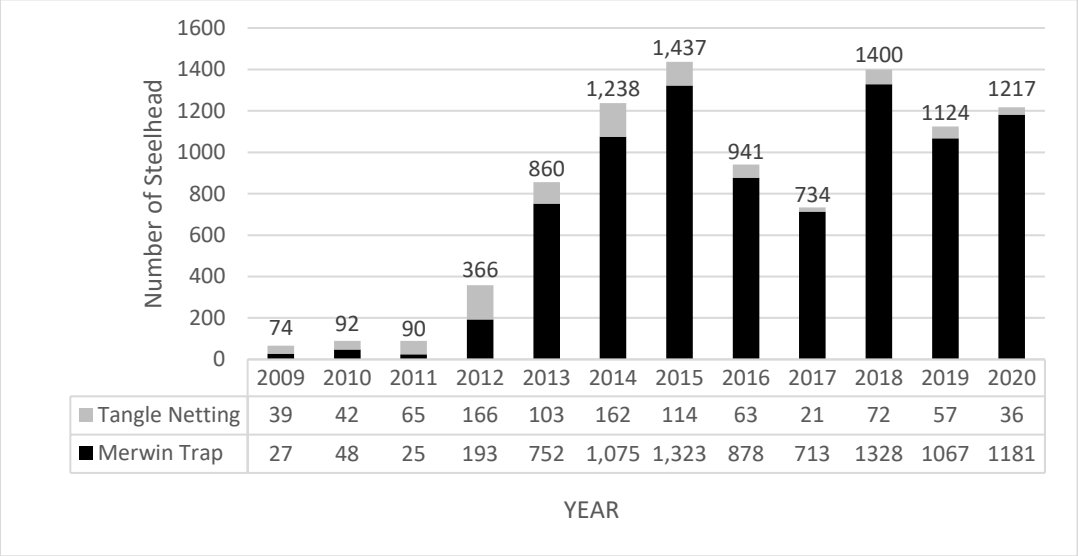

Figure 2-1. Total captures of NOR and BWT late winter steelhead by method between 2009 and 2020 (excludes same year recaptures and adipose fin clipped steelhead)

2.1 Broodstock Collection

In 2020, broodstock collection relied entirely on NOR returns from the Merwin trap. All NOR steelhead collected at the Merwin Trap were either transferred to Merwin Hatchery as potential broodstock or released upstream of Swift Dam. Sampling data for all steelhead transported to Merwin hatchery as potential broodstock are provided in Appendix A.

2.1.1 Merwin Trap

During the period from December 1, 2019 through June 8, 2020, a total of 455 NOR and 726 blank wire tagged[2] (BWT) winter steelhead were captured at the Merwin trap (Table 2-1).

Table 2-1. Origin and gender of late winter steelhead captured at the Merwin Trap from 2015 to 2020

		2015	2016	2017	2018	2019	2020
NOR							
	Males	40	26	47	46	51	245
	Females	28	23	43	72	28	210
HOR (BWT)							
	Males	743	403	340	680	511	341
	Females	504	414	283	530	477	385

Figure 2-2 illustrates the cumulative proportion of both NOR and BWT steelhead captured during the first six months of 2020 and, for comparison, the average cumulative proportion during the years 2015 through 2019.

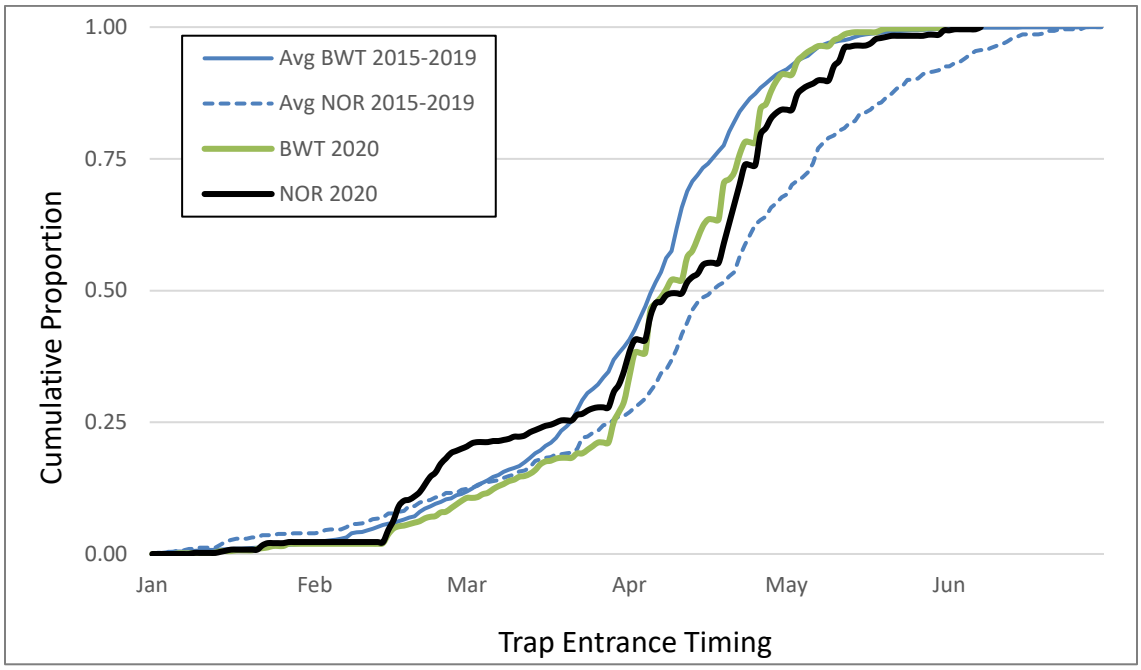

Figure 2-2. Cumulative proportion of NOR and BWT late winter steelhead trapped at the Merwin Collection Facility for the years between 2015 and 2019 (average) and 2020

[2] Adult steelhead that possess a blank wire tag in their snout are referred to as BWT steelhead and represent returns from the hatchery supplementation program using only verified NOR broodstock (i.e., pNOB = 1).

2.1.2 Tangle Netting

Tangle netting efforts began on March 11, 2020 and continued through May 1, 2020. A total of 21 netting days were conducted during this period. Table 2-2 provides a summary of late winter steelhead captured during the 2020 effort.

Table 2-2. Origin, gender and disposition of late winter steelhead captured through tangle netting between 2015 and 2020 (excludes same year recaptures)

	2015		2016		2017		2018		2019		2020		TOTAL
Disposition	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	
NOR shipped to Merwin	10	6	16	6	7	1	3	0	6	2	0	0	57
Upstream Transport	20	4	0	0	0	0	0	0	0	0	0	0	24
NOR Released on site	28	5	14	4	1	1	20	18	13	7	14	3	128
BWT Released on site	23	7	15	7	6	5	16	14	20	8	14	5	140
AD Clip (Euthanized)	0	4	0	1	0	0	0	3	1	0	0	0	9
AD Clip (released)	1	3	0	1	0	0	0	0	0	0	0	0	5
Mortality	0	0	1	0	0	0	1	0	0	0	0	0	2
TOTAL	82	29	46	19	14	7	40	35	40	17	28	8	365

In total, 36 (excluding 2 recaptures) steelhead were handled through the tangle netting program. Of these, 17 (47 %) were of natural origin and 19 (53 %) were of hatchery origin (Figure 2-3).

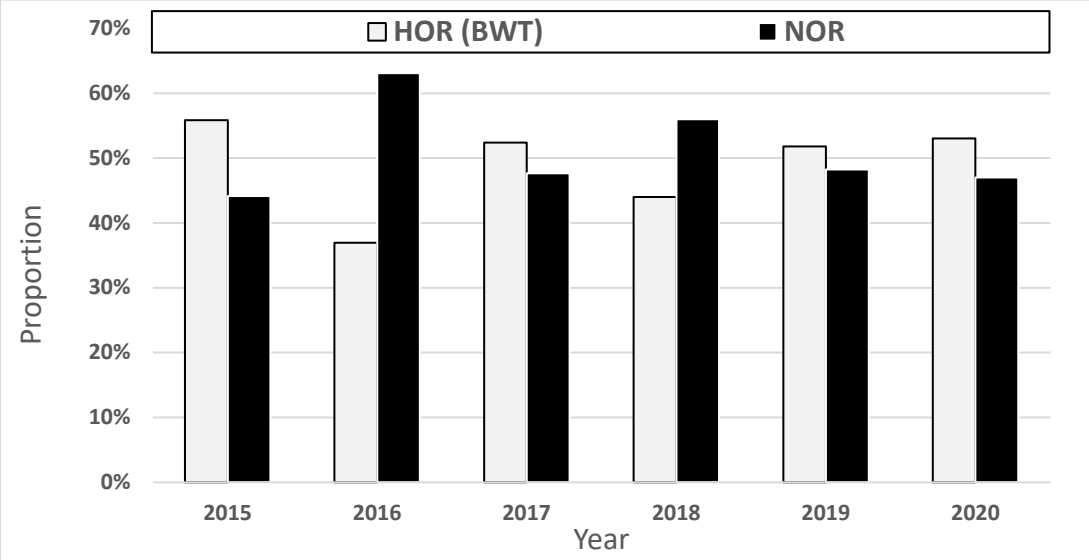

Figure 2-3. Composition of late winter steelhead captured by year through tangle netting from 2015 to 2020

Table 2-3 provides the timing of HOR and NOR captures by month. HOR (BWT) winter steelhead were mostly caught in March, while NOR steelhead were mostly caught in April for the years 2015 through 2020.

Table 2-3. Composition of late winter steelhead captured by month during tangle netting: 2015-2020

Month	2015		2016		2017		2018		2019		2020		TOTAL	
	HOR (BWT)	NOR	HOR (BWT)	NOR	HOR (BWT)	NOR	HOR (BWT)	NOR	HOR (BWT)	NOR	HOR (BWT)	NOR	HOR (BWT)	NOR
February	19	7	0	0	0	0	8	7	1	1	0	0	28	15
March	23	21	12	11	3	1	15	11	15	7	6	1	74	52
April	20	21	6	25	8	9	7	20	13	20	7	12	61	107
May	0	0	6	5	0	0	3	4	0	0	6	4	15	13
TOTALS	62	49	24	41	11	10	33	42	29	28	19	17	178	187

2.2 Late Winter Steelhead Broodstock Collection Timing

The ability to conform to predetermined collection curves presents several difficulties in the field. Several variables continue to make broodstock collection challenging including:

- Genetic assignment results may reduce available broodstock being held.
- Spawning maturity in females is highly variable creating uncertainty when deciding to retain or release male broodstock.
- The number of kelts increases substantially from mid to late April.
- Individual fecundity is highly variable

The collection curve proposed in the annual operating plan is intended to help ensure that broodstock are collected across their spawning period. Up to 50 steelhead are spawned over the course of the run with a collection goal total of 75.

In 2020, a total of 95 NOR steelhead were transferred to Merwin Hatchery as potential broodstock. Of these, 50 were spawned; 2 died while being held; 36 were planted upstream to spawn; 3 did not meet screening criteria and 4 were not needed for brood and were released downstream. All spawned steelhead were returned to river. Figure 2-4 shows the actual collection timing of broodstock retained at Merwin compared to the proposed timing curve.

Table 2-4. Actual collection and retention of late winter steelhead broodstock by year and period: 2015 – 2020

Period	Collection Curve (2018 - present)	2015	2016	2017	2018	2019	2020
Jan - Feb	3	5	3	4	3	0	3
Mar 1 – 15	6	4	2	4	7	1	10
Mar 16 – 31	9	13	2	7	8	2	16
Apr 1 – 15	21	12	15	16	20	25	21
Apr 16 – 30	24	10	8	15	14	13	16
May 1 – 15	9	5	6	2	7	4	8
May 16 – 31	3	1	1	0	1	0	0
Total	75	50	37	48	60	45	74

2.3 Genetic Analysis of Potential Broodstock

The ATS agreed to use a primary genetic assignment target level of 50 percent or greater to the NF Lewis River or Cedar Creek stock(s) to be considered acceptable broodstock. After April 1, steelhead may be considered broodstock if assignment probability is 50 percent or greater to Cascade Strata. The only exception to these requirements is any steelhead indicating assignment probabilities to any hatchery stock of more than 5 percent will never be incorporated in the broodstock.

A total of 67 samples were taken from steelhead captured in the Merwin Trap or through in-river capture. All sampled steelhead were assigned a probability percentage as to likelihood of assignment to known baselines established for Lower Columbia River tributaries including the North Fork Lewis River. Probabilities are classified as primary, secondary and tertiary to account for introgression from other basins and provide a more complete picture of diversity present within the samples. Figure 2-4 illustrates the results of primary assignment for all samples between 2009 and 2020. Appendix B provides the tabular genetic assignments results for each individual unclipped steelhead captured at the Merwin trap and tangle netting in 2020.

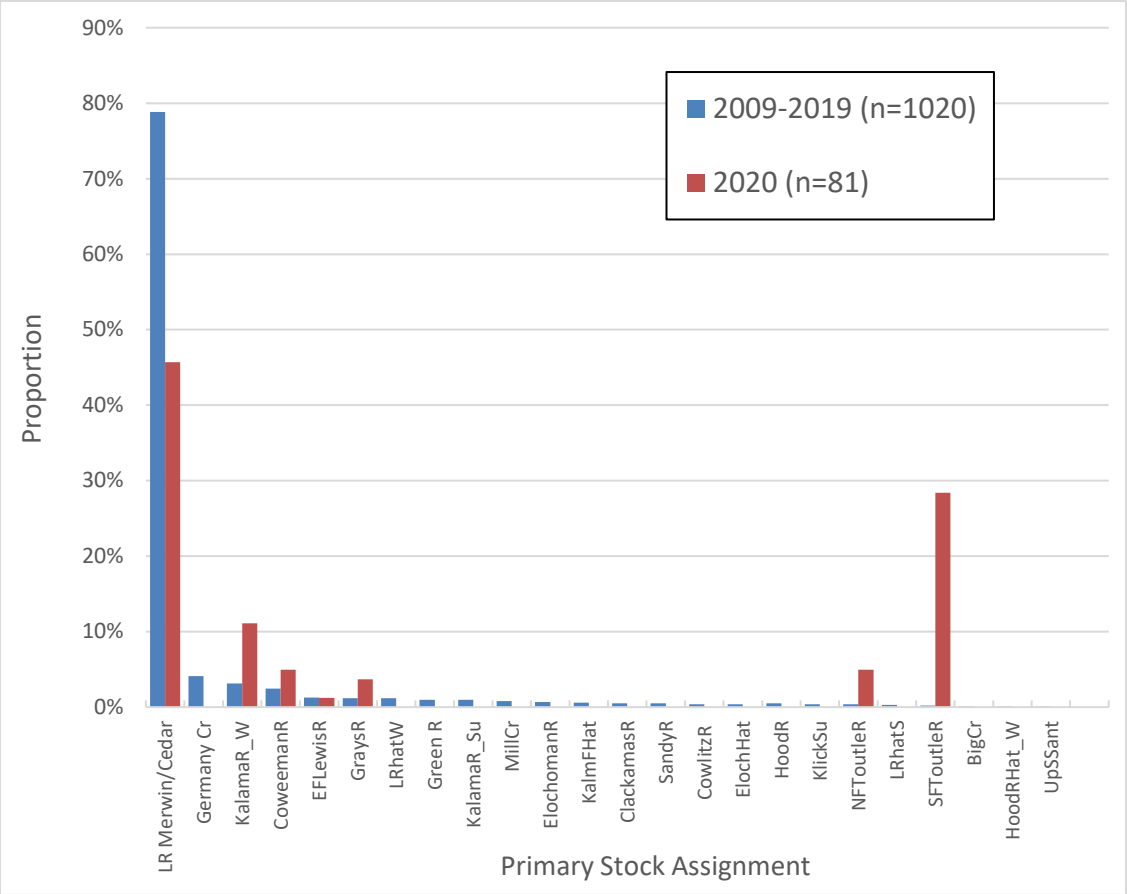

Figure 2-4. Proportion of primary genetic assignment of NOR late winter steelhead collected from the Merwin trap and tangle netting: 2009 - 2020

2.4 Spawning

A total of 50 NOR winter steelhead (25 females, 25 males) were spawned at Merwin Hatchery. There were 25 spawning crosses representing 65 potential families (Table 2-5, Appendix C).

Table 2-5. Number of spawning crosses and parents including the duration of each spawning periods for brood years between 2009 and 2020

Brood Year	Crosses	Females	Males	Potential Families	Spawn Period	Days
2009	10	12	19		Mar 2 - May 21	81
2010	22	22	24		Mar 17 - May 14	56
2011	9	16	19		Mar 30 - May 18	49
2012	12	19	23		Apr 10 - May 29	49
2013	8	8	11		Apr 10 - May 6	26
2014	26	26	25		Apr 7 - May 16	39
2015	25	25	25		Mar 26 - May 22	58
2016	10	17	20		Apr 8 - May 27	49
2017	10	25	24		Apr 7 - May 19	43
2018	22	22	23	54	Mar 23 - May 25	63
2019	14	14	14	28	Apr 16 - May 17	32
2020	25	25	25	65	Apr 10 - May 15	35

2.5 Spawn Timing

Steelhead broodstock are captured over a collection period that extends from February through mid-May. The purpose of this protocol is to collect steelhead over the course of the run so that a representative sample of the total run is spawned to limit selection bias in spawn time or other variables. However, collection timing is not always a reliable predictor of spawn timing as most NOR winter steelhead, regardless of collection time, typically spawn between April 1 and mid-May (Figure 2-5).

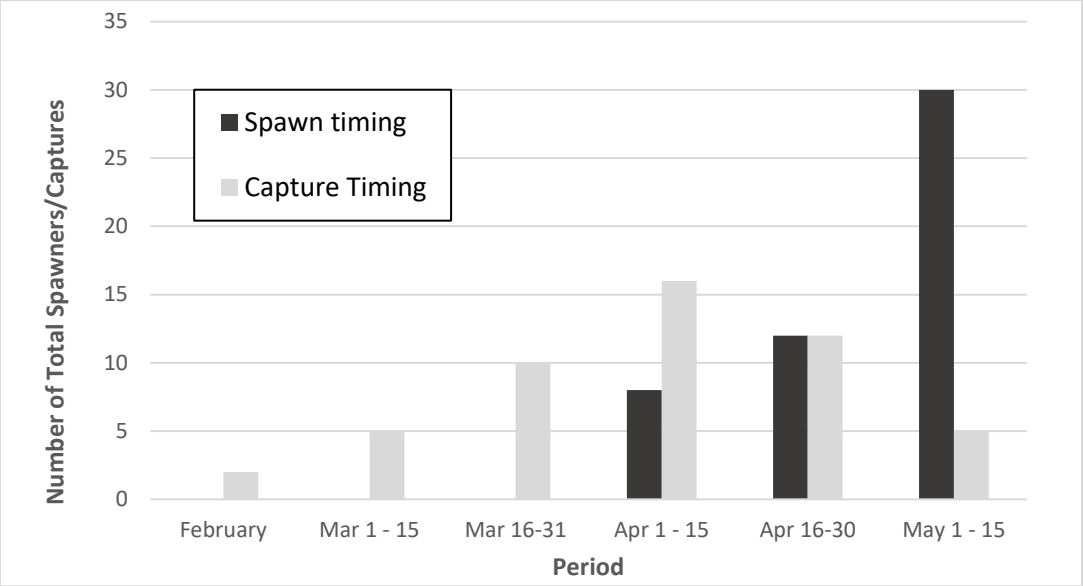

Figure 2-5. Proportion of spawners by period: 2015 - 2020

2.5.1 Tagging

All subyearling steelhead were tagged with a blank wire snout tag in December 2020.

2.5.2 Release

All broodyear 2020 late winter steelhead juveniles will be volitionally released starting on May 1, 2021 at the Merwin boat launch. Volitional release will continue until June 1, 2021. Any fish remaining in the ponds on June 1, 2021 will be forced out and released downstream at the Pekins Ferry Boat Launch (RM 3.1) near the confluence with the East Fork Lewis River. Projected average release size is 8 to 10 fish per pound. A total release number of approximately 60,000 to 80,000 smolts is projected. As of January 2021, total juveniles on hand were approximately 100,000.

3.0 MONITORING AND EVALUATION

OBJECTIVE 1: Evaluate the Effects of Hatchery Plants on Reintroduced Species.

This objective was moved to the Aquatic Monitoring and Evaluation Plan in 2016 and serves only as a placeholder until the H&S Plan is updated with revised objectives for 2021.

OBJECTIVE 2: Determine Proportion of Hatchery Origin Winter Steelhead, Spring Chinook and Coho Salmon on Spawning Grounds Downstream of Merwin Dam

Late Winter Steelhead

Program returns (BWT) are treated as hatchery origin (HOR) steelhead despite their genotype derived completely from verified NOR broodstock. This is due to the hatchery influence during mating and captive rearing conditions during their first year of life. As these program fish return as adults, there is opportunity for these (HOR) fish to spawn with NOR (and HOR) stocks. It has been shown that reproductive success (fitness) declines rapidly (up to 37 percent per captive reared generation) within a natural population (Araki et. al. 2007). The evolutionary mechanisms for declines in fitness are not fully understood, but hatchery protected rearing environments and controlled mating selection are suspected contributors to this decline (Araki et. al. 2007). Inbreeding between program fish is also a concern because of loss in genetic diversity or effective population size further limits fitness and adaptability of the natural spawning population.

Appendix D provides the formal analysis and estimates of pHOS for late winter steelhead downstream of Merwin Dam during the 2018 sampling seasons. In 2017 and 2020 there were insufficient numbers of steelhead captured for tagging. Poor capture rates are attributed to both poor in river returns and persistently high flow events during peak abundance periods (April). In 2019, an analysis of available data indicated several inconsistencies among the PIT tag releases and recaptures. It was determined by PacifiCorp and its contractors that an estimate of pHOS was not possible for 2019 due to these discrepancies. PHOS estimates including estimated abundance and resdiualism as provided by the pHOS model for the years 2016 and 2018 (Table 3-1).

Table 3-1. Summary of pHOS, abundance and residualism rates as estimated by the pHOS model for mainstem North Fork Lewis River late winter steelhead

Year	pHOS % (90% CL)	Steelhead Numbers		Residualism %	
		NOR	HOR	Males	Females
2016	51 (41.3-60.4)	175 (135, 218)	182 (142, 224)	7.7 (4.2-12)	0.7 (0, 2.2)
2017	*Insufficient number of marks and recaptures*				
2018	27.3 (21.1 - 33.9)	371 (341, 398)	121 (94, 151)	2.4 (1.0, 4.3)	1.6 (0.5, 3.2)
2019	*Data collection errors and discrepancies (see appendix D report)*				
2020	*Insufficient number of marks and recaptures*				

Coho Salmon

Carcass surveys are used to estimate abundance of Coho salmon spawning in the mainstem North Fork Lewis River. The origin (hatchery or natural) of each carcass sampled is determined by the presence or absence of an adipose fin. To assign proper origin, all fish are wanded for

the presence of a CWT as a portion of the return includes double index tagging (DIT). That is, adipose fin intact, but presence of CWT. An estimate of pHOS is generated by pooling the total number of carcasses sampled (including surveyed tributaries) over the sampling period (Table 3-2). Appendix E provides data and analysis related to coho sampling in the mainstem and tributaries of the North Fork Lewis River during the 2020 season.

Table 3-2. Origin of sampled Coho carcasses from pooled mainstem and tributary surveys downstream of Merwin Dam with implied pHOS: 2016 – 2020

Year	Carcasses Sampled			pHOS %
	HOR	NOR	TOTAL	
2016	42	39	81	52%
2017	17	20	37	46%
2018	51	11	62	82%
2019	24	26	50	48%
2020	184	39	223	83%

Chinook Salmon: *Awaiting results from WDFW for 2018, 2019 and 2020 fall Chinook and chum salmon surveys.*

Table 3-3. Fall Chinook pHOS estimates for tule and bright stocks downstream of Merwin Dam on the North Fork Lewis River mainstem: 2013 – 2017 (updates provided when available from WDFW)

	Stock	pHOS
2013		**0.077**
	Tule	*0.33*
	Bright	*0.02*
2014		**0.105**
	Tule	*0.51*
	Bright	*0.01*
2015		**0.180**
	Tule	*0.63*
	Bright	*0.01*
2016		**0.229**
	Tule	*0.60*
	Bright	*0.01*
2017		**0.176**
	Tule	*0.58*
	Bright	*0.02*

Source: Bentley 2018

OBJECTIVE 3: Develop and Monitor Hatchery Protocols to Reduce Hatchery Effects on Juvenile Native and Listed Species Present Downstream of Merwin Dam

Since 2018, morphological sampling of smolts has been implemented prior to (volitional) and at the end of (forced) volitional release periods. Sampling serves two primary purposes. First, a comparison can be made between hatchery smolts that volitionally leave the facility and those that do not. Secondly, handling smolts allows assessments to be made regarding maturity (e.g., smolt index or precocity). This is especially relevant for spring Chinook which are known to achieve sexual maturity as subyearlings (i.e., microjacks) and yearlings (i.e., minijacks).

As a result of COVID-19 restrictions in the spring of 2020, on site morphology sampling did not occur for several rearing groups. No sampling of coho or Chambers winter steelhead occurred during planned volitional releases in April 2020. This was primarily due to the absence of accepted field protocols to limit the spread of COVID-19. In May 2020, COVID-19 containment plans were finalized and designations for essential staff were provided for PacifiCorp employees and hatchery staff. This allowed field work to resume in May of 2020; however, due to the delay in approved field work only the NOR forced release group was sampled in May 2020 Sampling of pre and post release spring Chinook in October 2020 occurred as normal.

Table 3-4. Average length, weight, smolt indexes and K factors measured during volitional and forced release groups for spring Chinook, Coho salmon and late winter steelhead at the Lewis River hatcheries

Sample Date	Brood Year	Release Group	N	Length (avg, mm)	Weight (avg, g)	Smolt Index (avg)	K factor (avg)
Spring Chinook							
Sep 2018	2017	Volitional	100	144.2	37.7	2.58	1.23
Oct 2018		Forced	112	141.2	34.9	2.48	1.19
Jan 2019		Volitional	223	161.0	49.2		1.14
Feb 2019		Forced	180	144.0	35.8		1.15
Sep 2019	2018	Volitional	101	147.7	37.9		1.17
Oct 2019		Forced	126	135.9	39.4		1.58
Dec 2019		NA	293	145.8	38.6		1.21
Jan 2020		Volitional	300	162	47.4		
Winter Steelhead (Chambers Stock)							
Apr 2018	2017	Volitional	100	200.6	84.7	2.84	1.04
May 2008		Forced	150	195.3	73.5	2.77	0.96
Winter Steelhead (NOR)							
Apr 2018	2017	Volitional	150	165.0	48.5	2.27	1.03
May 2018		Forced	201	147.0	31.1	2.16	0.91
Apr 2019	2018	Volitional	100	161.4	52.0	1.87	1.15
May 2019		Forced	101	176.6	55.2	1.49	0.95
May 2020	2019	Forced	100	149.0	38.5		
Coho Salmon							
Mar 2018	2017	Volitional	802	130.6	25.6	1.73	1.14
Apr 2018		Forced	310	131.4	27.2	1.77	1.18
Mar 2019	2018	Volitional	347	134.2	28.7	1.97	1.17
Apr 2019		Forced	262	135.4	28.9	2.00	1.15

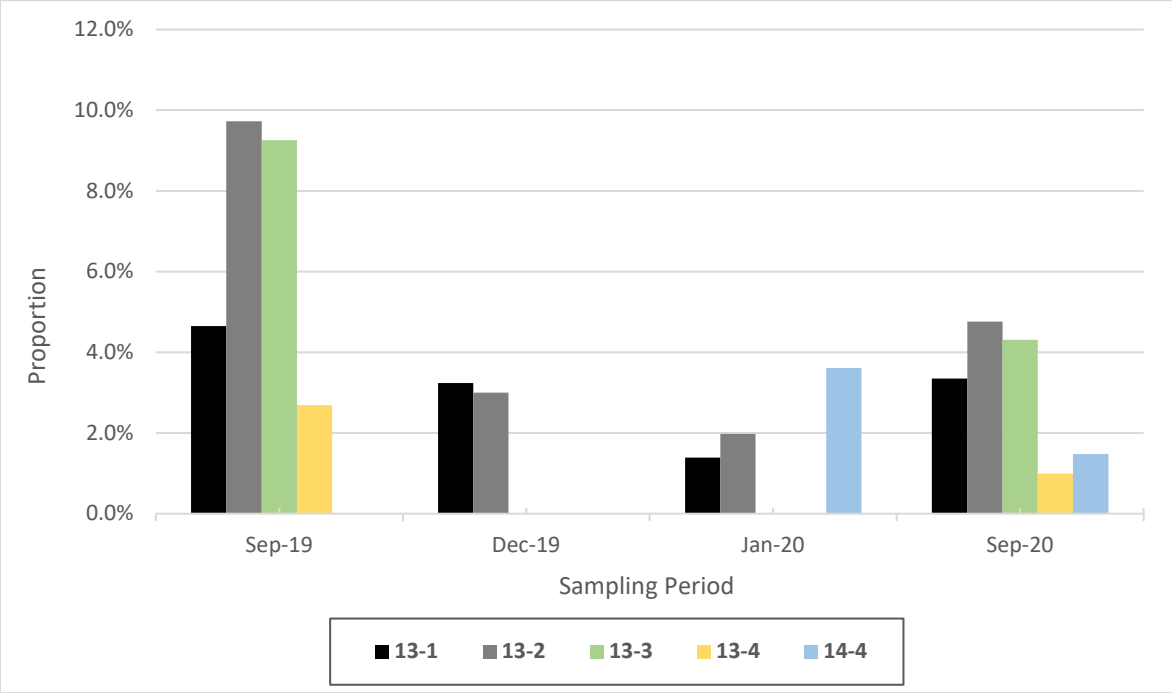

Figure 3-1. Milting rate among pre-release hatchery reared spring Chinook smolts at Lewis River Hatchery sampled in September 2019, December 2019, January 2020 and September 2020

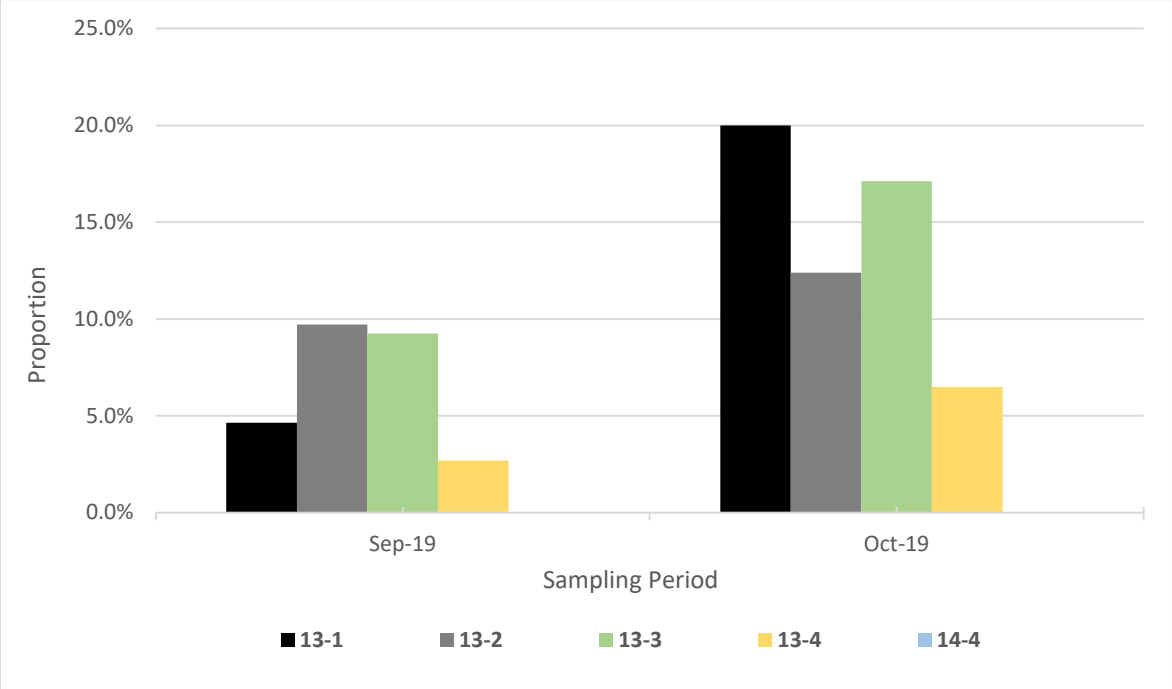

Figure 3-2. Comparison of milting rate between pre-release and post-release (forced) spring Chinook juveniles at Lewis River hatchery in 2019

OBJECTIVE 4: Estimate Juvenile Release Behavior or Residualism after Release from Hatcheries Downstream of Merwin Dam.

Methods to quantify residualism after release from the Lewis River hatcheries were not implemented in 2020. However, several hatchery surrogate metrics were included in the most recent final of the H&S plan (Objective 4) submitted to the FERC in December 2020. The use of hatchery surrogate metrics is consistent with methods described by NOAA (NOAA 2017) and will be monitored and reported on in the 2021 annual report.

OBJECTIVE 5: Produce an Annual Hatchery Operations Report

The annual hatchery operations report is provided in Appendix G

OBJECTIVE 6: Monitor Rearing Conditions to be Consistent with Producing a High Quality Smolt that Emigrates Quickly with a Relatively High Rate of Survival

Objectives 6 and 8 were combined into one rearing and release evaluation involving several treatment groups of spring Chinook that differ based on rations and release timing. Precocity evaluations among treatment groups are ongoing to determine maturity of subyearling spring Chinook (reported in objective 3). A pilot evaluation will be initiated in early 2021 to determine the ability to predict precocity (i.e., minijacks) among yearling spring Chinook as early as February. The methodology is included in the 2020 AOP. Initial results from these evaluations will be provided in the 2021 annual report and will continue to be reported as full cohorts return to the traps for each of the treatment groups.

OBJECTIVE 7: Monitor Hatchery Upgrades

All projects as prescribed by the Agreement have been completed (Table 3-5)

Table 3-5. Schedule of completion of hatchery upgrades

	COMPLETION YEAR							
Lewis River Hatchery	2008	2009	2010	2011	2012	2013	2014	2015
Pond 15 and Sorting Facility upgrades		✓						
Convert rearing ponds to raceways			✓	✓				
Modify downstream water intake								✓
Inspect Intake Pipe				✓				
Merwin Hatchery								
Ozone PLC upgrade							✓	
Rearing pond flow Enhancement			✓	✓				
Modify smolt release ponds			✓					
Purchase two fish hauling trucks	✓		✓					
Speelyai Hatchery								
Convert Pond 14 into raceways						✓		
Convert burrow's ponds into raceways		✓	✓					
Improve water intake structure								✓
Improve and Expand adult fertilization area			✓					
Improve adult kokanee trap			✓					
Net Pen purchase and installation			✓					

OBJECTIVE 8: Adopt Release Strategies that are Consistent with Hatchery Scientific Review Group and HGMP Recommendations

Please refer to description provided under Objective 6.

OBJECTIVE 9: Monitor Production Levels and Program Release Numbers

Table 3-6. Hatchery target and actual production by species

Species (or stock)	Target Production (smolts)	Annual Hatchery Smolt Releases (by release year)							
		2013	2014	2015	2016	2017	2018	2019	2020
Spring Chinook	1,350,000	1,286,171	1,086,637	1,244,910	600,967	402,224	802,048	1,278,855	1,314,441
Coho	2,000,000	1,864,208	2,055,206	2,148,984	2,177,701	1,666,442	2,016,371	2,193,389	1,916,165
Summer Steelhead[1]	175,000	192,325	179,431	176,498	175,504	175,647	182,178	180,146	184,809
Winter Steelhead	100,000	128,360	98,344	110,592	100,000	116,436	104,746	108,128	105,088
Late Winter Steelhead	50,000	49,650	22,295	70,805	67,922	51,816	52,119	44,861	45,153
Kokanee (pounds)[2]	12,500 pounds	12,910	9,206	8,263	10,091	7,435	11,269	12,866	11,076
Rainbow[3]	50,000	71,361	52,080	51,800	50,640	56,650	47,893	43,800	51,070
Acclimation Spring Chinook[4]	100,000	16,200	81,212	48,000	29,900	53,470			
		3,621,185	3,584,411	3,859,852	3,212,725	2,530,120	3,216,624	3,862,045	3,627,802

[1] Excludes Echo Bay net pen production (~150,000)

[2] Mitigation is based on pounds,average release size of kokanee is 7 to 8 fpp.

[3] Mitigation is based on pounds, average release size of rainbow trout is 2.5 fpp.

[4] This program was suspended by ACC decision in 2018 in favor of releasing acclimation allotment downstream of Merwin Dam due to poor adult returns

Table 3-7. Actual juvenile releases and adult HOR and NOR returns to the in-river traps by year: 2013 - 2020.

		2013	2014	2015	2016	2017	2018	2019	2020
COHO SALMON	Juvenile Release	1,864,208	2,055,206	2,148,984	2,177,701	1,666,442	2,016,371	2,193,389	1,916,165
	Adult HOR Trap Return	28,752	72,847	21,453	33,331	23,064	21,226	14,035	38,310
	Adult NOR Trap Return	218	2,098	202	2,009	2,613	1,011	1,725	5,548
SPRING CHINOOK	Juvenile Release	1,286,171	1,086,637	1,244,910	600,967	402,224	802,048	1,278,855	1,314,441
	Adult HOR Trap Return	1,907	997	945	547	2,871	2,668	1,065	2,259
	Adult NOR Trap Return	41	22	42	16	40	26	36	175
LATE WINTER STEELHEAD	Juvenile Release	49,650	22,295	70,805	67,922	51,816	52,119	44,861	45,153
	Adult HOR Trap Return	1,341	1,651	4,205	3,838	3,601	2,695	1,739	1,364
	Adult NOR Trap Return	19	29	72	54	95	120	76	455

OBJECTIVE 10: Submit and Gain HGMP Approval for all Hatchery Programs on the Lewis River

As of the date of this draft report, no HGMP's have been submitted to NOAA for approval.

OBJECTIVE 11: Determine the Genetic Effective Population Size of Late Winter Steelhead Downstream of Merwin Dam.

The utilities are waiting for a final report from NOAA on late winter steelhead tissue samples submitted since the program began in 2009. Assignment of late winter broodstock are the only analysis received to date by NOAA (as reported under Figure 2.4 and Appendix B).

OBJECTIVE 12: Develop Sampling Protocols for Supplementation Adults Returning to Traps or In-River Capture

See Appendix A and B of the 2020 AOP

OBJECTIVE 13: Effects of Upstream Adult and Juvenile Supplementation on Listed Species

This objective was moved to the Aquatic Monitoring and Evaluation Plan and is provided here only as a placeholder to ensure that numbering of each objective remains consistent with the Hatchery and Supplementation Plan.

OBJECTIVE 14: Estimate Adult and Juvenile Abundance of Winter Steelhead, Coho and Spring Chinook Downstream of Merwin Dam

Spawning Abundance

Spawning abundance estimates the number of spawners in the North Fork Lewis River mainstem downstream of Merwin Dam. This is not a total abundance estimate as spawner abundance estimates do not account for fish trapped and either used as broodstock or transported upstream as part of the supplementation program. Therefore, North Fork Lewis River total abundance should include trap counts regardless of their disposition after trapping.

Late Winter Steelhead

Spawning abundance estimates rely on new redd census data, assumed sex ratio and females per redd to calculate total spawner abundance (Freymond and Foley 1986). Females per redd follow WDFW generalized guidelines of 0.81 females per redd and sex ratio is assumed equal (Table 3-7). Beginning in 2013, we also calculate the spawner abundance using the observed sex ratio of late winter steelhead entering the Merwin Trap. This may be a more accurate estimate of female to male ratio in the river because of the large numbers captured in the trap and is unbiased in terms of capture efficiency for males or females.

Redd surveys are used to estimate spawning abundance and distribution of winter steelhead in the mainstem North Fork Lewis River. Surveys are conducted weekly throughout the spawning period, which starts on March 1 and extends into mid-June.

A total of 301 individual redds were counted during redd surveys in 2020. Surveys began on March 5, when the first redd was observed, and continued through June 16. The survey reach begins at Merwin Dam and continues downstream to the downstream end of Eagle Island.

Using Merwin Trap capture data between February 1 and June 21, 2020, a total of 569 late winter steelhead were trapped (excludes adipose clipped fish). This total includes 340 BWT and 229 NOR late winter steelhead. Of this total, 52 percent were male and 48 percent were female.

Therefore, based on observed trapping proportions, we provide a corrected sex ratio of 1.08 males for every female.

Table 3-8. Late winter steelhead abundance downstream of Merwin Dam 2008 through 2020 based on redd counts

Year	Number of Redds observed	Spawner Estimate (pHOS model)	Observed sex ratio (females : males)	Spawner Estimate (corrected)
2008	131	212		
2009	176	286		
2010	248	402		
2011	108	174		
2012	343	556		
2013	456	739	1:1.4	898
2014	364	590	1:0.8	531
2015	384	622	1:1.5	765
2016[1]	NA	(357 ± 82)	1:1	NA
2017[2]	NA	NA	1:1.2	NA
2018[1]	317	514 (492)	1:0.9	493
2019	292	473	1:1.1	500
2020	301	488	1:1.1	508

[1] Estimate is derived through H&S pHOS model using mark-recapture of tangle netted fish (See 2019 H&S AOP)

[2] Redd surveys were cancelled due to extreme river turbidity during spawning period

* No redd data are available in 2016 and 2017 due to severe spring turbidity.

Adult Spring Chinook:

No escapement data exist for spring Chinook

Adult Coho Salmon

Table 3-9. Adult Coho escapement estimates for the mainstem North Fork Lewis River downstream of Merwin Dam: 2013 to 2020

Year	Number of marked carcasses	Number (%) of recaptured carcasses	Est. Gross Population Size	Bootstrap SE	95%-Confidence Interval	CV	Total Weeks Surveyable	Average Daily Flow during Surveys (cfs)	Average Daily Flow Oct 16-Jan-31
2013	328	41 (13%)	**1,970**	297	1,523 to	0.17	15	4,700	4,804
2014	431	18 (4%)	**7,805**	2,106	5,172 to	0.27	15	7,765	7,876
2015	12	2 (17%)	**NA**	NA	NA	NA	12	5,632	8,429
2016	65	20 (31%)	**124**	17	103 to 169	0.14	16	4,587	6,721
2017	24	8 (33.3%)	**44**	5	33 to 55	0.11	16	8,817	8,587
2018	61	22 (36%)	**137**	20	98 to 176	0.15	16	5,009	5,044
2019	40	7 (17.5%)	**83**	10	64 to 102	0.12	15	6,181	6,761
2020	223	65(29%)	**527**	54	421 to 632	0.1	15	4,968	7,182

Juvenile Abundance

In 2020, the ATS agreed to include an additional trapping site approximately 1.2 km downstream of the existing (Upper Golf Course). The purpose of this additional site is to compare the capture efficiencies and total captures of the two locations to assess whether different site characteristics produce more favorable overall trapping efficiencies. Appendix F provides a detailed report on 2020 screw trapping results and comparisons between the two trap locations.

Table 3-10. Species, size and origin composition of fish captured by screw trapping in the mainstem North Fork Lewis River downstream of Merwin Dam: 2016 to 2020.

	HOR > 60mm	HOR < 60mm	NOR < 60 mm	NOR > 60 mm	Marked and Released > 60 mm	Recaptured	Seasonal Efficiency
2016							
Coho	25,539		62	1,447	2,867	57	0.020
Chinook	47		53,356	48	47	1	0.021
Steelhead	9		1	555	514	15	0.029
Cutthroat	0		0	66	48	0	NA
2017							
Coho	7,774		6,253	594	2,708	27	0.010
Chinook	0		12,221	182	181	2	0.011
Steelhead	181		67	80	254	6	0.024
Cutthroat	0		0	45	37	0	NA
2018							
Coho	21,753	0	60	117	3,434	49	0.014
Chinook	3	0	13,380	6	4	0	0.000
Steelhead	8	0	1	26	33	0	0.000
Cutthroat	0	0	0	12	10	0	0.000
2019	**No Data - Screwtrap was not installed (by ATS decision)**						
2020							
Coho							
Upper	7,554	0	289	115	5,310	19	0
Lower	4,560	0	119	57	171	0	0
Chinook							
Upper	0	4	14,718	24	25	0	0
Lower	0	0	1,348	21	0	0	0
Steelhead							
Upper	0	138	559	21	136	1	0.735
Lower	0	29	98	12	28	0	0
Cutthroat							
Upper	0	0	0	21	21	0	0
Lower	0	0	0	18	18	0	0

Table 3-11. Abundance estimates of outmigrating juvenile salmonids by origin and species: 2016 to 2020

	Trap Efficiency (%)	Bootstrap Estimate	CI 95% ±	Discrete Interval Estimate	CI 95% ±
2016					
NOR Coho	0.020	74,065	19,306	76,504	21,614
HOR Coho	0.020	1,309,518	330,310	1,548,800	644,012
NOR Chinook	0.021	2,327	854		
NOR Steelhead	0.029	20,404	11,942		
NOR Cutthroat	0.021	3,180	1,089		
2017					
NOR Coho	0.01	62,075	25,557	45,967	15,698
HOR Coho	0.01	811,302	314,270	808,227	384,804
NOR Chinook (all)	0.013	14,763	5,018	12,169	6,978
NOR Chinook (CWT)	0.013	2,114	1,494	1,822	1,306
NOR Rainbow	0.012	6,866	2,652	6,257	3,499
HOR Rainbow	0.012	14,941	5,093	14,540	8,649
Cutthroat	0.012	3,420	1,541	3,368	1,837
2018					
NOR Coho > 60 MM	0.011	10,893	4,072	9,648	4,645
NOR Coho < 60 MM	0.011	5,595	2,348	3,905	3,728
HOR Coho	0.012	1,852,836	546,035	1,352,784	450,647
NOR Chinook < 60MM	0.011	1,250,158	402,614	1,036,912	864,701
NOR Rainbow > 60 mm	0.012	2,212	1,084	2,001	1,761
NOR Cutthroat > 60mm	0.017	714	466	625	854
2019	*Trap not operated by ATS decision*				
2020					
NOR Coho > 60 MM	0.4000	29,161	5,926		
NOR Coho < 60 MM		*insufficient recaptures for estimate*			
HOR Coho	0.3900	1,820,357			
NOR Chinook < 60MM		*insufficient recaptures for estimate*			
NOR Rainbow > 60 mm		*insufficient recaptures for estimate*			
NOR Cutthroat > 60mm		*insufficient recaptures for estimate*			

OBJECTIVE 15: Determine Spatial and Temporal Distribution of Spawning Late Winter Steelhead, Coho and Spring Chinook Downstream of Merwin Dam

Late Winter Steelhead

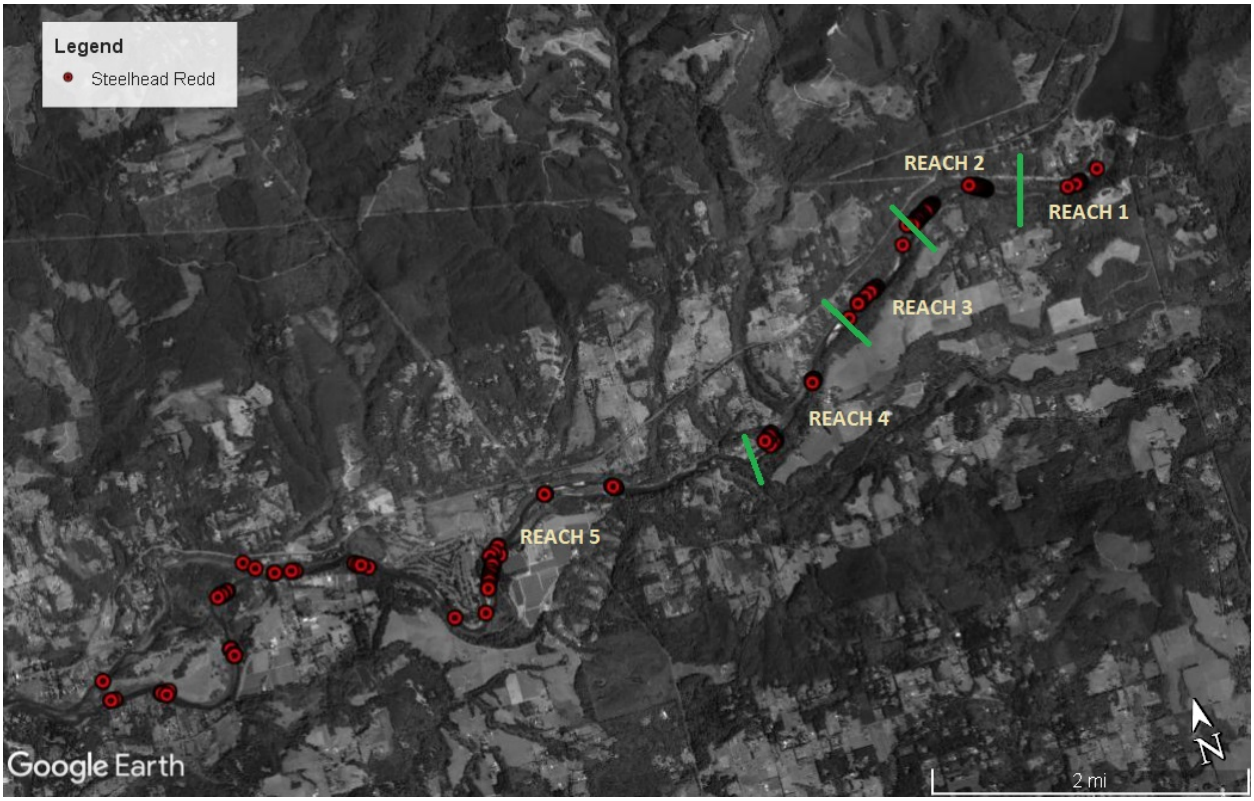

Figure 3-3. Distribution of late winter steelhead redds downstream of Merwin Dam – 2020

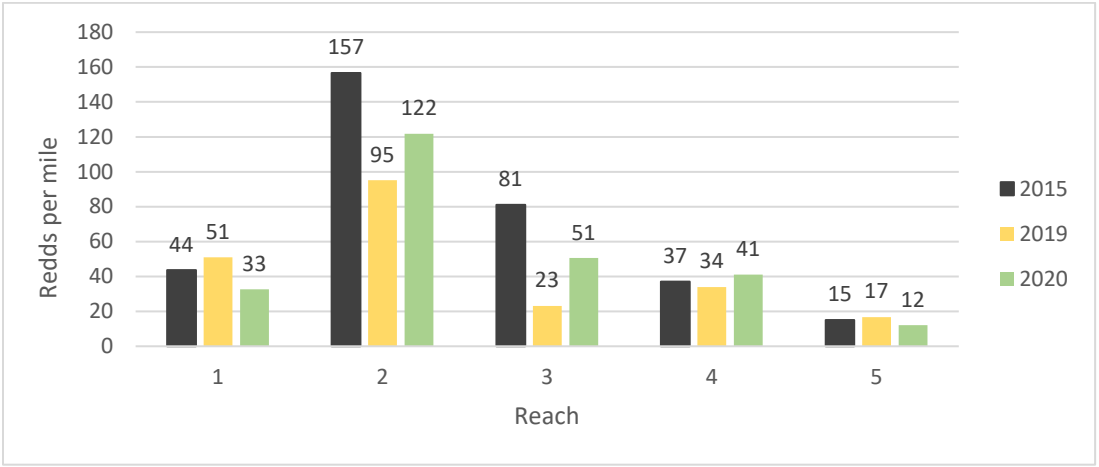

Figure 3-4. Distribution and density of late winter steelhead redds by reach for the years 2015, 2019 and 2020

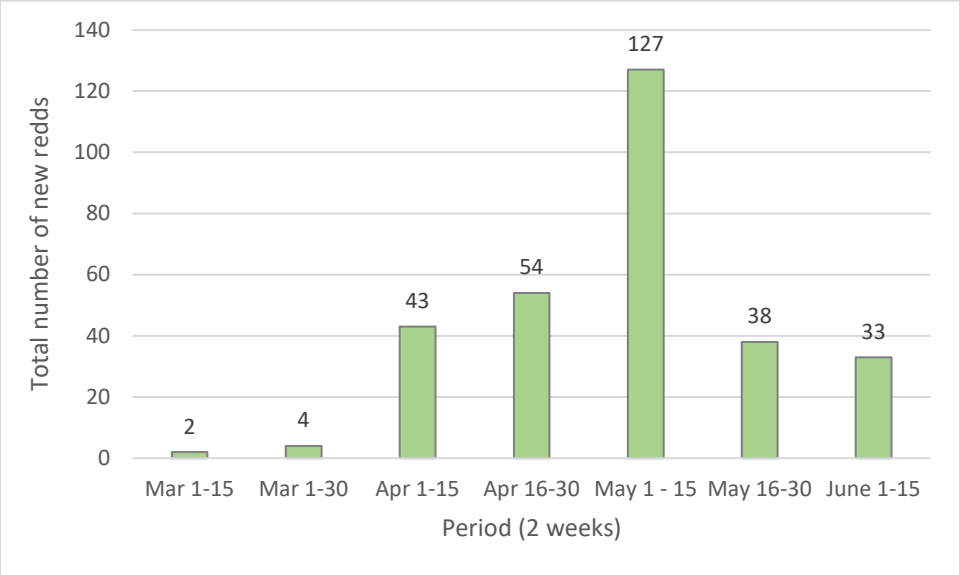

Figure 3-5. Total new late winter steelhead redds observed by time period in 2020

Chinook Salmon

No data available for 2020

Coho Salmon

Table 3-12. Coho distribution data downstream of Merwin Dam: 2016 to 2020

	NF Lewis River	Reach Length (miles)	Total Weeks (mid-Oct to Jan 31)	Total Weeks Surveyable	Total Live Holders	Total Live Spawners	Total Carcass Unable to Sample	Hatchery Male Carcass	Hatchery Female Carcass	Unmarked Male Carcass	Unmarked Female Carcass	Total Carcass	Total Carcass Tagged	Total Carcass Recoveries	% Pre-spawn Mortality (Females)	Carcass Wanded for CWT	CWT Positive Carcass
2016																	
	Reach 1	0.57	16	16	1	24		3	3	1	1	8	7	4	0%	8	1
	Reach 2	0.68	16	16	6	44		0	2	0	1	3	3	1	50%	3	0
	Reach 3	0.97	16	16	0	108		2	1	0	2	5	4	1	0%	5	1
	Reach 4	1.32	16	16	56	78		2	3	6	3	14	14	7	33%	14	0
	Reach 5	7.3	16	15	0	25		12	9	13	5	39	37	7	14%	39	0
	Total	10.84	16	16	63	279		19	18	20	12	69	65	20	18%	69	2
2017																	
	Reach 1	0.57	16	16	6	4		0	0	0	0	0	0	0	NA	0	0
	Reach 2	0.68	16	16	4	14		0	1	1	0	2	2	1	0%	2	0
	Reach 3	0.97	16	16	0	8		0	0	0	0	0	0	0	NA	0	0
	Reach 4	1.32	16	16	20	25		1	3	1	3	8	8	3	0%	8	0
	Reach 5	7.3	16	15	20	12		7	2	3	2	14	14	4	25%	14	0
	Total	10.84	16	16	50	63		8	6	5	5	24	24	8	9%	24	0
2018																	
	Reach 1	0.57	16	16	30	15	3	4	4	0	0	11	8	4	0%	8	0
	Reach 2	0.68	16	16	50	20	0	3	3	1	0	7	7	2	33%	7	0
	Reach 3	0.97	16	16	25	5	0	0	1	1	2	4	4	0	33%	4	0
	Reach 4	1.32	16	16	100	30	1	4	4	1	2	12	11	3	50%	11	5
	Reach 5	7.3	16	15	50	20	4	13	15	2	2	36	31	13	53%	32	3
	Total	10.84	16	16	255	90	8	24	27	5	6	70	61	22	42%	62	8
2019																	
	Reach 1	0.57	16	15	16	0	1	1	2	2	1	7	6	2	33%	6	0
	Reach 2	0.68	16	15	23	0	0	0	1	2	0	3	3	0	0%	3	0
	Reach 3	0.97	16	15	13	0	1	1	0	1	0	3	2	0	0%	2	0
	Reach 4	1.32	16	15	25	0	0	2	1	4	1	8	8	0	0%	8	0
	Reach 5	7.3	16	15	45	0	2	7	6	6	2	23	21	5	63%	21	0
	Total	10.84	16	15	122	0	4	11	10	15	4	44	40	7	43%	40	0

Coho Salmon (tributary surveys):

Table 3-13. Tributary Coho salmon survey summary: 2016 to 2020

	Stream	Reach Length (miles)	Total Weeks (mid-Oct through Jan)	Total Weeks Surveyable	Total New Redds	Total Live Holders	Total Live Spawners	Total Carcass Unable to Sample	Hatchery Male Carcass	Hatchery Female Carcass	Unmarked Male Carcass	Unmarked Female Carcass	Total Carcass	% Pre-spawn Mortality (Females)	Carcass Wanded for CWT	CWT Positive Carcass
2016																
	Hayes Trib 2	0.5	16	9	0	0	0		0	0	0	0	0	NA	0	0
	Lower Houghton	1	16	13	0	1	0		0	0	0	0	0	NA	0	0
	Ross Creek	1	16	15	33	9	49		2	1	5	2	10	0%	10	1
	Upper Houghton	1	16	16	10	7	10		2	0	0	0	2	NA	2	0
2017																
	Hayes Trib 1	1	16	16	2	0	0		0	0	0	0	0	NA	0	0
	Hayes Trib 2	0.5	16	16	0	0	0		0	0	0	0	0	NA	0	0
	Robinson Creek	1	16	16	15	0	16		0	0	1	1	2	0%	2	0
	Ross Creek	1	16	16	30	0	20		0	3	5	3	11	0%	11	0
2018																
	Ross Creek	1	16	15	12	1	10	0	1	2	0	0	3	0%	3	0
	Johnson Creek	0.95	16	16	17	2	8	1	1	0	0	1	3	0%	2	0
	Hayes Creek	1	16	13	1	0	1	0	0	0	0	0	0	0%	0	0
	Hayes Trib. 2	1	16	13	0	0	0	0	0	0	0	0	0	NA	0	0
	Bratton Creek	1	16	16	0	0	0	0	0	0	0	0	0	NA	0	0
2019																
	Ross Creek R1	1	15	12	13	2	29	2	0	2	2	4	10	0%	8	0
	Houghton Creek R1	1	15	14	16	0	5	0	0	1	0	1	2	0%	2	0
	Houghton Creek R2	1	15	11	0	0	0	0	0	0	0	0	0	NA	0	0
	Hayes Creek Trib 2	1	15	11	0	0	0	0	0	0	0	0	0	NA	0	0
2020																
	Robinson Creek R1	1	16	12	24	0	6	0	1	0	0	0	1	NA	1	0
	Hayes Creek	1	16	10	0	0	0	0	0	0	0	0	0	NA	NA	NA
	Hayes Trib 1	1	16	10	0	0	0	0	0	0	0	0	0	NA	NA	NA
	Hayes Trib 2	1	16	10	0	0	0	0	0	0	0	0	0	NA	NA	NA

OBJECTIVE 16: Evaluate Fall Chinook and Chum Populations Downstream of Merwin Dam

Note: Awaiting results from WDFW for 2018 - 2020 Fall Chinook and Chum salmon surveys.

Table 3-14. Fall Chinook escapement estimates in the North Fork Lewis River (excluding tributaries) downstream of Mewin Dam

Stock	pHOS	Mean	SD	L.95%	Median	U.95%	CV
2013	**0.077**	**20,862**	**496**	**19,990**	**20,830**	**21,940**	**2%**
Tule	*0.33*	*3,511*	*462*	*2,642*	*3,495*	*4,533*	*13%*
Bright	*0.02*	*17,351*	*450*	*16,500*	*17,340*	*18,300*	*3%*
2014	**0.105**	**24,859**	**588**	**23,790**	**24,830**	**26,100**	**2%**
Tule	*0.51*	*4,055*	*409*	*3,326*	*4,027*	*4,902*	*10%*
Bright	*0.01*	*20,803*	*620*	*19,670*	*20,780*	*22,050*	*3%*
2015	**0.180**	**24,364**	**981**	**22,550**	**24,310**	**26,431**	**4%**
Tule	*0.63*	*5,449*	*381*	*4,759*	*5,440*	*6,265*	*7%*
Bright	*0.01*	*18,915*	*992*	*17,120*	*18,850*	*21,080*	*5%*
2016	**0.229**	**13,487**	**496**	**12,660**	**13,440**	**14,600**	**4%**
Tule	*0.60*	4,127	482	3,329	4,073	5,225	12%
Bright	*0.01*	9,360	243	8,912	9,357	9,863	3%
2017	**0.176**	**9,523**	**536**	**8,632**	**9,470**	**10,720**	**6%**
Tule	*0.58*	*2,255*	*450*	*1,560*	*2,203*	*3,258*	*20%*
Bright	*0.02*	*7,268*	*355*	*6,664*	*7,240*	*8,084*	*5%*

Source: Bentley 2018

OBJECTIVE 17: Annual Review of Existing and Proposed Harvest Regulations (if any) to Determine if Recommendations are Warranted to Protect Supplementation Program Objectives

No recommendations were received by the ATS or ACC during 2020.

3.4 Upstream Transport of Steelhead, Coho and Spring Chinook

In 2020, a total of 1,052 blank wire tagged steelhead were transported upstream of Swift Dam (Table 3-16). All steelhead were transported from the Merwin Trap. This year represents the 9th year of steelhead transportation activities. The target goal of the H&S program is 500 winter steelhead transported each year. We have exceeded this target since 2013.

Spring Chinook continue to remain below the target transport goal of 2000 adults. Since the program began, there have been insufficient numbers of adult Chinook to meet transport targets.

Nearly 9,500 adult coho were transported upstream in 2020, exceeding expectations, and continues to meet transport targets in most years.

Table 3-15. Number of fish transported upstream of Swift Dam: 2012 to 2020

YEAR	WINTER STEELHEAD			COHO				SPRING CHINOOK			
	Male	Female	Total	Male	Female	Jack	Total	Male	Female	Jack	Total
2012	141	48	189				206	0	0	0	0
2013	440	301	741	3,858	3,104	73	7,035	270	243	66	579
2014	452	581	1,033	4,788	4,217	174	9,179	0	0	0	0
2015	746	477	1,223	2,030	1,694	30	3,754	0	0	0	0
2016	382	390	772	3,430	3,377	539	7,346	0	0	0	0
2017	331	261	592	3,254	3,494	65	6,813	370	430	310	1,110
2018	682	535	1,227	3,999	2,659	402	7,060	491	177	32	700
2019	527	486	1,013	2,946	2,373	268	5,587	12	12	85	109
2020	517	535	1,052	4,319	4,911	256	9,486	193	56	385	634

4.0 RECOMMENDATIONS FOR ONGOING MANAGEMENT

The annual operating plan (AOP) for the Hatchery and Supplementation program continues to be updated and used as an adaptive management tool to address both ongoing and new priorities as they relate to hatchery operations, supplementation activities and development of effective monitoring designs.

In 2020, the ATS finalized a revised H&S Plan which was submitted to the FERC in December 2020. This revised plan includes substantial revisions to the monitoring objectives incorporating HSRG recommendations, NMFS guidance in the form of VSP guidance and draws from recent hatchery Biological Opinions.

During the next 5 years it is expected that HGMP's will be finalized and NMFS will issue a Biological Opinion(s) for each of the hatchery programs on the North Fork Lewis River. The content of these Opinions may require some revisions to the existing set of monitoring objectives. However, we expect any revisions to be captured in the annual planning efforts of the ATS and AOP.

A key step in determining the success of the hatchery and supplementation program is contained in the program key questions of the H&S plan. As we continue to implement the AOP, we should work towards providing the data necessary to address these key questions. In 2025, the Services are required to determine whether the program is achieving the stated goals in the Agreement. It is therefore the responsibility of the ATS and ACC to ensure that the data collected under the H&S plan, AOP and AMEP provides sufficient detail and accuracy for the Services to make this determination as required by the Agreement.

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APPENDIX A –

Late winter unmarked steelhead captured at the Merwin Trap and Tangle Netting and transported to Merwin Hatchery - 2020

#	Trap Date	Location of Capture	Gender	Fork Length (CM)	Floy Tag #	Pit Tag #	DNA VIAL #	Disposition	Scale Card	Comments
1	2/24/2020	Merwin Trap	M	63	PUR/GLD 25	3DD-003 C011378	#20CX-1	RELEASED	62774-1	5/21 Planted upstream
2	2/24/2020	Merwin Trap	M	66	PUR/GLD 24	3DD-003 C0113BF	#20CX-2	SPAWNED	62774-2	4/10 Spawn w/Female #20&28
3	2/25/2020	Merwin Trap	M	68	BLU/WHT 25	3DD-003 C0113A7	#20CX-3	RELEASED	62774-3	Returned to river 3/2/20, surplus of collection curve
4	2/25/2020	Merwin Trap	M	64	BLU/WHT 24	3DD-003 C01138A	#20CX-4	RELEASED	62774-4	Returned to river 3/2/20, surplus of collection curve
5	2/25/2020	Merwin Trap	M	60	BLU/WHT 23	3DD-003 C0113B8	#20CX-5	SPAWNED	62774-5	4/17 Spawn w/ Females #8, #9, #18
6	2/25/2020	Merwin Trap	M	64	BLU/WHT 22	3DD-003 C0113B7	#20CX-6	RELEASED	62774-6	Returned to river 3/2/20, surplus of collection curve
7	2/25/2020	Merwin Trap	M	67	BLU/WHT 21	3DD-003 C0113BE	#20CX-7	RELEASED	62774-7	Returned to river 3/2/20, surplus of collection curve
8	3/2/2020	Merwin Trap	F	68	ORG/WHT 25	3DD-003 C011386	#20CX-8	SPAWNED	62774-8	4/17 Spawn w/ Males #55, #50, & #5
9	3/2/2020	Merwin Trap	F	64	ORG/WHT 24	3DD-003 C0113A1	#20CX-9	SPAWNED	62774-9	4/17 Spawn w/ Males #55, #50, & #5
10	3/2/2020	Merwin Trap	F	73	ORG/WHT 23	3DD-003 BE8D3AA	#20CX-10	SPAWNED	62775-1	5/1 Spawn w/ Males #57, 58
11	3/2/2020	Merwin Trap	F	58	ORG/WHT 22	3DD-003 BE8D3BA	#20CX-11	SPAWNED	62775-2	5/1 Spawn w/ Male #60,74,63
12	3/3/2020	Merwin Trap	M	73	PNK/WHT 25	3DD-003 BE8D3B6	#20CX-12	RELEASED	62775-3	5/21 Planted upstream
13	3/3/2020	Merwin Trap	M	71	PNK/WHT 24	3DD-003 BE8D38A	#20CX-13	RELEASED	62775-4	5/21 Planted upstream
14	3/9/2020	Merwin Trap	M	64	PNK/WHT 23	3DD-003 BE8D39B	#20CX-14	RELEASED	62775-5	5/21 Planted upstream
15	3/10/2020	Merwin Trap	M	82	PNK/WHT 22	3DD-003 BE8D3A0	#20CX-15	SPAWNED	62775-6	4/10 Spawn w/ Female #29 & 23
16	3/11/2020	Merwin Trap	M	57	PNK/WHT 21	3DD-003 BE8D3AB	#20CX-16	RELEASED	62775-7	5/21 Planted upstream
17	3/13/2020	Merwin Trap	M	59	PNK/WHT 20	3DD-003 BE8D3A8	#20CX-17	RELEASED	62775-8	5/21 Planted upstream
18	3/16/2020	Merwin Trap	F	75	GRN/WHT 4	3DD-003 BE8D364	#20CX-18	SPAWNED	62775-9	4/17 Spawn w/ Males #55, #50, & #5
19	3/16/2020	Merwin Trap	F	63	GRN/WHT 5	3DD-003 BE8D387	#20CX-19	SPAWNED	62775-10	5/1 Spawn w/ Male #68, 75
20	3/16/2020	Merwin Trap	F	64	GRN/WHT 6	3DD-003 BE8C5DC	#20CX-20	SPAWNED	62776-1	4/10 Spawn w/ Male #2 & 21
21	3/17/2020	Merwin Trap	M	88	GRN/WHT 7	3DD-003 BE8C5BC	#20CX-21	SPAWNED	62776-2	4/10 Spawn w/ Female #20&28
22	3/17/2020	Merwin Trap	F	68	GRN/WHT 8	3DD-003 BE8C5B2	#20CX-22	RELEASED	62776-3	5/21 Planted upstream
23	3/18/2020	Merwin Trap	F	61	GRN/WHT	3DD-003 BE8C5C1	#20CX-23	SPAWNED	62776-4	4/10 Spawn w/ Male #25 & 15
24	3/19/2020	Merwin Trap	M	60	GRN/WHT	3DD-003 BE8C5D3	#20CX-24	RELEASED	62776-5	5/21 Planted upstream
25	3/19/2020	Merwin Trap	M	68	GRN/WHT	3DD-003 BE8C5CD	#20CX-25	SPAWNED	62776-6	4/10 Spawn w/ Female #29 & 23

#	Trap Date	Location of Capture	Gender	Fork Length (CM)	Floy Tag #	Pit Tag #	DNA VIAL #	Disposition	Scale Card	Comments
26	3/23/2020	Merwin Trap	M	68	BLU/WHT 12	3DD-003 BE8C5D1	#20CX-26	RELEASED	62776-7	5/21 Planted upstream
27	3/23/2020	Merwin Trap	F	62	BLU/WHT 13	3DD-003 BE8C5C7	#20CX-27	SPAWNED	62776-8	5/8 Spawn w/ Male #91,84,89
28	3/23/2020	Merwin Trap	F	70	BLU/WHT 14	3DD-003 BE8C5C2	#20CX-28	SPAWNED	62776-9	4/10 Spawn w/ Male #2 & 21
29	3/23/2020	Merwin Trap	F	54	BLU/WHT 15	3DD-003 BE8C5BD	#20CX-29	SPAWNED	62777-1	4/10 Spawn w/ Male #25 & 15
30	3/24/2020	Merwin Trap	M	83	PNK/BLU 2113	3DD-003 BE8C5DF	#20CX-30	RELEASED	62777-2	Genetics Failed 4/11 / Planted Upstream
31	3/25/2020	Merwin Trap	M	68	PNK/BLU 2114	3DD-003 BE8C5BE	#20CX-31	RELEASED	62777-3	Genetics Failed 4/11 / Planted Upstream
32	3/26/2020	Merwin Trap	M	60	PNK/BLU 2115	3DD-003 BE8C5C0	#20CX-32	RELEASED	62777-4	Genetics Failed 4/11 / Planted Upstream
33	3/26/2020	Merwin Trap	M	59	PNK/BLU 2116	3DD-003 BE8C5AE	#20CX-33	RELEASED	62777-5	Genetics Failed 4/11 / Planted Upstream
34	3/27/2020	Merwin Trap	M		PNK/BLU 2117	3DD-003 BE8C60C	#20CX-34	RELEASED	62777-6	Genetics Failed 4/11 / Planted Upstream
35	3/30/2020	Merwin Trap	F	72	PUR/GLD 12	3DD-003 BE8C5B7	#20CX-35	SPAWNED	62777-7	5/15 Spawn w/ Male #80,65
36	3/30/2020	Merwin Trap	F	66	PUR/GLD 13	3DD-003 BE8C605	#20CX-36	RELEASED	62777-8	5/21 Planted upstream
37	3/30/2020	Merwin Trap	M	62	PUR/GLD 14	3DD-003 BE8C5F1	#20CX-37	RELEASED	62777-9	5/21 Planted upstream
38	3/30/2020	Merwin Trap	F	50	PUR/GLD 15	3DD-003 BE8C5C5	#20CX-38	RELEASED	62778-1	Genetics Failed 4/11 / Planted Upstream
39	3/30/2020	Merwin Trap	M	79	PUR/GLD 16	3DD-003 BE8C5C3	#20CX-39	RELEASED	62778-2	Genetics Failed 4/11 / Planted Upstream
40	3/30/2020	Merwin Trap	M	75	PUR/GLD 17	3DD-003 BE8C5EF	#20CX-40	RELEASED	62778-3	Genetics Failed 4/11 / Planted Upstream
41	3/30/2020	Merwin Trap	M	59	PUR/GLD 18	3DD-003 BE8C606	#20CX-41	RELEASED	62778-4	Genetics Failed 4/11 / Planted Upstream
42	3/30/2020	Merwin Trap	M	85	PUR/GLD 19	3DD-003 BE8C5FA	#20CX-42	RELEASED	62778-5	5/21 Planted upstream
43	4/6/2020	Merwin Trap	M	67	PUR/GLD 26	3DD-003 BE8C63B	#20CX-43	RELEASED	62778-6	5/21 Planted upstream
44	4/6/2020	Merwin Trap	M	70	PUR/GLD 27	3DD-003 C0113DA	#20CX-44	RELEASED	62778-7	5/21 Planted upstream
45	4/6/2020	Merwin Trap	F	69	PUR/GLD 28	3DD-003 C011405	#20CX-45	RELEASED	62778-8	Coastal Strata >20% Planted downstream 4/13
46	4/6/2020	Merwin Trap	M	68	PUR/GLD 29	3DD-003 C0113D4	#20CX-46	RELEASED	62778-9	5/21 Planted upstream
47	4/6/2020	Merwin Trap	M	66	PUR/GLD 30	3DD-003 BE8C669	#20CX-47	RELEASED	62779-1	Coastal Strata >20% Planted downstream 4/13
48	4/6/2020	Merwin Trap	M	63	PUR/GLD 31	3DD-003 C011420	#20CX-48	RELEASED	62779-2	Genetics Failed 4/11 / Planted Upstream
49	4/6/2020	Merwin Trap	F	67	PUR/GLD 32	3DD-003 C0113FF	#20CX-49	SPAWNED	62779-3	5/1 Spawn w/ Male #60,74,63
50	4/6/2020	Merwin Trap	M	75	PUR/GLD 33	3DD-003 C011417	#20CX-50	SPAWNED	62779-4	4/17 Spawn w/ Females #8, #9, #18

#	Trap Date	Location of Capture	Gender	Fork Length (CM)	Floy Tag #	Pit Tag #	DNA VIAL #	Disposition	Scale Card	Comments
51	4/6/2020	Merwin Trap	M	72	PUR/GLD 34	3DD-003 BE8C65F	#20CX-51	RELEASED	62779-5	5/21 Planted upstream
52	4/6/2020	Merwin Trap	F	65	PUR/GLD 35	3DD-003 C01141F	#20CX-52	RELEASED	62779-6	Coastal Strata >20% Planted downstream 4/13
53	4/6/2020	Merwin Trap	F	65	PUR/GLD 36	3DD-003 C011412	#20CX-53	RELEASED	62779-7	Genetics Failed 4/11 / Planted Upstream
54	4/6/2020	Merwin Trap	M	63	PUR/GLD 37	3DD-003 C011402	#20CX-54	RELEASED	62779-8	Genetics Failed 4/11 / Planted Upstream
55	4/6/2020	Merwin Trap	M	60	PUR/GLD 38	3DD-003 BE8C674	#20CX-55	SPAWNED	62779-9	4/17 Spawn w/ Females #8, #9, #18
56	4/13/2020	Merwin Trap	F	60	White/Green 1	3DD.003BE8C654	#20CX-56	SPAWNED	62780-1	5/1 Spawn w/ Males #57, 58
57	4/13/2020	Merwin Trap	M	65	White/Green 2	3DD.003BE8C63F	#20CX-57	SPAWNED	62780-2	5/1 Spawn w/ Female # 10, 56
58	4/13/2020	Merwin Trap	M	56	NO FLOY	3DD.003BE8C64C	#20CX-58	SPAWNED	62780-3	5/1 Spawn w/ Female # 10, 56
59	4/13/2020	Merwin Trap	M	68	White/Green 4	3DD.003BE8C64F	#20CX-59	SPAWNED	62780-4	4/24 Spawn w/ Females 62, 81, & 69
60	4/13/2020	Merwin Trap	M	76	White/Green 5	3DD.003BE8C67B	#20CX-60	SPAWNED	62780-5	5/1 Spawn w/ Female #70,11,49
61	4/13/2020	Merwin Trap	M	66	White/Green 6	3DD.003BE8C664	#20CX-61	RELEASED	62780-6	5/21 Planted upstream
62	4/13/2020	Merwin Trap	F	68	White/Green 7	3DD.003BE8C612	#20CX-62	SPAWNED	62780-7	4/24 Spawn w/ Males 59, 66, & 82
63	4/13/2020	Merwin Trap	M	65	White/Green 8	3DD.003BE8C668	#20CX-63	SPAWNED	62780-8	5/1 Spawn w/ Female #70,11,49
64	4/14/2020	Merwin Trap	F	63	White/Green 9	3DD-003 BE8C6D8	#20CX-64	SPAWNED	62781-1	5/8 Spawn w/ Male #91,84,89
65	4/14/2020	Merwin Trap	M	61	White/Green 10	3DD-003 BE8C68E	#20CX-65	SPAWNED	62781-2	5/15 Spawn w/ Female #35,88
66	4/14/2020	Merwin Trap	M	75	White/Green 11	3DD-003 BE8C6B7	#20CX-66	SPAWNED	62781-3	4/24 Spawn w/ Females 62, 81, & 69
67	4/14/2020	Merwin Trap	F	60	White/Green 12	3DD-003 BE8C6C8	#20CX-67	SPAWNED	62781-4	5/8 Spawn w/ Male #90,78,71
68	4/15/2020	Merwin Trap	M	70	Pink/Wht 25	3DD.003BE8C6B8	#20CX-68	SPAWNED	62781-5	5/1 Spawn w/ Female #72, 19
69	4/15/2020	Merwin Trap	F	65	Pink/Wht 24	3DD.003BE8C6C5	#20CX-69	SPAWNED	62781-6	4/24 Spawn w/ Males 59, 66, & 82
70	4/20/2020	Merwin Trap	F	77	ORG/WHT 1	3DD-003 D91E1F0	#20CX-70	SPAWNED	62781-7	5/1 Spawn w/ Male #60,74,63
71	4/20/2020	Merwin Trap	M	67	ORG/WHT 2	3DD-003 D91E1FB	#20CX-71	SPAWNED	62781-8	5/8 Spawn w/ Female #92,67,73
72	4/20/2020	Merwin Trap	F	71	ORG/WHT 3	3DD-003 D91E1FD	#20CX-72	SPAWNED	62781-9	5/1 Spawn w/ Male #68, 75
73	4/20/2020	Merwin Trap	F	68	ORG/WHT 4	3DD-003 D91E21F	#20CX-73	SPAWNED	62782-1	5/8 Spawn w/ Male #90,78,71
74	4/20/2020	Merwin Trap	M	75	ORG/WHT 5	3DD-003 D91E1EC	#20CX-74	SPAWNED	62782-2	5/1 Spawn w/ Female #70,11,49
75	4/20/2020	Merwin Trap	M	61	ORG/WHT 6	3DD-003 D91E213	#20CX-75	SPAWNED	62782-3	5/1 Spawn w/ Female #72, 19

#	Trap Date	Location of Capture	Gender	Fork Length (CM)	Floy Tag #	Pit Tag #	DNA VIAL #	Disposition	Scale Card	Comments
76	4/20/2020	Merwin Trap	M	70	ORG/WHT 7	3DD-003 D91E20E	#20CX-76	RELEASED	62782-4	5/21 Planted upstream
77	4/20/2020	Merwin Trap	M	60	ORG/WHT 8	3DD-003 D91E21E	#20CX-77	RELEASED	62782-5	5/21 Planted upstream
78	4/20/2020	Merwin Trap	M	69	ORG/WHT 9	3DD-003 D91E1F4	#20CX-78	SPAWNED	62782-6	5/8 Spawn w/ Female #92,67,73
79	4/20/2020	Merwin Trap	M	65	ORG/WHT 10	3DD-003 D91E227	#20CX-79	RELEASED	62782-7	5/21 Planted upstream
80	4/20/2020	Merwin Trap	M	77	RG/WHT 11 & 1	3DD-003 D91E1DA	#20CX-80	SPAWNED	62782-8	5/15 Spawn w/ Female #35,88
81	4/20/2020	Merwin Trap	F	68	ORG/WHT 13	3DD-003 D91E1F3	#20CX-81	SPAWNED	62782-9	4/24 Spawn w/ Males 59, 66, & 82
82	4/20/2020	Merwin Trap	M	68	ORG/WHT 14	3DD-003 D91E1FA	#20CX-82	SPAWNED	62783-1	4/24 Spawn w/ Females 62, 81, & 69
83	4/27/2020	Merwin Trap	F	72	PUR/GLD 50	3DD-003 D91E23D	#20CX-83	MORTALITY	62783-2	MORT 4/29
84	4/27/2020	Merwin Trap	M	72	PUR/GLD 49	3DD-003 D91E290	#20CX-84	SPAWNED	62783-3	5/8 Spawn w/ Female #85,27,64
85	4/27/2020	Merwin Trap	F	71	PUR/GLD 48	3DD-003 D91E25F	#20CX-85	SPAWNED	62783-4	5/8 Spawn w/ Male #91,84,89
86	4/27/2020	Merwin Trap	M	60	PUR/GLD 47	3DD-003 D91E239	#20CX-86	RELEASED	62783-5	5/21 Planted upstream
87	4/27/2020	Merwin Trap	M	67	PUR/GLD 46	3DD-003 D91E258	#20CX-87	MORTALITY	62783-6	MORT 4/28
88	5/4/2020	Merwin Trap	F	64	BLU/WHT 1	3DD-003 D47BDD1	#20CX-88	SPAWNED	62783-7	5/15 Spawn w/ Male #80,65
89	5/4/2020	Merwin Trap	M	80	BLU/WHT 2	3DD-003 D47B8BB	#20CX-89	SPAWNED	62783-8	5/8 Spawn w/ Female #85,27,64
90	5/4/2020	Merwin Trap	M	63	BLU/WHT 3	3DD-003 D47BDE4	#20CX-90	SPAWNED	62783-9	5/8 Spawn w/ Female #92,67,73
91	5/4/2020	Merwin Trap	M	76	BLU/WHT 4	3DD-003 D47B8D3	#20CX-91	SPAWNED	62784-1	5/8 Spawn w/ Female #85,27,64
92	5/4/2020	Merwin Trap	F	61	BLU/WHT 6	3DD-003 D47B8E4	#20CX-92	SPAWNED	62784-2	5/8 Spawn w/ Male #90,78,71
93	5/11/2020	Merwin Trap	M	74	ORG/WHT 21	3DD.003D47B906	#20CX-93	RELEASED	62784-3	5/21 Planted upstream
94	5/11/2020	Merwin Trap	M	69	ORG/WHT 20	3DD.003D47B905	#20CX-94	RELEASED	62784-4	5/21 Planted upstream
95	5/11/2020	Merwin Trap	F	63	ORG/WHT 19	3DD.003D47B913	#20CX-95	RELEASED	62784-5	5/21 Planted upstream

APPENDIX B –

Genetic Assignment Results from Late Winter Steelhead Captures at Merwin Trap (MFCF) and Tangle Netting (TN) – 2020

			Assignment Probability					
	DATE	LABEL	Primary Stock	*P*	Secondary Stock	*P*	Tertiary Stock	*P*
1	2/24/2020	20CX0001	KalamaR_W	0.89	LR Merwin	0.09	SFToutle	0.02
2	2/24/2020	20CX0002	SFToutleR	1.00				
3	2/25/2020	20CX0003	SFToutleR	0.89	KalamaR_W	0.10		
4	2/25/2020	20CX0004	KalamaR_W	0.84	SFToutle	0.11	LR Merwin	0.03
5	2/25/2020	20CX0005	LR Merwin	0.85	SFToutle	0.12	NFToutleR	0.02
6	2/25/2020	20CX0006	NFToutleR	0.72	SFToutle	0.25	KalamaR_W	0.01
7	2/25/2020	20CX0007	KalamaR_W	0.94	WashougalW	0.05		
8	2/24/2020	20CX0008	SFToutleR	0.91	KalamaR_W	0.07	NFToutleR	0.01
9	2/24/2020	20CX0009	KalamaR_W	0.55	NFToutleR	0.34	SFToutle	0.10
10	3/2/2020	20CX0010	SFToutleR	0.85	KalamaR_W	0.15		
11	3/2/2020	20CX0011	SFToutleR	0.95	KalamaR_W	0.05		
12	3/3/2020	20CX0012	KalamaR_W	0.78	SFToutle	0.21		
13	3/3/2020	20CX0013	KalamaR_W	0.78	WashougalW	0.21	SFToutle	0.01
14	3/9/2020	20CX0014	KalamaR_W	0.93	SFToutle	0.07		
15	3/10/2020	20CX0015	LR Merwin	0.98	SFToutle	0.02		
16	3/11/2020	20CX0016	LR Merwin	1.00				
17	3/13/2020	20CX0017	SFToutleR	0.55	LR Merwin	0.45		
18	3/16/2020	20CX0018	LR Merwin	1.00				
19	3/16/2020	20CX0019	LR Merwin	0.70	KalamaR_W	0.20	SFToutle	0.11
20	3/16/2020	20CX0020	LR Merwin	0.62	SFToutle	0.38		
21	3/17/2020	20CX0021	LR Merwin	0.61	SFToutle	0.39		
22	3/17/2020	20CX0022	SFToutleR	1.00				
23	3/18/2020	20CX0023	SFToutleR	0.99				
24	3/19/2020	20CX0024	SFToutleR	1.00				
25	3/19/2020	20CX0025	SFToutleR	0.91	KalamaR_W	0.08		
26	3/23/2020	20CX0026	SFToutleR	0.98	LR Merwin	0.02		
27	3/23/2020	20CX0027	LR Merwin	0.96	SFToutle	0.04		
28	3/23/2020	20CX0028	SFToutleR	1.00				
29	3/23/2020	20CX0029	SFToutleR	1.00				
30	3/30/2020	20CX0035	SFToutleR	0.79	KalamaR_W	0.19	CoweemanR	0.02
31	3/30/2020	20CX0036	SFToutleR	0.99				
32	3/30/2020	20CX0037	NFToutleR	0.46	HoodR	0.37	LR Merwin	0.16
33	3/30/2020	20CX0042	CoweemanR	0.98	LR Merwin	0.02		
34	4/6/2020	20CX0043	SFToutleR	0.98	LR Merwin	0.02		
35	4/6/2020	20CX0044	KalamaR_W	1.00				
36	4/6/2020	20CX0045	GraysR	0.53	LR Merwin	0.34	CoweemanR	0.13
37	4/6/2020	20CX0046	NFToutleR	0.92	SFToutle	0.07		
38	4/6/2020	20CX0047	GraysR	0.40	LR Merwin	0.25	SFToutle	0.23
39	4/6/2020	20CX0049	SFToutleR	0.59	CoweemanR	0.25	LR Merwin	0.09
40	4/6/2020	20CX0050	LR Merwin	0.92	KalamaR_W	0.07		
41	4/6/2020	20CX0051	SFToutleR	0.93	LR Merwin	0.07		
42	4/6/2020	20CX0052	GraysR	0.96	LR Merwin	0.04		
43	4/6/2020	20CX0055	LR Merwin	0.80	SFToutle	0.19	KalamaR_W	0.01
44	4/13/2020	20CX0056	LR Merwin	1.00				
45	4/13/2020	20CX0057	LR Merwin	1.00				
46	4/13/2020	20CX0058	LR Merwin	1.00				
47	4/13/2020	20CX0059	LR Merwin	1.00				
48	4/13/2020	20CX0060	LR Merwin	1.00				
49	4/13/2020	20CX0061	LR Merwin	0.65	SFToutle	0.18	CoweemanR	0.18
50	4/13/2020	20CX0062	LR Merwin	1.00				

			Assignment Probability					
	DATE	LABEL	Primary Stock	*P*	Secondary Stock	*P*	Tertiary Stock	*P*
51	4/13/2020	20CX0063	LR Merwin	1.00				
52	4/14/2020	20CX0064	LR Merwin	1.00				
53	4/14/2020	20CX0065	LR Merwin	1.00				
54	4/14/2020	20CX0066	LR Merwin	1.00				
55	4/14/2020	20CX0067	SFToutleR	0.94	LR Merwin	0.06		
56	4/15/2020	20CX0068	LR Merwin	0.96	CoweemanR	0.04		
57	4/15/2020	20CX0069	CoweemanR	0.69	LR Merwin	0.28	SFToutle	0.02
58	4/20/2020	20CX0070	LR Merwin	1.00				
59	4/20/2020	20CX0071	LR Merwin	1.00				
60	4/20/2020	20CX0072	SFToutleR	1.00				
61	4/20/2020	20CX0073	SFToutleR	0.77	LR Merwin	0.23		
62	4/20/2020	20CX0074	LR Merwin	1.00				
63	4/20/2020	20CX0075	LR Merwin	1.00				
64	4/20/2020	20CX0076	LR Merwin	1.00				
65	4/20/2020	20CX0077	CoweemanR	0.84	SFToutle	0.13	LR Merwin	0.02
66	4/20/2020	20CX0078	LR Merwin	1.00				
67	4/20/2020	20CX0079	SFToutleR	0.92	LR Merwin	0.08		
68	4/20/2020	20CX0080	LR Merwin	1.00				
69	4/20/2020	20CX0081	CoweemanR	0.87	SFToutle	0.12	LR Merwin	0.01
70	4/20/2020	20CX0082	SFToutleR	1.00				
71	4/27/2020	20CX0084	LR Merwin	1.00				
72	4/27/2020	20CX0085	LR Merwin	1.00				
73	4/27/2020	20CX0086	NFToutleR	0.84	LR Merwin	0.16		
74	5/4/2020	20CX0088	LR Merwin	1.00				
75	5/4/2020	20CX0089	LR Merwin	1.00				
76	5/4/2020	20CX0090	LR Merwin	1.00				
77	5/4/2020	20CX0091	LR Merwin	1.00				
78	5/4/2020	20CX0092	EFLewisR	0.99				
79	5/11/2020	20CX0093	LR Merwin	1.00				
80	5/11/2020	20CX0094	KalamaR_W	0.70	LR Merwin	0.30		
81	5/11/2020	20CX0095	LR Merwin	1.00				

APPENDIX C –

NOR Late Winter Steelhead Spawning Crosses -2020

Date	Spawning Cross	Female	Male	Male	Male	Potential Families
4/10/2020	1	20	2	21		2
4/10/2020	2	28	2	21		2
4/10/2020	3	29	25	15		2
4/10/2020	4	23	25	15		2
4/17/2020	5	9	55	50	5	3
4/17/2020	6	8	55	50	5	3
4/17/2020	7	18	55	50	5	3
4/24/2020	8	62	59	66	82	3
4/24/2020	9	81	59	66	82	3
4/24/2020	10	69	59	66	82	3
5/1/2020	11	56	57	58		2
5/1/2020	12	10	57	58		2
5/1/2020	13	72	68	75		2
5/1/2020	14	19	68	75		2
5/1/2020	15	70	60	74	63	3
5/1/2020	16	11	60	74	63	3
5/1/2020	17	49	60	74	63	3
5/8/2020	18	92	90	78	71	3
5/8/2020	19	67	90	78	71	3
5/8/2020	20	73	90	78	71	3
5/8/2020	21	85	91	84	89	3
5/8/2020	22	27	91	84	89	3
5/8/2020	23	64	91	84	89	3
5/15/2020	24	88	80	65		2
5/15/2020	25	35	80	65		2
TOTAL	**25**	**25**	**10**	**10**	**5**	**65**

APPENDIX D –

Final pHOS, abundance and residual estimates for the 2018 late winter steelhead run, North Fork Lewis River

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MEMORANDUM

To: Michelle Havey, Larissa Rohrbach and Sarah Montgomery, Anchor QEA

From: Dalton Hance and Russell Perry, USGS

Date: June 9, 2020

Subject: **Mark-Recapture Modelling of Lewis River Steelhead Proportion of Hatchery-Origin Spawners for 2018 and 2019**

BACKGROUND

The proportion of hatchery-origin spawners, or pHOS, is a metric used to monitor the genetic influence that hatchery-produced fish may have on a naturally spawning population. Estimating pHOS for steelhead is particularly challenging due to their iteroparous spawning strategy. The number of fish of each origin cannot be confirmed through post-spawning carcass surveys, which are routine for semelparous Pacific salmon species. Instead estimates must be made based on observations of live steelhead.

In late 2016, a draft multistate mark-recapture model was developed by Anchor QEA for PacifiCorp to estimate pHOS in the population of late winter-run steelhead that spawn in the North Fork Lewis River, below Merwin Dam (the pHOS model). The model is based upon a study design that takes advantage of existing field efforts to collect broodstock by tangle netting, and the capture of all fish that migrate upstream to the Merwin Trap and Lewis Hatchery Ladder. The draft pHOS model was documented in Objective 2 of the Draft Annual Operating Plan (AOP) for the North Fork Lewis Hatchery and Supplementation Program (AOP). In 2018, in consulation between USGS and Anchor QEA, the pHOS model used to estimate pHOS for the 2016 brood year. In late 2019, USGS was contracted by Anchor QEA and PacifiCorp to apply the pHOS model to data acquired from the 2018 and 2019 field seasons. This memo summarizes the effort to adapt the model to the new data.

In the following sections we briefly review the assumed pHOS data generating process and the model as applied to 2016 data. We next discuss divergences between the assumed data generating process in 2016 and the data collected in 2018 and 2019 that required several modifications to the model. We review inconsistencies in the various data sources and the actions we took to address these data issues. The final section of this model presents the results of this modelling effort for 2018 and 2019 and provides recommendations for implementing the pHOS model in future years.

REVIEW OF PHOS MODEL

The pHOS model was based on the capture by tangle netting and marking of live steelhead on spawning grounds and capture or recapture of marked and unmarked individuals in subsequent tangle net sampling events or at the Merwin Trap. The pHOS model was developed based off the study design implemented in 2016 where multiple tangle net sampling events occur at approximately weekly intervals during the early spring of each year, while the Merwin trap was operated continuously. Each fish captured by either mode was classified by sex, origin, and anadramous status based on physical appearance and/or the presence of marks. Origin was determined by the presence of a blank wire tag (BWT) or stubby dorsal fin. Anadromy was determined primarily based on the size of the individuals. Some natural origin anadramous fish captured during tangle netting were removed for broodstock, otherwise most hatchery origin fish and some natural origin fish were marked with a PIT tag and released and so were available for recapture. The pHOS model utilized this study design to identify the relative proportion of four groups in the Lewis River steelhead population: 1) natural origin anadramous fish, 2) hatchery

origin anadramous fish, 3) natural origin residual fish, and 4) hatchery origin residuals fish. Each of these groups were presumed to have separate probabilities of transitioning to the Merwin trap or remaining on the spawning grounds as either potential or known spawners in the interval between each tangle net sampling event. Fish that transitioned to the Merwin trap were assumed to be removed from the sampling frame and thus were neither able to be recaptured nor contribute to the spawning population. Each tangle net event was assumed to have a capture efficiency, defined as the probability that a fish that is present on the spawning grounds will be captured. Capture efficiency was allowed to vary among tangle net sampling events, but a single capture efficiency was assumed for all tangle net locations and for each group of fish present on the spawning grounds during a given event. After the final tangle net sampling event, the model assumed that all fish remaining on the spawning grounds contribute to the spawning population. The pHOS was then calculated as the proportion of fish in this spawning population that were of hatchery origin.

The data provided by Anchor QEA and PacifiCorp in 2016 consisted of three interrelated spreadsheets containing 1) records of tangle net sampling efforts, 2) daily counts of fish captured and recaptured at the Merwin Trap broken down by sex and origin status of fish, and 3) records of PIT tags from the tangle net file later observed at the Merwin trap. Tangle net data consisted of a row in the table for each fish captured or recaptured during a given tangle net sampling event with data entries including the date of capture, life stage (smolt, adult, residual), presence of BWT, presence of stubby dorsal fin, sexual maturity (green, ripe, or kelt), sex, length, retention status (marked/released, removed for broodstock, removed due to mortality), and, if PIT-tagged, a PIT ID. A total of 10 approximately weekly tangle net events were represented in the data, with the first event occuring on March 8, 2016 and the final event occuring on May 10, 2016. Merwin trap records covered the time period from January 1, 2016 to June 27, 2016. Twenty-six fish with PIT tags from tangle netting were observed at Merwin trap. To avoid double-counting these fish, the appropriate number of fish per day were subtracted from the daily counts file.

The three datafiles from 2016 were restructured to facilitate modelling the hypothesized data generating process. The observed data matrix was structured to contain a row for each fish with a set of columns for identifying information (PIT-ID, Origin, Sex, and Anadromy), a column for the observed state of the fish at each tangle netting event including an extra psuedo-event for fish captured at the Merwin Trap after the last tangle net event, plus a dummy column for the initial state. The observed data matrix was constructed in three steps. First, all fish observed during tangle net efforts were processed resulting in 66 records of fish captured or recaptured. Second, all fish observed at the Merwin trap were processed resulting in 791 additional records. Additionally, an indicator matrix was constructed to signify which fish were unavailable for recapture during any sampling event. Fish were assigned as unavailable for recapture for all events after the event in which they were captured and removed. A total of 24 fish become unavailable for further tangle net capture either because they were removed for broodstock or died. All fish captured at the Merwin Trap were also considered unavailable for recapture after initially being captured at the Merwin trap.

The model did not allow fish to transition from "returning"" back to "potential", from "spawner" back to "returning" or "up-river migrant", nor from "up-river migrant" back to "returning" or to "spawner". Additionally we assumed that the PIT ID, date of capture, origin, sex, and residual status were identified and recorded correctly in the field and that once fish become unavailable for recapture they did not become available again. A handful of data records in 2016 violated these assumptions and required further processing. These instances were noted in our previous memo.

DATA QUALITY AND DEVIATIONS FROM EXISTING PHOS MODEL STRUCTURE IN 2018 & 2019

Data from 2018 and 2019 were provided by Anchor QEA and PacifiCorp in a similar format to the data from 2016. The initally provided data consisted of three spreadsheet files: 1) `tanglenet_2016-2019` which con-

tained records of tangle net captures and recaptures of individual fish identified by PIT ID, 2) `2018 2019 Merwin Trap Summary` which contained daily counts of fresh and recaptured fish at Merwin trap, and 3) `merwintrap_2016-2019` which contained the dates of recapture at Merwin trap for fish captured or recaptured during tangle net sampling.

Initial examination of the data revealed numerous discrepancies, particulary for the 2019 data. An incomplete summary of these discrepancies includes:

- Dates of capture differing between `tanglenet_2016-2019` and PTAGIS queries of the PIT IDs
- PIT IDs listed in `tanglenet_2016-2019` not in PTAGIS database or present as "ORPHAN" tags (i.e. missing a mark record)
- Typos in PIT IDs in `tanglenet_2016-2019`, e.g. a capital letter "O" in place of a zero (0)
- In 2019, no fish recorded as marked during tangle net were recorded as recaptured in `tanglenet_2016-2019`, however recaptures with the location "Lewis River" of some PIT IDs `tanglenet_2016-2019` were found in PTAGIS
- In 2019, duplicate PIT IDs were recorded for clearly different fish (e.g. the same PIT ID was recorded as a mark record for fish of different sexes, sizes and/or origin)
- In 2019, no broodstock removals were noted in the `RETENTION` column. A file was later provided by Anchor QEA and PacifiCorp, `2019 Wild Late Winter Steelhead Data Sheet_Broodstocking` which showed 8 fish with a capture method "Tangle Net" or "Hook & Line" which indicates removal for broodstock. However, only 6 of these were able to be matched to PIT IDs in `tanglenet_2016-2019`

In light of these data quality issues, and in consultation with Anchor QEA and PacifiCorp, we did not attempt to fit the model to the data from 2019.

Beyond these data quality discrepancies, the study design from 2018 deviated from the structure of the existing pHOS model in several respects. We summarize these deviations and their consequences.

First, there were substantially more capture dates in the tangle net file at irregular intervals. This deviates from the pattern of approximately weekly sampling events assumed by the model. For example, in 2018 there were 21 distinct dates with intervals between dates ranging between 1 and 7 days. It is possible that capture attempts occurred on more dates than these, but these dates were not recorded if no fish where captured. Remedy: captures were grouped into approximately weekly intervals resulting in 11 capture "events". Consequences: the model assumes that capture efficiency is constant across all sampling locations for a given capture event; it is possible that by lumping capture dates into single events resulted in capture events with unequal effort across locations thus violating this assumption. Recommendations: ensure consistency in capture effort across weeks and record capture effort to ensure that tangle net attempt resulting in zero captures are recorded and modeled.

Second, fish that transitioned to Merwin trap were later captured during tangle net sampling. Previously, the model assumed that fish that became unavailable for recapture either through broodstock removal or by transitioning to the trap were removed from the potential spawning population and did not become available for recapture again. After consultation with Anchor QEA and PacifiCorp it became clear that there were two sources of potential tanglenet recaptures of fish previously captured or recaptured at Merwin trap.

The first source came from two field experiment to assess trap efficiency. The first of the these experiments involved hatchery origin fish initially captured at Merwin trap, radio and PIT tagged, and released to Lewis River. These data were made available in a spreadsheet file named `MFCF ATE tag log`. A total of 73 fish were involved in this experiment. Of these, 61 were successfully recaptured at Merwin trap and permanently removed; 12 were not and thus became potential spawners. Additionally, 3 of the 73 fish were recaptured during tangle netting, 1 of which was subsequently recaptured at Merwin. The second field experiment consisted of 19 hatchery origin steelhead originally captured through tangle netting. These data were made available in a spreadsheet file named

`Tangle Netting tag log`. Of these 19 fish, 16 were subsequently recaptured at Merwin. Of these 16, 7 were re-released into the Lewis River and the rest were permanently removed. Of these 7, 4 were recaptured at Merwin a second time. Because these fish were known to be present on the spawning ground for at least some period of time after being released, the model needed to be expanded to account for their influence on capture efficiency. Additionally, because fish that were not recaptured may have spawned in the Lewis River, these fish needed to be accounted for their influence on pHOS. Remedy: the model was changed to allow for fish to transition back to a "returning" state from the "up-river migrant" state if the fish's capture history indicated it was released as part of trap efficiency trials. This required several alterations to the transition matrix and the availability matrix. Additionally, to avoid double counting of individual fish captured at the trap, the appropriate numbers of male and female hatchery origin "fresh" fish were subtracted from daily Merwin trap counts. Consequences: the model assumes that all fish in the Lewis River have the same capture efficiency if they are in the returning state; it is possible that trap efficiency fish may have a different capture efficiency in the Lewis River than other fish.

The second source of fish captured in the tangle net after transitioning to Merwin trap were natural origin fish selected for broodstock at Merwin trap. A total of 93 natural origin fish were held at least temporarily at the hatchery for broodstock sampling. These data were provided in a spreadsheet file named `WWST data 2016 2018`. Of the 93 fish held as potential broodstock, 90 were captured at Merwin trap. Of these, 4 were also captured during tangle net sampling. 46 of the 93 fish taken for broodstock were spawned in the hatchery, the remainder with the exception of 3 mortalities were released back into the Lewis River and so potentially contributed to the spawning population. However, because all of these fish were held in the hatchery for some period of time this temporary removal needed to be accounted for to avoid biasing capture efficiency estimates. Remedy: the model was changed to allow for temporary removal of natural origin fish while being held at the hatchery. After a known release date back into the Lewis River these fish were once again subject to capture, and allowed to remain in the "returning" state or to transition to "spawner" or "up river migrant" state. Any natural origin fish that transitioned to the "up river migrant" state and was not held at the hatchery upon capture was forced to transition back into the "returning" state. Fish that were spawned and released back into the Lewis River were subject to capture if they were released prior to the last tangle net event. However, these fish were subtracted from the spawning population in the model and do not contribute to pHOS.

Additionally, per PacifiCorp and Anchor QEA, all other natural origin fish captured at the Merwin trap were also immediately released back into the Lewis River and also potentially contributed to the spawning population. A total of 118 natural origin "fresh" fish were recorded in `2018 2019 Merwin Trap Summary` versus the 90 listed in `WWST data 2016 2018`. To account for these additional natural origin fish while while also avoiding double counting of fish, we used the capture date as recorded in `WWST data 2016 2018` to subtract the appropriate number of fish of each sex from the daily counts of natural origin fresh fish in `2018 2019 Merwin Trap Summary`. However, for some dates more natural origin fish were recorded as being captured in `WWST data 2016 2018` than in `2018 2019 Merwin Trap Summary`. Rather than admitting negative counts, we reduced the count in `2018 2019 Merwin Trap Summary` to zero. This left 49 fish from `2018 2019 Merwin Trap Summary` that were not accounted for in `WWST data 2016 2018`. If all natural origin fish were recorded accurately in `2018 2019 Merwin Trap Summary` and all capture dates recorded accurately in `WWST data 2016 2018` we would expect only 28 excess natural origin fish. Consequence: allowing natural origin fish to return to the spawning ground after capture at the Merwin trap has the effect of reducing pHOS because these fish can now contribute to the spawning population. There remains the potential of overcounting of natural origin fish released back into Lewis River from the Merwin trap due to the discrepancy in the capture dates between the two files. This has the potential to bias pHOS too low.

Because of these additional complications and modifications to the study design, in particular the non-stochastic interventions of the trap efficiency study and of temporarily removing fish and holding them for broodstock, we were not able to implement a posterior predictive check for the study design of 2018. To do so, we would need to

be able to simulate the data generating process for both of these additional processes. This would require the addition of several spurious parameters to account for the various ways fish may be temporally removed and/or re-released into the Lewis River.

RESULTS

Here we summarize results from fitting the multistate mark-recapture model to estimate the proportion of hatchery origin spawners among Lewis River steelhead to data collected in 2018. The proportion of hatchery origin spawners was estimated to be 27.2% [90% CI: 21.1%, 33.9%]. This is based on an estimate of 371 [341, 398] natural origin steelhead and 121 [94, 151] hatchery origin steelhead remaining on the spawning grounds after the conclusion of tangle net and trapping efforts. To calculate pHOS the number of natural origin spawners was reduced by 46 to account for fish spawned in the hatchery. The three mortalities recorded at the hatchery were removed from the model at their point of initial capture and did not contribute to pHOS or capture efficiency estimation after that.

Additional parameter estimates of potential interest include capture efficiency and rate of residualism. The rate of residualism did not differ significantly between males and females though the point estimate was higher for males, with 2.4% [1%, 4.3%] of males taking a residual life history, compared to 1.6% [0.5%, 3.2%] of females. A common tangle net capture efficiency was estimated for all groups of fish present on the spawning grounds during a given tangle net event, but was allowed to vary among tangle net events. Even so, capture efficiency was fairly consistent among events averaging between 1% - 2% (Figure 2).

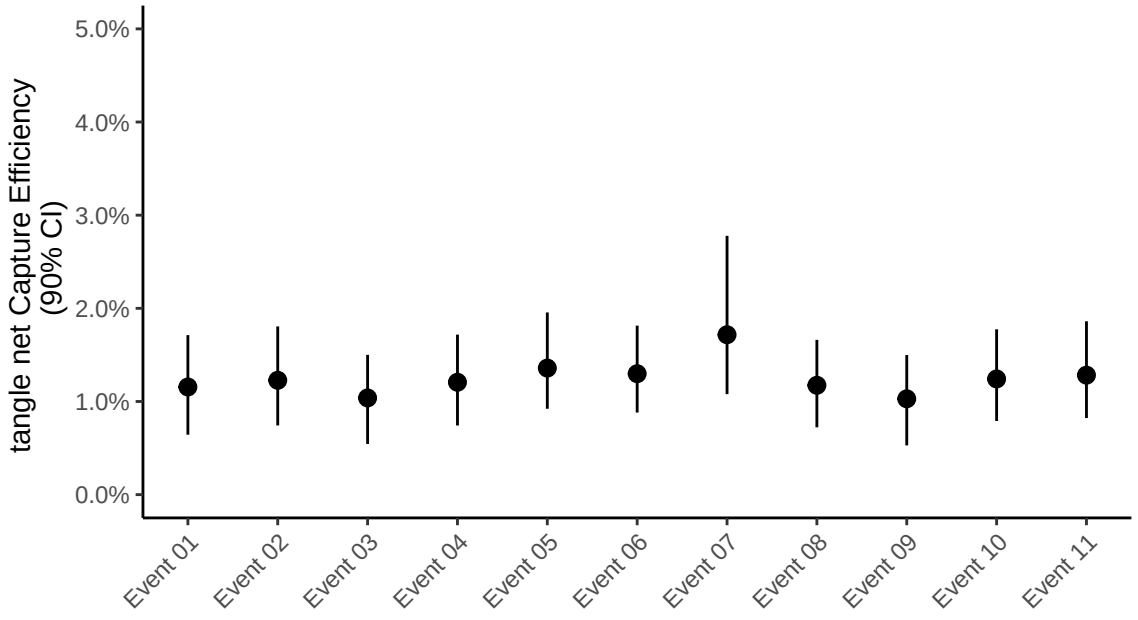

Figure 1: Tangle net capture efficiency for each sampling event. Capture efficiency refers to the probability that a fish that is present on spawning grounds will be captured during tangle netting efforts. Capture efficiency is pooled among all tangle net locations and is common among all groups of fish.

CONCLUSION

The results for 2018 are largely similar to the previous model results in 2016. pHOS in 2016 was estimated to be 51% based on estimates of 175 natural origin steelhead and 182 hatchery origin steelhead remaining on the

spawning grounds. However, the model from 2016 did not account for the release of natural origin fish captured at Merwin trap back into the Lewis River. Tangle net capture efficiency for both years was estimated to be between 1% and 2%. The rate of residualism was much higher for males in 2016 than in 2018. A similar number of uniquely identifiable residuals were observed in each year (9 in 2016, 8 in 2018), but in 2016 all residuals were male whereas in 2018, 3 of the 8 were female. This year-to-year consistency in model results suggests that pHOS model and study design can be used to produce reliable estimates year to year.

Data quality, consistency and integration across data sources remains a challenge to estimating pHOS for late winter steelhead in the Lewis River. The pHOS model relies on the ability to track individually identifiable fish across data sources so that, for example, an individual marked during tangle netting can be traced to a recapture at Merwin or a release back into the Lewis River after being held for broodstock selection. The use of a centralized database and electronic record keeping (e.g. recording a PIT tag directly via scanning versus manual entry) such as PTAGIS should help eliminate data entry errors. However, when we attempted to cross reference PIT IDs in 2018 and 2019 with PTAGIS we found several inconsistencies or missing mark and recapture records. These errors precluded analysis of pHOS for 2019. Similarly daily counts at Merwin could not be fully reconciled with records from individual fish in 2018 which may have resulted in an overcount of natural origin fish. To the extent pHOS estimates are used to make management decisions, we recommend efforts to improve data tracking to ensure high quality data are used to produce these estimates.

APPENDIX A: UPDATED MODEL CODE

```
model {
#-----------------------------------------------
#####DATA:
 # N: number of fish, including data augmentation
 # K: number of capture occasions
 # z: ecological state matrix (partially observed) N x K
 # y: observation matrix (fully observed)
 # n_spawned: number spawned in hatchery prior to release, 46 in 2018
 # avail: availability matrix,
 #      -1 means a fish was released back into Lewis River from Merwin Trap
 #       0 means a fish is unavailable for capture or state transition
 #       1 means a fish is available

#####STATES:
# Ecological States: 1 - Potential Population
#                    2 - Returning Fish
#                    3 - Kelt/Spawner
#                    4 - Trap

# Observed States:   1 - Not Observed
#                    2 - Tangle Net trapped
#                    3 - Tangle Net trapped Kelt
#                    4 - Trapped

#####PARAMETERS:
#beta: origin ratio
#sex_ratio: male-female ratio
#resid_ratio: residual ratio
```

```
#gamma: entry probability
#delta: probability of becoming a spawner
#phi: probability of moving to trap
#p: tangle net capture probability

####PRIORS AND CONSTRAINTS:

mean.p  ~ dnorm(-1.5, 1)
  #prior on tangle net detection efficiency which we expect to be low
sigma.p ~ dnorm(0, 0.5) T(0,)
#prior on standard deviation for detection efficiency random effect (per event)
tau.p   <- pow(sigma.p, -2)

##gamma: probability of entering from potential population
mean.gamma  ~ dt(0, .1, 7)
sigma.gamma ~ dnorm(0, 0.5) T(0,)
tau.gamma   <- pow(sigma.gamma, -2)
resid.gamma ~ dbeta(1, 1)
#probability of entering for residual fish which only enter on first timestep

## delta: probability of remaining in returning state
beta_delta[1] ~ dt(0, .1, 7)
beta_delta[2] ~ dt(0, .25, 7)
beta_delta[3] ~ dt(0, .25, 7)
beta_delta[4] ~ dt(0, .25, 7)

sigma.delta ~ dnorm(0, 0.5) T(0,)
tau.delta   <- pow(sigma.delta, -2)

beta_phi[1] ~ dt(0, .1, 7)
beta_phi[2] ~ dt(0, .25, 7)
beta_phi[3] ~ dt(0, .25, 7)
beta_phi[4] ~ dt(0, .25, 7)
sigma.phi   ~ dnorm(0, .5) T(0,)
tau.phi     <- pow(sigma.phi, -2)

beta           ~ dbeta(1, 1)
sex_ratio      ~ dbeta(5, 5)
resid_ratio[1] ~ dbeta(1, 9) # % of male population that residualize
resid_ratio[2] ~ dbeta(1, 9) # % of female population that residualize

## gamma: probability of entering from potential population
## Event 0 through Event K - 2
e.gamma[1] ~ dnorm(0, tau.gamma)
logit(gamma[1]) <- mean.gamma + e.gamma[1]
# probability of entering at time 1 for anadramous fish
# logit(gamma[1]) <- resid.gamma
```

```
# probability of entering at time 1 for residual fish

for (t in 2:(K - 2)) {
  e.gamma[t] ~ dnorm(0, tau.gamma)
  logit(gamma[t]) <- mean.gamma + e.gamma[t]
  # probability of entering at time 1 for anadramous fish
  # logit(gamma[1]) <- 0
  # probability of entering at time 1 for residual fish
}

## delta: probability of remaining in returning state
## Event 1 through Event K - 2
for (t in 1:(K - 3)) {
  e.delta[t] ~ dnorm(0, tau.delta)

  logit(delta[t, 1]) <- beta_delta[1] + e.delta[t]
  # probability of remaining in returning state for HOR anadramous fish
  logit(delta[t, 2]) <- beta_delta[1] + beta_delta[2] + e.delta[t]
  # probability of remaining in returning state for NOR anadramous fish
  logit(delta[t, 3]) <- beta_delta[1] + beta_delta[3] + e.delta[t]
  # probability of remaining in returning state for HOR residual fish
  logit(delta[t, 4]) <- beta_delta[1] + beta_delta[2] +
                        beta_delta[3] + beta_delta[4] + e.delta[t]
  # probability of remaining in returning state for NOR residual fish
}

#phi: probability of moving to trap
## Event 1 through Event K - 1
for (t in 1:(K - 1)) {
  e.phi[t] ~ dnorm(0, tau.phi)

  logit(phi[t, 1]) <- beta_phi[1] + e.phi[t]
  # probability of transitioning to the trap for HOR anadramous fish
  logit(phi[t, 2]) <- beta_phi[1] + beta_phi[2] + e.phi[t]
  # probability of transitioning to the trap for NOR anadramous fish
  logit(phi[t, 3]) <- beta_phi[1] + beta_phi[3] + e.phi[t]
  # different probability of transitioning to the trap for HOR residual fish
  logit(phi[t, 4]) <- beta_phi[1] + beta_phi[2] +
                      beta_phi[3] + beta_phi[4] + e.phi[t]
  #probability of transitioning to the trap for NOR residual fish
}

#p: detection probability
#Event 1 through Event K - 1
for (t in 1:(K - 2)) {
  e.p[t] ~ dnorm(0, tau.p)
  logit(p[t]) <- mean.p + e.p[t]
```

```
}


####TRANSITION & OBSERVATION MATRICES

for (i in 1:M){
  origin[i] ~ dbern(beta) # 0 - HOR, 1 - NOR
  sex[i]    ~ dbern(sex_ratio)  # 0 - M, 1 - F
  resid[i]  ~ dbern(resid_ratio[1 + sex[i]]) # 0 - anadramous, 1 - residual

  g[i] <- 1 + 1 * origin[i] + 2 * resid[i]

  ## Initial entry to Lewis River (all fish start as potential population)
  ##TRANSITION ## Event 0 -> Event 1
  ############################
  #[time, individual, current state, next state]

  ps[1, i, 1, 1] <- 1 - (gamma[1] * (1 - resid[i]) +
                           resid.gamma * resid[i])
  ps[1, i, 1, 2] <- (gamma[1] * (1 - resid[i]) +
                       resid.gamma * resid[i]) * (1 - phi[1, g[i]])
  ps[1, i, 1, 3] <- 0
  ps[1, i, 1, 4] <- (gamma[1] * (1 - resid[i]) +
                       resid.gamma * resid[i]) * phi[1, g[i]]

  ps[1, i, 2, 1] <- 0
  ps[1, i, 2, 2] <- 1
  ps[1, i, 2, 3] <- 0
  ps[1, i, 2, 4] <- 0

  ps[1, i, 3, 1] <- 0
  ps[1, i, 3, 2] <- 0
  ps[1, i, 3, 3] <- 1
  ps[1, i, 3, 4] <- 0

  ps[1, i, 4, 1] <- 0
  ps[1, i, 4, 2] <- 0
  ps[1, i, 4, 3] <- 0
  ps[1, i, 4, 4] <- 1
  ############################

  ##OBSERVATION## Event 1
  ############################
  #[time, individual, actual state, observed state]

  po[1, i, 1, 1] <- 1
  po[1, i, 1, 2] <- 0
```

```
po[1, i, 1, 3] <- 0
po[1, i, 1, 4] <- 0

po[1, i, 2, 1] <- 1 - p[1] * abs(avail[i, 2])
po[1, i, 2, 2] <- p[1] * abs(avail[i, 2])
po[1, i, 2, 3] <- 0
po[1, i, 2, 4] <- 0

po[1, i, 3, 1] <- 1 - p[1] * abs(avail[i, 2])
po[1, i, 3, 2] <- 0
po[1, i, 3, 3] <- p[1] * abs(avail[i, 2])
po[1, i, 3, 4] <- 0

po[1, i, 4, 1] <- 1 - abs(avail[i, 2])
po[1, i, 4, 2] <- 0
po[1, i, 4, 3] <- 0
po[1, i, 4, 4] <- abs(avail[i, 2])
############################

for (k in 2:(K - 2)) {
  ##TRANSITION ## Event 1 -> Event 2, ..., Event K - 2 -> Event K - 1
  ############################
  ps[k, i, 1, 1] <- 1 - gamma[k]
  ps[k, i, 1, 2] <- gamma[k]
  ps[k, i, 1, 3] <- 0
  ps[k, i, 1, 4] <- 0

  # line 157, for troubleshooting
  ps[k, i, 2, 1] <- 0
  ps[k, i, 2, 2] <- (delta[k - 1, g[i]] * abs(avail[i, k])) +
                      (1 - abs(avail[i, k]))
  ps[k, i, 2, 3] <- (1 - delta[k - 1, g[i]]) * (1 - phi[k, g[i]]) *
                      abs(avail[i, k])  # should be 0 when avail = -1
  ps[k, i, 2, 4] <- (1 - delta[k - 1, g[i]]) * (phi[k, g[i]]) *
                      abs(avail[i, k]) # should be 0 when avail = -1

  ps[k, i, 3, 1] <- 0
  ps[k, i, 3, 2] <- 0
  ps[k, i, 3, 3] <- 1
  ps[k, i, 3, 4] <- 0

  ps[k, i, 4, 1] <- 0
  ps[k, i, 4, 2] <- ((abs(avail[i, k]) - avail[i, k])/2) * delta[k - 1, g[i]]
  #should be 1 when avail = -1
  ps[k, i, 4, 3] <- ((abs(avail[i, k]) - avail[i, k])/2) *
                     (1 - delta[k - 1, g[i]]) * (1 - phi[k, g[i]])
  ps[k, i, 4, 4] <- (1 - (abs(avail[i, k]) - avail[i, k])/2) +
```

```
                    ((abs(avail[i, k]) - avail[i, k])/2) *
                     (1 - delta[k - 1, g[i]]) * (phi[k, g[i]])
                     # should be 1 when avail = 0 or 1

  ############################

  ##OBSERVATION## Event 2, ..., Event K - 1
  ############################
  po[k, i, 1, 1] <- 1
  po[k, i, 1, 2] <- 0
  po[k, i, 1, 3] <- 0
  po[k, i, 1, 4] <- 0

  po[k, i, 2, 1] <- 1 - p[k] * abs(avail[i, k + 1])
  po[k, i, 2, 2] <- p[k] * abs(avail[i, k + 1])
  po[k, i, 2, 3] <- 0
  po[k, i, 2, 4] <- 0

  po[k, i, 3, 1] <- 1 - p[k] * abs(avail[i, k + 1])
  po[k, i, 3, 2] <- 0
  po[k, i, 3, 3] <- p[k] * abs(avail[i, k + 1])
  po[k, i, 3, 4] <- 0

  po[k, i, 4, 1] <- 1 - abs(avail[i, k + 1])
  po[k, i, 4, 2] <- 0
  po[k, i, 4, 3] <- 0
  po[k, i, 4, 4] <- abs(avail[i, k + 1])
  ############################
}

##TRANSITION ## Event K - 1 -> Event K
############################
# Turn all fish remaining on spawning grounds into spawners
ps[K - 1, i, 1, 1] <- 1
ps[K - 1, i, 1, 2] <- 0
ps[K - 1, i, 1, 3] <- 0
ps[K - 1, i, 1, 4] <- 0

ps[K - 1, i, 2, 1] <- 0
ps[K - 1, i, 2, 2] <- 1 - abs(avail[i, K - 1])
ps[K - 1, i, 2, 3] <- (1 - phi[K - 1, g[i]]) * abs(avail[i, K - 1])
ps[K - 1, i, 2, 4] <- phi[K - 1, g[i]] * abs(avail[i, K - 1])

ps[K - 1, i, 3, 1] <- 0
ps[K - 1, i, 3, 2] <- 0
ps[K - 1, i, 3, 3] <- 1
ps[K - 1, i, 3, 4] <- 0
```

```
  ps[K - 1, i, 4, 1] <- 0
  ps[K - 1, i, 4, 2] <- 0
  ps[K - 1, i, 4, 3] <- 0
  ps[K - 1, i, 4, 4] <- 1
  ############################

  ##OBSERVATION## Event K
  ############################
  # No tangle netting, only trap observations after last tangle netting event.
  po[K - 1, i, 1, 1] <- 1
  po[K - 1, i, 1, 2] <- 0
  po[K - 1, i, 1, 3] <- 0
  po[K - 1, i, 1, 4] <- 0

  po[K - 1, i, 2, 1] <- 1
  po[K - 1, i, 2, 2] <- 0
  po[K - 1, i, 2, 3] <- 0
  po[K - 1, i, 2, 4] <- 0

  po[K - 1, i, 3, 1] <- 1
  po[K - 1, i, 3, 2] <- 0
  po[K - 1, i, 3, 3] <- 0
  po[K - 1, i, 3, 4] <- 0

  po[K - 1, i, 4, 1] <- 1 - abs(avail[i, K])
  po[K - 1, i, 4, 2] <- 0
  po[K - 1, i, 4, 3] <- 0
  po[K - 1, i, 4, 4] <- abs(avail[i, K])
  ############################
}

####LIKELIHOOD:
for (i in 1:M){
  for (k in 2:K){
    z[i, k] ~ dcat(ps[k - 1, i, z[i, k - 1], ])
    y[i, k] ~ dcat(po[k - 1, i, z[i, k], ])
  }
}

###DERIVED PARAMETERS:
for (i in 1:M){
  NOR_entered[i] <- (1 - equals(z[i,K], 1)) * equals(origin[i], 1)
  HOR_entered[i] <- (1 - equals(z[i,K], 1)) * equals(origin[i], 0)
  NOR_trap[i] <- (1 - equals(z[i,K], 1)) * (equals(z[i,K], 4)) *
                 equals(origin[i], 1)
  HOR_trap[i] <- (1 - equals(z[i,K], 1)) * (equals(z[i,K], 4)) *
                 equals(origin[i], 0)
```

```
  NOR_spawn[i]   <- NOR_entered[i]
  HOR_spawn[i]   <- HOR_entered[i] - HOR_trap[i]
}
N_NOR_entered <- sum(NOR_entered[])
N_HOR_entered <- sum(HOR_entered[])

N_NOR_spawn <- sum(NOR_spawn[])
N_HOR_spawn <- sum(HOR_spawn[])

pHOS <- N_HOR_spawn/(N_HOR_spawn + N_NOR_spawn - n_spawned)
}
```

APPENDIX E –
North Fork Lewis River Downstream of Merwin Dam – 2020 Coho Salmon Spawning Survey Results (October 2020 through January 2021)

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Meridian Environmental, Inc.

Environmental Sciences
Regulatory Planning
Project Management

To: Erik Lesko and Chris Karchesky, PacifiCorp

From: Jason Shappart, Senior Fisheries Scientist

Date: Draft – February 28, 2021

Re: North Fork Lewis River Downstream of Merwin Dam – 2020 Coho Salmon Spawning Survey Results (mid-October 2020 through January 2021)

Introduction

As a component of its existing FERC license, PacifiCorp conducts annual Coho Salmon spawning surveys from mid-October through January to facilitate estimating Coho Salmon spawning escapement in the North Fork (NF) Lewis River downstream of Merwin Dam (PacifiCorp and Cowlitz PUD 2017). Meridian Environmental, Inc. (Meridian) has performed these surveys under contract with PacifiCorp since 2013 using the same survey crew each year. The mainstem NF Lewis River spawning survey area is divided into five index reaches as defined by the Washington Department of Fish and Wildlife (WDFW), extending from the boat barrier downstream of Merwin Dam to the downstream end of Eagle Island (Figure 1), encompassing 10.84 river miles (mainstem channel and Eagle Island side channel). The NF Lewis River tributary spawning survey reaches are defined annually by WDFW using a Generalized Random Tessellation Stratified (GRTS) sample design. The tributary survey data is used by WDFW to estimate Coho escapement within the lower Columbia River area. In 2020, WDFW designated three survey reaches within the Hayes Creek watershed, and one reach each in the Robinson Creek watershed (Figure 1). Each survey reach was approximately one mile in length. All surveys were conducted on a weekly basis as environmental conditions allowed (flow, turbidity, etc.) following methods described in PacifiCorp's revised Monitoring and Evaluation Plan (PacifiCorp and Cowlitz PUD 2017). This memorandum summarizes the results of the Coho Salmon spawning surveys from mid-October 2020 through January 2021.

Survey Conditions

In 2020, NF Lewis River flows downstream of Merwin Dam were variable. Flows were generally at or below median flow conditions in November and December, but well above median flow conditions through most of January due to spill associated with intense storm events (Figure 2). Conditions were surveyable during every week of the survey period for the mainstem NF Lewis River except the second week in January, due to spill at Merwin Dam (Figure 3). Tributary survey reaches were generally surveyable every week through December; however, conditions in all tributaries were either poor or not surveyable during most of January due to high flows and/or high turbidity. Survey days and mainstem NF Lewis River discharge are depicted in Figure 3.

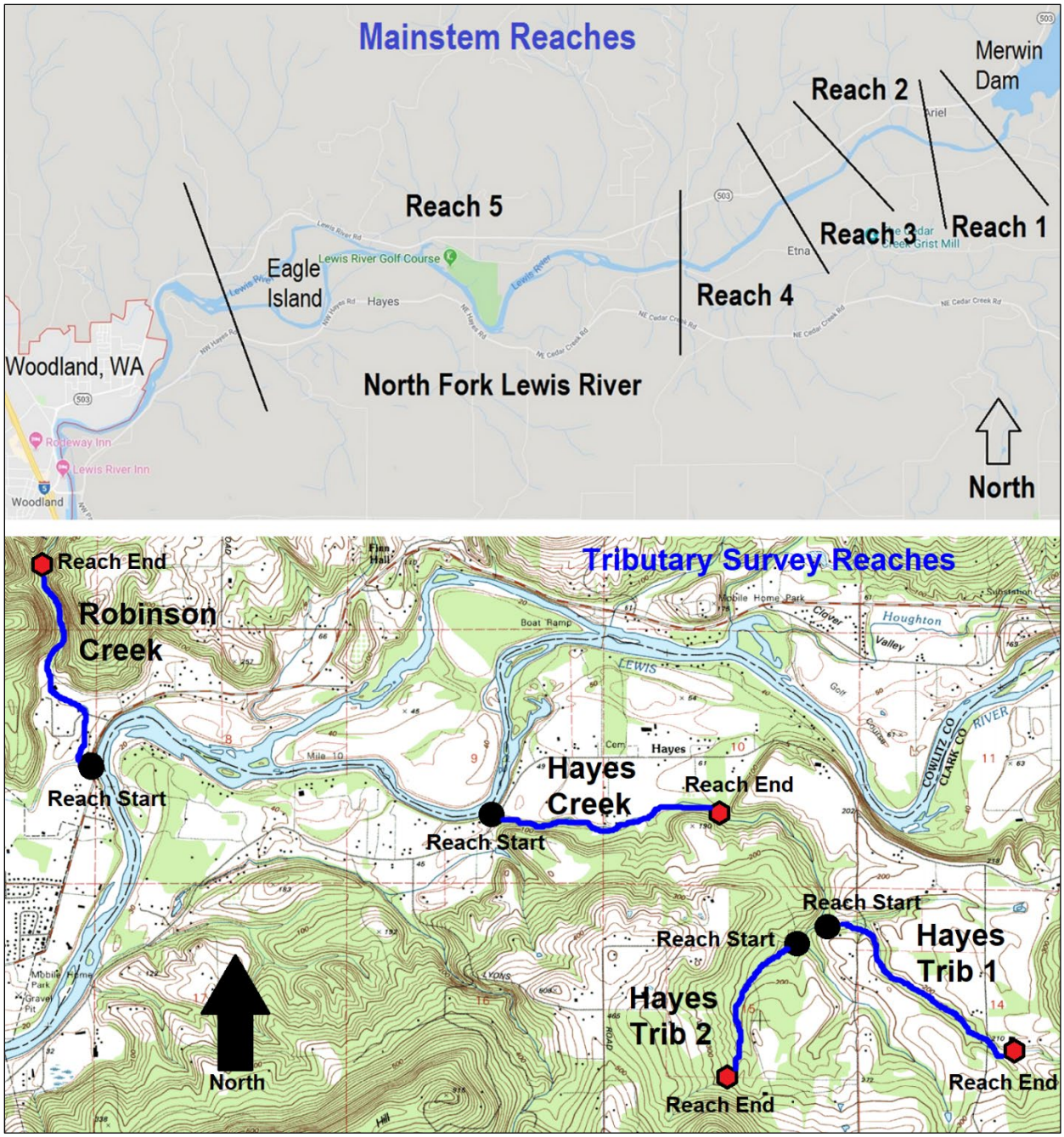

Figure 1. NF Lewis River mainstem and tributary Coho spawning survey reaches below Merwin Dam in 2020.

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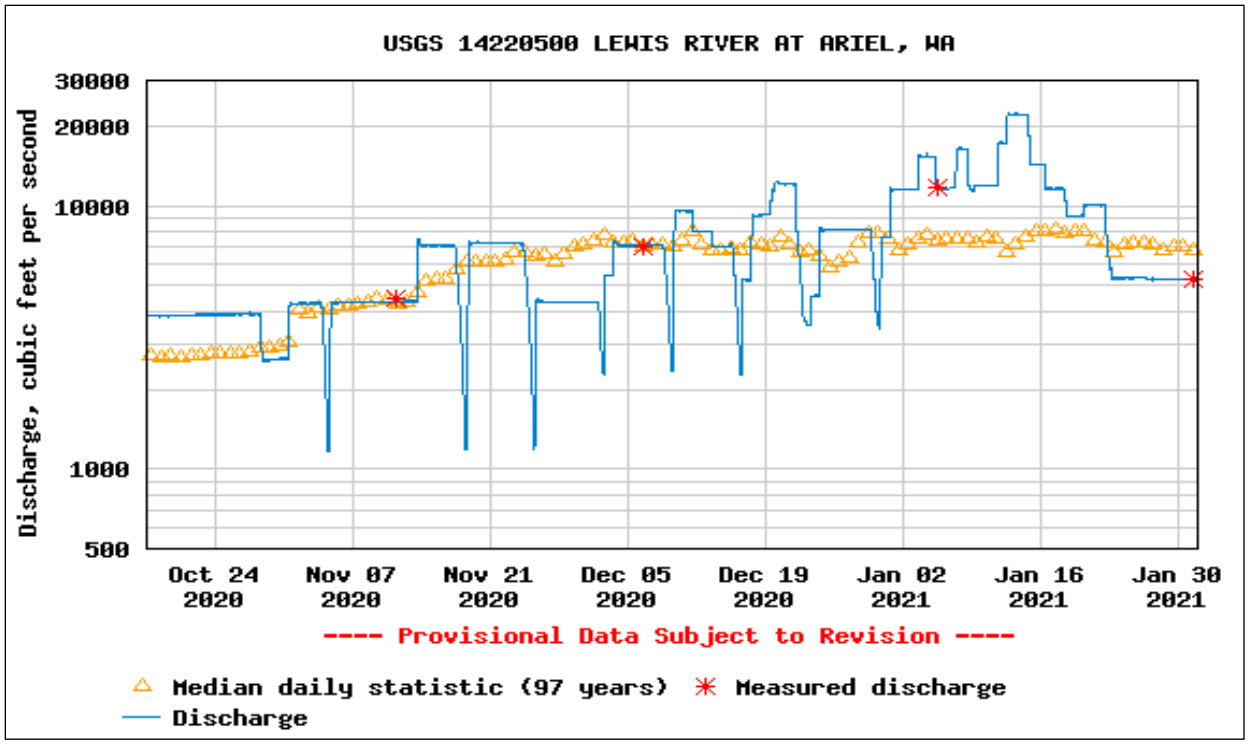

Figure 2. USGS Lewis River Ariel Gage – 15 minute interval reported discharge (cfs) during the 2020 survey season and period of record median daily statistic.

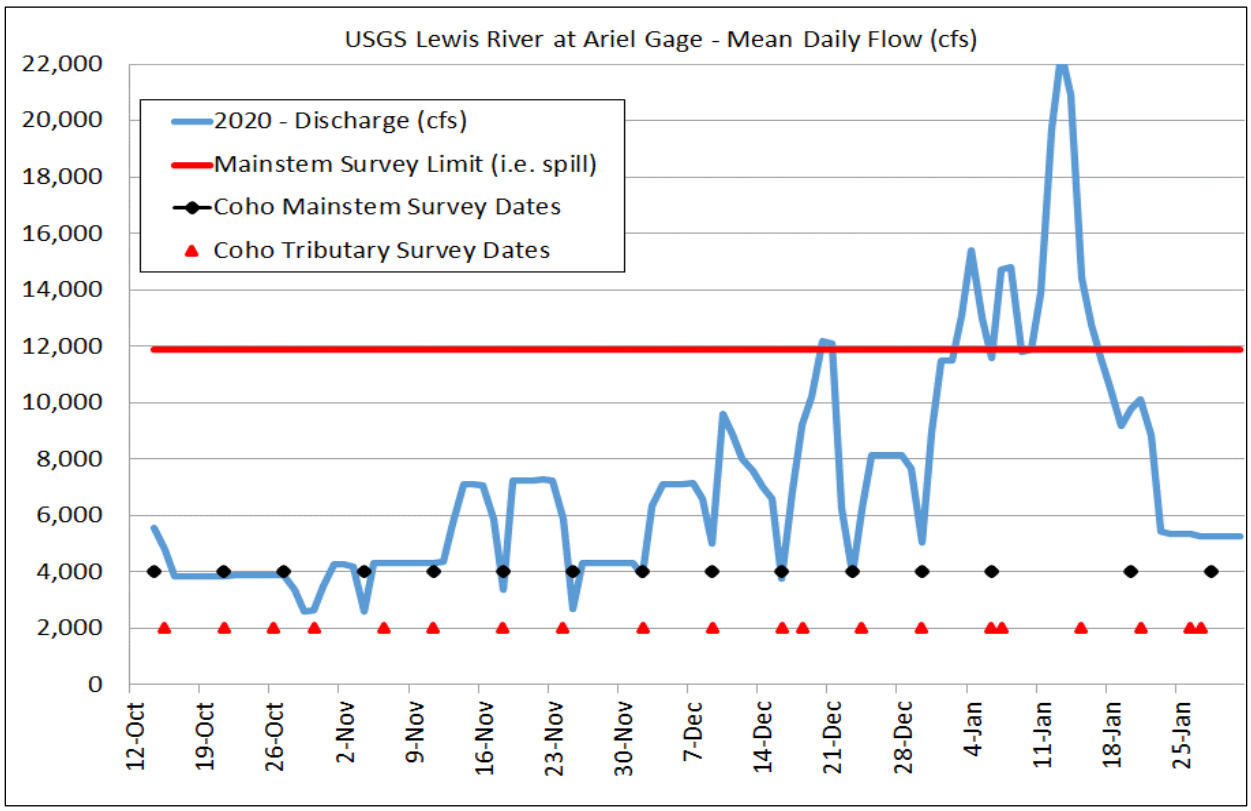

Figure 3. USGS Lewis River Ariel Gage – mean daily discharge (cfs) and survey timing in 2020.

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On each survey occasion, all five mainstem NF Lewis River reaches were surveyed via jet boat during a single day. All tributary surveys were conducted on foot. In prior years, PacifiCorp conducted river drawdowns once per week during the Coho and fall Chinook spawning survey seasons at the request of WDFW to facilitate WDFW's ability to recover fall Chinook carcasses. From 2013 to 2015, Meridian purposefully avoided conducting Coho surveys during the weekly drawdowns at the request of WDFW. However, additional data analyses suggested that Coho carcass recovery rates may be improved during lower flows. As a result, starting in 2016, Meridian conducted Coho surveys during drawdown days to improve carcass detection probability and increase carcass resight probability. Drawdown days continued to be targeted for surveys during the 2020 season.

Results

NF Lewis River Tributary Surveys

Meridian biologists counted a total of 24 redds, 6 live Coho spawners, and 1 Coho carcass across the four tributary survey reaches. All Coho and redds observed were in Robinson Creek (Table 1). No Coho or redds were observed in Hayes Creek or its tributaries. These same tributary reaches were surveyed in some or all prior years from 2013 to 2019; data for years when surveys were conducted is summarized in Table 2. The single carcass found was of hatchery origin (identified as having an adipose fin clip). Coho spawning activity has not been observed in Hayes Creek Tributary 2 since Meridian began surveys in 2013 (Table 2).

Table 1. Summary of tributary Coho Salmon spawning surveys downstream of Merwin Dam (mid-October 2020 through January 2021).

Stream	Reach Length (miles)	Total Weeks (mid-Oct to Jan 31)	Total Weeks Surveyable	Total New Redds	Total Live Holders	Total Live Spawners	Total Carcass Not Sampled[a]	Hatchery Male Carcass	Hatchery Female Carcass	Unmarked Male Carcass	Unmarked Female Carcass	Total Carcass	% Pre-spawn Mortality (Females)	Carcass Wanded for CWT	CWT Positive Carcass
Robinson Creek Reach 1	1.0	16	12	24	0	6	0	1	0	0	0	1	NA	1	0
Hayes Creek Reach 1	1.0	16	10	0	0	0	0	0	0	0	0	0	NA	NA	NA
Hayes Creek Tributary 1	1.0	16	10	0	0	0	0	0	0	0	0	0	NA	NA	NA
Hayes Creek Tributary 2	1.0	16	10	0	0	0	0	0	0	0	0	0	NA	NA	NA

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Table 2. Prior year survey data summary (2013-2020) for tributary stream reaches selected for survey in 2020 (if a year is not shown under a specific stream reach, then it was not selected for survey during that year by WDFW).

Year	Weeks Surveyable	Total Live Spawners	Total Carcasses	Total Redds
Robinson Creek				
2014	10	28	3	4
2017	16	16	2	15
2020	12	6	1	24
Hayes Creek				
2014	4	0	0	0
2015	11	0	1	0
2018 (2 reaches surveyed)[a]	13	1	0	1
2020	10	0	0	0
Hayes Tributary 1				
2013	13	0	0	0
2014	4	0	0	0
2017	16	0	0	2
2020	10	0	0	0
Hayes Tributary 2				
2013	14	0	0	0
2014	2	0	0	0
2016	9	0	0	0
2017	16	0	0	0
2018	13	0	0	0
2019	11	0	0	0
2020	10	0	0	0

[a]Note: A single one mile-long reach was surveyed in each year for each stream, except two reaches (one mile-long each) were surveyed in Hayes Creek in 2018.

NF Lewis River Mainstem Surveys

As in prior years, Meridian biologists conducting Coho redd surveys in the mainstem NF Lewis River found it difficult to differentiate Coho redds from fall Chinook redds due to the relatively large number of fall Chinook spawning in the mainstem NF Lewis River compared to Coho. A total of 314 Coho carcasses were observed in the entire mainstem NF Lewis River survey area over the 16-week survey period (Table 3). Of those, 60 carcasses could not be sampled (i.e., were generally too deep to recover). A total of 31 carcasses were counted, but not sampled or tagged during sub-sampling of a high number of carcasses in Reach 4. The tails were chopped on these 31 carcasses to prevent re-counting on subsequent surveys. A total of 223 carcasses were sampled and tagged. A total of 1 carcass had a CWT present. A total of 83 percent of sampled carcasses were of hatchery origin (identified as having an adipose fin clipped or CWT present). All sampled carcasses were tagged and released to complete the mark-resight estimate of total carcasses. After a subsequent resight occasion, the tagged carcass was left in place for potential subsequent resights. A total of 65 (29 percent) of the tagged carcasses were resighted at least once during the survey season (Table 3). A total of 53 carcasses were resighted once, 8 carcasses were resighted twice times, and 4 carcasses were resighted three times.

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Carcass tagging results were used to make estimates of spawner escapement (i.e., total carcasses; Starcevich 2021). Total Coho carcasses in the NF Lewis River mainstem between the downstream end of Eagle Island and the boat barrier downstream of Merwin Dam during the 2020 survey season was estimated to be 527 carcasses; bootstrap 95 percent confidence interval: 421 to 632 (Starcevich 2020). The coefficient of variation for the total carcass estimate was 0.10. The carcass sighting probability was estimated as 0.44 (95 percent confidence interval of 0.27 to 0.62).

Table 3. Summary of NF Lewis River mainstem Coho Salmon spawning surveys downstream of Merwin Dam (mid-October 2019 through January 2020).

NF Lewis River	Reach Length (miles)	Total Weeks (mid-Oct to Jan 31)	Total Weeks Surveyable	Total Carcass Not Sample[a]	Hatchery Male Carcass	Hatchery Female Carcass	Unmarked Male Carcass	Unmarked Female Carcass	Total Carcass	Total Carcass Tagged	Total Carcass Recoveries	% Pre-spawn Mortality (Females)	Carcass Wanded for CWT	CWT Positive Carcass
Reach 1	0.57	16	15	4	6	10	4	1	25	21	7	45%	21	0
Reach 2	0.68	16	15	3	7	12	2	2	26	23	8	57%	23	0
Reach 3	0.97	16	15	4	16	20	0	0	40	36	16	70%	36	0
Reach 4	1.32	16	15	58	30	34	10	5	137	79	23	38%	79	1
Reach 5	7.3	16	15	22	24	25	8	7	86	64	11	47%	64	0
Total	**10.84**	**16**	**15**	**91**	**83**	**101**	**24**	**15**	**314**	**223**	**65**	**49%**	**223**	**1**

[a]Includes carcasses too deep to sample (60 total) and carcasses counted but not sampled during periods of subsampling a large number of carcasses (31 total in Reach 4) where the unsampled carcass tails were chopped to prevent re-counting on subsequent surveys.

Discussion and Conclusions

Incorporating surveys on drawdown days in 2016 nearly doubled the proportion of tagged carcasses that were resighted compared to the highest resight proportion in previous years (2013 to 2015) when surveys were conducted on non-drawdown days (Table 4). It is important to note that the same crew conducted all surveys during all eight years covering the same reaches and season. Nearly all surveys were conducted during drawdown days during 2020 and 29 percent of carcasses tagged were resighted at least once, which is consistent with the rates observed since Meridian began conducting surveys during drawdown days in 2016 (Table 4). The 2020 estimate had the lowest CV value (highest precision) of all years since 2013 (Table 4).

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Table 4. Total Coho redd estimates for 2013 to 2020.

Year	Total Carcasses Tagged	Total Carcasses Resighted	% Carcasses Resighted	Total Weeks Surveyable	Average Daily Flow during Survey Days (cfs)	Average Daily Flow All Days Mid-Oct to Jan-31	Total Carcass Estimate	Bootstrap SE	95% Confidence Interval	CV
2013 Season Total	328	41	13%	15	4,700	4,804	1,970	297	1,523 to 2,679	0.17
2014 Season Total	431	18	4%	15	7,765	7,876	7,805	2,106	5,172 to 13,186	0.27
2015 Season Total	12	2	17%	12	5,632	8,429	no estimate due to low sample size 52 (simple Chapman estimator)			
2016 Season Total	65	20	31%	16	4,587	6,721	124	17	103 to 169	0.14
2017 Season Total[a]	24	8	33%	16	8,817	8,587	44	5	33 to 55	0.11
2018 Season Total	61	22	36%	16	5,009	5,044	137	20	98 to 176	0.15
2019 Oct 18-Dec 20	21	6	29%	10	3,491	3,240	Low water period			
2019 Dec 21-Jan 31	19	1	5%	5	10,942	10,440	High water period			
2019 Season Total[a]	40	7	18%	15	6,181	6,761	83	10	64 to 102	0.12
2020 Season Total	223	65	29%	15	4,968	7,182	527	54	421 to 632	0.10

[a]Drawdowns for spawning surveys generally did not occur during the Coho spawning survey season.

Comparing the total number of adult Coho trapped annually each year at the Lewis River Hatchery and Merwin traps to the total carcass estimates since 2013 (Figure 4) suggests that as the trap-and-haul upstream passage program has been implemented to transport Coho upstream of the Lewis River Hydroelectric Projects (beginning in 2012 and refined over time), returning Coho are electing to travel further upstream to spawn or spawn in lower NF Lewis River tributaries, rather than spawn in the lower mainstem NF Lewis River. The primary evidence of this effect is that thousands of adult Coho have been captured at the fish passage facilities annually since 2013 (Figure 4), while the number of Coho carcasses encountered in the lower NF Lewis River mainstem downstream of the fish passage facilities appears to have declined greatly after 2014 (Figure 4). From 2013 to 2014, total carcass estimates as a percentage of total Coho trapped annually ranged from 7 to 11 percent; but have dropped to 0.2 to 0.5 percent from 2015 through 2019 (Figure 4). Even with the relatively large return of Coho in 2020, the total carcass estimate as a percentage of total Coho trapped was only 1.2 percent.

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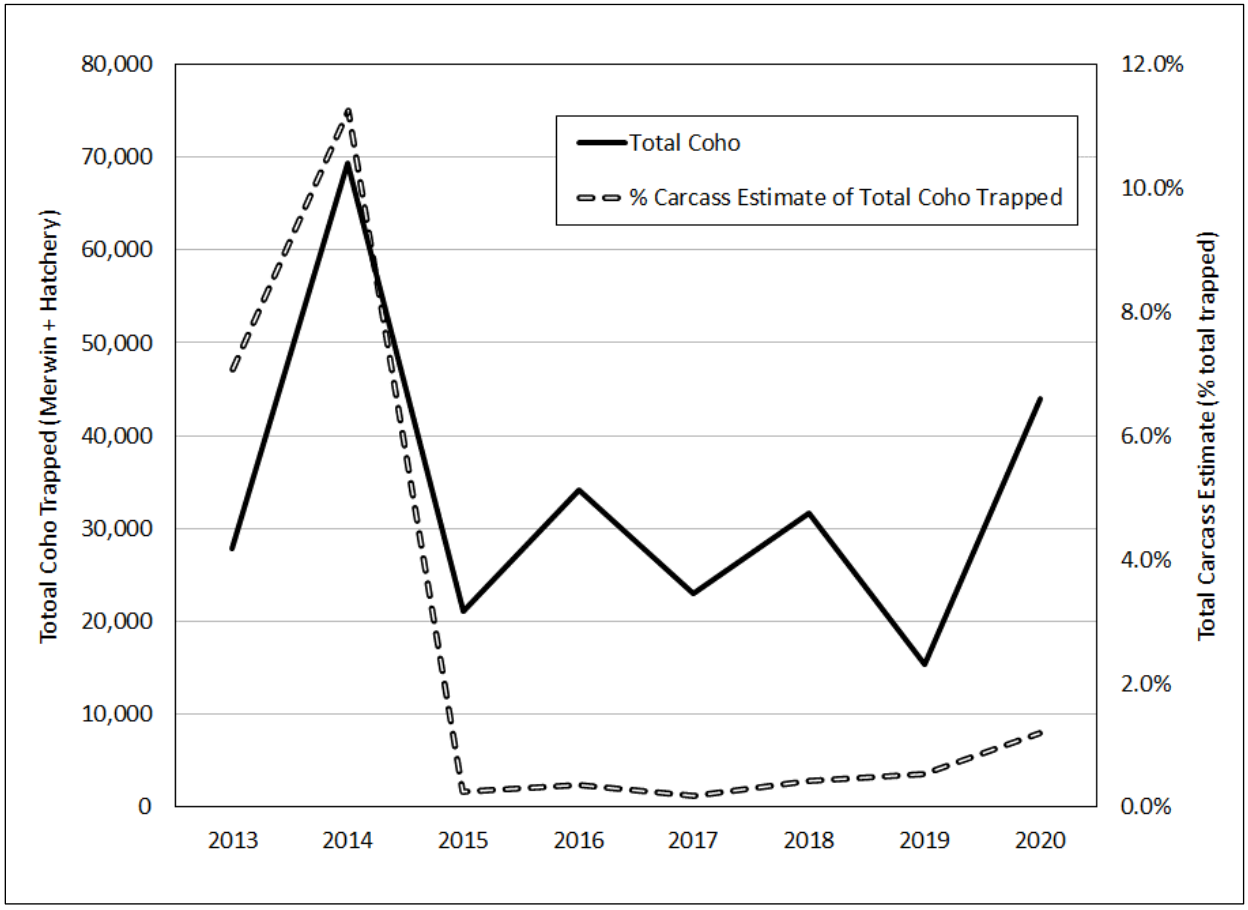

Figure 7. Total Coho captured vs. carcass estimates.

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References

PacifiCorp and Cowlitz PUD. 2017. Aquatic monitoring and evaluation plan for the Lewis River – first revision, objective 15 - determine spawner abundance, timing and distribution of transported anadromous adults, dated February 28, 2017. Prepared by PacifiCorp and Public Utility District No. 1 of Cowlitz County.

Starcevich, L.A. 2021. Estimates of 2020 Coho Adult Escapement from Tagged Carcass Surveys in the Lower North Fork Lewis River downstream of Merwin Dam, dated February 25, 2021. Prepared for Meridian Environmental, Inc. by Leigh Ann Starcevich, PhD, Biometrician, West Inc., Environmental & Statistical Consultants, Corvallis, Oregon.

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Appendix F –

Screw trapping results from lower river sampling 2020, North Fork Lewis River

JMX Smolt Trap Protocols and Reporting

This document includes three sections:

- **Part 1 – Data Collection is to be completed prior to the trapping season.**
- **Part 2 – Implementation Notes is to be completed once data are collected in preparation for analysis.**
- **Part 3 – Analysis and Results is to be completed as the last step.**

All protocols reported in this document reflect standardized Region 5 smolt trapping and analysis methods. The purpose of this document is to ensure consistency among projects and to document protocols for posterity.

****

Part 1: DATA COLLECTION PROTOCOLS

Protocol Name: North Fork Lewis River (downstream of Merwin Dam) - 2020

Project Supervisor: Jason Shappart (Meridian Environmental, Inc. – PacifiCorp contractor)

Science Leader: Jason Shappart (Meridian Environmental, Inc. – PacifiCorp contractor)

ESA Take Permit No. (if applicable): ESA Section 7(a)(2) Consultation, Biological Opinion for PacifiCorp's operation of the Lewis River Hydroelectric Projects (NMFS Consultation No. 2005/05891). August 27, 2007.

Trap information:

Trap Name	Type of Trap	Trap Location RKM	Start Date (Planned)	End Date (Planned)
Upper Lewis River Golf Course Trap	8-foot rotary screw trap	21.6	03/01/2020	06/30/2020
Lower Lewis River Golf Course Trap	8-foot rotary screw trap	20.1	03/01/2020	06/30/2020

1.1 Field Objectives:

Trap Name	Upper and Lower Lewis River Golf Course Traps							
Species	Origin	Life Stage	Age Class	Catch	Efficiency Trials	Fork Length	Scales	Other
Chinook	All	All	All	Y	Y	Y	N	Scan for CWT
Chum	All	All	All	Y	N	Y	N	
Steelhead	All	F	Subyearling	Y	N	Y	N	
Steelhead	All	P	Subyearling	Y	Y	Y	N	Scan for BWT
Steelhead	All	T/S	Yearling	Y	Y	Y	N	Scan for BWT
Coho	All	F	Subyearling	Y	N	Y	N	Scan for CWT
Coho	All	P	Subyearling	Y	Y	Y	N	
Coho	All	T/S	Yearling	Y	Y	Y	N	Scan for CWT
Cutthroat	All	T/S/A	All	Y	Y	Y	N	

Additional Comments/Narrative: Fry (F), Parr (P), Transitional (T), Smolt (S), Adult (A), lank Wire Tag (BWT), Coded Wire Tag (CWT)

1.2 Site Selection:	
• *Why was this site selected for the smolt trap?*	Anchoring, permitting, laminar flow, ease of access and downstream of the majority of spawning
• *Are there spawner estimates above the trap site that can be used to estimate freshwater productivity, capacity, and smolt-to-adult return?*	Mainstem Chinook, Coho and Steelhead: Yes Chum: No
• *Describe the method used for adult escapement estimates (e.g., Carcass tagging, adult MR, AUC, redds, PCE, other).*	Chinook and Coho: Carcass tagging in mainstem NF Lewis River, WDFW GRTS redd surveys in tributaries Steelhead: Redd Surveys
• *Estimated % of the total basin-specific population that spawn above the trap. Include source for this information (% can be a range).*	Steelhead: > 90% (Annual Operations Report) Chinook: unknown Coho: unknown
• *Estimated % of yearling life stage juveniles that continuously rear) above the trap (summer and winter) prior to outmigrating. Include source for this information.*	Unknown
• *Additional Information*	Juvenile anadromous fish transported from upstream of the Lewis River Projects are released downstream of the trap locations (spring Chinook, Steelhead, Coho, Cutthroat).

1.3 Collection Event:	
Describe the planned frequency for enumerating and sampling fish caught in the trap.	Traps to be checked daily (between 09:00 and 15:00 hours).
Describe and explain any planned trap outages.	None
• *Describe process of handling and anaesthetizing fish.*	Dip nets used to transfer all fish to buckets or bins with battery aeration units. Salmonids to be anesthetized in solution of 1 ml Aqui-S to 2 gallons river water prior to sampling.
Describe method for measuring rotation per minute (rpm)	Visually for 1 minute (daily)
List flow gauge associated with the trap.	USGS Lewis River at Ariel Gage Station - 14220500
• *Describe method for measuring visibility and frequency of measurements.*	Not estimated
• *Describe method for measuring stream temperature and frequency of measurements.*	Not measured
• *Describe additional environmental variables measured, the method for the measurement, and the frequency of measurements.*	None

1.4 Fish Count by Group and Individual Measures:	
• *Life stage will be assigned according to the Region 5 Decision Tree (see attachment). Note any exceptions to the Decision Tree for species/life stage. Exceptions need to be approved by your Science Leader in advance!*	No exceptions to the Region 5 Decision Tree.
• *Describe how origin is assigned.*	Combination of presence and absence of adipose fin clips and CWT or BWT snout tags.
• *Describe the characteristics of individual fish (species/life stage, condition, and mark status) that are sorted and released downstream of the trap.*	All non-salmonids and Chum to be released downstream of trap regardless of life stage.
• *Describe that characteristics of individual fish (species/life stage, condition, and mark status) that are selected for efficiency trials.*	All Chinook regardless of life stage; all parr greater ≥60 mm, transitional and smolting Steelhead, Coho, and Cutthroat. Fish with visual injury or other impairment shall not be used for trials regardless of species or life stage.

Note: Age at length data are not available for this trapping site.

Table 1.4a. Date and length criteria used for field calls of Chinook age classes.

Life Stage	Age Class	Date Range	Length Range (mm FL)	Phenotype
Fry		3/1 to 6/30	≤45 mm	
Parr/Trans/Smolt		3/1 to 6/30	Greater than 45 mm	Determined by using Region 5 Decision Tree based on physical appearance
Individual Fish Measures:				
• *Sample rate for fork length*		F – 10 per day; P/T/S – up to 50 per day per each category		
• *Sample rate for scales*		NA		

Table 1.4b. Date and length criteria used for field calls of Coho age classes.

Life Stage	Age Class	Date Range	Length Range (mm FL)	Phenotype
Fry		3/1 to 6/30	≤45 mm	
Parr/Trans/Smolt		3/1 to 6/30	Greater than 45 mm	Determined by using Region 5 Decision Tree based on physical appearance
Individual Fish Measures:				
• *Sample rate for fork length*		F – 10 per day; P/T/S – up to 50 per day per each category		
• *Sample rate for scales*		NA		

Table 1.4c. Date and length criteria used for field calls of Steelhead age classes.				
Life Stage	**Age Class**	**Date Range**	**Length Range (mm FL)**	**Phenotype**
Fry		3/1 to 6/30	≤45 mm	
Parr/Trans/Smolt		3/1 to 6/30	Greater than 45 mm	Determined by using Region 5 Decision Tree based on physical appearance
Individual Fish Measures:				
• *Sample rate for fork length*		F – 10 per day; P/T/S – up to 50 per day per each category		
• *Sample rate for scales*		NA		

Table 1.4d. Date and length criteria used for field calls of Cutthroat age classes.				
Life Stage	**Age Class**	**Date Range**	**Length Range (mm FL)**	**Phenotype**
Fry		3/1 to 6/30	≤45 mm	
Parr/Trans/Smolt		3/1 to 6/30	Greater than 45 mm	Determined by using Region 5 Decision Tree based on physical appearance
Individual Fish Measures:				
• *Sample rate for fork length*		F – 10 per day; P/T/S – up to 50 per day per each category		
• *Sample rate for scales*		NA		

1.5 Marking and Release:	
• *Explain purpose of applying marks or tags to fish prior to release (if applicable).*	Marks are used to calibrate trap efficiency.
• *Describe the schedule for which fish will be released to determine trap efficiency.*	Daily (seven days per week)
• *Describe the target number of fish for each release group (species/life stage/age class).*	For all species in which outmigration estimates are planned (Chinook, Coho, Steelhead, and Cutthroat) all captured fish in good condition are marked and used in efficiency trials.
• *Describe marking or tagging method used for each species/origin/life stage/age class.*	**For Chinook fry**: Bismarck brown dye. Use 0.4 grams of dye per approximately 4 gallons of water. **For all maiden capture salmonids (≥60 mm FL),** Alcian Blue tattoo marks varied by week.
• *Describe release location for efficiency trials (rkm).*	In pool/run with bank habitat structures located at N45.937741, W-122.644367 about 0.85 miles upstream of the upper trap site.
• *Describe where and how long marked or tagged fish are held prior to release for efficiency trials.*	Marked fish are held in aerated buckets for recovery after sampling and released immediately after each trap is sampled.
• *Describe what time of day marked or tagged fish are released for efficiency trials.*	Between 0900 and 1500 hours – depending on the number of fish sampled each day.
• *Describe plans to evaluate mark retention and mark-related mortality.*	None
• *Describe plans to evaluate mark-recapture assumption that the second sample is a random representative sample (i.e., marked and unmarked fish are completely mixed)*	None planned for 2020

Table 1.5. Marking Plan for Trap Efficiency Trials

Species	Origin	Life Stage	Age Class	Start Date (Planned)	Stop Date (Planned)	Mark Rotation (Frequency)	Mark Type
Chinook	all	F		3/1	6/30	Same all season	Bismark Brown dye
Chinook	all	P/T/S		3/1	6/30	Weekly	tattoo (dye)
Steelhead	all	P/T/S		3/1	6/30	Weekly	tattoo (dye)
Coho	all	P/T/S		3/1	6/30	Weekly	tattoo (dye)
Cutthroat	all	P/T/S		3/1	6/30	Weekly	tattoo (dye)

1.6 Recapture:	
• *Describe how fish are examined for all marks (visual, PIT scan, CWT wand).*	Visual inspection for Alcian Blue tattoo marks or Bismark Brown dye. When applicable, fish will be wanded for presence of CWT or BWT.
• *Describe how maiden/recapture status is assigned.*	Captured fish indicating the presence of Alcian Blue tattoo marks are considered recaptures. All other fish are considered maiden captures.
• *Describe effort to accurately detect marked fish used in efficiency trial. Include methods used to evaluate detection rates.*	All fish captured are visually evaluated for a previous mark.

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Part 2: IMPLEMENTATION NOTES

The Upper Lewis River Golf Course Trap was fished in the same location continuously the entire season with no alterations and with no missed trapping periods. Alterations and missed trapping periods for the Lower River Golf Course Trap are summarized in Tables 2.1 and 2.2 below.

2.1 Trap Alterations

Trap Name: Lower Lewis River Golf Course Trap

Date	Type of Alteration	Details
3/16/2020	Attempted adjusting position of trap to move into higher velocity current to increase cone RPMs	Adjusted trap dropper cable length to test cone RPMs at various positions, but ultimately left trap in the same position because cone RPMs were not increased by moving trap into different locations. Testing occurred during a 1-hour period.
3/23/2020	Attempted adjusting position of trap to move into higher velocity current to increase cone RPMs	Adjusted trap dropper cable length to test cone RPMs at various positions, but ultimately left trap in the same position because cone RPMs were not increased by moving trap into different locations. Testing occurred during a 1-hour period.
4/13/2020	Attempted adjusting position of trap to move into higher velocity current to increase cone RPMs	Adjusted trap dropper cable length to test cone RPMs at various positions, but ultimately left trap in the same position because cone RPMs were not increased by moving trap into different locations. Testing occurred during a 1-hour period.
4/20/2020	Attempted adjusting position of trap to move into higher velocity current to increase cone RPMs	Adjusted trap dropper cable length to test cone RPMs at various positions, but ultimately left trap in the same position because cone RPMs were not increased by moving trap into different locations. Testing occurred during a 1-hour period.
5/25/2020	Attempted adjusting position of trap to move into higher velocity current to increase cone RPMs	Adjusted trap dropper cable length to test cone RPMs at various positions, but ultimately left trap in the same position because cone RPMs were not increased by moving trap into different locations. Testing occurred during a 1-hour period.
6/1/2020	Attempted adjusting position of trap to move into higher velocity current to increase cone RPMs	Adjusted trap dropper cable length to test cone RPMs at various positions, but ultimately left trap in the same position because cone RPMs were not increased by moving trap into different locations. Testing occurred during a 1-hour period.
6/22/2020	Attempted adjusting position of trap to move into higher velocity current to increase cone RPMs	Adjusted trap dropper cable length to test cone RPMs at various positions, but ultimately left trap in the same position because cone RPMs were not increased by moving trap into different locations. Testing occurred during a 1-hour period.
6/29/2020	Attempted adjusting position of trap to move into higher velocity current to increase cone RPMs	Adjusted trap dropper cable length to test cone RPMs at various positions, but ultimately left trap in the same position because cone RPMs were not increased by moving trap into different locations. Testing occurred during a 1-hour period.
7/6/2020	Dropped trap downstream approximately 75 feet	Moved trap to higher velocity micro-pool tailout improved cone RPMs from 1 to 2. Trap movement took about 20 minutes.
7/11/2020	Moved trap upstream approximately 25 feet	Water becoming too shallow so moved upstream to slightly deeper water, improved cone RPMs from 1 to 2, trap movement took about 15 minutes.

2.2 Missed Trapping Periods				
Trap Name: Lower Lewis River Golf Course Trap				
Last Time Observed Fishing	**Time Stopped Fishing**	**Method to Determine Trap Not Fishing**	**Time Start Fishing again**	**Comments**
3/18/2020 ~3:00pm	unknown	NA	3/19/2020 ~9:00am	cone stopper: logs/brush
3/29/2020 ~2:30pm	unknown	NA	3/30/2020 ~9:00am	cone stopper: logs/brush
3/30/2020 ~1:45pm	unknown	NA	3/31/2020 ~9:00am	cone stopper: logs/brush
4/6/2020 ~1:30pm	unknown	NA	4/7/2020 ~9:00am	cone stopper: logs/brush
4/19/2020 ~10:30am	unknown	NA	4/20/2020 ~9:00am	cone stopper: logs/brush
4/27/2020 ~2:15pm	unknown	NA	4/28/2020 ~9:00am	cone stopper: logs/brush
4/28/2020 ~12:45pm	unknown	NA	4/29/2020 ~9:00am	cone stopper: logs/brush
5/3/2020 ~2:30pm	unknown	NA	5/4/2020 ~9:00am	cone stopper: logs/brush
5/13/2020 ~1:00pm	unknown	NA	5/14/2020 ~9:00am	cone stopper: logs/brush
5/14/2020 ~12:40pm	unknown	NA	5/15/2020 ~9:00am	cone stopper: logs/brush
5/17/2020 ~1:30pm	unknown	NA	5/18/2020 ~9:00am	cone stopper: logs/brush
6/19/2020 ~3:30pm	unknown	NA	6/20/2020 ~9:00am	cone stopper: logs/brush

2.3 Raw Data for Mark-Recapture Analysis

At the Upper and Lower traps combined, total maiden naturally produced salmonids caught included 580 Coho, 16,011 Chinook, 696 Steelhead, and 39 Cutthroat. Most naturally produced Coho, Chinook, and Steelhead were young-of-year, though all Cutthroat were larger than young-of-year. For both traps combined, total maiden hatchery produced salmonids caught included 12,114 Coho, 4 Chinook and 167 Steelhead. In addition, the Upper and Lower traps caught 10 3-spine Stickleback, 10 Lamprey, 36 Northern Pikeminnow, 925 Sculpin, 1 Whitefish, 1 Banded Killifish, and 1 Redside Shiner.

The total number of salmonids captured during each weekly period by origin and species from March 9 through July 15, 2020 is summarized in Table 2.3a (Upper Lewis River Golf Course Trap) and Table 2.3b (Lower Lewis River Golf Course Trap). Salmonids ≥60 mm FL marked at each trap were placed upstream of the Upper Trap for efficiency tests. Recaptures at the Upper Trap were placed below that trap. Therefore, all marked fish placed upstream were potentially available for recapture at both traps. Fork length distribution for each salmonid origin and species is summarized by trap in Table 2.3c. Only hatchery Coho and hatchery Steelhead were recaptured, and the number marked/released upstream and recaptured by period (week) are listed in Tables 2.3a and 2.3b for each trap. Almost 100% of all other salmonids ≥60 mm FL were marked/released upstream each week as well (only a few fish in poor condition were not marked). Bismark Brown could not be procured for fry marking during the COVID-19 outbreak due to supply chain disruption. Therefore, fish <60 mm FL were not marked for efficiency testing.

Though 5,310 hatchery Coho were marked and released upstream, only 15 and 4 hatchery Coho were recaptured in the Upper and Lower Trap (respectively). All 19 hatchery Coho recaptures occurred between the 4th and 7th weeks (out of 19 weeks total). A total of 164 hatchery Steelhead were marked and released upstream and one was recaptured at the Upper Trap, but none were captured at the Lower Trap. No other fish species or origins were recaptured. Because relatively few fish were available to determine mark-recapture rates, trap efficiency by period (week) was not calculated.

Table 2.3a - Summary of salmonids captured at the Upper Lewis River Golf Course Trap during 2020 by period.

Lewis River below Merwin Dam – Upper Golf Course Screw Trap 2020			Naturally Produced Coho		Hatchery Produced Coho			Naturally Produced Chinook		Hatchery Produced Chinook	Naturally Produced Steelhead		Hatchery Produced Steelhead			Naturally Produced Cutthroat	Ave. Weekly Cone RPMs	Ave. Weekly Flow (cfs)[b]
Period	Start Date	End Date	<60 mm	≥60 mm	≥60 mm	No. Up	No. Recap	<60 mm	≥60 mm	≥60 mm	<60 mm	≥60 mm	≥60 mm	No. Up	No. Recap	≥60 Mm		
1	9-Mar	15-Mar	40	2	1	1	0	1,235	0	1	0	1	0	0	0	0	3	2,460
2	16-Mar	22-Mar	25	7	0	0	0	2,375	1	0	0	1	0	0	0	2	3.1	2,710
3	23-Mar	29-Mar	29	0	0	0	0	1,485	0	0	0	2	0	0	0	2	3.4	2,734
4	30-Mar	5-Apr	0	7	2,264	902	1	332	1	0	0	4	0	0	0	1	3.1	4,947
5	6-Apr	12-Apr	4	2	715	611	6	1,005	1	0	0	0	0	0	0	4	5.0	2,949
6	13-Apr	19-Apr	1	4	3,826	1,422	5	466	0	0	0	2	4	2	0	1	4.3	2,926
7	20-Apr	26-Apr	164	6	406	404	3	1,071	1	0	0	4	2	2	0	1	4.5	4,691
8	27-Apr	3-May	10	14	125	125	0	1,696	0	0	0	6	3	3	0	4	4.6	5,057
9	4-May	10-May	0	20	136	135	0	1,446	0	0	0	4	76	76	0	2	4.0	4,376
10	11-May	17-May	3	19	37	36	0	1,141	0	0	0	0	27	27	0	2	3.9	4,936
11	18-May	24-May	0	16	22	22	0	897	0	0	0	1	17	17	0	0	4.1	3,603
12	25-May	31-May	0	3	5	5	0	825	0	0	0	0	3	3	0	2	3.4	4,080
13	1-Jun	7-Jun	1	5	7	7	0	122	3	1	0	1	5	5	1	0	3.1	3,079
14	8-Jun	14-Jun	5	0	2	2	0	335	3	0	4	0	1	1	0	0	3.0	3,973
15	15-Jun	21-Jun	1	2	4	4	0	190	5	2	12	0	0	0	0	0	3.6	4,153
16	22-Jun	28-Jun	1	3	3	3	0	74	2	0	95	0	0	0	0	0	3.0	2,797
17	29-Jun	5-Jul	5	2	0	0	0	16	2	0	173	1	0	0	0	0	2.8	2,451
18	6-Jul	12-Jul	0	1	0	0	0	5	5	0	219	0	0	0	0	0	2.3	2,201
19	13-Jul	15-Jul	0	2	1	1	0	2	0	0	56	0	0	0	0	0	2.2	1,002
Total Maiden Captures			**289**	**115**	**7,554**			**14,718**	**24**	**4**	**559**	**27**	**138**			**21**		
Total Marked-Released Up[a]			**0**	**114**		**3,680**		**0**	**24**	**4**	**0**	**24**		**136**		**21**		
Total Recaptures[c]			**NA**	**0**			**15**	**NA**	**0**	**0**	**NA**	**0**			**1**	**0**		
Total Season Efficiency[a]			**NA**	**NA**	**15/(3680+1630)= 0.003**			**NA**	**NA**	**NA**	**NA**	**NA**	**1/(136+28)= 0.006**			**NA**		

[a]Note: All fish marked at both traps were placed upstream of the Upper Golf Course Trap for efficiency tests. Only fish ≥60 mm FL were marked and released upstream.

[b]Note: USGS Lewis River at Ariel, WA (Gage No. 14220500).

[c]Note: Hatchery Coho were recaptured at both traps. Hatchery Steelhead were only recaptured at the Upper Trap. No other salmonid origin/species categories were recaptured.

Table 2.3b - Summary of salmonids captured at the Lower Lewis River Golf Course Trap during 2020 by period.

Lewis River below Merwin Dam – Lower Golf Course Screw Trap 2020			Naturally Produced Coho		Hatchery Produced Coho			Naturally Produced Chinook		Hatchery Produced Chinook	Naturally Produced Steelhead		Hatchery Produced Steelhead			Naturally Produced Cutthroat	Ave. Weekly Cone RPMs	Ave. Weekly Flow (cfs)[b]
Period	Start Date	End Date	<60 mm	≥60 mm	≥60 mm	No. Up	No. Recap	<60 mm	≥60 mm	≥60 mm	<60 mm	≥60 mm	≥60 mm	No. Up	No. Recap	≥60 Mm		
1	9-Mar	15-Mar	24	2	0	0	0	89	1	0	0	2	3	3	0	2	1.0	2,460
2	16-Mar	22-Mar	7	9	0	0	0	148	1	0	0	0	1	1	0	1	0.9	2,710
3	23-Mar	29-Mar	15	4	0	0	0	261	0	0	0	2	0	0	0	1	1.0	2,734
4	30-Mar	5-Apr	2	10	547	255	0	56	1	0	0	2	1	1	0	0	1.9	4,947
5	6-Apr	12-Apr	1	4	161	160	0	19	0	0	0	0	1	1	0	4	1.1	2,949
6	13-Apr	19-Apr	3	7	3,590	965	3	22	1	0	0	3	4	3	0	3	1.1	2,926
7	20-Apr	26-Apr	1	0	78	75	1	28	0	0	0	1	1	1	0	2	1.8	4,691
8	27-Apr	3-May	4	3	58	55	0	113	0	0	0	0	2	2	0	3	1.6	5,057
9	4-May	10-May	0	2	33	30	0	14	0	0	0	0	9	9	0	0	1.9	4,376
10	11-May	17-May	1	2	30	29	0	162	2	0	0	0	1	1	0	1	1.4	4,936
11	18-May	24-May	54	1	23	23	0	56	2	0	0	1	5	5	0	0	1.1	3,603
12	25-May	31-May	4	0	24	22	0	89	0	0	0	0	1	1	0	0	1.2	4,080
13	1-Jun	7-Jun	2	2	1	1	0	56	2	0	0	0	0	0	0	1	0.8	3,079
14	8-Jun	14-Jun	0	2	2	2	0	144	3	0	0	0	0	0	0	0	1.2	3,973
15	15-Jun	21-Jun	0	1	3	3	0	38	2	0	1	0	0	0	0	0	1.1	4,153
16	22-Jun	28-Jun	1	4	7	7	0	45	4	0	0	0	0	0	0	0	1.4	2,797
17	29-Jun	5-Jul	0	1	1	1	0	4	1	0	13	0	0	0	0	0	0.9	2,451
18	6-Jul	12-Jul	0	2	2	2	0	4	0	0	56	1	0	0	0	0	1.5	2,201
19	13-Jul	15-Jul	0	1	0	0	0	0	1	0	28	0	0	0	0	0	1.7	1,002
Total Maiden Captures			**119**	**57**	**4,560**			**1,348**	**21**	**0**	**98**	**12**	**29**			**18**		
Total Marked-Released Up[a]			**0**	**54**		**1,630**		**0**	**21**	**NA**	**0**	**11**	**0**	**28**		**18**		
Total Recaptures[c]			**NA**	**0**			**4**	**NA**	**0**	**NA**	**NA**	**0**	**NA**		**0**	**0**		
Total Season Efficiency[a]			**NA**	**NA**	**4/(3680+1630)= 0.001**			**NA**	**NA**	**NA**	**NA**	**NA**	**NA**			**NA**		

[a]Note: All fish marked at both traps were placed upstream of the Upper Golf Course Trap for efficiency tests. Only fish ≥60 mm FL were marked and released upstream.

[b]Note: USGS Lewis River at Ariel, WA (Gage No. 14220500).

[c]Note: Hatchery Coho were recaptured at both traps. Hatchery Steelhead were only recaptured at the Upper Trap. No other salmonid origin/species categories were recaptured.

Table 2.3c - Summary of salmonids captured at the Lewis River Golf Course Traps during 2020 by size class.

Fork Length Bin (mm)	Naturally Produced Coho		Hatchery Produced Coho		Naturally Produced Chinook		Hatchery Produced Chinook		Naturally Produced Steelhead		Hatchery Produced Steelhead		Naturally Produced Cutthroat		Hatchery Coho Mark[a] / Recapture[b]			Hatchery Steelhead Mark[a] / Recapture[b]	
	Upper Trap	Lower Trap	Upper Trap	Lower Trap	Upper Trap	Lower Trap	Upper Trap	Lower Trap	Upper Trap	Lower Trap	Upper Trap	Lower Trap	Upper Trap	Lower Trap	Hatchery Coho Released Upstream	Upper Trap Recaps	Lower Trap Recaps	Hatchery Steelhead [a]Released Upstream	Upper Trap Recaps
20-29	20	3			202	10													
30-39	175	17			2,512	82			559	97									
40-49	89	41			11,861	1,167				1									
50-59	5	58			143	89													
60-69	1	4		1	14	12	2								1				
70-79	1	1	3		5	7	1		1						3				
80-89	3	1	4	1	1	1				1					5				
90-99	6	7	7	4					4	1			1	2	11				
100-109	12	9	18	8	2					2			1		26	1			
110-119	32	12	94	63					2	4			3	4	156				
120-129	30	9	434	238	1				1	1	2		1	5	669			2	
130-139	16	4	1,151	564	1	1			1		2	1		2	1,601	9	1	3	
140-149	10	8	3,409	3,304			1		1		1	1	1	1	1,807	4	3	2	
150-159	2		2,308	343					2	1	3	2		2	871	1		5	
160-169	2	2	111	28					3	1	14	3	2	1	139			17	
170-179			13	4					3	1	32	4	3	1	17			36	
180-189			2	2					5		34	6	2		4			40	1
190-199									1		27	4	3					31	
200-249									3		23	7	4					27	
250-299												1						1	
Total	**404**	**176**	**7,554**	**4,560**	**14,742**	**1,369**	**4**	**0**	**586**	**110**	**138**	**29**	**21**	**18**	**5,310**	**15**	**4**	**164**	**1**

[a]Note: All fish marked at both traps were placed upstream of the Upper Golf Course Trap for efficiency tests. Only fish ≥60 mm FL were marked and released upstream.

[b]Note: Hatchery Coho were recaptured at both traps. Hatchery Steelhead were only recaptured at the Upper Trap. No other salmonid origin/species categories were recaptured.

2.4 Age Results from Scale Data

Scale and age data were not collected.

2.5 Data Collected to Evaluate Mark-Recapture Assumption that Marking the Fish Does Not Affect Behavior (e.g., Mark-Related Mortality) and that Marks Are Not Lost

Mark-recapture assumptions were not tested.

2.6 Data Collected to Evaluate Mark-Recapture Assumption that the Second Sample is a Random Representative sample (i.e., Marked and Unmarked Fish are Completely Mixed)

Mark-recapture assumptions were not tested.

2.7 Smolt Trapping Assumption Testing Summary

The following table is the same for both the Upper and Lower Lewis River Golf Course Traps.

Trap Name: Upper and Lower Lewis River Golf Course Traps			
Species: All Salmonids	**Origin(s): All**	**Life Stage(s): All**	**Age Class(es): All**

Closure - Population is geographically closed to immigration, emigration, births, and deaths.

Place "X"	Method to test/satisfy assumption	Comments
Unknown	Minimized by trapping over entire run	
	Minimized predation by checking trap box multiple times per day	
	Tested optimal release location to minimize predation on fry	
	Test predation by lavaging Coho, steelhead, and cutthroat and enumerating marked and unmarked fry [fry migrants only]	
	Adjusted for missed trapping days	

*Assumption Met? (**Unknown**) Comments: Trapping is conducted from early March to the end of June as specified by PacifiCorp Contract.*

Marks are not lost

X	Minimized by following standard marking/tagging protocols with known mortality	
	Minimized by double tagging experiment	
	Tested by holding fish for 1-3 days to test mark/tag retention and adjusted marks released	
	Tested by double tagging experiment, estimated tag loss, and adjusted marks released	

*Assumption Met? (**Yes**) Comments: Marking follows standard procedures.*

Marking does not affect behavior

X	Minimized by using standard procedures for marking and only releasing healthy marked fish	
	Tested by holding marked fish overnight to assess mark related mortality; adjust mark release numbers accordingly	

*Assumption Met? (**Yes**) Comments: Marking follows standard procedures.*

Capture probabilities are homogeneous by strata

X	Minimized heterogeneous capture probability by stratifying the trap efficiency data	
X	Tested for differences in capture probabilities among trap efficiency trials	
X	Tested for differences in initial capture probability (e.g., due to body size)	

*Assumption Met? (**Yes**) Comments:*

Second Sample is random representative sample (i.e., marked and unmarked fish are completely mixed)

X	Maximize mixing by releasing fish upstream of sinuous reaches above trap site	
	Maximize mixing by releasing fish during the time of migration (e.g., night releases)	
	Tested optimum release site for mixing (consider statistical power to detect differences)	

*Assumption Met? (**Unknown**) Comments: Typical recapture rates preclude statistical testing of release sites.*

Mark status is reported correctly

X	Minimized error through staff training and careful examination of all fish	
X	Minimize error associated with subsampling high catch numbers by obtaining a representative subsample for evaluating mark status	All fish are examined, no subsampling occurs
	Tested by having samplers counting known numbers of marked and unmarked fish mixed in a bin	
	Tested by having a second sampler check first samplers placement of fish into marked and unmarked bins	

*Assumption Met? (**Yes**) Comments:*

2.8 Graphical presentation of catch, trap efficiency, and flow

As discussed previously, because relatively few fish were available to determine mark-recapture rates, trap efficiency by period (week) was not calculated. The weekly catch (percent of total maiden captures) of each salmonid species by origin and size (<60 mm FL or ≥60 mm FL) and weekly average flow are presented in Figures 2.8a (Coho), 2.8d (Chinook) and 2.8g (Steelhead and Cutthroat). Length frequency is presented in Figures 2.8b (Coho), 2.8e (Chinook) and 2.8h (Steelhead and Cutthroat). Scatter plots of fork lengths caught by day and average daily flow are presented in Figures 2.8c (Coho), 2.8f (Chinook), and 2.8i (Steelhead and Cutthroat).

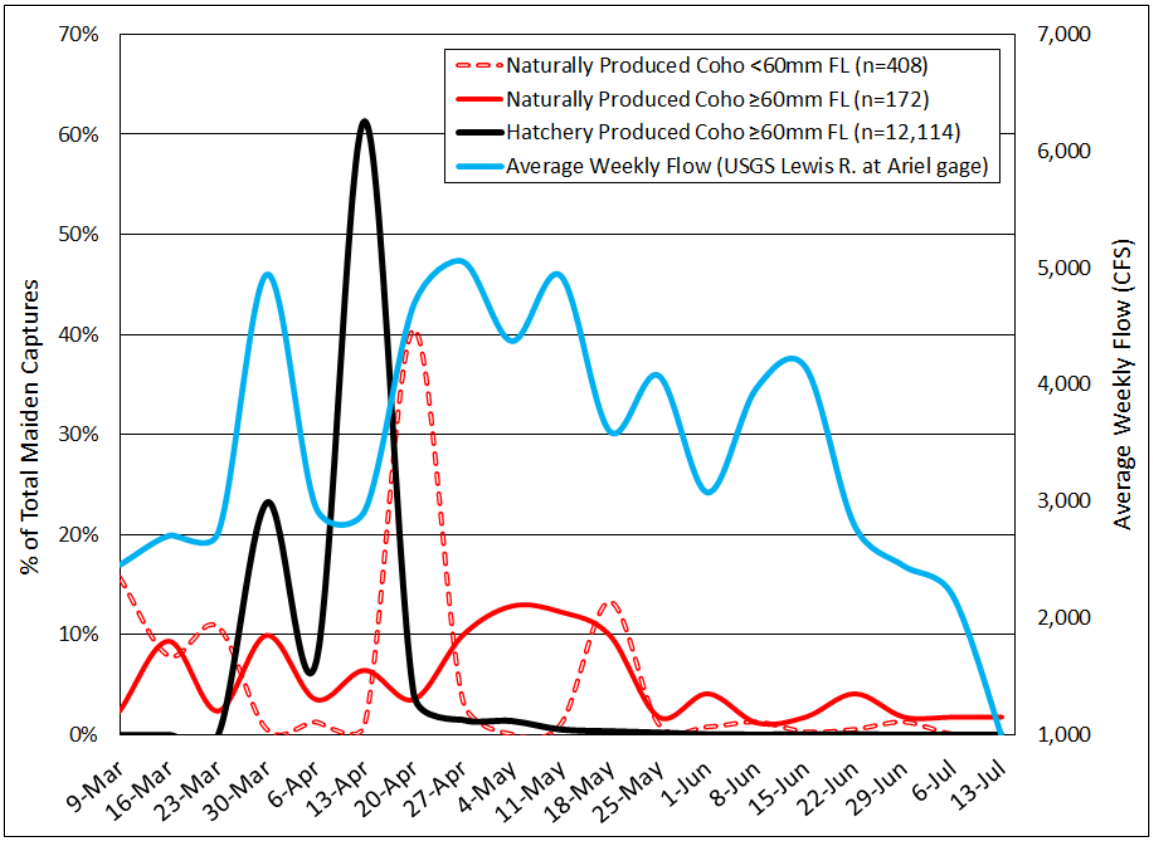

Figure 2.8a - Percent of total Coho maiden catch and flow by period (both traps combined).

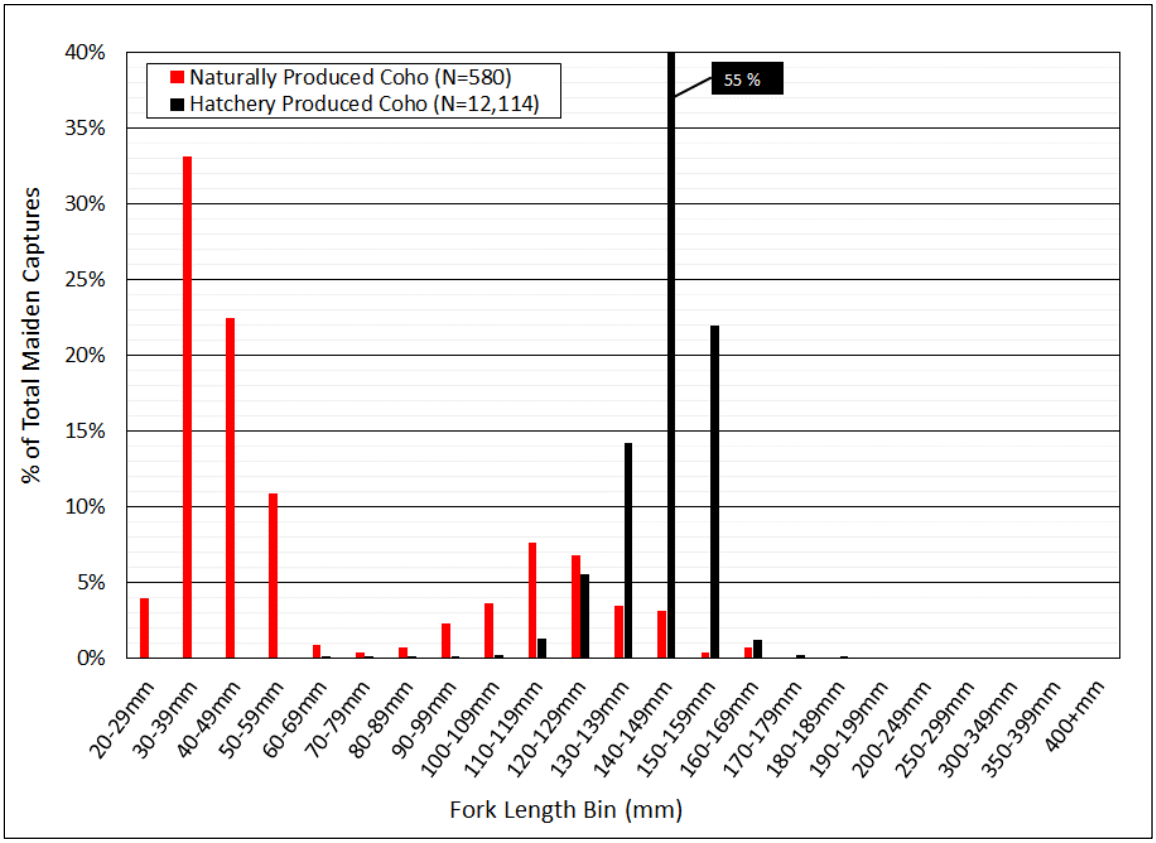

Figure 2.8b - Length frequency of all Coho maiden catch (both traps combined).

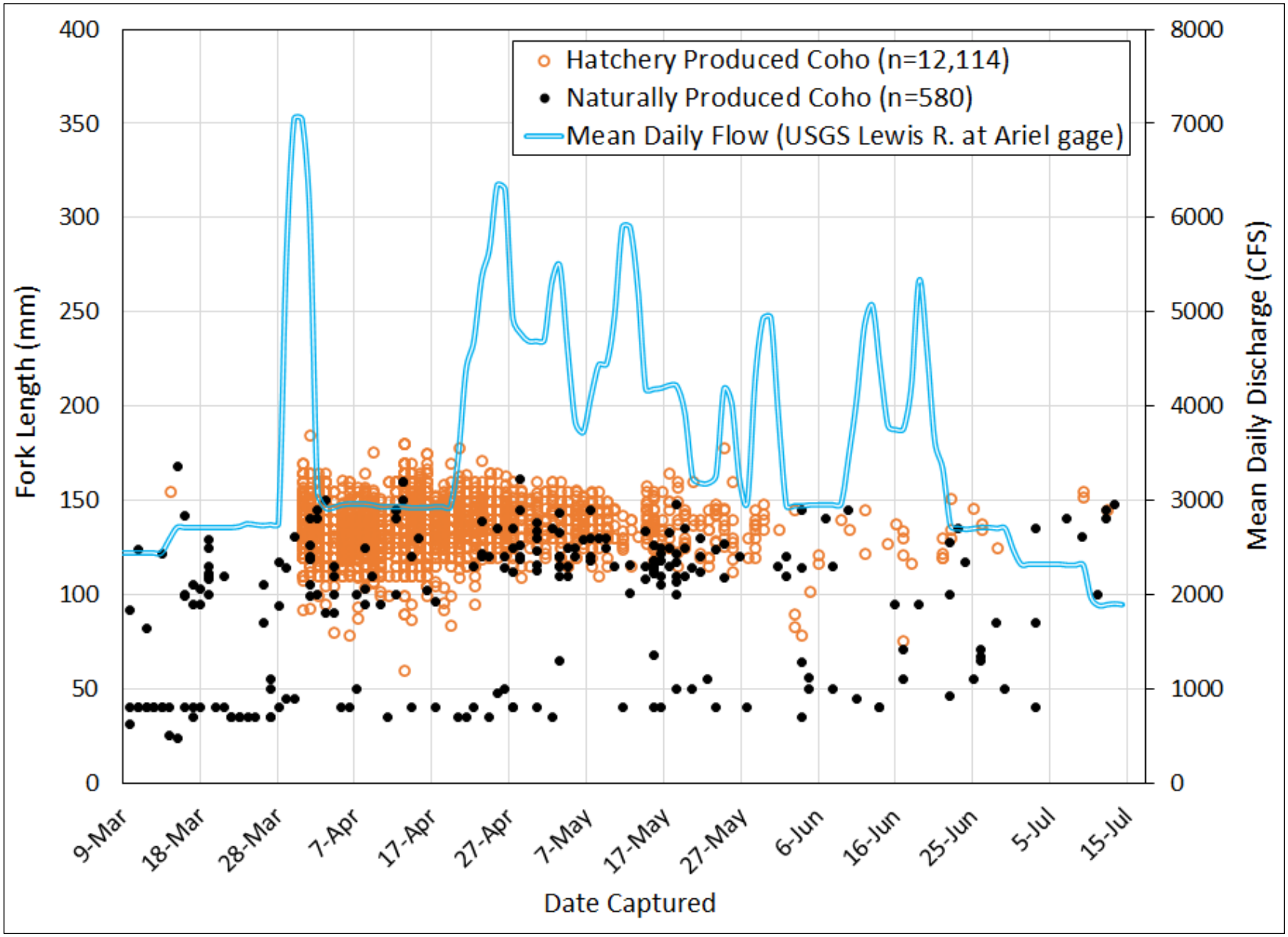

Figure 2.8c - Fork lengths of all Coho maiden catch and flow by day in 2020 (both traps combined).

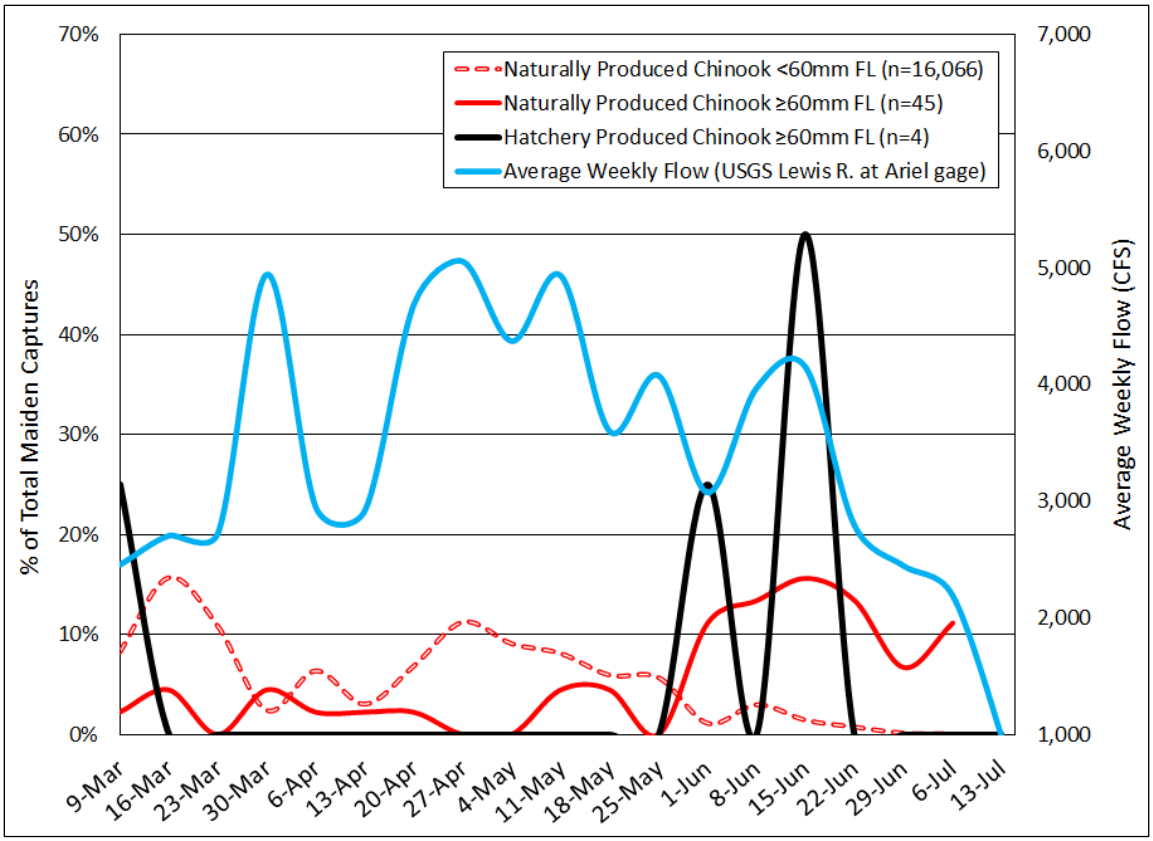

Figure 2.8d - Percent of total Chinook maiden catch and flow by period (both traps combined).

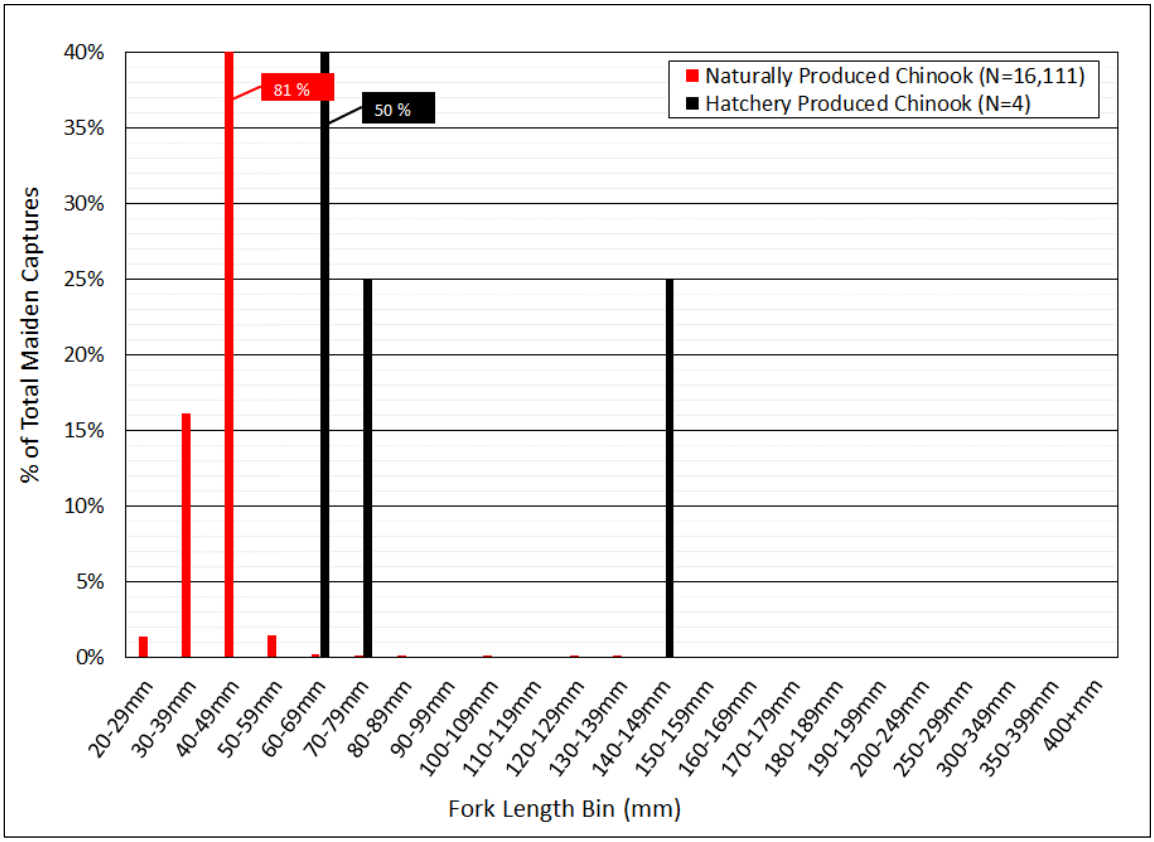

Figure 2.8e - Length frequency of all Chinook maiden catch (both traps combined).

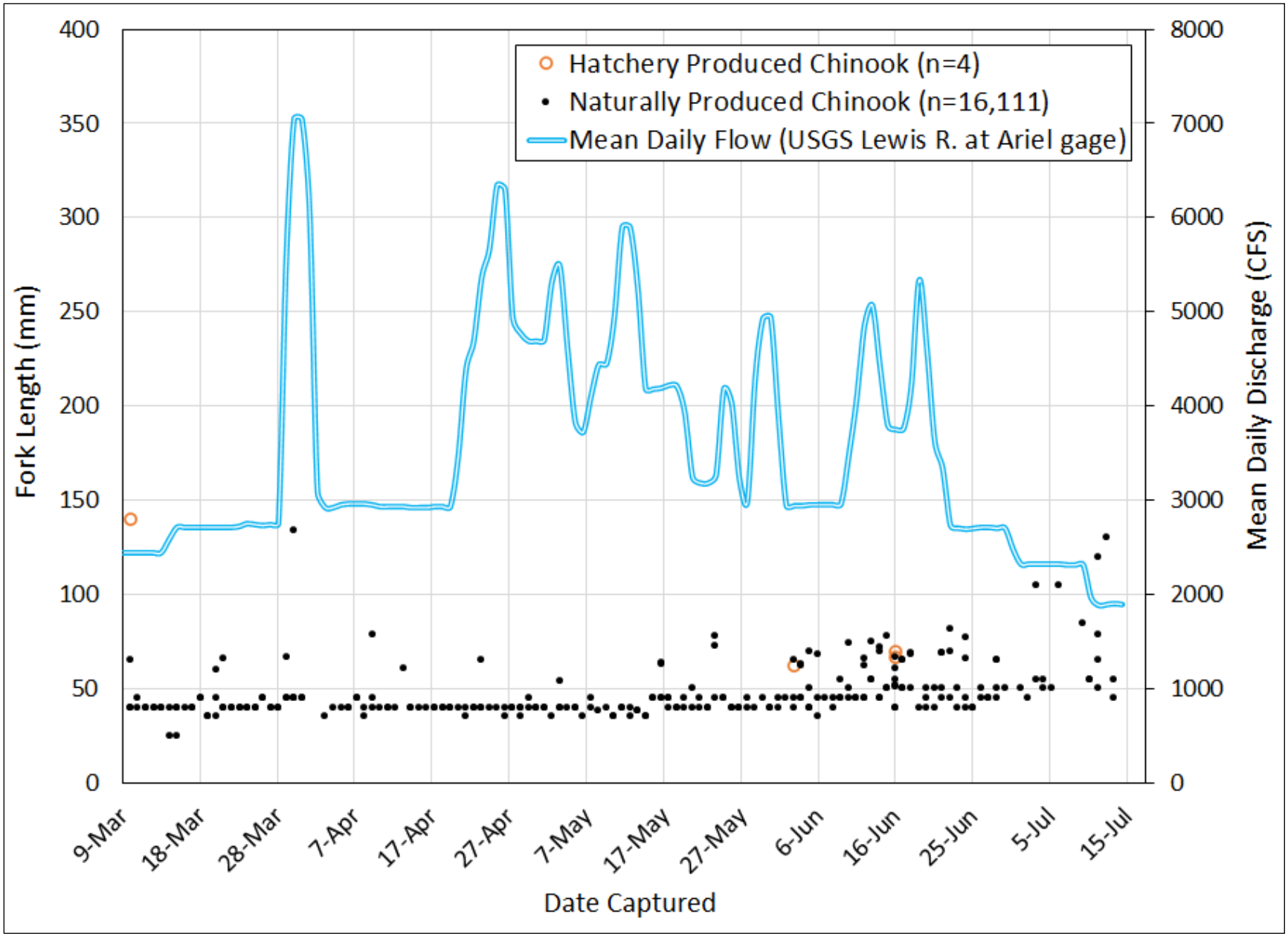

Figure 2.8f - Fork lengths of all Chinook maiden catch and flow by day in 2020 (both traps combined).

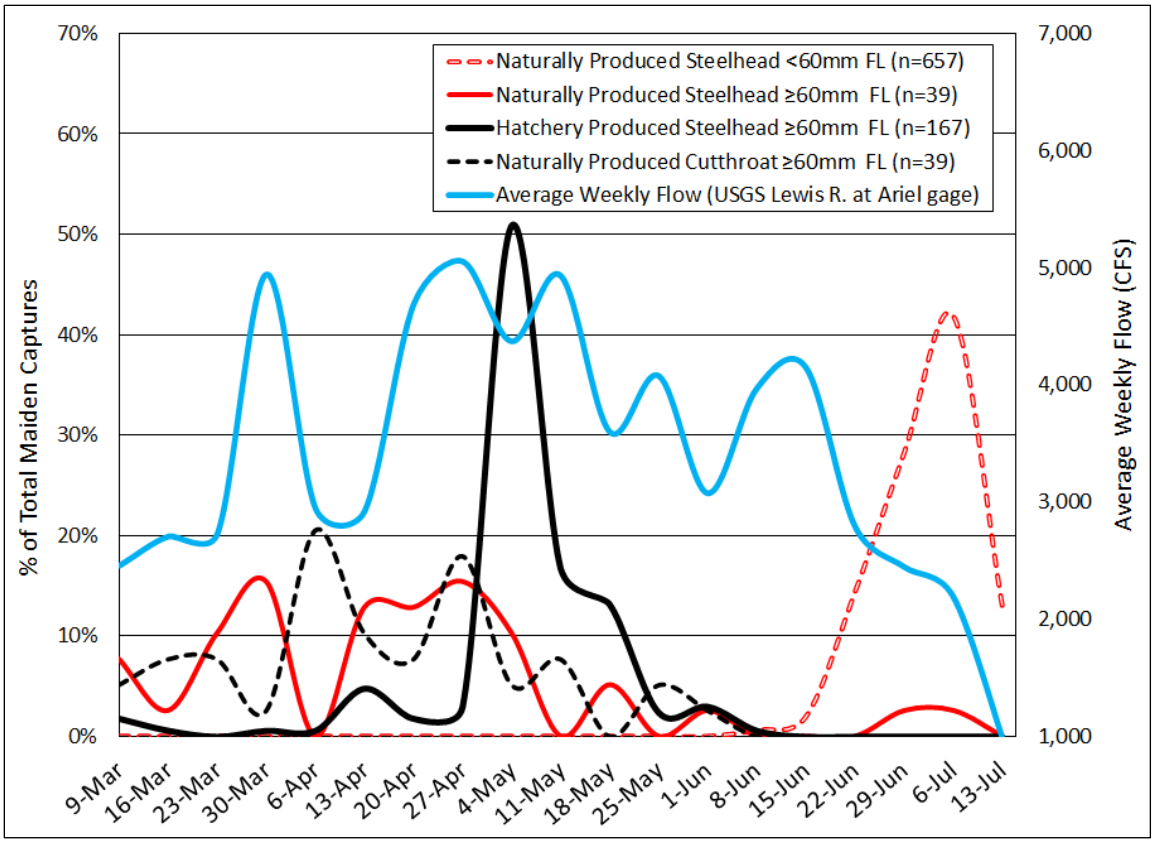

Figure 2.8g - Percent of total trout maiden catch and flow by period (both traps combined).

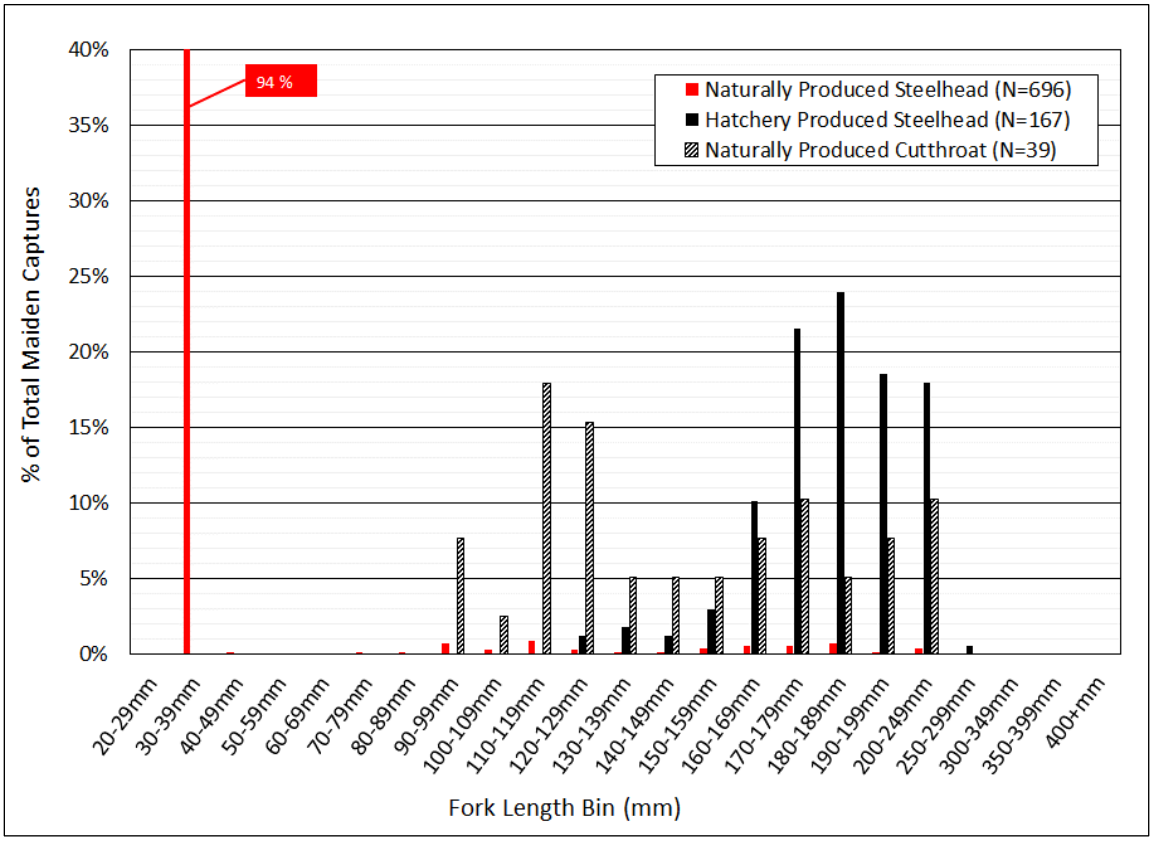

Figure 2.8h - Length frequency of all trout maiden catch (both traps combined).

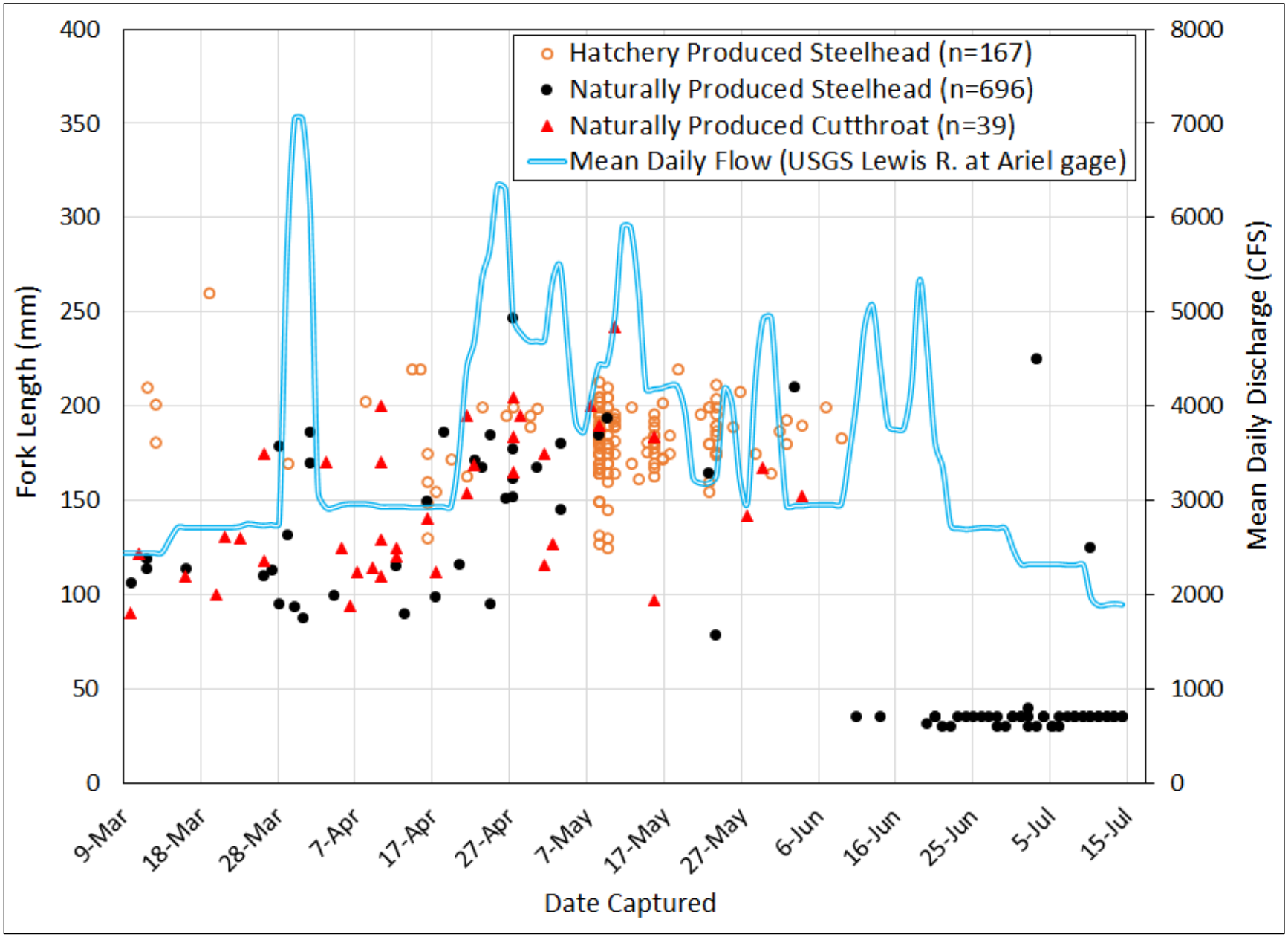

Figure 2.8i - Fork lengths of all trout maiden catch and flow by day in 2020 (both traps combined).

****

Part 3: ANALYSIS AND RESULTS

3.1 Description of changes made to raw Capture-Mark-Recapture Data (Tables 2.3a and 2.3b) prior to generating the final Capture-Mark-Recapture Data (Tables under 3.2). Add additional bullets as needed.		
• *Were capture, mark, and/or recapture data from multiple trapping periods combined (i.e., pooled)?*	Yes	The entire season was pooled to generate total estimates for naturally produced Coho (≥60mm FL) using the Bootstrap Method.
• *Were capture, mark, and/or recapture data from an entire period omitted prior to or as part of the analysis?*	No	
• *Were capture, mark, and/or recapture data from a single day or multiple days with a period or periods omitted?*	No	
• *Describe any additional changes that were made to the raw data set prior to generating the final data set*	None	

3.2 Final Data Summary for Mark-Recapture Analysis

The Upper Lewis River Golf Course Trap efficiency for hatchery Coho for weeks 4 through 7 combined (periods when hatchery Coho were recaptured) was 0.313% (15 recaptures / 4,794 marked hatchery Coho placed upstream during that time). Almost all (95%) hatchery Coho captures at the Upper Trap occurred during this time. The Lewis River Hatchery released a total of 1,916,165 hatchery Coho during the screw trapping season. Assuming hatchery Coho catch timing was representative of the movement of all hatchery Coho released during the monitoring period, an estimated 1,820,357 hatchery Coho passed the Upper Trap during weeks 4 through 7. Using the total number of hatchery Coho as a marked group released upstream of the trap, the Upper Trap efficiency for hatchery Coho (weeks 4 through 7 combined) was estimated to be 0.396% (7,211 maiden captures / 1,820,357 hatchery Coho) and for the entire season, 0.394% (7,554 maiden captures / 1,916,165 hatchery Coho). These results suggest that efficiency of marked and released Coho caught at the Upper Trap was approximately representative of hatchery Coho moving past the trap during the 2020 monitoring period. The length distribution of naturally produced Coho ≥60 mm FL overlaps with the length distribution of hatchery Coho caught at the Upper Trap (though not entirely).

For mark-recapture analysis, a total season Upper Trap efficiency of 0.4% was used to estimate the number of naturally produced Coho passing the Upper Trap during the 2020 monitoring period using the Bootstrap Method and using the total number of hatchery Coho released from the hatchery as the mark group (Table 3.2a). Due to the sparse number of Coho recaptures, lack of recaptures for other species, and concerns regarding applicability of hatchery Coho capture efficiency to other species size classes, no other estimates were calculated.

Table 3.2a. Final Capture-Mark-Recapture Data Used for Analysis									
Trap Name: Upper Lewis River Golf Course Trap									
Species: Coho		Origin(s): Naturally Produced			Life Stage(s): >60mm FL			Age Class(es):	
Analysis: Bootstrap Method (total season estimate)									
Period	Start Date	End Date	Actual Catch	Est. Catch	Est. Catch Var	Marks Released	Mark Group (M, M2, S, B)	Marks Recaps	Prop fished
All	3/9/20	7/15/20	115	NA	NA	1,916,165	S	7,554	1

Mark-recapture data for hatchery Coho (≥60 mm FL) following the BTSPAS format given below in Table 3.2b is for informational purposes only and was not used to generate total outmigration estimates due to the low number of periods with recaptures.

Table 3.2b. Final Capture-Mark-Recapture Data (for informational purposes only; not used in analysis)										
Trap Name: Upper Lewis River Golf Course Screw Trap										
Species: Coho		Origin(s): Hatchery			Life Stage(s): ≥60mm FL			Age Class(es):		
Analysis: BTSPAS (diagonal)										
Period	Start Date	End Date	Total Mark	Mark Group (M, M2, S, B)	Period 0	Period 1	Period 2	Total Recap	Total Capture	Prop fished
1	9-Mar	15-Mar	1	M				0	1	1
2	16-Mar	22-Mar	0	M				0	0	1
3	23-Mar	29-Mar	0	M				0	0	1
4	30-Mar	5-Apr	1,157	M, M2	1			1	2,264	1
5	6-Apr	12-Apr	771	M, M2	6			6	715	1
6	13-Apr	19-Apr	2,387	M, M2	5			5	3,826	1
7	20-Apr	26-Apr	479	M, M2	3			3	406	1
8	27-Apr	3-May	180	M, M2				0	125	1
9	4-May	10-May	165	M, M2				0	136	1
10	11-May	17-May	65	M, M2				0	37	1
11	18-May	24-May	45	M, M2				0	22	1
12	25-May	31-May	27	M, M2				0	5	1
13	1-Jun	7-Jun	8	M, M2				0	7	1
14	8-Jun	14-Jun	4	M, M2				0	2	1
15	15-Jun	21-Jun	7	M, M2				0	4	1
16	22-Jun	28-Jun	10	M, M2				0	3	1
17	29-Jun	5-Jul	1	M2				0	0	1
18	6-Jul	12-Jul	2	M2				0	0	1
19	13-Jul	15-Jul	1	M				0	1	1
		Total:	5,310					15	7,554	

Mark-recapture data for hatchery Steelhead (≥60 mm FL) following the BTSPAS format given below in Table 3.2c is for informational purposes only and was not used to generate total outmigration estimates due to the low number of periods with recaptures.

Table 3.2c. Final Capture-Mark-Recapture Data (for informational purposes only; not used in analysis)										
Trap Name: Upper Lewis River Gold Course Screw Trap										
Species: Steelhead			**Origin(s): Hatchery**		**Life Stage(s): ≥60mm FL**			**Age Class(es):**		
Analysis: BTSPAS (non-diagonal)										
Period	**Start Date**	**End Date**	**Total Mark**	**Mark Group (M, M2, S, B)**	**Period 0**	**Period 1**	**Period 2**	**Total Recap**	**Total Capture**	**Prop fished**
1	9-Mar	15-Mar	3	M2				0	0	1
2	16-Mar	22-Mar	1	M2				0	0	1
3	23-Mar	29-Mar	0					0	0	1
4	30-Mar	5-Apr	1	M2				0	0	1
5	6-Apr	12-Apr	1	M2				0	0	1
6	13-Apr	19-Apr	5	M, M2				0	4	1
7	20-Apr	26-Apr	3	M, M2				0	2	1
8	27-Apr	3-May	5	M, M2				0	3	1
9	4-May	10-May	85	M, M2				0	76	1
10	11-May	17-May	28	M, M2				0	27	1
11	18-May	24-May	22	M, M2			1	1	17	1
12	25-May	31-May	4	M, M2				0	3	1
13	1-Jun	7-Jun	5	M				0	5	1
14	8-Jun	14-Jun	1	M				0	1	1
15	15-Jun	21-Jun	0					0	0	1
16	22-Jun	28-Jun	0					0	0	1
17	29-Jun	5-Jul	0					0	0	1
18	6-Jul	12-Jul	0					0	0	1
19	13-Jul	15-Jul	0					0	0	1
		Total:	164					1	138	1

3.3 Equations or Software Used to Complete Analysis

A nonparametric bootstrap method (Thedinga et al. 1994, Manly 2007, Efron and Tibshirani 1986) was used to calculate the mean population estimate of total hatchery Coho (≥60 mm FL) passing the Upper Lewis River Golf Course Trap during the 2020 monitoring period and to estimate variance to produce 95% confidence intervals. The bootstrap was run with 1,000 iterations. The 95% confidence interval was calculated as the square root of the mean bootstrap variance multiplied by 1.96. The coefficient of variation was calculated by dividing the standard deviation by the mean population estimate.

3.4 Final Outmigrant Abundance Estimates

Year	Trap	Species	Origin	Life Stage(s)	Age	Abundance	Estimate Type	95% CI	CV
2020	Upper Golf Course Trap	Coho	Naturally Produced	≥60mm FL		29,161	Bootstrap Mean	5,926	10%

3.5 Graphical Presentation of Results

Period specific outmigrant abundance was not estimated due to the low number of periods with recaptures. Therefore, time series abundance estimates are not provided.

3.6 Project Assessment

The overall lack of recaptures limited the potential to make species/size/origin/period specific outmigration estimates for the 2020 Lewis River trapping season. The naturally produced Coho estimate of fish passing the Upper Lewis River Golf Course Trap (Section 3.4) relies on the assumption that the hatchery Coho trap efficiency (measured through mark-recapture) was similar to that of naturally produced Coho (not measured due to lack of naturally produced Coho recaptures). The estimate of naturally produced Coho outmigrants ≥60 mm FL was relatively low, but not unexpected as there were relatively few spawned out Coho carcasses observed in the NF Lewis River mainstem upstream of the traps during the 2018 and 2019 Coho spawning season (Meridian Environmental, Inc. 2020).

Bismark Brown could not be procured for fry marking during the COVID-19 outbreak due to supply chain disruption. Therefore, fish <60 mm FL were not marked for efficiency testing, which limited the ability to estimate total outmigration for this size/age class of naturally produced salmonids.

3.7 Self-Assessment

The Lower Lewis River Golf Course Trap was not as effective at catching fish as the Upper Golf Course Trap likely due to persistent low trap cone RPMs due to overall low water velocity compared to the Upper Trap. In addition, the Lower Trap box was consistent filled with debris (primarily grass clippings) on a weekly basis. There is a relatively large area of maintained lawn located approximately 1,000 feet upstream of the Lower Trap. It is suspected that the landowners deposit grass clippings into the river, which then float downstream to the trap.

The Upper Trap was not fished in the most optimal location (to maximize cone RPMs) due to angler concerns over trap placement expressed in previous years, as this location is a popular salmon and steelhead fishing hole. For the 2021 trapping season, both traps will be fished in tandem at the Upper Lewis River Golf Course site. The traps will be placed within the thalweg as much as possible to maximize cone RPMs (and fish captures) with consideration to minimize

navigation effects only. Bismark Brown is now available and will be procured for use during the 2021 trapping season.

References

Efron, B., and R. Tibshirani. 1986. Bootstrap methods for standard errors, confidence intervals, and other measures of statistical accuracy. Statistical Science, Vol. 1, No. 1, 54-77.

Manly, B. 2007. Randomization, Bootstrap, and Monte Carlo Methods in Biology, 3rd edition. Chapman and Hall, Boca Raton, Florida, USA.

Meridian Environmental, Inc. 2020. North Fork Lewis River Downstream of Merwin Dam – 2019 Coho Spawning Survey Results (mid-October 2019 through January 2020). Memorandum dated March 30, 2020 to Erik Lesko, PacifiCorp, from Jason Shappart (Meridian).

Thedinga J.F., M.L. Murphy, S.W. Johnson, J.M. Lorenz, and K.V. Koski. 1994. Determination of salmonid smolt yield with rotary-screw traps in the Situk River, Alaska, to predict effects of glacial flooding. North American Journal of Fisheries Management 14:837 851.

Appendix G –

Lewis River Hatchery Complex Annual Report 2020

WASHINGTON STATE DEPARTMENT OF FISH AND WILDLIFE
FISH PROGRAM
HATCHERIES DIVISION

LEWIS RIVER COMPLEX OPERATIONS
FOR
JANUARY 1, 2020 TO DECEMBER 31, 2020

Funded By
PACIFICORP ENERGY & COWLITZ PUD

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Merwin Hatchery Introduction

The Merwin Hatchery is a PacifiCorp owned and funded facility that is operated by the State of Washington Department of Fish and Wildlife. The facility has been in operation since 1993.

Merwin Hatchery is located 11 miles east of Woodland off state route 503 adjacent to PacifiCorp Merwin Dam and Merwin Reservoir.

Program Goals

- 175,000 summer Steelhead @ 4.8 f/lb planted into N.F. Lewis River
- 100,000 winter Steelhead @ 4.8 f/lb planted into N.F. Lewis River
- 50,000 wild winter Steelhead @ 6-8 f/lb planted into N.F. Lewis River
- 7,000 Rainbow Trout planted into Swift Power Canal
- 45,000 Rainbow Trout transferred to Speelyai Hatchery

Approximately 5000 gallons per minute can be delivered to the hatchery by three intake pumps located on Merwin Dam which draft water from Merwin Reservoir. Two screened intakes located at depths of fifteen and ninety feet below the surface of the reservoir enable some temperature manipulation for fish rearing.

Ozone water sterilization is part of the design criteria to meet fish health needs not only at the hatchery but also for fish stocks and the Lewis River Hatchery downstream of our effluent discharge. Two ozone generators fed by compressed air supply ozone gas to a water/ozone contact chamber. A maximum flow of 3800 gpm can be sterilized and supplied to the hatchery.

There is approximately 216,470 cubic feet of rearing space. These areas consist of four one quarter acre rearing ponds, ten 9.5’ x 80’ x 2.5’ fingerling raceways, four 7.5’ x 33’ x 4’ adult holding ponds, six 4.5’ x 34’ x 2’ intermediate raceway and 15 double stack Mari Source incubation trays.

The hatchery has an operations building housing the office, feed room, shop, lab, day room, locker room and restrooms. Other buildings associated with this facility are hatchery building with attached covered adult holding ponds, water treatment facility including the ozone generator building, one three bay storage building, chemical storage building and three residence.

Brood Stock & Spawning – Merwin Hatchery

During this reporting period, trapping was conducted at the Merwin Dam Fish Collection Facility, Lewis River Hatchery, and the lower river, pending on the species. In the below stocks the carcass distribution line represents surplus fish not needed for program goals and may go to food bank/tribes, nutrient enhancement, or landfill.

2021 Brood Merwin Hatchery Origin Summer Steelhead

A total of 344 adults were received for spawning purposes. All fish were trapped at the Merwin Dam FCF. Spawned carcasses, mortality, and surplus fish were disposed by landfill. Disposition is as follows:

Final Trapping & Disposition

Adults Received from FCF	344
Adults Spawned	238
Non-viable Females	11
Adult Mortality (6.3%)	22
Adult Carcass Distribution	73

2021 Brood Merwin Hatchery Origin Winter Steelhead

A total of 157 adults were received for spawning purposes. All fish were trapped at the Merwin Dam FCF and Lewis River Hatchery. Spawned carcasses, mortality, and surplus fish were disposed by landfill. Disposition is as follows:

Final Trapping & Disposition

Adults Received from Lewis Ladder	82
Adults Received from FCF	75
Adults Spawned	84
Non-viable Females	3
Adult Mortality (0.2%)	2
Adult Carcass Distribution	8

2020 Brood Lewis River Wild Origin Late Winter Steelhead

A total of 104 adults were received for live spawning purposes. These fish were collected at various sites to include Merwin FCF, tangle net fishing in the lower river and Lewis River Hatchery. Mortality and culled fish are disposed by landfill, all live spawned fish were hauled downstream to North Fork Lewis River, at river mile five, Martin's access site. Disposition is as follows:

Final Trapping & Disposition

Adults Received from FCF	104
Adults Spawned	48
Non-viable Females	0
Adult Mortality (1.9%)	2
Males Culled (Hatchery Genetics)	0
Females Culled (Hatchery Genetics)	0
Adults Planted Downstream	102

Adult Trapping – Merwin Dam FCF

2020 Brood Lewis River Hatchery Origin Spring Chinook

The first spring chinook was trapped at the Merwin FCF on April 6, 2020. Spring chinook are planted in the upper watershed of North Fork Lewis River, hauled to Speelyai Hatchery for brood, and donated to food banks / tribes. Mortality is disposed by landfill.

Final Trapping & Disposition

Adults Trapped	1,293
Jacks Trapped	844
Adult Mortality (.02%)	2
Jack Mortality (0.0%)	0
Adults Planted Upstream	45
Jacks Planted Upstream	275
Males Shipped	1,246
Jacks Shipped	84
Jacks Carcass Distribution	485

2020 Brood Lewis River Wild Origin Spring Chinook

The first wild spring chinook returned to the FCF on March 7, 2020. This stock is planted in the upper watershed of North Fork Lewis River. All Mortality is disposed by landfill.

Final Trapping & Disposition

Adults Trapped	129
Jacks Trapped	41
Adult Mortality	0
Jack Mortality	0
Adults Planted Upstream	129
Jacks Planted Upstream	41

2020 Brood Hatchery Unknown Origin Fall Chinook

This first arrival of unknown hatchery origin fall chinook was August 6, 2020. This unknown origin hatchery stock is surplus to food banks and tribes. Mortality can be disposed by landfill or donated to American Canadian Fisheries.

Final Trapping & Disposition

Adults Trapped	246
Jacks Trapped	82
Adult Mortality (17.9%)	44
Jack Mortality (3.7%)	3
Adult Carcass Distribution	202
Jack Carcass Distribution	79

2020 Brood Lewis River Wild Origin Fall Chinook

Lewis River Wild Origin Fall Chinook first arrived at Merwin FCF on August 3, 2020. This stock is planted downstream to North Fork Lewis River, river mile 5 at Martin's access site. All mortality is disposed by landfill.

Final Trapping & Disposition

Adults Trapped	343
Jacks Trapped	36
Adult Mortality	0
Jack Mortality	0
Males Planted Downstream	343
Jacks Planted Downstream	36

2020 Brood Lewis River Hatchery Origin (Type S) Early Coho

On August 19, 2020 the first hatchery origin early Coho showed up to Merwin FCF. This stock is planted upstream to North Fork Lewis River, shipped to Speelyai Hatchery for brood, and surplus to food banks / tribes. Low grade quality surplus carcasses and mortality are used for nutrient enhancement, donated to American Canadian Fisheries and or disposed by landfill.

Final Trapping & Disposition

Adults Trapped	3,594
Jacks Trapped	2,024
Adult Mortality (8.0%)	288
Jack Mortality (4.2%)	86
Adults Planted Upstream	2,570
Jacks Planted Upstream	0
Adults Shipped	51
Jacks Shipped	0
Adult Carcass Distribution	685
Jack Carcass Distribution	1,938

2020 Brood Lewis River Wild Origin Early Coho

This stock first arrived at Merwin FCF on August 26, 2020. These fish are planted upstream to the North Fork Lewis River at Eagle Creek site. Mortality is disposed by landfill.

Final Trapping & Disposition

Adults Trapped	3,490
Jacks Trapped	184
Adult Mortality (.08%)	31
Jacks Mortality (0.0%)	0
Adults Planted Upstream	3,459
Jacks Planted Upstream	184

2020 Brood Lewis River Hatchery Origin (Type N) Late Coho

The first hatchery origin late Coho was trapped at the Merwin FCF on October 20, 2020. These fish are planted upstream to the North Fork Lewis River at Eagle Creek site, shipped to Lewis River Hatchery for brood stock, and surplus to food banks / tribes. Low grade carcasses and mortality can be used for nutrient enhancement, donated to American Canadian Fisheries, or disposed by landfill.

Final Trapping & Disposition

Adults Trapped	1,341
Jacks Trapped	290
Adult Mortality (2.0%)	27
Jack Mortality (2.8%)	8
Adults Planted Upstream	365
Jacks Planted Upstream	13
Adults Shipped to Lewis River	71
Adult Carcass Distribution	878
Jacks Carcass Distribution	269

2020 Brood Lewis River Wild Origin Late Coho

The first returning wild origin late Coho to Merwin FCF was on November 5, 2020. This stock is planted upstream to the North Fork Lewis River at Eagle Creek site and shipped to Lewis River Hatchery for an intergraded brood stock. Mortality is disposed by landfill.

Final Trapping & Disposition

Adults Trapped	782
Jacks Trapped	18
Adult Mortality (0.1%)	1
Jack Mortality (0.0%)	0
Adults Planted Upstream	417
Jacks Planted Upstream	17
Males Shipped to Lewis River	364
Jacks Shipped to Lewis River	1

2019 Brood Lewis River Hatchery Origin (Type N) Late Coho

The first late hatchery origin Coho was trapped at the Merwin FCF on October 15, 2019. Adult late Coho are planted upstream to North Fork Lewis River at Eagle Creek sit, shipped to Lewis River Hatchery for brood, and surplus to food banks / tribes. Low grade carcasses and mortality can be used for nutrient enhancement, donated to American Canadian Fisheries, or disposed by landfill.

Final Trapping & Disposition

Adults Trapped	506
Jacks Trapped	168
Adult Mortality (7.9%)	40
Jack Mortality (0.0%)	0
Adults Planted Upstream	167
Adults Shipped to Lewis River	277
Jacks Shipped to Lewis River	27
Adult Carcass Distribution	22
Jacks Carcass Distribution	141

2019 Brood Lewis River Wild Origin Late Coho

The first wild origin late Coho was trapped at Merwin FCF on November 4, 2019. Wild late Coho are shipped to Lewis River Hatchery for an integrated brood stock and planted upstream to North Fork Lewis River at Eagle Creek Site. Mortality is disposed by landfill

Final Trapping & Disposition

Adults Trapped	257
Jacks Trapped	37
Adults Mortality (1.5%)	4
Jack Mortality	0
Adults Planted Upstream	215
Jacks Planted Upstream	37
Adults Shipped to Lewis River	38

2020 Brood Lewis River Wild Origin Summer Steelhead

This stock was first trapped at the Merwin FCF on May 22, 2019. These fish are planted downstream to the North Fork Lewis River, river mile 5 at Martin's access site. Mortality is disposed by landfill

Final Trapping & Disposition

Adults Trapped	9
Adult Mortality	0
Adults Planted Downstream	9

2021 Brood Merwin Hatchery Origin Summer Steelhead

The first Merwin Hatchery origin summer steelhead was trapped at Merwin FCF on April 27, 2020. Summer steelhead are shipped for brood to Merwin Hatchery, hauled downstream to river mile 5 on the North Fork Lewis River at Martin's access site to enhance sport fisheries, and surplus to food banks / tribes. Mortality is disposed by landfill.

Final Trapping &Disposition

Adults Trapped	1,804
Adults Mortality (0.4%)	8
Adults Recycled Downstream	448
Adults Shipped to Merwin	344
Adult Carcass Distribution	1,004

2021 Brood Lewis River Wild Origin Summer Steelhead

The first Lewis River wild origin summer steelhead was collected at Merwin FCF on June 24, 2020. This stock is planted downstream to the North Fork Lewis River, river mile 5 at Martin's access site. Mortality is disposed by landfill.

Finale Trapping and Disposition

Adults Trapped	3
Adult Mortality	0
Adults Planted Downstream	3

2020 Brood Merwin Hatchery Origin Winter Steelhead

This stock began returning last period and the first winter steelhead was trapped at Merwin FCF on November 19, 2019 and the last was trapped on May 12, 2020. Merwin Hatchery origin winter steelhead are shipped for brood to Merwin Hatchery, planted to Horseshoe Lake (Cowlitz County) to enhance sport fisheries, and surplus to food banks / tribes. Mortality is disposed by landfill

Final Trapping & Disposition

Adults Trapped	631
Adult Mortality	0
Adults Planted to Horseshoe Lake	113
Adults Shipped to Merwin	184
Adult Carcass Distribution	334

2021 Brood Merwin Hatchery Origin Winter Steelhead

The first winter steelhead arrived at the Merwin FCF on December 10, 2020. Merwin Hatchery origin winter steelhead are shipped for brood to Merwin Hatchery, planted into Horseshoe Lake (Cowlitz County) to enhance sport fisheries, and surplus to food banks / tribes. Mortality is disposed by landfill.

In-season Trapping & Disposition

Adults Trapped	161
Adult Mortality	0
Adults Shipped to Merwin	61
Adult Carcass Distribution	100

2020 Brood Lewis River Late Winter Hatchery Origin Steelhead

This stock is a result of live spawning wild winter Steelhead brood stock at Merwin Hatchery. The adult wild steelhead were collected from the Merwin FCF, tangle netting in the lower river and Lewis River Hatchery. These fish are reared at Merwin Hatchery and blank wire tagged as juveniles. Upon return as adults they are transported upstream by PacifiCorp staff as part of a supplementation project. No fish were hauled downstream this season for trapping efficiency study. The first arrival at Merwin FCF was on December 21, 2019 and the last was trapped on June 1, 2020. All upstream fish are planted on the North Fork Lewis River at Eagle Creek site. Mortality is disposed by landfill.

Final Trapping & Disposition

Adults Trapped	726
Adult Mortality (.14%)	1
Adults Planted Upstream	725

2020 Brood Lewis River Wild Origin Late Winter Steelhead

This stock began returning last period and the first adult retuned to Merwin FCF on December 1, 2019. Wild late-winter steelhead can be trapped at the FCF or tangle netted on the Lewis River. Wild late-winter steelhead are planted upstream / downstream, shipped for brood to Merwin Hatchery. Returning downstream planted adults were planted upstream after trapped. Upstream fish are planted on the North Fork Lewis River at the Eagle Creek site. Mortality is disposed by landfill.

Final Trapping & Disposition

Adults trapped	409
Adult Mortality (0.2%)	1
Adults Planted Upstream	246
Adults Planted Downstream	59
Adults Recaptured & Planted Upstream	37
Total Adults Planted Upstream	304
Adults Shipped to Merwin	104

2021 Brood Lewis River Wild Origin Late Winter Steelhead

The first wild origin late-winter steelhead was trapped at Merwin FCF on November 24, 2019. Wild origin late winter steelhead are planted upstream, downstream, and shipped to Merwin Hatchery for brood stock. Upstream adults are planted on the North Fork Lewis River at Eagle Creek site. Mortality is disposed by landfill.

In-season Trapping & Disposition

Adults Trapped	2
Adult Mortality	0
Adults Planted Upstream	2

INCIDENTAL TRAPPING

2020 Brood Unknown Stock & Wild Origin Sockeye

The first unknown origin wild sockeye returned to the Merwin FCF on June 8, 2020. This stock is planted downstream on the North Fork Lewis River at Martin's access site. Mortality is disposed by landfill.

Final Trapping & Disposition

Adults Trapped	14
Adults Planted Downstream	14

2020 Brood Lewis River Wild Origin Chum

The one and only Lewis River wild origin Chum was trapped at the Merwin FCF on September 4, 2020. This stock is planted downstream on the North Fork Lewis River at Martin's access site. Mortality is disposed by landfill.

Final Trapping & Disposition

Adults Trapped	1
Adults Planted Downstream	1

2020 Brood Lewis River Wild Origin Anadromous Coastal Cutthroat

The first returning wild origin anadromous coastal cutthroat was collected at the Merwin FCF on March 6, 2019 and the last was on January 13, 2020. These fish are planted upstream on the North Fork Lewis River at Eagle Creek access site.

Final Trapping & Disposition

Adults Trapped	40
Adults Planted Downstream	40

2021 Brood Lewis River Wild Origin Anadromous Coastal Cutthroat

The first trapped wild origin anadromous coastal cutthroat was collected at the Merwin FCF on April 1, 2020 and the last was on January 19, 2021. These fish are planted upstream on the North Fork Lewis River at Eagle Creek access site.

Final Trapping & Disposition

Adults Trapped	93
Adult Mortality (1.1%)	1
Adult Planted Downstream	92

	CK:SP:LEHA:20:H			CK:SP:LEWI:20:W			CK:FA:UNKN:20:H			CK:FA:LEWI:20:W		
	M	F	J	M	F	J	M	F	J	M	F	J
Planted Dow nstream										153	184	36
Recycled Fish Trapped												
Planted Upstream	45		275	77	52	41						
Shipped	682	564	84									
Mortalities	1	1					30	14	3			
Carcass Distribution			485				119	83	79			
Total	**728**	**565**	**844**	**77**	**52**	**41**	**149**	**97**	**82**	**156**	**187**	**36**

	CO:SO:LEHA:20:H			CO:SO:LEWI:20:W			CO:NO:LEWI:20:H			CO:NO:LEWI:20:W		
	M	F	J	M	F	J	M	F	J	M	F	J
Planted Dow nstream												
Recycled Fish Trapped												
Planted Upstream	979	1591		1467	1992	184	176	189	13	220	197	17
Shipped	24	27					24	47		182	182	1
Mortalities	158	130	86	18	13		8	19	8		1	
Carcass Distribution	488	197	1938				565	313	269			
Total	**1649**	**1945**	**2024**	**1485**	**2005**	**184**	**773**	**568**	**290**	**402**	**380**	**18**

	CO:NO:LEWI:19:H			CO:NO:LEWI:19:W		
	M	F	J	M	F	J
Planted Dow nstream						
Recycled Fish Trapped						
Planted Upstream	83	84		120	95	37
Shipped	149	128	27	15	23	
Mortalities	22	18		2	2	
Carcass Distribution	15	7	141			
Total	**269**	**237**	**168**	**137**	**120**	**37**

	SH:SU:LEWI:20:W			SH:SU:MEHA:21:H			SH:SU:LEWI:21:W		
	M	F	J	M	F	J	M	F	J
Planted Downstream	7	2		147	301		2	1	
Recycled Fish Trapped									
Planted Upstream									
Shipped				171	173				
Mortalities				2	6				
Carcass Distribution				340	664				
Total	**7**	**2**	**0**	**660**	**1144**	**0**	**2**	**1**	**0**

	SH:WI:MEHA:20:H			SH:WI:MEHA:21:H		
	M	F	J	M	F	J
Planted Downstream						
Recycled Fish Trapped						
Planted Upstream						
Shipped	114	70		27	34	
Mortalities						
Carcass Distribution	197	137		33	67	
Planted Horseshoe Lake	82	31				
Total	**393**	**238**	**0**	**60**	**101**	**0**

	SH:WL:LEWIS:20:H			SH:WL:LEWIS:20:W			SH:WL:LEWIS:21:W		
	M	F	J	M	F	J	M	F	J
Planted Downstream				27	31				
Recycled Fish Trapped				20	17				
Planted Upstream	340	385		143	161		1	1	
Shipped				67	37				
Mortalities	1				1				
Carcass Distribution									
Total	**341**	**385**	**0**	**257**	**247**	**0**	**1**	**1**	**0**

	SO:NA:UNKN:20:U			CH:NA:LEWI:20:W			CT:AC:LEWI:20:W			CT:AC:LEWI:21:W		
	M	F	J	M	F	J	M	F	J	M	F	J
Planted Dow nstream	8	6		1								
Recycled Fish Trapped												
Planted Upstream							3	1		84	1	
Shipped												
Mortalities												
Carcass Distribution												
Total	**8**	**6**	**0**	**1**	**0**	**0**	**3**	**1**	**0**	**84**	**1**	**0**

Incubation Summary

2020 Brood Goldendale Rainbow

Merwin Hatchery received 95,000 eyed eggs from Goldendale Hatchery on December 3, 2020.

2021 Brood Lewis River Summer Steelhead

The first eggs were taken on November 23, 2020. Disposition of this stock to date is as follows:

Total Egg Take	556,075
Egg Loss (19.9%)	110,549
Eggs Culled	170,105
Fecundity	4,673

2021 Brood Lewis River Winter Steelhead

The first eggs were taken on December 22, 2020. All eggs are currently in incubation trays and have not been shocked or picked. Disposition of this stock to date is as follows:

Estimated Total Egg Take	184,800
Estimated Fecundity	4,400

2020 Brood Lewis River Winter Steelhead

The first eggs were taken on December 23, 2019 and finalized on January 8, 2020. Disposition of this stock to date is as follows:

Total Egg Take	158,884
Egg Loss (3.56%)	5,655
Eggs Culled	33,420
Fecundity	5,125

2020 Brood Lewis River Wild Winter Steelhead

These fish were spawned from April 13, 2020 to May 18, 2020. Disposition is as follows.

Total Egg Take	91,103
Egg Loss (13.64%)	12,431
Fecundity	3,644

Rearing Summary

2019 Brood Lewis River Summer Steelhead

The overall rearing of this brood has gone well, and program goals were achieved. 9,194 juveniles were shipped to Cowlitz Trout Hatchery on November 7, 2019. During this rearing cycle, these fish were diagnosed with ichthyopthirius. They were therapeutically treated accordingly with average loss. Hatchery staff began releasing the fish on station in April 2020. All these fish were trucked and planted at river mile five on the North Fork Lewis River.

Final Stock Inventory

Fry Ponded	275,495
Fry Pounds Ponded	110
Juveniles Shipped	9,194
Juvenile Pounds Shipped (15.1 fpp)	609
Smolts Planted	184,809
Smolt Pounds Planted @ Release (5.4 fpp)	43,847
Rearing Mortality (5.4%)	15,011
Feed Fed (lbs)	44,110
Net Gain (lbs)	43,737
Feed Conversion	1.01
Average CV @ Release	7.79

2019 Brood Lewis River Summer Steelhead @ Echo Net Pens

Final Stock Inventory

Juveniles Shipped	64,000
Juvenile Pounds Shipped (7.1 fpp)	9,014
Smolts Planted	64,000
Smolt Pounds Planted @ Release (6.0 fpp)	10,666
Rearing Mortality (0.0%)	0
Feed Fed (lbs)	1,584
Net Gain (lbs)	1,652
Feed Conversion	0.96
Average CV @ Release	7.66

2019 Brood Lewis River Winter Steelhead

The overall rearing of this brood has gone well, and program goals were achieved. During this rearing cycle, these fish were diagnosed with ichthyopthirius. They were therapeutically treated accordingly with average loss. Hatchery staff began releasing the fish on station in April 2020. All these fish were trucked and planted at river mile five on the North Fork Lewis River.

Final Stock Inventory

Fry Ponded	115,522
Fry Pounds Ponded	46
Juveniles Shipped	0
Juvenile Pounds Shipped (NA fpp)	0
Smolts Planted	105,088
Smolt Pounds Planted @ Release (5.1 fpp)	20,605
Rearing Mortality (7.1%)	8,209
Feed Fed (lbs)	20,278
Net Gain (lbs)	20,559
Feed Conversion	0.99
Average CV @ Release	8.03

2019 Brood Lewis River Wild Winter Steelhead

The overall rearing of this brood has very well. Due to insufficient brood stock collection and unfed fry plants program goals were not met. During this rearing cycle, these fish were diagnosed with ichthyopthirius. They were therapeutically treated accordingly with average loss. Hatchery staff began releasing these fish in May 2020. All volitional release fish were planted at the Merwin Boat Launch on NF Lewis River, the remaining forced out fish were planted at Martin Access river mile five on the NF Lewis River.

Final Stock Inventory

Fry Ponded	60,861
Fry Pounds Ponded	24
Juveniles Shipped	0
Juvenile Pounds Shipped (NA fpp)	0
Smolts Planted	45,153
Smolt Pounds Planted @ Release (8.1 fpp)	5,585
Rearing Mortality (10.4%)	6,310
Unfed Fry Plant	11,075
Feed Fed (lbs)	4,888
Net Gain (lbs)	5,531
Feed Conversion	0.88
Average CV @ Release	8.74

2020 Brood Lewis River Summer Steelhead

The rearing of this brood has been going very well this period. During this rearing cycle this stock was diagnosed with ichthyopthirius and bacterial gill disease. These fish were therapeutically treated accordingly with average loss for ichthyopthirius. However, the treatment for bacterial gill disease with potassium permanganate and effects of the disease resulted in higher than normal mortality. In order to maintain program goals, 8,762 fish @ 16.4fpp totaling 534 pounds were shipped from Skamania Hatchery to Merwin Hatchery on November 4, 2020. They were added to Rearing vessel RP-11 and will be shipped to Echo Net Pen site in March 2021. Hatchery staff will begin planting the remaining fish on station to Martin Access river mile five on the North Fork Lewis River starting April 2021.

Stock Inventory This Period

Fry Ponded	269,193
Fry Pounds Ponded	108
Juveniles On-Hand	241,557
Juvenile Pounds (9.2 fpp)	26,256
Rearing Mortality (9.7%)	26,082
Feed Fed (lbs)	24,394
Net Gain (lbs)	26,148
Feed Conversion	0.93

2020 Brood Lewis River Winter Steelhead

The rearing cycle for this stock was been excellent this period with no problems. These fish were diagnosed with ichthyopthirius and therapeutically treated with little to no mortality. Hatchery staff will begin planted this stock to Martin Access river mile five of the North Fork Lewis River on April 2021.

Stock Inventory This Period

Fry Ponded	117,849
Fry Pounds Ponded	47
Juveniles On-Hand	104,651
Juvenile Pounds (9.5 fpp)	11,016
Rearing Mortality (8.7%)	10,198
Feed Fed (lbs)	10,253
Net Gain (lbs)	10,969
Feed Conversion	0.93

2019 Brood Goldendale Rainbow

The rearing cycle of this stock has gone excellent this period. These fish were diagnosed with ichthyopthirius and therapeutically treated accordingly with little to no mortality. 53,167 fish @ 12.8 fpp and totaling 4,154 pounds were shipped to Speelyai Hatchery on November 6, 2020 and they are to be planted as part of Speelyai's program goal to Swift Reservoir / Power Canal in 2021. The stocking plan for this stock has been altered for next year's planted season and is as follows: Merwin Hatchery will plant to Swift Power Canal in 2021; 3,500 @ 2.5 fpp in April 2,100 @ 1.5 fpp in May, and 1,400 @ 1.0 fpp in June. This will total 4,200 pounds. Merwin Hatchery will also retain 1,500 fish for MSKD in July 2021, 1,500 fish for the Forest Service Derby held at Merwin Park in June 2021, and 2,000 fish for MSKD in July 2022.

Stock Inventory This Period

Fry Ponded	78,554
Fry Pounds Ponded	22
Fish Planted	0
Fish Transferred	53,167
Pounds Transferred	4,154
Rearing Mortality (12.9%)	10,109
Fish On-Hand (Derby 2021/2022)	6,500
Fish On-Hand (Swift Power Canal Plant)	10,500
Pounds On-Hand	3,818
Feed Fed (lbs)	6,197
Net Gain (lbs)	7,972
Feed Conversion	0.78

2020 Merwin special Kids Derby and Forest Service Derby

The 2020 fishing derbies were cancelled due to COVID-19 pandemic. All derby fish were planted into Merwin Reservoir in June 2020 or Swift Power Canal in April thru June 2020. Disposition is as follows:

Stock Inventory This Period 2017 Brood:

Beginning Balance	2,200
Rearing Mortality (10.7%)	235
Planted to Merwin Reservoir 2020	2,097
Pounds Planted (0.25 fpp)	524

Stock Inventory This Period 2018 Brood:

Beginning Balance	7,484
Rearing Mortality (2.3%)	171
Planted to Swift Power Canal 2020	5,541
Pounds Planted to Swift Power Canal (1.3 fpp)	4,238
Planted to Merwin Reservoir 2020	0
Pounds Planted to Merwin Reservoir (NA)	0
On hand for 2021 MSKD	2,633

Temperature & Rainfall

	Jan	*Feb*	*Mar*	*Apr*	*May*	*June*	*July*	*Aug*	*Sept*	*Oct*	*Nov*	*Dec*
Avg High (F)	45.0	42.6	42.9	45.4	50.4	53.8	56.3	58.7	60.4	61.2	54.6	48.1
Avg Low (F)	44.3	42.1	42.4	43.8	49.1	52.3	54.5	56.4	58.8	60.3	53.6	47.2
****Rain (inches)***	20.6	9.9	7.5	3.2	5.1	7.3	.6	1.1	3.9	6.0	13.6	12.1

** 2020 total rainfall accumulation 90.9 inches*

Treatments

Date	Brood Year / Species	Pond Numbers	Treatment Chemical	Disease
January – July	2020 Summer, Winter, & Late-Winter Steelhead eggs	Incubators	Formalin	Fungus
June – November	2021 Summer Steelhead adults (Brood)	Smolt Pond 1 & Smolt Pond 2	Formalin	Fungus
September – October	2018 Goldendale Rainbow derby fish	Raceways 9 & 10	Formalin	Ichthyopthirius
September – October	2019 Goldendale Rainbow Juveniles	Raceways 1, 2, 5, & 6	Formalin	Ichthyopthirius
September – October	2020 Winter Steelhead	Raceway 4 & Rearing Pond 13	Formalin	Ichthyopthirius
September – October	2020 Summer Steelhead	Raceway 3 & Rearing Ponds 11, 12, & 14	Formalin	Ichthyopthirius
June	2020 Summer Steelhead	Raceways 4, 5, & 6	Potassium Permanganate	Bacterial Gill Disease
September – October	2020 Late-Winter Steelhead	Raceways 7 & 8	Formalin	Ichthyopthirius
December	2021 Goldendale Rainbow eggs	Incubators	Formalin	Fungus
November – December	2021 Summer & Winter Steelhead eggs	Incubators	Formalin	Fungus
December	2021 Winter Steelhead Adults (Brood)	AP-2	Formalin	Fungus
February – June	2020 Late-Winter Steelhead Adults (Brood)	AP-1	Formalin	Fungus

Maintenance & Capital Projects

Maintenance

- Cleaned all dielectric tubes, inspected all fuses and rings, replaced any damaged or worn out parts on Ozone Generator #2
- Replaced all elements and filters on Kaser Compressor supply lines and Pure Gas air dryers
- Routine Maintenance on Kaser Compressors
- Annual calibration for ambient ozone sensors and generators
- Repaired cooling water pump #5 at Ozone Plant
- Replaced leaking Y-strainer for DOR at Ozone Plant
- Replaced pressure gauges for cooling water pump #5 & drying line at Ozone Plant
- Routine maintenance for Ford Cargo planting truck & installed new muffler
- Routine maintenance for International planting truck & installed new radiator hose
- Install new tag axle on International planting truck
- Routine service for Ford F-250 pickup truck
- Repaired brakes for Ford F-350 flatbed
- Replaced alarms for smolt ponds
- New gravel for 3-Bay storage area
- Replaced starter on Magic Valley fish pump
- Replaced clutch on John Deere Gator
- Routine service for all on station equipment; gator, mowers, pumps, trimmers, blowers, saws, etc.
- Trimmed all deciduous trees, bushes, & hedges around facility
- Repainted chemical storage building & replaced placards
- Replaced winch for Raceway #6 sump
- Routine service for hatchery building walk in freezer compressor & heat pump
- Routine service for residence heat pumps

Capital

- Repaired major sink hole and replaced manhole responsible for raceway and rearing pond discharge water to the pollution abatement settling ponds

Lewis River Hatchery Introduction

The Lewis River Salmon Hatchery is located approximately eight miles east of Woodland, WA on the North Fork Lewis River. Originally constructed in 1909 on Johnson Creek, the hatchery was moved to its present site in 1923.

Program Goals

- 1,350,000 yearling Spring Chinook @ 8-12 f/lb planted into N.F. Lewis River
- 1,100,000 yearling Early Coho @ 16 f/lb planted into N.F. Lewis River
- 9000,000 yearling Late Coho @ 16 f/lb planted into N.F. Lewis River

Approximately 29,000 gallons of water per minute can be delivered to the hatchery by eight pumps that are located at two separate intakes. Four booster pumps permit further distribution of water to other areas of the facility as needed. Three gas stabilization towers and one packed column are available to remove supersaturated gases from the water supply when necessary.

There is approximately 312,000 cubic feet of available rearing space. This space consists of 14 super raceways and 12 standard raceways. Adult holding space consists of four large concrete ponds with a common center channel totaling 53,000 cubic feet.

The incubation facility houses fifty stacks (16 trays/stack) of vertical incubators and four shallow troughs.

The Lewis River Hatchery also includes three residence, hatchery/office building, freezer building, two three bay storage buildings, two small storage buildings, public restrooms, two intake structures, two generator/pump control buildings, two compressor buildings, domestic water pump house and a two-story adult handling facility.

Adult Trapping and Brood Stock

The Lewis River Ladder operates continuously year around. Once the fish are captured, staff identify, numerate and sort for hatchery brood stock and watershed escapement goals. In the below stocks the carcass distribution line represents surplus fish not needed for program goals and may go to food bank/tribes, nutrient enhancement, or landfill. The trapping and disposition of the stocks below only represent fish that were trapped at the Lewis River Hatchery Ladder.

2020 Lewis River Winter Steelhead

The last 2020 brood winter steelhead was trapped at the Lewis Ladder on March 4, 2020. Brood stock was collected at the Lewis Ladder and shipped to Merwin Hatchery.

Final Trapping & Disposition

Total Trapped	135
Mortality (2.2%)	3
Brood Stock Shipped	20
Carcass Distribution	112

2020 Brood Lewis River Late Winter Steelhead, Hatchery Origin

The only Late Winter Steelhead trapped at Lewis River Hatchery were on May 15, 2020. All fish were planted into the upper Lewis River watershed.

Final Trapping & Disposition

Total Trapped	3
Planted Upstream	3

2021 Brood Lewis River Summer Steelhead

The first summer steelhead trapped at the Lewis River Ladder was on June 9,2020.

Final Trapping & Disposition

Total Trapped	220
Recycled	5
Mortality (5.5%)	12
Carcass Distribution	211

2021 Brood Lewis River Winter Steelhead

The first Winter Steelhead was trapped November 23, 2020 at the Lewis River Ladder. Brood stock was collected at the Lewis Ladder and shipped to Merwin Hatchery.

In-season Trapping & Disposition

Total Trapped	102
Trap Mortality	0
Brood Shipped	82
Carcass Distribution	20

2019 Brood Lewis River (Type N) Coho

The last Late Coho captured at the Lewis River Ladder was on February 4, 2020.

Final Trapping & Disposition

Adults Trapped	4,856
Jacks Trapped	928
Adult Mortality (16.7%)	814
Jack Mortality (3.4%)	32
Adults Spawned	1,676
Jacks Spawned	27
Adult Carcass Distribution	304
Jack Carcass Distribution	869
Adults Planted Upstream	2,062
Jacks Planted Upstream	0
Adults Received from Merwin FCF	277
Jacks Received from Merwin FCF	27

2020 Brood Lewis River Spring Chinook

The first arrival at the Lewis Ladder was on May 15, 2020. Brood stock was collected and shipped to Speelyai Hatchery.

Final Trapping & Disposition

Adults Trapped	44
Jacks Trapped	118
Adult Mortality (4.5%)	2
Jack Mortality	0
Adult Carcass Distribution	0
Jacks Carcass Distribution	83
Adult Brood Shipped	37
Jack Brood Shipped	10
Adults Planted Upstream	7
Jacks Planted Upstream	25

2020 Brood Lewis River (Type S) Early Coho

The first early Coho trapped at the Lewis River Ladder was on September 1, 2020. Brood stock for hatchery production is collected and then shipped to Speelyai Hatchery. This year we did spawn a small number of Coho at Lewis River and shipped eggs to Speelyai Hatchery.

Final Trapping & Disposition

Adults Trapped	7,546
Jacks Trapped	7,080
Adult Mortality (10.4%)	789
Jack Mortality (.7%)	52
Adult Carcass Distribution	3,669
Jack Carcass Distribution	6,990
Adult Brood Shipped	1,289
Jack Brood Shipped	38
Adults Planted Upstream	1,669
Jacks Planted Upstream	0
Adults spawned	130

2020 Brood Lewis River (Type N) Late Coho

The first Late Coho trapped at the Lewis River Ladder was on October 20, 2020. All brood stock is held and spawned at the Lewis River Hatchery.

Final Trapping & Disposition

Adults Trapped	11,452
Jacks Trapped	4,878
Adult Mortality (7.5%)	861
Jack Mortality (2.1%)	105
Adults Spawned	1,305
Jacks Spawned	8
Adult Carcass Distribution	9,286
Jack Carcass Distribution	4765

INCIDENTAL TRAPPING

2020 Brood Lewis River Wild Spring Chinook

The first wild Spring Chinook trapped at the Lewis River Ladder was on May 15, 2020. Merwin F.C.F. on March 7, 2020. All fish trapped were planted into the Lewis River.

Final Trapping & Disposition

Adults Trapped	5
Jacks Trapped	0
Adults Planted Upstream	5

2019 Brood Lewis River Wild Fall Chinook

The last wild Fall Chinook trapped at the Lewis Ladder was on December 10, 2019. All fish were returned to the Lewis River.

Final Trapping & Disposition

Adults Trapped	11
Jacks Trapped	1
Adult Planted Downstream	11
Jacks Planted Downstream	1

2020 Brood Lewis River Wild Fall Chinook

The first Wild Fall Chinook was trapped at the Lewis River Ladder was on September 1, 2020. All fish were returned to the Lewis River.

Final Trapping & Disposition

Adults Trapped (Lewis)	8
Jacks Trapped (Lewis)	2
Adult Planted Downstream	8
Jacks Planted Downstream	2

2020 Brood Fall Chinook (Unknown Hatchery Origin)

There is no hatchery released Fall Chinook on the Lewis River, we identify any adipose clipped Fall Chinook as "unknown" origin. The first Fall Chinook of hatchery origin was trapped at the Lewis River Ladder on September 1, 2020.

Final Trapping & Disposition

Adults Trapped	142
Jacks Trapped	35
Adult Mortality (4.1%)	59
Jack Mortality (8.5%)	3
Adult Carcass Distribution	83
Jack Carcass Distribution	32

2020 Brood Lewis River Wild Early Coho

The first natural origin Early Coho was trapped at the Lewis River Ladder was on September 1, 2020. All wild Early Coho were planted into the Lewis River.

Final Trapping & Disposition

Adults Trapped	237
Jacks Trapped	23
Adults Planted Upstream	237
Jacks Planted Upstream	23

2020 Brood Lewis River Wild Late Coho

The first wild Late Coho was trapped at the Lewis River Ladder on October 27, 2020. Lewis River Hatchery received some wild Late Coho from the Merwin FCF that were used for brood stock as part of the integrated portion of the Late Coho hatchery program. Fish not used for brood stock were planted into the Lewis River.

Final Trapping & Disposition

Adults Trapped	866
Jacks Trapped	30
Adult Mortality (6.6%)	58
Jack Mortality (26.6%)	8
Adults Spawned	212
Jacks Spawned	3
Adults Planted Upstream	613
Jacks Planted Upstream	20
Adults Received from Merwin FCF	364
Jacks Received from Merwin FCF	1

Adult Trapping – Lewis Hatchery Ladder

	CK:SP:LEHA:20:H			CK:SP:LEWI:20:W			CK:FA:UNKN:20:H			CK:FA:LEWI:20:W		
	M	F	J	M	F	J	M	F	J	M	F	J
Return to Stream										8		2
Planted Upstream	7		25	2	3							
Shipped	17	20	10									
Mortalities							37	22	3			
Carcass Distribution			83				46	37	32			
Total	**24**	**20**	**118**	**2**	**3**	**0**	**83**	**59**	**35**	**8**	**0**	**2**

	CO:SO:LEHA:20:H			CO:SO:LEWI:20:W			CO:NO:LEWI:20:H			CO:NO:LEWI:20:W		
	M	F	J	M	F	J	M	F	J	M	F	J
Return to Stream						4						
Planted Upstream	1086	583	0	142	95	19				302	311	20
Shipped	632	657	38									
Mortalities	383	406	52				381	480	105	28	30	8
Carcass Distribution	2171	1498	6990				5668	3618	4765	1	2	
Spaw ned	65	65					627	678	8	126	86	3
Received from FCF										182	182	1
Total	**4337**	**3209**	**7080**	**142**	**95**	**23**	**6676**	**4776**	**4878**	**457**	**429**	**31**

	CO:NO:LEWI:19:H			CO:NO:LEWI:19:W		
	M	F	J	M	F	J
Return to Stream						
Planted Upstream	1330	732	0	55	40	4
Shipped						
Mortalities	588	226	32	4	5	0
Carcass Distribution	203	101	869			
Spaw ned	825	851	27	25	26	
Received from FCF	149	128	27			
Total	**2946**	**1910**	**928**	**84**	**71**	**4**

	SH:SU:MEHA:21:H		SH:WI:MEHA:20:H		SH:WI:MEHA:21:H		SH:WL:LEWIS:20:H	
	M	F	M	F	M	F	M	F
Return Downstream	2	3						
Planted Upstream							2	1
Shipped to Merwin Hatchery			2	18	22	60		
Mortalities		4	2	1				
Carcass Distribution	68	143	79	33	12	8		
Total	**70**	**150**	**83**	**52**	**34**	**68**	**2**	**1**

Incubation Summary

2019 Brood Lewis River Late Coho (Integrated and Segregated)

Once a strong eye developed, the eggs were shocked and picked to remove dead eggs. After the morbid eggs were removed, the eyed eggs were inventoried and laid down to hatch or ship. Total egg loss (roughly 8.7%) was 241,811. The integrated 1,095,792 eyed eggs for the Lewis River program were kept on station for the entirety.

A total of 1,556,535 segregated eyed and green eggs were shipped out of Lewis River Hatchery. Washougal Hatchery received 1,484,035 green eggs. The 72,500 eyed eggs were distributed as follows: The Steve Syverson Project 5,000; Ridgefield High School 10,000; Clark PUD 46,000; Columbia Springs 11,500. Egg inventory and distribution was as follows:

Total Egg Take (green)	2,763,787
Egg Loss	241,811
Short/Over	16,711
Adjusted Egg Take	2,780,498
Total Eyed Eggs	2,538,687
Shipped (Green)	1,482,506
Adjusted Shipped (Green)	1,484,035
Shipped (Eyed)	72,500
Females Spawned	875
Fecundity	3,178

2020 Brood Lewis River Early Coho

Most of the Early Coho brood stock were shipped to Speelyai and spawned there. However, 65 pair were spawned at Lewis and the eggs shipped to Speelyai, as to ensure egg take goals were accomplished. Speelyai spawned the remainder of the brood and Incubated the resulting eggs to the eyed stage. From October through December, the 1,510,956 eggs were shipped to Lewis River Hatchery to Finish their incubation.

2020 Brood Lewis River Late Coho (Integrated and Segregated)

Over 2.8 million eggs were taken in 2020. The first spawn of late Coho took place on November 17, 2020, and the last was on December 9, 2020. The Washougal Hatchery received about 1.53 million (segregated) green eggs. The remaining eggs were laid down for incubation at Lewis River Hatchery. Of the remaining eggs, 61,000 were incubated to the eyed stage and were distributed to the following schools and coops: 46,000 to Clark County PUD, 5,000 to the Steve Syverson Project, 100 to Captain Strong Primary School, and 10,000 to Ridgefield High School. An additional 4,500 eyed eggs will be shipped to Columbia Springs Coop in January of 2021. The remaining eggs on hand, approximately 1.2 million, are the integrated portion of the egg take, and will be kept at Lewis River Hatchery and released into the Lewis River in April of 2022. At the time of this report eggs are still in incubation and have not been inventoried.

Total Egg Take (green)	2,815,754
Egg Loss	0
Short/Over	0
Shipped (green)	1,526,951
Adult Females Spawned	764
Fecundity	3,686

Rearing Summary

2018 Brood Lewis River Late Coho

Lewis River Hatchery volitionally released 827,576 Late Coho averaging 16 fpp, between April 1 and 13, 2020. Approximately 75K were adipose clipped and coded wire tagged; while 75K were coded wire tagged only. The remaining fish were only adipose fin clipped.

Final Stock Inventory

Beginning Balance	934,550
Pounds Ponded	705
Rearing Mortality (2.7%)	25,484
Adjustment	(81,490)
Fish Planted	827,576
Pounds Planted	51,724
Feed Fed (lbs.)	48,751
Net Gain (lbs.)	51,019
Conversion	0.96:1
CV	7.68

2018 Brood Spring Chinook

The last of the 2018 brood Spring Chinook were volitionally released from February 11 through 28, of 2020. This group totaled 460,556 and was a mix of fish that were at 8 and 12 fish per pound. The prior October release consisted of 776,042 smolts released, making a total of 1,236,598 fish planted from the 2018 brood year. Of the 2018 brood Spring Chinook, 32-36k out of each of the four unique release groups (October 12fpp early transfer, February 8fpp early transfer, February 12fpp late transfer, and February 8fpp late transfer) were adipose clipped with a coded wire tag, and another 32-36k out of each group were coded wire tagged with adipose fin present. The remaining fish in each group were adipose marked.

Final Stock Inventory

Fish Received	1,345,080
Pounds Received	27,763
Rearing Mortality (8.1%)	108,482
Fish Planted	1,236,598
Pounds Planted	116,762
Feed Fed (lbs.)	67,060
Net Gain (lbs.)	88,999
Conversion	0.75:1
Average CV of Groups Planted	6.75

2018 Brood Lewis River Early Coho

Lewis River Hatchery volitionally released 1,088,589 Early Coho, averaging 15.3 fish per pound, between April 1st and 20th of 2020. Approximately 75K were coded wire tagged and adipose clipped and another 75K were only coded wire tagged. All other fish in the release group were adipose fin clipped.

Final Stock Inventory

Beginning Balance	1,351,639
Pounds Ponded	964
Rearing Mortality (8.0%)	107,643
Adjustment	(155,407)
Fish Planted	1,088,589
Pounds Planted	71,155
Feed Fed (lbs.)	63,436
Net Gain (lbs.)	70,191
Conversion	0.90:1
Average CV	6.81

2019 Brood Lewis River Spring Chinook

On May 4th and 5th of 2020, the Lewis River Hatchery received 1,051,010 Spring Chinook from Speelyai Hatchery. In addition, 318,740 were shipped from Speelyai to Lewis River Hatchery on December 2nd and 3rd of 2020. Out of each size and release group of 2019 brood springers (May transfer 12fpp, May transfer 8fpp, December transfer 12fpp, December transfer 8fpp), approximately 37k were coded wire tagged and adipose fin clipped, 37k were only coded wire tagged, and the remaining were only adipose fin clipped. From October 21st through 29th of 2020, a total of 853,885 of the 2019 brood year Spring Chinook were released into the Lewis River and the remaining group of approximately 165k is being held on site, to be released with the December transfer groups in February of 2021.

Stock Inventory This Period

Fish Received	1,369,750
Pounds Received	27,291
Rearing Mortality (3.4%)	47,458
Planted as of December 31st	853,885
On Hand as of December 31st	473,795
Pounds Planted	69,777
Pounds on Hand	43,275
Feed Fed (lbs.)	66,326
Net Gain (lbs.)	85,761
Conversion	0.77:1
CV of Fish Planted	7.69

2019 Brood Lewis River Early Coho

The last take of Early Coho was ponded on January 21, 2020. Approximately 75k were snout tagged with an adipose mark, and 75k were snout tagged without an adipose mark. The remaining were only adipose fin marked. The 2019 brood Early Coho are scheduled for release in April of 2021.

Stock Inventory This Period

Balance Prior To Ponding	1,360,353
Fry Loss (5.1%)	69,824
Beginning Rearing Balance	1,322,453
Pounds Ponded	779
Rearing Mortality (17.6%)	232,720
Adjustment	(146,042)
Fish on Hand	911,767
Pounds on Hand	31,668
Feed Fed (lbs.)	31,782
Net Gain (lbs.)	30,889
Conversion	1.03:1

2019 Brood Lewis River Late Coho

The 2019 brood Late Coho were moved from the incubation room toe standard raceways between February 14th and April 1st of 2020. Approximately 75k were coded wire tagged and adipose fin clipped, 75k were only coded wire tagged, and the remaining fish were only adipose fin clipped.

Stock Inventory This Period

Balance Prior to Ponding	1,103,792
Fry Loss	8,000
Beginning Balance	1,095,792
Pounds Ponded	776
Rearing Mortality (1.9%)	20,815
Rearing Adjustment	(19,039)
Fish on Hand	1,055,938
Pounds on Hand	35,688
Feed Fed (lbs.)	30,685
Net Gain (lbs.)	34,912
Conversion	0.88:1

Temperature and Rainfall

	Jan.	***Feb.***	***Mar.***	***Apr.***	***May***	***June***	***July***	***Aug.***	***Sept.***	***Oct.***	***Nov.***	***Dec.***
Average High (F)	45.7	43.3	43.8	45.4	49.2	53.7	57.2	59.3	59.2	60.3	54.6	48.9
Avg. Low (F)	45.1	42.5	42.3	43.3	47.1	51.6	53.8	55.5	56.8	59.1	53.8	48.1
****Rain (inches)***	19.4	8.9	7.4	3.1	5.0	7.5	0.3	0.7	4.0	5.7	14.2	12.1

** 2020 total rainfall accumulation 88.3 inches*

Treatments

Date	Brood Year / Species	Pond Numbers	Treatment Chemicals	Disease
January	2019 Late Coho	Incubators	Formalin	Fungus
January-March	2019 Early Coho	Raceways 2-7	Formalin	Gill Fungus
May	2019 Late Coho	Raceways 8-12	Formalin	Gill Fungus
May-June	2019 Late Coho	Raceways 8-12	Potassium Permanganate	Bacterial Coldwater Disease

Maintenance and Capital Projects

Maintenance:

- Installed sprinkler systems on raceways for Spring Chinook.
- Routine service of walk-in freezer, compressor, and heat pump.
- Routine service for residence heat pumps.
- Routine maintenance for compressors.
- Replaced worn tires on Gators.
- Yearly tree trimming was done.
- Alarms on raceways 1-12 were replaced.
- Had preventative maintenance done on all pumps.
- Pressure washed sorting facility.
- Routine service for Ford F-250 pickup and Ford one-ton flatbed.
- Repaired and replaced heaters in restrooms.
- Repaired upwell grating in the Pond 15 Center Channel.
- Replaced pump 2 at DSI.
- Welded and strengthened walkway grating for Marking Trailer and added handrail sockets.
- Replaced overhead yard lights behind Main Hatchery Building and raceways 1-12.
- Replaced packing in incubation pump.
- Rebuilt table for bench sander.
- Rebuilt and maintained pond crowders.
- Replaced hot water heater in Residence 1
- Had forklifts serviced.
- Repainted hatchery shallow troughs.
- Replace Hinges on EA baskets.
- Repainted upstream booster pump for standards and incubation.

Capital:

- Had new asphalt laid in front of office and 3-bay. Also applied seal coat behind Main Hatchery Building.

Speelyai Hatchery Introduction

Speelyai Hatchery is a PacifiCorp owned and funded facility that is operated by the Washington Department of Fish and Wildlife. It has been in operation since 1958.

Speelyai Hatchery is located 21 miles east of Woodland, WA just off Highway 503. The hatchery is adjacent to Speelyai Creek on the north shore of Lake Merwin.

Program Goals

- 1,050,000 Spring Chinook transferred to Lewis River Hatchery in May
- 360,000 Spring Chinook transferred to Lewis River Hatchery in December
- 50,000 sub-yearling Spring Chinook @ 80 f/lb planted into the N.F Lewis River
- 1,325,000 Type S Coho eyed eggs transferred to Lewis River Hatchery
- 45,000 Kokanee @ 8.0 f/lb planted into Merwin Reservoir
- 48,000 Kokanee @ 6.9 f/lb planted into Merwin Reservoir
- 36,000 Rainbow Trout @ 2.5 f/lb planted into Swift Reservoir
- 3,500 Rainbow Trout @ 2.5 f/lb planted into Swift power Canal

Approximately 9,200 gallons per minute can be delivered to the hatchery system by gravity flow from Speelyai Creek.

There is approximately 166,450 cubic feet of rearing space available. This space consists of four 17x3'x3' intermediate troughs, twenty-four 10'x80'x4' raceways, four 115'x10'x5' raceways and one large asphalt pond for adult holding/spawning. Incubation consists of fifty stacks of FAL vertical incubators, two deep troughs and one shallow trough. Staff is also responsible for ten 20'x20'x20' net pens located in Merwin Reservoir.

Speelyai Hatchery site also includes two residence, hatchery building, two bay storage building, shop/garage, domestic pump house, small storage building and two chemical storage buildings.

Adult Holding

All Spring Chinook and Coho are trapped at the Merwin Fish Collection Facility or the Lewis River Hatchery Ladder and hauled by truck to Speelyai Hatchery. Kokanee are trapped on-site thru the hatchery effluent trap on Speelyai Creek. In the below stocks the carcass distribution line represents surplus fish not needed for program goas and may go to food banks/tribes, nutrient enhancement, or landfill.

2020 Lewis River Spring Chinook, Hatchery Origin

The first Spring Chinook was received on April 6, 2020. Both ELISA and PCR (Polymerase Chain Reaction) testing that checks DNA extracts for bacterium in salmonid eggs was performed. Enough females were tested to ensure that only gametes from females that tested in the "Below Low" range will be used in the February release groups.

Final Trapping & Disposition

Adults Received	1,274
Jacks Received	102
Adult Mortality (5.7%)	72
Jack Mortality (14.7%)	15
Adults Spawned	1,114
Non-Viable	7
Jack Carcass Distribution	14
Adult Planted Upstream	81
Jacks Planted Upstream	34

2020 Lewis River Type S Coho

The first Early Coho was received on September 15, 2020.

Final Trapping & Disposition

Adults Received	1,321
Jacks Received	39
Adult Mortality (17.0%)	225
Jack Mortality (5.1%)	2
Adults Spawned	1,054
Jacks Spawned	12
Non-Viable	1
Adult Carcass Distribution	41
Jack Carcass Distribution	25

2020 Lake Merwin Kokanee

Adult collection started September 11, 2020. Fish were collected from the hatchery effluent Kokanee trap and held in raceway 25.

Final Trapping & Disposition

Adults Received 540
Adults Spawned 540

	CK:SP:LEHA:20:H				KO:NA:MERL:20:U		CO:SO:LEHA:20:H			
	M	F	NVF	J	M	F	M	F	NVF	J
Planted Upstream	81			34						
Mortalities	31	41		15			123	102		2
Carcass Distribution				14			15	26		25
Lethal Spawn	526	588	7	39	360	180	519	535	1	12
Live Spawn										
Tags Recovered	456	456		55			37	55		4
Total	638	629	7	102	360	180	657	663	1	39

Incubation Summary

2020 Lewis River Spring Chinook, Hatchery Origin

Egg Inventory and distribution is as follows:

Total Egg Take	1,923,900
Egg Loss (3.2%)	62,400
Destroyed	0
Fecundity	3,278
Ponded	1,861,500

2020 Lewis River Type S Coho, Hatchery Origin

Egg Inventory and distribution is as follows:

Total Egg Take	1,844,956
Egg Loss (18.1%)	334,000
Shipped	1,510,956
Fecundity	3,075

2020 Lake Merwin Kokanee, Mixed Origin

Egg Inventory and distribution is as follows: At the time of this report, the 2020 Kokanee are still in incubation and will be ponded in January 2021.

Total Egg Take	163,600
Egg Loss (16.3%)	26,600
Destroyed	0
Fecundity	909

Rearing Summary

2018 Lake Merwin Kokanee

On March 1, 2020, the remaining 46,730 Kokanee were released from Speelyai hatchery at an average size of 6.69 f/lb.

Final Stock Inventory

Beginning Balance	104,000
Pounds Ponded	27
Rearing Mortality (11.0%)	11,470
Adjustment	0
Fish Planted	92,530
Pounds Planted	12,487
Feed Fed (lbs.)	10,494
Net Gain (lbs.)	12,460
Conversion	0.84:1

2018 Goldendale Rainbow Trout

On May 21, 2020, 42,600 fish at 2.86 f/lb were hauled to Swift reservoir.

Final Stock Inventory

Beginning Balance	43,120
Pounds Ponded	N/A
Rearing Mortality (1.2%)	520
Adjustment	0
Fish Planted	42,600
Pounds Planted	14,895
Feed Fed (lbs.)	9,937
Net Gain (lbs.)	11,815
Conversion	0.84:1

2019 Lewis River Spring Chinook, Hatchery Origin

Coded-wire tagging and mass marking were completed on April 27, 2020. In May, 1,051,010 hatchery origin spring Chinook were shipped to Lewis river hatchery at an average size of 138 f/lb. In June, 113,915 were planted in the Lewis River at Pekins boat launch. In December, the remaining 318,740 were shipped to Lewis river hatchery.

Final Stock Inventory

Beginning Balance	1,529,100
Pounds Ponded	1,330
Rearing Mortality (2.0%)	31,075
Adjustment	-14,360
Fish Shipped	1,369,750
Pounds Shipped	27,296
Fish Planted	113,915
Pounds Planted	1,315
Feed Fed (lbs.)	21,370
Net Gain (lbs.)	27,281
Conversion	0.78:1

2019 Kalama River Spring Chinook, Hatchery Origin

In March, 125,009 Kalama spring Chinook were mass marked, leaving the remaining 108,591 as unmarked. On March 26, 2020, 125,000 AD ONLY and 108,200 Unmarked Chinook were hauled to Beaver Creek hatchery in two separate loads. Once marking and tagging was completed at Beaver Creek Hatchery, these fish were to be used as part of the Deep River Net Pen project.

Final Stock Inventory

Beginning Balance	234,800
Pounds Ponded	204
Rearing Mortality (0.7%)	1,600
Adjustment	0
Fish Shipped	233,200
Pounds Shipped	1,127
Fish Planted	0
Pounds Planted	0
Feed Fed (lbs.)	513
Net Gain (lbs.)	923
Conversion	0.56:1

2019 Lake Merwin Kokanee

On September 9, 2020, 46,010 Kokanee at 17.2 F/LB were released early due to Speelyai Hatchery being under a Level II wildfire evacuation. On December 18, 2020, 15,580 Kokanee at 11.0 f/lb were released early due to Bacterial Kidney Disease diagnosis. At the time of this report, there are 33,170 on hand at an average size of 9.21 f/lb scheduled to be released into Speelyai Bay on March 1, 2021.

2019 Goldendale Rainbow Trout

On November 6, 2020, 53,167 fish were received from Merwin hatchery at an average size of 12.8 f/lb. At the time of this report, there are 53,000 on hand at 9.26 f/lb. These fish are currently being reared in pond 13 and are on schedule to be released into Swift reservoir and the Swift Power Canal starting in May 2021.

2020 Lewis River Spring Chinook, Hatchery Origin

At the time of this report, 1,707,450 have been ponded and are at an average size of 902 f/lb. There are an additional 95,000 in incubation that will be ponded in early January. Mass marking and coded-wire tagging will begin in March, 2021.

2020 Lake Merwin Kokanee

At the time of this report, there are 137,000 fish in incubation to be ponded in early January, 2021.

Temperature & Rainfall

	Jan	*Feb*	*Mar*	*Apr*	*May*	*June*	*July*	*Aug*	*Sept*	*Oct*	*Nov*	*Dec*
Avg High (F)	48.1	47.9	48.3	50.5	52.4	55.4	55.1	55.7	54.8	52.2	49.4	48.4
Avg Low (F)	47.0	46.2	47.1	48.9	51.1	53.4	53.6	53.8	52.1	49.7	47.6	46.8
****Rain (inches)***	32.4	12.3	7.8	4.8	6.6	6.4	.65	.55	6.2	6.4	11.9	13.6

** 2020 total rainfall accumulation 109.6 inches*

Treatments

Date	Brood Year / Species	Pond Numbers	Treatment Chemical	Disease
2/1 – 4/27	2019 Lewis spring Chinook	Raceways	Formalin Drip	Prophylactic for Costia
2/1 – 4/27	2019 Kokanee	Raceways	Formalin Drip	Prophylactic for Costia
4/6 – 9/18	2020 spring Chinook Brood	Raceways 25-28	Formalin Drop	Fungus
9/15 – 10/28	2020 Type S Coho Brood	Adult pond	Hydrogen Peroxide	Fungus
9/15 – 10/7	2020 kokanee Brood	RW 25	Formalin Drip	Fungus
9/1 – 11/19	2020 spring Chinook	Incubation	Formalin Drip	Fungus
9/28 – 12/6	2020 Kokanee	Incubation	Formalin Drip	Fungus
10/14 – 11/21	2020 Type S Coho	Incubation	Formalin Drip	Fungus

Maintenance & Capital Projects

Maintenance:

- Septic tanks pumped for hatchery and both residences
- Routine service and maintenance to Ford F250
- Replaced worn outlets on marking trailer cords
- Routine service and maintenance to Chevy 3500
- Replaced plywood and vinyl on boat floor
- Bi-Annual maintenance to residential HVAC
- Routine service and maintenance to small motors and pumps
- New breaker installed for 3 phase compressors
- Replace electric jack on Neilson fish pump
- Annual pruning of trees
- Paint motor box covers on all four intake screens
- Install water depth gauge at intake
- Annual maintenance to back up generator
- Annual maintenance to forklift
- New batteries in alarm panel
- Rebuilt Van Gaalen egg picker
- Light, heater, and sump pump installed in vacuum pump building
- Build net pens to hold CWT retention fish
- Replaced heaters in shop, incubation, and residence #2 garage

Capital

- Replaced UV treatment unit in domestic water building
- Rebuild submersible spray-bar pump at intake
- Replaced John Deere Gator

Fish & Carcass Distribution

2020 Total Carcass DistributionSummary

	M	F	J
CK:SP:LEHA:20:H	557	636	635
CK:FA:UNKN:20:H	140	96	110
CO:SO:LEHA:20:H	3,905	2960	9104
CO:SO:LEWI:20:W	18	13	0
CO:NO:LEWI:20:H	7,218	5074	5045
CO:NO:LEWI:20:W	155	118	11
CO:NO:LEWI:19:H	27	10	10
SH:SU:MEHA:20:H	0	5	0
SH:SU:MEHA:21:H	581	980	0
SH:WI:MEHA:20:H	334	223	0
SH:WI:MEHA:21:H	69	111	0
SH:WL:LEWI:20:W	1	2	0
SH:WL:LEWI:20:H	1	0	0
KO:NA:MERL:20:M	360	180	0
Total	**13,366**	**10,408**	**14,915**

	Lower Columbia (CAP) Community Action Team			NW Harvest			Cowlitz Tribe			Total
	M	F	J	M	F	J	M	F	J	
CK:SP:LEHA:20:H									61	**61**
CK:FA:UNKN:20:H				38	41	5	25	13	8	**130**
CO:SO:LEHA:20:H	149	56	400	2,517	1,600	3,040	3	17		**7,782**
CO:SO:LEWI:20:W										**0**
CO:NO:LEWI:20:H				6,273	3,943	2,776				**12,992**
CO:NO:LEWI:20:W				66	48					**114**
CO:NO:LEWI:19:H										**0**
SH:SU:MEHA:20:H										**0**
SH:SU:MEHA:21:H				8	19		397	774		**1,198**
SH:WI:MEHA:20:H							210	159		**369**
SH:WI:MEHA:21:H				23			45	52		**120**
SH:WL:LEWI:20:W										**0**
SH:WL:LEWI:20:H										**0**
KO:NA:MERL:20:M										**0**
Total	**149**	**56**	**400**	**8,925**	**5,651**	**5,821**	**680**	**1,015**	**69**	

	American Canadian			Landfill			Nutrient Enhancement			Total
	M	F	J	M	F	J	M	F	J	
CK:SP:LEHA:20:H				557	636	574				**1,767**
CK:FA:UNKN:20:H	37	22	3	40	20	94				**216**
CO:SO:LEHA:20:H	465	430	120	493	498	5,404	278	359	140	**8,187**
CO:SO:LEWI:20:W				18	13					**31**
CO:NO:LEWI:20:H	318	391	100	54	85	1,933	573	655	236	**4,345**
CO:NO:LEWI:20:W	28	30	8				61	40	3	**170**
CO:NO:LEWI:19:H				27	10	10				**47**
SH:SU:MEHA:20:H					5					**5**
SH:SU:MEHA:21:H		4		176	183					**363**
SH:WI:MEHA:20:H				124	64					**188**
SH:WI:MEHA:21:H				24	36					**60**
SH:WL:LEWI:20:W				1	2					**3**
SH:WL:LEWI:20:H				1						**1**
KO:NA:MERL:20:M				360	180					**540**
Total	**848**	**877**	**231**	**1,875**	**1,732**	**8,015**	**912**	**1,054**	**379**	

Mitigation Summary

Stock	Program Goals	Actual Production
*Spring Chinook	1,350,000 @ 8-12 f/lb	1,314,441 @ 8-12 f/lb
Early Coho	1,100,000 @ 16 f/lb	1,088,589 @ 16 f/lb
Late Coho	900,000 @ 16 f/lb	827,576 @ 16 f/lb
Summer Steelhead	175,000 @ 4.8 f/lb	184,809 @ 5.4 f/lb
Winter Steelhead	100,000 @ 4.8 f/lb	105,088 @ 5.1 f/lb
Late Winter Steelhead	50,000 @ 6-8 f/lb	45,153 @ 9.5 f/lb
Kokanee	12,500 pounds	11,076 pounds
Rainbow Trout	20,000 pounds	20,428 pounds

**100,000 Spring Chinook upstream production was suspended and moved to the hatchery downstream production.*

Lewis River Complex Staff

Complex Manager	Aaron Roberts
Fish Hatchery Specialist 4	Mike Chamberlain
Fish Hatchery Specialist 4	Kevin Young
Fish Hatchery Specialist 3	Scott Peterson
Fish Hatchery Specialist 3	Jesse Cody
Fish Hatchery Specialist 3	Luke Miller
Fish Hatchery Specialist 2	Jim Trammell
Fish Hatchery Specialist 2	Doni Calstoy
Fish Hatchery Specialist 2	Tiffany Farrar
Fish Hatchery Specialist 2	Jay VonBargen
Fish Hatchery Specialist 2	Chris Roe
Fish Hatchery Specialist 2	Bryan Coyle
Fish Hatchery Specialist 2	Dwayne Fossen
Fish Hatchery Specialist 2	Grant Sill
Fish Pathologist	Sean Roon

Executive Summary

Adult returns for 2020 for the Lewis River were descent on some but others were low. Early and Late Coho each exceeded 10,000 adults and was enough to provide all program goals for brood stock, shipping fish upstream and achieving our egg take goal, Spring Chinook returned 1337 which is about what was projected for the pre-season run forecast and is showing signs of improvements. We were able to meet program goals for brood stock and egg take. Steelhead returns were low this year as they were region wide, we had 2024 Summer Steelhead and currently only 766 Winter Steelhead returned. We were able to meet program goals for brood stock, egg take and managed to continue our Summer Steelhead recycling program to allow anglers another chance to catch them. We also planted Horseshoe Lake with 113 adult winter Steelhead to give anglers an opportunity.

The overall juvenile rearing for all stocks went well with no major issues. Our Spring Chinook release strategies continued in 2020 with an October group, 3 groups in February and a June release group. We are just starting to see our returns from these strategies and the next few years we will be able to pull some data and determine how the future of this program will continue. As for Coho, Steelhead and Kokanee rearing was good with nothing significant to report. Rainbow Trout were planted into Swift Reservoir and the Swift Power Canal. This year due to COVID-19 there were no fishing derbies held at the Merwin Park or Merwin Hatchery. The fish for those derbies were planted into Swift Power Canal and Merwin Reservoir.

All facilities kept up with maintenance of equipment, infrastructure, and hatchery grounds. There were a couple of capital projects done in 2020 those were replacing asphalt at Lewis River Hatchery, Merwin Hatchery had a sink hole materialize in October that required a lot of attention. The sink hole was created by the hatchery effluent pipes flowing into a manhole had detached overtime, so the manhole was replaced with a larger size and the pipes were put back in place this project took approximately two months of work. All facilities are looking and operating well thanks to the staff of WDFW and PacifiCorp.

Staff here on the Lewis River system both WDFW and PacifiCorp are some of the best in the industry and committed to facing challenges in front of us now and in the future with both professionalism and dedication.