Klamath Falls National Fish Hatchery

Annual Report for Fiscal Year 2022

Prepared by:

U.S. Fish and Wildlife Service

Klamath Falls National Fish Hatchery

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Table of Contents

Executive Summary

The 2022 fiscal year (FY) (October 1, 2021 to September 30, 2022) saw many important developments and improvements made the Sucker Assisted Rearing Program (SARP), now also known as the Klamath Falls National Fish Hatchery (KFNFH). To help support the dwindling populations of Klamath Basin Suckers, the staff collected a total of 51,929 wild larval suckers, from the CY2022 year class, and approximately 37,005, about 71.3%, were incorporated into the hatchery population in ponds. During fiscal year 2022, 12,768 production fish and 4,655 fingerlings were stocked and released, and 19,993 experimentally hatched fry were transferred to another hatchery, totaling 37,416 produced in FY22. This brings the total number of fish reared and released or transferred to date from the hatchery program to approximately 75,423 fish, with approximately 1,312 of the tagged fish being detected on remote arrays in Upper Klamath Lake to date.

Applied research was conducted by staff during the FY2022 to improve the following: fish spawning and incubation, larval collection and rearing methods, monitoring the species assemblage of the larval drift, assessing how different diets affects growth and survival, and changing net pen locations to assess growth and overall survival during summer grow out. Many of these efforts will continue to be monitored through the FY2023 so that we can continue to refine our processes.

A major milestone for the Klamath Falls National Fish Hatchery was the commencement of hatchery construction. After several years of environmental assessment and feasibility planning, conceptual design planning, securing the site through a long-term lease, the designation of the national fish hatchery, and bid solicitations and awards, both Phases 1 and 2 of construction were awarded within the fiscal year. The Phase 1 construction package includes initial site grading, the installation of a new retention head pond, the formation of four 0.125-acre and six 0.25-acre production ponds, and the installation of utility, communication, water supply and effluent drainage, and stormwater drainage infrastructure from the top of the lease area 1 to the entrance road. The Phase 2 construction package will include the construction of our building infrastructure to include a hatchery and administrative building, a maintenance shed, a chemical storage outbuilding, and a feed storage building, along with fencing of the entire perimeter of the lease area 1 site and will be completed during the fall of 2024. While the active construction will limit production space and capacity in 2023, it will allow us to gain an additional 2.0-acres of production pond space in 2024. Also, the Phase 3 construction package is currently being planned for an award in 2023 and will include the addition of six 0.125-acre, six 0.25-acre, and eight 0.5-acre production ponds, as well as a 0.5-acre effluent retention pond, for a total of an additional 6.25-acres of production space, which will be completed in 2025. This new hatchery infrastructure will greatly increase the production capacity.

For more information on the fiscal activities described, please see below for summaries and results for the activities completed in FY2022.

Introduction

The Shortnose Sucker (*Chasmistes brevirostris*) and the Lost River Sucker (*Deltistes luxatus*) were listed by the US Fish and Wildlife Service (USFWS) as endangered in 1988. These species are long-lived freshwater fish that are endemic to very few lakes and rivers in the upper Klamath Basin of southern Oregon and northern California, with lifespans of 30+ and 50+ years respectively. The Revised Recovery Plan for the Lost River Sucker (*Deltistes luxatus*) and Shortnose Sucker (*Chasmistes brevirostris*) called for the development of a controlled propagation program to prevent extinction. This was initially achieved in 2016, through a cooperative partnership with a local landowner of fish rearing facility to use the existing geothermal water source, ponds, and infrastructure to growout wild caught sucker larvae, which was known as the Sucker Assisted Rearing Program (SARP). Due to the success of the program, in 2022 the USFWS signed a 30-year lease with the landowner and designated the site as the Klamath Falls National Fish Hatchery (KFNFH). The facility is currently under construction through 2026/2027 to expand the production capacity and infrastructure. Upon completion, the KFNFH will include a total of 31 production ponds, a new influent retention pond, an effluent retention pond, a hatchery and administrative building, a maintenance shop, chemical and feed storage buildings, a backup well, and telecom and supervisory control and data acquisition (SCADA) systems. This new infrastructure will allow for the production of approximately 60,000 suckers annually to help stabilize and rebuild existing sucker populations. For more information on the collections and releases of suckers since the program's inception, including releases to date in the current fiscal year of 2023, please see **Table 1**.

Table 1 – Collection and release information for the Klamath Falls National Fish Hatchery since its inception in 2016 by fiscal years; federal fiscal years run from October 1st through the following September 30th of each year. During fiscal year 2022, 12,768 production fish and 4,655 fingerlings were released, and 19,993 experimentally hatched fry were transferred to another hatchery, totaling 37,416 produced in FY22.

Fiscal Year	Larvae Collected	Production Release	TL (mm)	Fingerling Release	TL (mm)	Fry Release	TL (mm)	Salvage Release	SL or TL (mm)
2016	4,134	-	-	-	-	-	-	-	-
2017	8,730	-	-	-	-	-	-	-	-
2018	9,544	2,355	147	-	-	-	-	784	102 [SL]
2019	24,426	4,497	189	-	-	-	-	1,586	103 [SL]
2020	40,603	11,774	223	-	-	-	-	1,928	94 [SL]
2021	106,710	13,394	208	-	-	-	-	1,689	143 [SL]
2022	51,929	12,768	193	4,655	118	19,993	10	-	-
Total	**246,076**	**44,788**		**4,655**		**19,993**		**5,987**	

The KFNFH uses a geothermal well permitted to supply up to 399 gallons per minute (GPM) of water at approximately 88°C. To make this water suitable for fish culture operations, it is currently retained in three serial head ponds, whereby it is allowed to cool to ambient temperatures for use in tanks and ponds. It can also be used in small quantities directly into ponds for water exchange purposes year-round, or in larger quantities to artificially warm the ponds in the winter months, allowing KFNFH to alter and/or extend the growing season. During FY2022, the outdoor facility included 46 0.03-acre ponds and four 0.25-acre ponds, totaling nearly 2.1 acres of space. These ponds were utilized for broodstock

retention and primary grow out space of production juvenile suckers. For more information on the outdoor pond layout, please see **Figure 1** below.

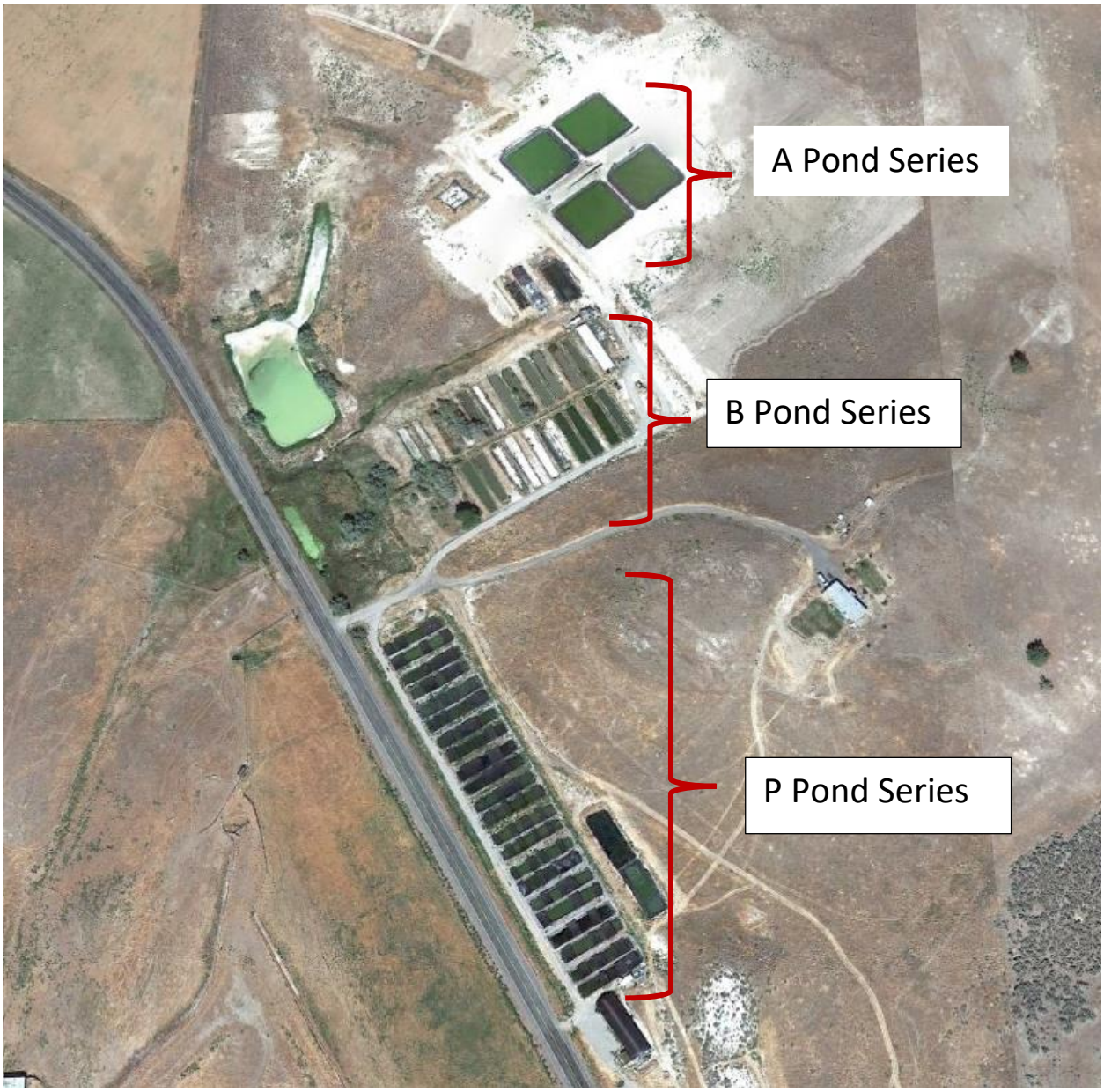

Figure 1 – An aerial view of the layout of ponds during Fiscal Year 2022 at the Klamath Falls National Fish Hatchery.

The indoor facility is located in a 30'x100' greenhouse, includes five 1300-gallon, three 500-gallon green circular tanks, thirteen 150-gallon dark blue rectangular tanks, twelve 90-gallon green circular tanks, eight 60-gallon light blue circular tanks, three 175-gallon light blue circulars, and four bulk utility rack

systems (hereafter Research Racks), each equipped with a 180-gallon light blue rectangular sump. For more information on the tank layout in the greenhouse, please see **Figure 2** below**.**

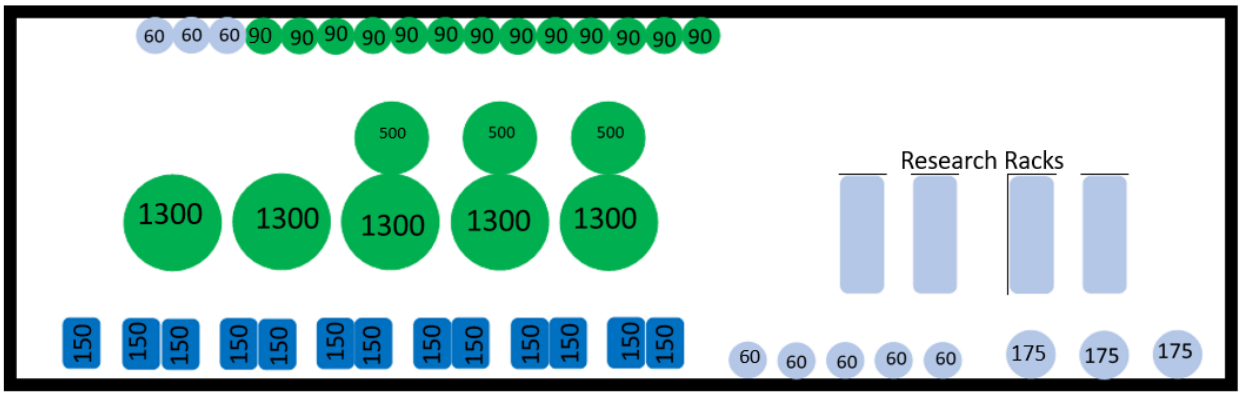

Figure 2 –Layout of tanks in the greenhouse at the Klamath Falls National Fish Hatchery in FY2022. The numbers indicate the tank capacity in gallons.

The production cycle begins with the collection of larval suckers, that drift down the Williamson River from early May through late June or early July of each year. Larval suckers are collected, either with stationary drift nets and/or by active pursuit with dip nets. The fish are then transported back to the hatchery in 48-50 quart coolers where they are tempered to the hatchery water supply, and enumerated into rearing tanks. Once in the tanks, fish are fed Artemia nauplii and put on a four-day prophylactic treatment protocol, for removal of ectoparasites, then stocked into ponds. The fish are occasionally kept indoors for an additional four to six weeks for feed training. During feed training they are fed decapsulated and freshly hatched Artemia nauplii multiple times daily. After14-21 days post-collection, larvae are supplemented with commercially available starter diets. All ponds are fertilized and contain high zooplankton blooms for natural forage before any juvenile fish are ponded.

Once fish are ponded, water quality is monitored daily by staff. Throughout the 18-24 month grow out cycle, staff ensure that fish have adequate dissolved oxygen (DO) levels, that are conducive to lower stress and optimize growth; this includes morning DO measurements above 4-5 mg/L. If the DO is less than 3 mg/L during morning DO measurements, fish are temporarily not fed or were given a reduced ration, and/or corrective actions using surface aerators were immediately taken. The fish were fed commercially available diets in progressively larger pellet sizes as they grew, at rates that began at 15-30% body weight (BW) daily and then were reduced progressively down to about 3-5% BW daily. By the end of the first growing season, generally the juvenile suckers are nearing 100-125mm total length by November or December. During the cooler winter months, feed rates are usually reduced to 1-2% BW, one to three times weekly, depending upon water temperature and the lower metabolism in colder water. During the second growing season, which usually starts in April or May, feed rates usually range between 2-3% BW daily as the fish get older and their metabolism and growth slows. After the second growing season they average approximately 200mm total length. They are thereby strategically stocked and repatriated into various parts of Upper Klamath Lake and its tributaries.

Larval Collections

Larval suckers were collected in 2022 primarily using a motorized boat to actively dip net fish in the lower Williamson River. Active netting is conducted between 8:00am to 12:00pm each collection day. Traditional passive drift net techniques were utilized early in the collection season, but it was determined that low river flows led to ineffective catch rates, which called for the transition to active collection methods. In total, 51,929 larval suckers were collected and counted into tanks at KFNFH. From the 51,929 fish collected, approximately 37,005 fish were ponded from the early rearing effort. Initial survival through early rearing was 71.3%. Please see **Figures 3** for more information on collection numbers and the overall rate of collection of fry during 2022.

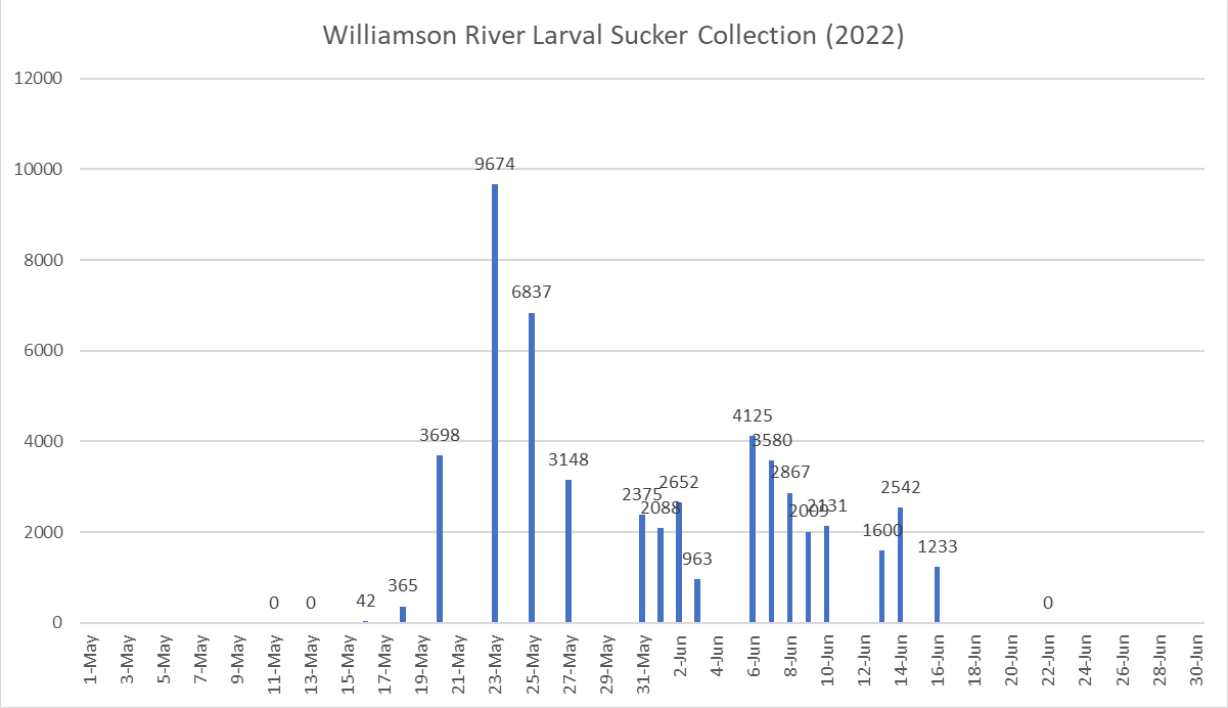

Figure 3 – Display of the collection peaks daily, with approximately 51,929 larval suckers collected from 5/11/2022 to 6/22/2022 from the lower Williamson River.

Hatchery Operations

Daily operations of the hatchery include monitoring water quality in ponds, adjusting geothermal flows to regulate temperatures, feeding fish, monitoring fish health, growth, and size. Fish are harvested from ponds each spring and fall to inventory stocks, redistribute fish to new ponds to lower rearing densities, to PIT tag younger fish, and/or to stock or transfer fish off station for repatriation or off site grow out. Overall, the hatchery saw high survival rates, generally over 85-90% for most age 1+ lots and consistent growth rates throughout the production cycles (**Table 2**, **Table 3, Table 4**).

Observed fish mortality increased when temperature was augmented in the winter, using geothermal inputs. Generally, mortality was low in the warmer summer months, however there were two exceptions to this; Ponds A4 and A2 (collected in 2022) had significant and ongoing mortality in August and September, which prompted fish health evaluations. Fish health assessments were conducted by staff from the USFWS CA/NV Fish Health Center and no signs of infectious agents were detected or observed. The only noteworthy observation was that many of the fish were showing signs of tetany, with visual bruising on the lateral side of the fish. Causes of tetany in these fishes remain unknown and the chronic mortality continued until the ponds started to cool down in October. One other small mortality event occurred in Pond P9 (collected in 2022) in December. The fish health evaluation showed no signs of infectious agents but tetany was also observed in several of the fish sampled. One other significant finding was that several of the fish were also experiencing necrosis of the gill lamellae due to complications with the winter phenomena of developing thickened lamellae and intracellular masses to help conserve ion loss. The suckers in this pond were treated with a salt bath to help alleviate these symptoms. Mortality decreased in all feed study ponds (Ponds P9-P16) when temperatures were cooled from an augmented target of 12^{o}C to under 5^{o}C in early December. For more information on fish mortality during the calendar year of 2022, please see **Figure 5**.

The ponds are monitored daily each morning for water temperature and dissolved oxygen readings, which in turn determine the feed rations given to the fish in the ponds each feed day. These data values are recorded electronically and on hard copy data sheets daily. For more information on water temperature and dissolved oxygen trends during the calendar year of 2022, please see **Figures 6 and 7**.

Table 2 - This shows inventory, growth, and survival for ponds during the production cycle starting in the Spring of 2021 through the Fall of 2021 at the Klamath Falls National Fish Hatchery. The last six rows in the table are summary numbers for each year class on station and the overall for the harvest season.

Pond	Lot	Stocked to Pond	Start #	Start TL (mm)	Harvest Date	End #	End TL (mm)	Total Days	Growth (mm/day)	Total Growth (mm)	Harvest Morts	Overall Survival (%)
P18	2020	4/25/2021	1100	131	10/4/2021	1085	185	162	0.33	54	35	101.8
P20	2020	4/19/2021	994	118	10/4/2021	858	152	168	0.20	34	5	86.8
P19	2020	4/19/2021	1000	131	10/6/2021	803	168	170	0.22	37	35	83.8
P21	2020	3/19/2021	1100	121	10/6/2021	936	165	201	0.22	44	25	87.4
B2	2020	3/23/2021	450	123	10/18/2021	354	195	209	0.34	72	9	80.7
B4	2020	3/26/2021	600	152	10/18/2021	458	195	206	0.21	43	1	76.5
B6	2020	3/23/2021	750	139	10/18/2021	655	183	209	0.21	44	17	89.6
B8	2020	3/24/2021	900	142	10/18/2021	754	185	208	0.21	43	12	85.1
B1	2020	3/22/2021	450	121	10/20/2021	357	190	212	0.33	69	3	80.0
B3	2020	3/23/2021	600	121	10/20/2021	542	180	211	0.28	59	11	92.2
B5	2020	3/22/2021	750	122	10/20/2021	599	168	212	0.22	46	19	82.4
B7	2020	3/25/2021	900	143	10/20/2021	698	188	209	0.22	45	16	79.3
B9	2020	3/31/2021	450	122	10/25/2021	420	189	208	0.32	67	9	95.3
B11	2020	4/1/2021	600	124	10/25/2021	564	186	207	0.30	62	8	95.3
B13	2020	3/31/2021	750	139	10/25/2021	633	179	208	0.19	40	1	84.5
B15	2020	4/1/2021	900	125	10/25/2021	806	175	207	0.24	50	6	90.2
B10	2020	3/30/2021	450	102	10/26/2021	401	178	210	0.36	76	3	89.8
B12	2020	3/31/2021	600	123	10/26/2021	556	188	209	0.31	65	4	93.3
B14	2020	3/29/2021	750	102	10/26/2021	643	171	211	0.33	69	9	86.9
B16	2020	4/2/2021	900	125	10/27/2021	846	186	208	0.29	61	11	95.2
B17	2020	4/8/2021	450	118	11/1/2021	421	181	207	0.30	63	0	93.6
B19	2020	4/9/2021	600	119	11/1/2021	541	178	206	0.29	59	4	90.8
B21	2020	4/7/2021	750	119	11/1/2021	672	174	208	0.26	55	7	90.5
B23	2020	4/5/2021	900	129	11/1/2021	845	171	210	0.20	42	9	94.9
B24	2020	4/5/2021	900	128	11/2/2021	762	180	211	0.25	52	28	87.8
B22	2020	4/6/2021	600	129	11/3/2021	528	187	211	0.27	58	20	91.3
B20	2020	4/2/2021	750	121	11/3/2021	697	177	215	0.26	56	8	94.0
B18	2020	1/4/2021	450	149	11/5/2021	420	191	305	0.14	42	12	96.0
P0	2019	4/15/2021	244	230	11/8/2021	230	266	207	0.17	36	0	94.3
P8	2018	9/16/2020	262	243	11/8/2021	255	279	418	0.09	36	0	97.3
P1	2017	5/11/2021	100	323	11/9/2021	91	348	182	0.14	25	0	91.0
P9	2019	9/16/2020	295	229	11/10/2021	290	272	420	0.10	43	1	98.6
P2	2021	7/9/2021	603	22	11/10/2021	518	98	124	0.61	76	1	86.1
P3	2021	3/4/2021	905	21	11/10/2021	818	89	251	0.27	68	14	91.9
P4	2021	7/9/2021	1210	21	11/16/2021	1017	89	130	0.52	68	30	86.5
P5	2021	7/9/2021	601	20	11/16/2021	385	93	130	0.56	73	60	74.0
P6	2021	7/9/2021	1811	19	11/17/2021	1372	93	131	0.56	74	119	82.3
P7	2021	7/9/2021	1555	18	11/17/2021	1486	89	131	0.54	71	120	103.3
P10	2021	7/9/2021	1500	19	11/22/2021	542	100	136	0.60	81	29	38.1
P11	2021	7/9/2021	901	18	11/22/2021	800	97	136	0.58	79	11	90.0
P12	2021	3/12/2021	1207	19	11/23/2021	1055	96	256	0.30	77	24	89.4
P13	2021	3/12/2021	1502	18	11/23/2021	1137	101	256	0.32	83	12	76.5
P17	2021	2/24/2021	1501	22	11/29/2021	1237	99	278	0.28	77	270	100.4
P16	2021	2/16/2021	1200	23	11/29/2021	969	101	286	0.27	78	64	86.1
P15	2021	3/9/2021	914	23	11/30/2021	783	105	266	0.31	82	10	86.8
P14	2021	3/11/2021	604	22	11/30/2021	575	103	264	0.31	81	4	95.9
	2017		**100**			**91**					**0**	**91.0**
	2018		**262**			**255**					**0**	**97.3**
	2019		**539**			**520**					**1**	**96.7**
	2020		**20394**			**17854**					**327**	**89.1**
	2021		**16014**			**12694**					**768**	**84.1**
	Overall		**37309**			**31414**					**1096**	**87.1**

Table 3 - This shows inventory, growth, and survival for ponds during the production cycle starting in the Fall of 2021 through the Spring of 2022 at the Klamath Falls National Fish Hatchery. The last six rows in the table are summary numbers for each year class on station and the overall for the harvest season.

Pond	Lot	Stocked to Pond	Start #	Start TL (mm)	Harvest Date	End #	End TL (mm)	Total Days	Growth (mm/day)	Total Growth (mm)	Harvest Morts	Overall Survival (%)
P3	2019	3/2/2021	230	228	2/28/2022	228	265	363	0.10	37	0	99.1
P1	2018	3/2/2021	254	281	2/28/2022	251	281	363	0.00	0	0	98.8
P0	2017	5/10/2021	91	323	2/28/2022	90	351	294	0.10	28	0	98.9
P2	2019	11/11/2021	290	286	3/1/2022	287	279	110	-0.06	-7		99.0
B1	2020	11/4/2021	450	178	3/7/2022	363	173	123	-0.04	-5	9	82.7
B3	2020	11/4/2021	450	178	3/7/2022	342	172	123	-0.05	-6	6	77.3
B5	2020	11/4/2021	450	186	3/7/2022	398	176	123	-0.08	-10	4	89.3
B7	2020	11/4/2021	450	192	3/7/2022	388	186	123	-0.05	-6	10	88.4
B9	2020	11/4/2021	450	194	3/9/2022	408	188	125	-0.05	-6	8	92.4
B11	2020	11/4/2021	450	188	3/9/2022	402	181	125	-0.06	-7	0	89.3
B13	2020	11/5/2021	450	200	3/9/2022	420	191	124	-0.07	-9	1	93.6
B2	2020	10/21/2021	1000	179	3/14/2022	829	171	144	-0.06	-8	14	84.3
B4	2020	10/22/2021	1000	179	3/14/2022	747	173	143	-0.04	-6	13	76.0
B6	2020	10/27/2021	1000	179	3/14/2022	636	173	138	-0.04	-6	32	66.8
B8	2020	10/27/2021	1000	179	3/14/2022	822	168	138	-0.08	-11	9	83.1
B10	2020	10/29/2021	1000	179	3/16/2022	737	177	138	-0.01	-2	35	77.2
B12	2020	11/2/2021	1000	181	3/16/2022	851	172	134	-0.07	-9	13	86.4
B14	2020	11/4/2021	393	185	3/16/2022	314	178	132	-0.05	-7	5	81.2
P18	2020	10/7/2021	1011	178	3/21/2022	658	169	165	-0.05	-9	29	68.0
P19	2020	10/12/2021	989	176	3/21/2022	817	165	160	-0.07	-11	10	83.6
P20	2020	10/4/2021	986	172	3/21/2022	872	164	168	-0.05	-8	31	91.6
P21	2020	10/21/2021	1000	179	3/23/2022	698	172	153	-0.05	-7	33	73.1
B16	2021	11/23/2021	1003	97.4	3/28/2022	947	99	125	0.01	2	8	95.2
B22	2021	11/18/2021	1009	90	3/28/2022	904	99	130	0.07	9	23	91.9
B24	2021	11/24/2021	1001	101	3/28/2022	903	104	124	0.02	3	33	93.5
B18	2021	11/17/2021	999	97	3/29/2022	924	99	132	0.02	2	19	94.4
B20	2021	11/24/2021	985	96	3/29/2022	896	96	125	0.00	0	0	91.0
B21	2021	11/18/2021	1042	90	3/30/2022	968	90	132	0.00	0	25	95.3
B17	2021	11/12/2021	992	90	3/30/2022	839	94	138	0.03	4	37	88.3
B15	2021	11/12/2021	1043	99	3/31/2022	934	103	139	0.03	4	36	93.0
B23	2021	12/6/2021	996	88	3/4/2022	923	91	88	0.03	3	12	93.9
B19	2021	11/17/2021	985	94	3/4/2022	865	94	107	0.00	0	11	88.9
P16	2021	12/6/2021	1000	99	3/7/2022	832	101	91	0.02	2	81	91.3
P15	2021	12/6/2021	1014	105	3/7/2022	883	107	91	0.02	2	22	89.3
P14	2021	12/6/2021	539	100	3/7/2022	459	105	91	0.05	5	22	89.2
A1	2021	6/17/2021	15000	20		9717	115			95	65	65.2
A2	2021	6/17/2021	12500	20		6154	120			100	194	50.8
A4	2021	6/17/2021	10000	20		2128					43	21.7
	2017		**91**			**90**					**0**	**98.9**
	2018		**254**			**251**					**0**	**98.8**
	2019		**520**			**515**					**0**	**99.0**
	2020		**13529**			**10702**					**262**	**81.0**
	2021		**50108**			**29276**					**631**	**59.7**
	Overall		**64502**			**40834**					**893**	**64.7**

Table 4 - This shows inventory, growth, and survival for ponds during the production cycle starting in the Spring of 2022 through the Fall of 2022 at the Klamath Falls National Fish Hatchery. The last seven rows in the table are summary numbers for each year class on station and the overall for the harvest season.

Pond	Lot	Stocked to Pond	Start #	Start TL (mm)	Harvest Date	End #	End TL (mm)	Total Days	Growth (mm/day)	Total Growth (mm)	Harvest Morts	Overall Survival (%)
P0	2017	3/2/2022	90	351	9/19/2022	87	393	201	0.21	42	0	96.7
P1	2018	3/1/2022	251	281	9/19/2022	232	317	202	0.18	36	0	92.4
P2	2019	3/3/2022	288	271	9/19/2022	259	309	200	0.19	38	0	89.9
P3	2019	3/3/2022	228	265	9/19/2022	183	319	200	0.27	54	0	80.3
P4	2020	3/8/2022	499	173	9/20/2022	468	230	196	0.29	57	0	93.8
P5	2020	3/9/2022	500	181	9/20/2022	470	243	195	0.32	62	0	94.0
P6	2020	3/24/2022	546	172	9/21/2022	502	318	181	0.80	146	0	91.9
P7	2020	3/24/2022	550	169	9/21/2022	505	279	181	0.60	110	0	91.8
P8	2021/2019	6/16/2022	80	98	9/21/2022	53	398	97	3.09	300	0	66.3
A3	2021	4/29/2022	3076	120	10/3/2022	803	195	157	0.48	75	0	26.1
P17	2021	5/3/2022	1079	120	10/17/2022	1024	177	167	0.34	57	33	98.0
P19	2021	5/3/2022	900	120	10/17/2022	868	174	167	0.32	54	9	97.4
P18	2021	5/3/2022	900	120	10/18/2022	866	176	168	0.33	56	19	98.3
P20	2021	5/3/2022	900	120	10/18/2022	837	182	168	0.37	62	34	96.8
B1	2021	4/14/2022	600	114	10/24/2022	380	168	193	0.28	54	12	65.3
B3	2021	4/18/2022	600	116	10/24/2022	430	178	189	0.33	62	15	74.2
B5	2021	4/18/2022	600	115	10/25/2022	574	189	190	0.39	74	2	96.0
B7	2021	4/18/2022	600	115	10/25/2022	565	174	190	0.31	59	2	94.5
B9	2021	4/19/2022	600	115	10/26/2022	547	175	190	0.32	60	5	92.0
B11	2021	4/19/2022	600	115	10/26/2022	556	172	190	0.30	57	5	93.5
B13	2021	4/20/2022	600	115	10/26/2022	575	185	189	0.37	70	3	96.3
B15	2021	4/20/2022	600	115	10/27/2022	537	170	190	0.29	55	2	89.8
B17	2021	4/19/2022	600	115	10/27/2022	580	187	191	0.38	72	3	97.2
B19	2021	4/19/2022	600	115	10/31/2022	544	184	195	0.35	69	7	91.8
B21	2021	4/14/2022	600	115	10/31/2022	587	185	200	0.35	70	2	98.2
B23	2021	4/14/2022	600	115	11/2/2022	568	182	202	0.33	67	2	95.0
B24	2021	4/1/2022	600	97	11/2/2022	557	177	215	0.37	80	21	96.3
B20	2021	4/1/2022	600	97	11/2/2022	575	177	215	0.37	80	3	96.3
B22	2021	3/31/2022	600	103	11/7/2022	522	164	221	0.28	61	7	88.2
B18	2021	3/31/2022	600	97	11/7/2022	496	174	221	0.35	77	0	82.7
B16	2021	3/31/2022	600	95	11/7/2022	544	177	221	0.37	82	34	96.3
B12	2021	3/29/2022	600	99	11/7/2022	587	171	223	0.32	72	3	98.3
B14	2021	3/30/2022	600	98	11/14/2022	561	181	229	0.36	83	8	94.8
B10	2021	3/30/2022	600	98	11/14/2022	565	167	229	0.30	69	2	94.5
B4	2021	3/28/2022	600	102	11/14/2022	562	177	231	0.32	75	9	95.2
B2	2021	3/28/2022	600	104	11/14/2022	569	193	231	0.39	89	14	97.2
B8	2021	3/29/2022	600	99	11/16/2022	563	176	232	0.33	77	6	94.8
B6	2021	3/29/2022	600	102	11/16/2022	565	192	232	0.39	90	5	95.0
A2	2022	5/23/2022	18985	11	12/7/2022	17430	96	198	0.43	85	335	93.6
	2017		**90**			**87**					**0**	**96.7**
	2018		**251**			**232**					**0**	**92.4**
	2019		**516**			**442**					**0**	**85.7**
	2020		**2095**			**1945**					**0**	**92.8**
	2021		**21255**			**17507**					**267**	**83.6**
	2022		**18985**			**17430**					**335**	**93.6**
	Overall		**43192**			**37643**					**602**	**88.5**

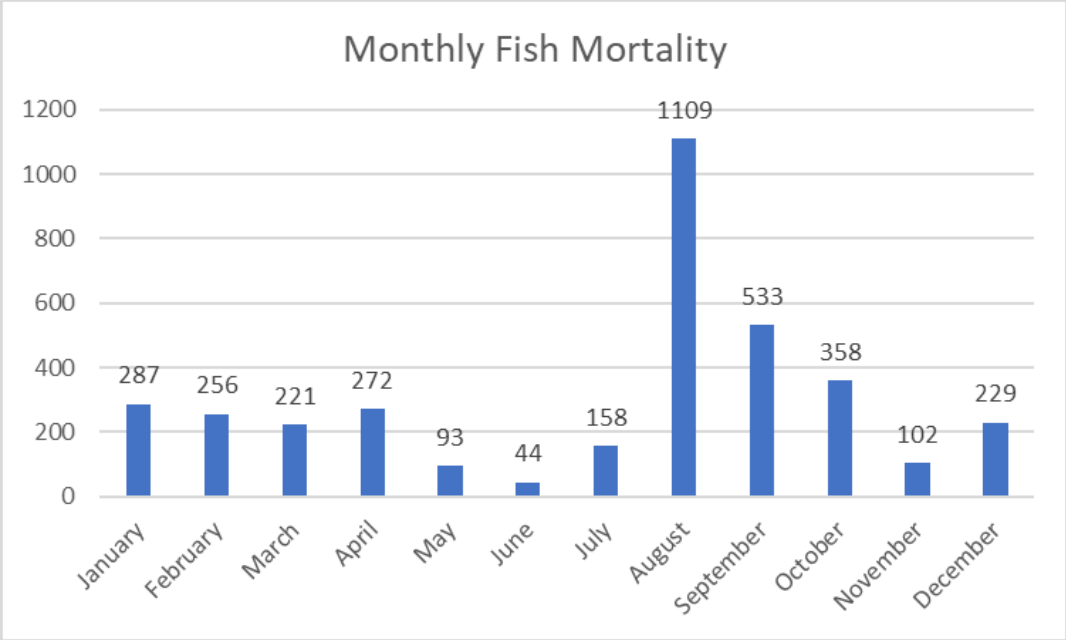

Figure 4- This shows the mortality trends, including harvest mortalities, at the Klamath Falls National Fish Hatchery during the calendar year of 2022.

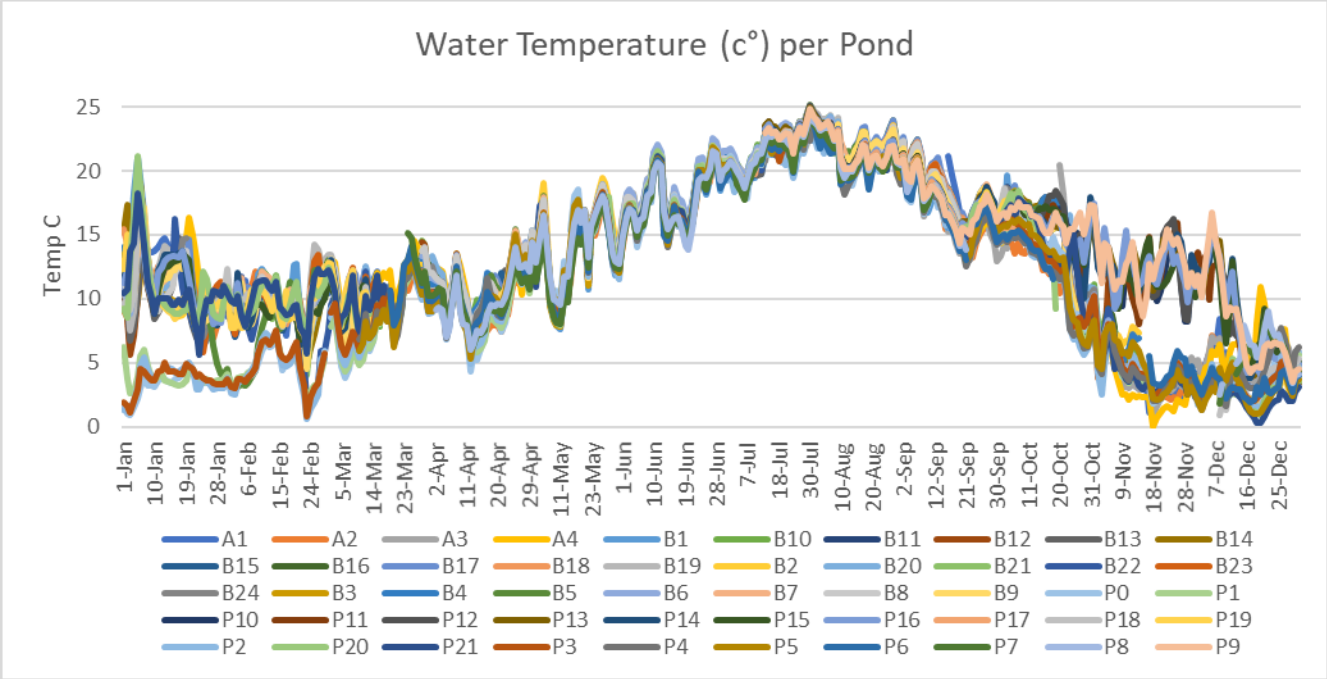

Figure 5 – Daily water temperature measured in degrees Celsius in each pond at the Klamath Falls National Fish Hatchery during the calendar year of 2022. Water temperature was measured once per day around 0630 am.

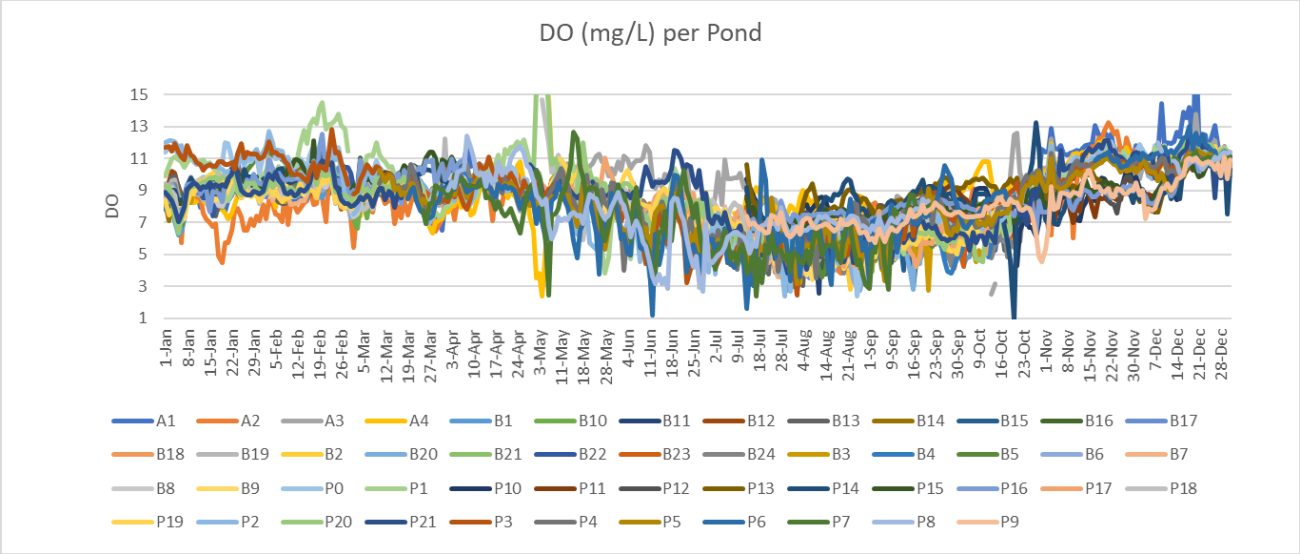

Figure 6 – Daily dissolved oxygen concentration measured in milligrams per liter in each pond at the Klamath Falls National Fish Hatchery during the calendar year of 2022. Dissolved oxygen was measured once per day around 0630 am.

Net Pen Grow Out

In 2019, the USFWS initiated the Net Pen Project in Upper Klamath Lake. Each spring, PIT-tagged, age 1+, hatchery-raised suckers are introduced to one of two net pens. The objective is to provide an *in situ* location, away from predation, for suckers to grow while survival is monitored. This program allows for suckers to be held at lower stocking densities and provides a transitional season for net pen suckers to acclimate to some of the environmental conditions in UKL.

In 2022, the Net Pen was stocked with the 2021 (age 1) year class of suckers at a new location, near the mouth of Four Mile Canal on the west side of Agency Lake, near Chiloquin, Oregon (**Figure 7**). The fish were PIT-tagged six months before net pen stocking, during the late fall of 2021, to detect presence and provide a real time estimate of sucker survival, two Biomark 5' wagon wheel antennas are placed in each net on the net pen. Having fish tagged from the previous growing season speeds up processing and release of fish and ensures the fish have healed from their tag wound prior to stocking the net pens.

Upper Klamath Lake West net pen (UKLW) was stocked 4/8/2022 with 1,999 fish with an estimated 200+ fish lost during transport across Agency Lake due to high winds and large waves. Upper Klamath Lake East net pen (UKLE) was stocked 4/15/2022 with 1,852 suckers, with no fish lost due to choppy water. A Yellow Springs Instrument (YSI) EXO1 water quality sonde monitored water temperature, dissolved oxygen, pH, and conductivity hourly at a depth of 1 feet below surface just outside the UKL net pens from 5/12/2022 to 10/11/2022. Water quality sondes were cleaned weekly and swapped with a lab-calibrated sonde every month. Net pens were visited weekly to check for the presence of observable fish mortality and to check sonde and PIT tag array operations. The net pens were harvested 10/13/2022 and 10/14/2022, suckers were scanned for the presence of a PIT tag, measured to total length and weight, any observable afflictions were noted, and all suckers were released at the site of the net pen, the mouth of Four-Mile Canal.

A steady decline in the number of suckers was inferred from detections on submersible antennas throughout the growing season (**Figure 8**). Bycatch density of nontarget fish in the net pens may have played a role in overall growth and survival of suckers. The nets were partially harvested in June, only to remove large numbers of bycatch, namely fathead minnows, tui chub, and blue chub, and to sample the suckers for size and condition before restocking into the net pen. Suckers had low growth and reduced body condition between June and October; many suckers were emaciated. Low growth in the net pen in the second half of the season may have been associated with the high bycatch density, which may have limited the amount of available food, and poor water quality. Dissolved oxygen concentrations were 0.0 mg/L on 8/1/22, 8/13/22-8/16/22, and 8/19/22 during the early part of each day. Dissolved oxygen dropped below 2 mg/L 20 times over the monitoring period, all occurring between 7/29/22 to 8/25/22 (**Figure 9**). Such unfavorable conditions certainly can contribute to increased stress, poor growth, and lower survival for suckers.

From harvest processing data, 947 suckers survived in UKLW (47.4 % survival) and 897 survived in UKLE (48.4%) for a total release of 1,844 suckers into the wild at the mouth of four-mile canal with an overall survival percentage of 47.9%. This is the highest net pen survival in program history, along with highest initial stocking densities of the net pen program to date in Upper Klamath and Agency Lakes. These higher stocking numbers may have contributed to the lower body condition and overall low growth but similar stocking densities have been used with even better growth and survival from the Gerber Reservoir net pen in 2021. This was also the first year at this location which has natural protection from

the wind and waves and could have decreased fish stress and probably improved survival overall, compared with the previous location in 2021 in Upper Klamath Lake, off Rattlesnake Point.

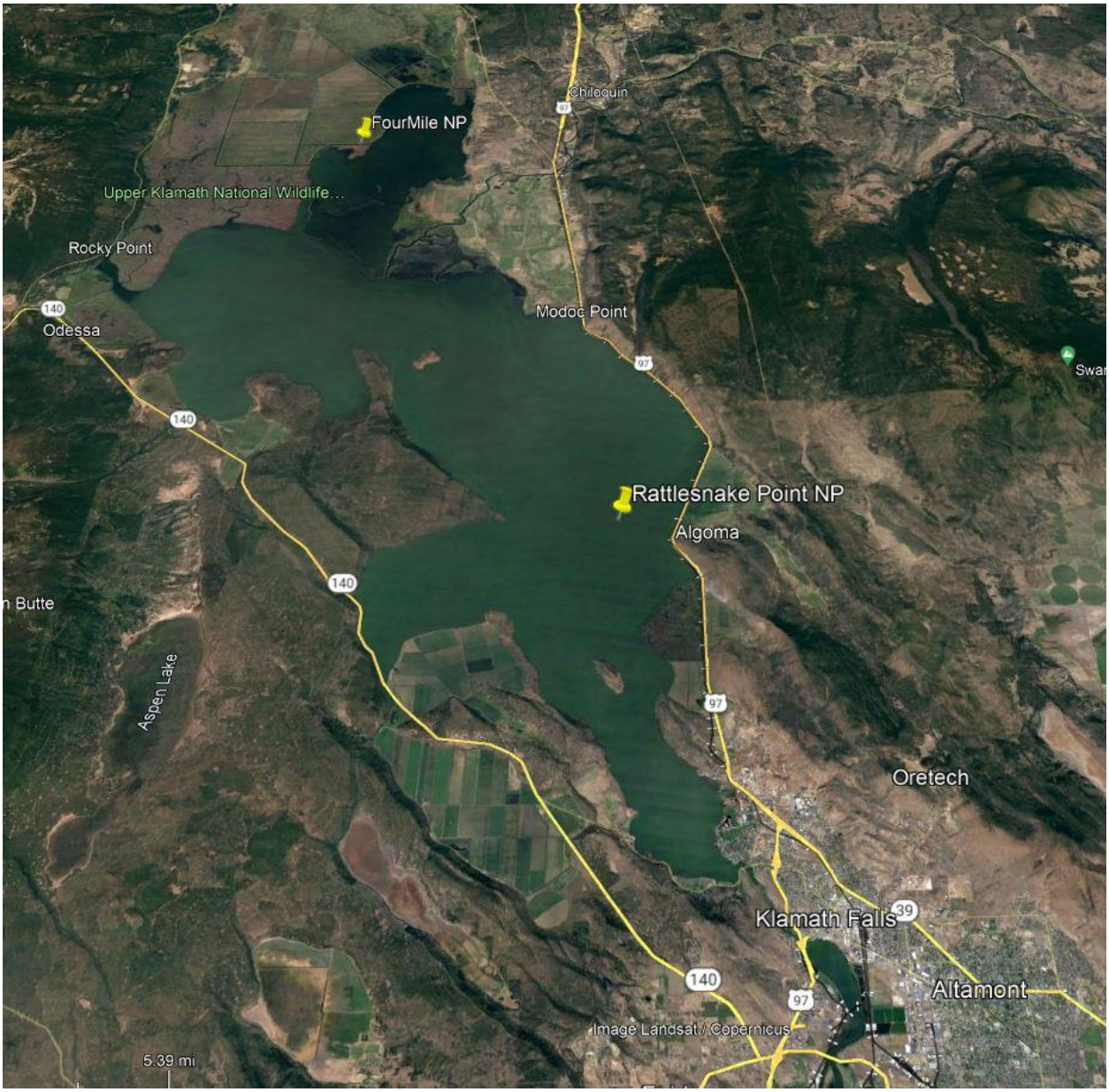

Figure 7 – Locations of the previous net pen location, Rattlesnake Point, in Upper Klamath Lake, and the current net pen location, Four Mile Canal, in Agency Lake.

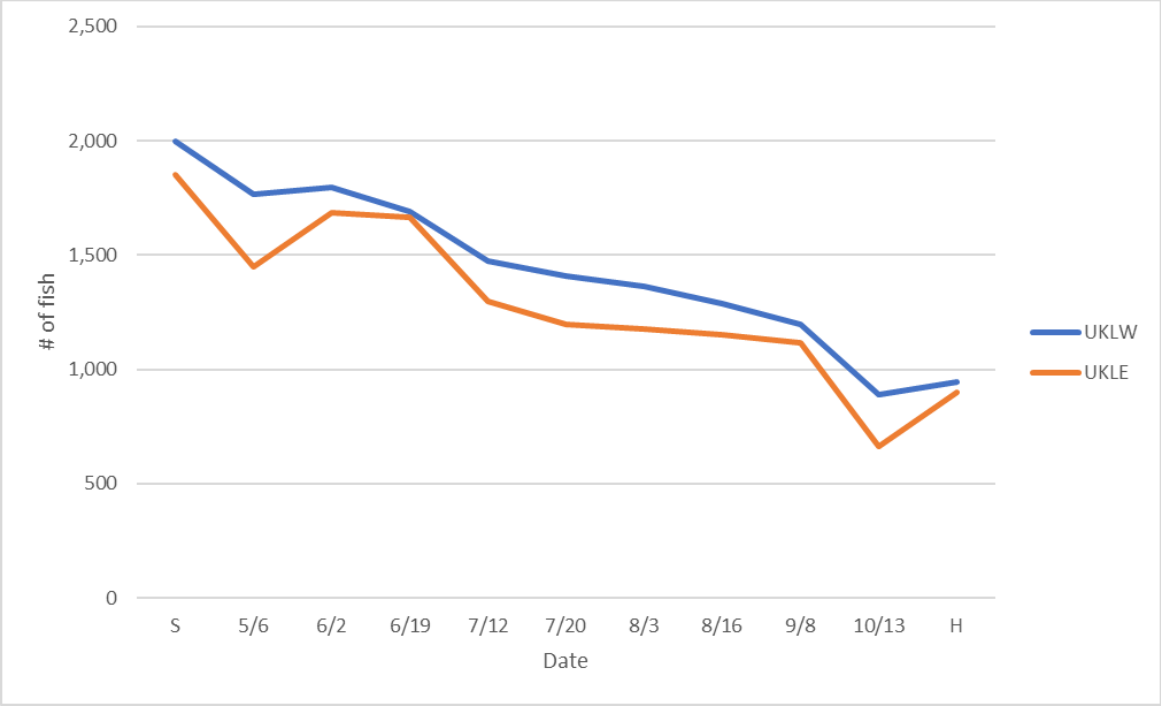

Figure 8 – Estimated number of suckers alive in net pens located at Four Mile Canal (UKLW and UKLE), based on detections from 5' submersible PIT tag antenna located two feet deep inside each net pen, in two-week time intervals. Census counts of suckers are known for the stock (S) and harvest (H) of each net pen.

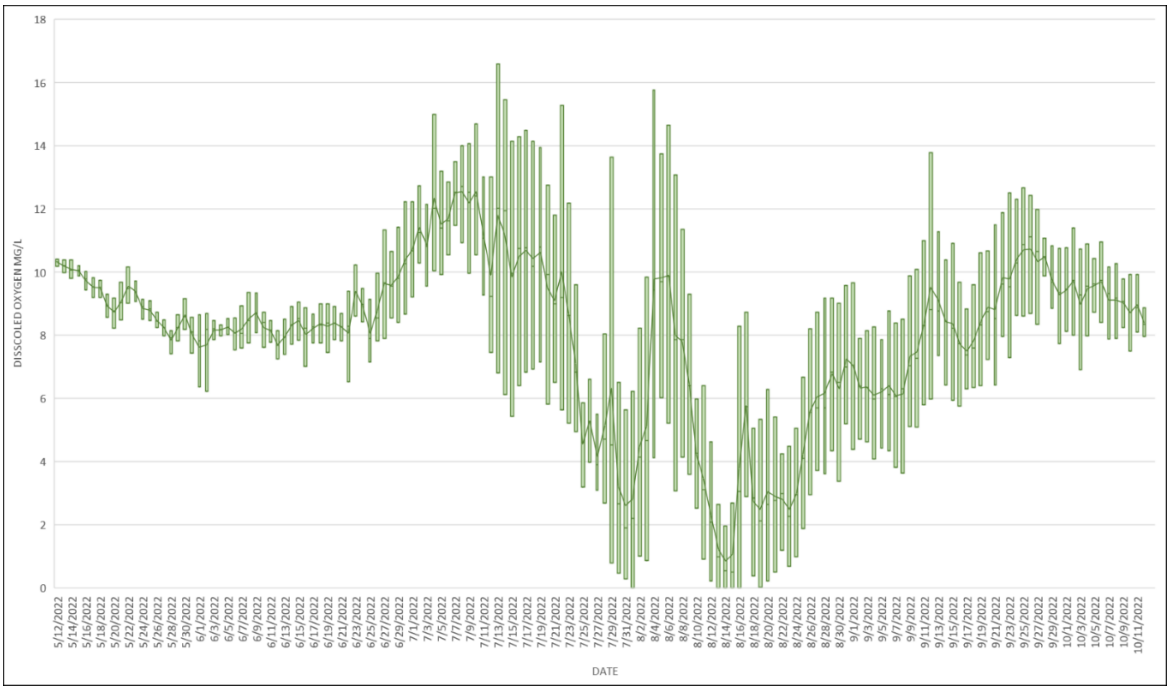

Figure 9 – Daily dissolved oxygen concentration minimum, maximum, and average recorded at the USFWS net pen at the mouth of 4 Mile Canal in Agency Lake near Chiloquin, Oregon. Measurements were taken hourly using a YSI multiparameter sonde.

Fish Distribution

In fiscal years 2018 and 2019, suckers were released in the spring of each year, when 22-24 months old. In 2020, suckers were released in the fall releases, when they were 17-18 months as they reached the target size of 200 millimeters, total length (TL) within this time. The smaller fish remained at the hatchery for a second winter before being released the following spring at 22-24 months old. In the fall of 2021, a total of 4,219 suckers were stocked from the 2020 collection year. In the spring of 2022, 8,549 suckers were stocked, bringing the fiscal year total to 12,768. The average total length overall was 193 mm. The first ever fingerling releases and fry transfers also occurred in the spring with 4,655 fingerlings (~9-10 months old) stocked to Lakeside Farms, ponds adjacent to Upper Klamath Lake and 19,993 fry transferred to the Klamath Tribes Hatchery. A total of 37,416 suckers were raised and released or transferred during the 2022 fiscal year. This brings the total number of fish reared and released or transferred to date from the hatchery program to approximately 75,423 fish. For more information on Fiscal Year 2022 fish distributions, please see **Tables 5**.

Table 5 – Number of suckers raised and released by the Klamath Falls National Fish Hatchery during fiscal year 2022, spanning from October 1, 2021 to September 30, 2022.

Date	Species	Lot	Fish Type	#	Weight (lb.)	#/lb.	Actual TL (mm)	Projected TL (mm)	Stocking Location
10/8/2021	LRS	2020	Production	354	56.43	6.27	206	203	Williamson River @ TNC
	SNS	2020	Production	207	37.78	5.48	201	202	Williamson River @ TNC
10/20/2021	LRS	2020	Production	401	64.66	6.20	204	203	Agency Lake @ Henzel
	SNS	2020	Production	731	153.2	4.77	207	211	Agency Lake @ Henzel
10/22/2021	LRS	2020	Production	155	24.36	6.36	199	202	Agency Lake @ Henzel
	SNS	2020	Production	537	99.03	5.42	201	202	Agency Lake @ Henzel
10/26/2021	LRS	2020	Production	258	39.7	6.50	199	200	Odessa Springs @ Campground
	SNS	2020	Production	478	86.74	5.51	199	201	Odessa Springs @ Campground
10/28/2021	LRS	2020	Production	165	25.36	6.51	199	200	Odessa Springs @ Campground
	SNS	2020	Production	590	106.75	5.53	199	201	Odessa Springs @ Campground
October	**LRS**	**2020**	**Production**	**1333**	**210.51**	**6.33**		**202**	
	SNS	**2020**	**Production**	**2543**	**483.5**	**5.26**		**204**	
	Overall Total			**3876**	**694.01**	**5.58**		**211**	
11/3/2021	LRS	2020	Production	107	17.22	6.21	200	203	Upper Klamath Lake @ Rocky Point
	SNS	2020	Production	236	42.26	5.58	198	200	Upper Klamath Lake @ Rocky Point
November	**LRS**	**2020**	**Production**	**107**	**17.22**	**6.21**		203	
	SNS	**2020**	**Production**	**236**	**42.26**	**5.58**		200	
	Overall Total			**343**	**59.48**	**5.77**		**208**	
3/11/2022	LRS	2020	Production	370	52.23	7.08	183	195	Upper Klamath Lake @ Rocky Point
	SNS	2020	Production	985	129.8	7.59	177	181	Upper Klamath Lake @ Rocky Point
3/16/2022	LRS	2020	Production	837	102.76	8.15	175	186	Williamson River @ TNC
	SNS	2020	Production	2285	271.34	8.42	170	175	Williamson River @ TNC
3/18/2022	LRS	2020	Production	341	51.08	6.68	185	198	Agency Lake @ Henzel
	SNS	2020	Production	1355	161.38	8.40	173	175	Agency Lake @ Henzel
3/24/2022	LRS	2020	Production	757	83	9.12	169	179	Upper Klamath Lake @ Eagle Ridge Park
	SNS	2020	Production	1619	163.72	9.89	165	166	Upper Klamath Lake @ Eagle Ridge Park
March	**LRS**	**2020**	**Production**	**2305**	**289.07**	**7.97**		**187**	
	SNS	**2020**	**Production**	**6244**	**726.24**	**8.60**		**173**	
	Overall Total			**8549**	**1015.31**	**8.42**		**184**	
4/21/2022	LRS	2021	Fingerling	236	6.96	33.91	115	115	ODOT Pond
	SNS	2021	Fingerling	569	16.77	33.93	115	110	ODOT Pond
4/21/2022	LRS	2021	Fingerling	502	14.79	33.94	115	115	Lakeside Farms Pond
	SNS	2021	Fingerling	1210	35.66	33.93	115	110	Lakeside Farms Pond
April	**LRS**	**2021**	**Fingerling**	**738**	**21.75**	**33.93**		**115**	
	SNS	**2021**	**Fingerling**	**1779**	**52.43**	**33.93**		**110**	
	Overall Total	**2021**		**2517**	**74.18**	**33.93**		**115**	
5/3/2022	LRS	2021	Fingerling	626	20.68	30.27	121	120	Lakeside Farms Pond
	SNS	2021	Fingerling	1512	49.96	30.26	121	114	Lakeside Farms Pond
5/12/2022	LRS	2022	Fry	12793	0.28	45689.29	10.5	10	Transfer to Klamath Tribes Hatchery
5/23/2022	LRS	2022	Fry	7200	0.159	45283.02	10.5	10	Transfer to Klamath Tribes Hatchery
May	**LRS**	**2021**	**Fingerling**	**626**	**20.68**	**30.27**		**120**	
	SNS	**2021**	**Fingerling**	**1512**	**49.96**	**30.26**		**114**	
	LRS	**2022**	**Fry**	**19993**	**0.439**	**45542.14**		**10**	
	Overall Total			**22131**	**71.079**	**311.36**		**55**	
Fall of 2021	**LRS**	**2020**	**Production**	**1440**	**227.73**	**6.32**		**202**	
	SNS	**2020**	**Production**	**2779**	**525.76**	**5.29**		**215**	
	Overall Total			**4219**	**753.49**	**5.60**		**210**	
Spring of 2021	**LRS**	**2020**	**Production**	**2305**	**289.07**	**7.97**		**187**	
	LRS	**2021**	**Fingerling**	**1364**	**42.43**	**32.15**		**118**	
	LRS	**2022**	**Fry**	**19993**	**0.439**	**45542.14**		**10**	
	SNS	**2020**	**Production**	**6244**	**726.24**	**8.60**		**173**	
	SNS	**2021**	**Fingerling**	**3291**	**102.39**	**32.14**		**112**	
	Overall Total			**33197**	**1160.569**	**28.60**		**122**	
All of Fiscal Year 2022		**2020**	**Production**	**12768**	**1768.8**	**7.22**		**193**	
		2021	**Fingerling**	**4655**	**144.82**	**32.14**		**118**	
		2022	**Fry**	**19993**	**0.439**	**45542.14**		**10**	
Grand Total				**37416**	**1914.06**	**19.55**		**139**	

Hatchery Construction

After several years of planning, environmental compliance, permitting, and finalizing conceptual designs for various phases of construction, and developing bid packages, the first two phases of construction were awarded to contractors in fiscal year 2022 to advance the build of the new hatchery infrastructure. These awards totaled approximately $13.9 million of appropriated funds, either from 1311 Fisheries and Aquatic Conservation funds and/or Bipartisan Infrastructure Law funds.

Phase 1 construction was awarded to Morello Construction General Contractors in June of 2022 for the approximate price of $5.6 million. The contract outlined a variety of work tasks to include the site grading and preparation and installation of a one-acre head pond and four 0.12-acre fry production ponds in the top Tier-1 series of ponds, at the top of the facility on the first lease parcel, as well as the various water supplies, drain plumbing, liners, and kettles associated with each pond, a new stainless steel supply from the well to the head pond, electrical and SCADA conduit to each pond kettle, and storm water collection and drainage for the upper half of the site (**Figure 10**). This contract has a 24-month performance period running through June/July of 2024. Two tasks originally specified in Phase 1 were not awarded, due to line year funding limitations, which included the construction of an additional six 0.25-acre fry production ponds in the top Tier-1 series. These final two tasks are scheduled for award to Morello Construction General Contractors in fiscal year 2023, likely in the spring, when funds become available to cover the expense of this work. At the close of the fiscal year in September of 2022, the contractors had already completed rough grading and excavation of the ponds and were building levees to finish grade, as well as trenching in the cement storm water collection system near the upper tier of ponds. At the time of writing this in January of 2023, they had also extended the stormwater collection plumbing down to the bottom of the second lease area where a future effluent retention pond will be located in a future phase of construction but had demobilized for the winter due to unfavorable weather and soil conditions. They also continue to provide materials submittals for engineering approval to begin orders so that materials are on hand when they remobilize in the spring. For more information on what area of the facility is being constructed in Phase 1, please see **Figure 10**, where the blue lines encircle and/or delineate the work area.

Phase 2 construction was awarded to RJS Construction Inc. in August of 2022 for the approximate price of $8.3 million. The contract outlined a variety of tasks that include the construction of a hatchery and administrative building, a maintenance shop with a photovoltaic array, a chemical storage building, a feed storage building, an asphalt parking lot and entrance road, electrical and plumbing infrastructure, a septic system, and perimeter fencing around the larger main lease area. This contract has a 24-month performance period running through August of 2024. At the close of the fiscal year in September of 2022, the contractors had not even been authorized to begin work, since the preconstruction meeting was scheduled for October of 2022. At the time of writing this in January of 2023, they had begun the submittal of construction materials for approval and are planning to break ground by demolishing the current B-series ponds in March or April of 2023, pending weather and soil conditions. For more information on what area of the facility is being constructed in Phase 2, please see **Figure 10**, where the red line encircles the work area.

At the time of writing this in January 2023, Phase 3 construction designs were drafted into a solicitation package that will be put out for bid in February 2023, for an anticipated award by March/April of 2023. This contract will entail the construction of six 0.25-acre and eight 0.5-acre juvenile production ponds in

the Tier-2 series of ponds in the middle of the hatchery site on the first lease parcel, six 0.12-acre broodstock ponds, and one 0.5-acre effluent retention pond near the road in the second lease parcel, as well as the various water supplies, drain plumbing, liners, and kettles associated with each pond, electrical and SCADA conduit to each pond kettle, and storm water collection and drainage for the lower half of the site. This contract will likely have a 24-month performance period running through March/April of 2025. For more information on what area of the facility will be constructed in Phase 3, please see **Figure 10**, where the yellow lines encircle the work areas.

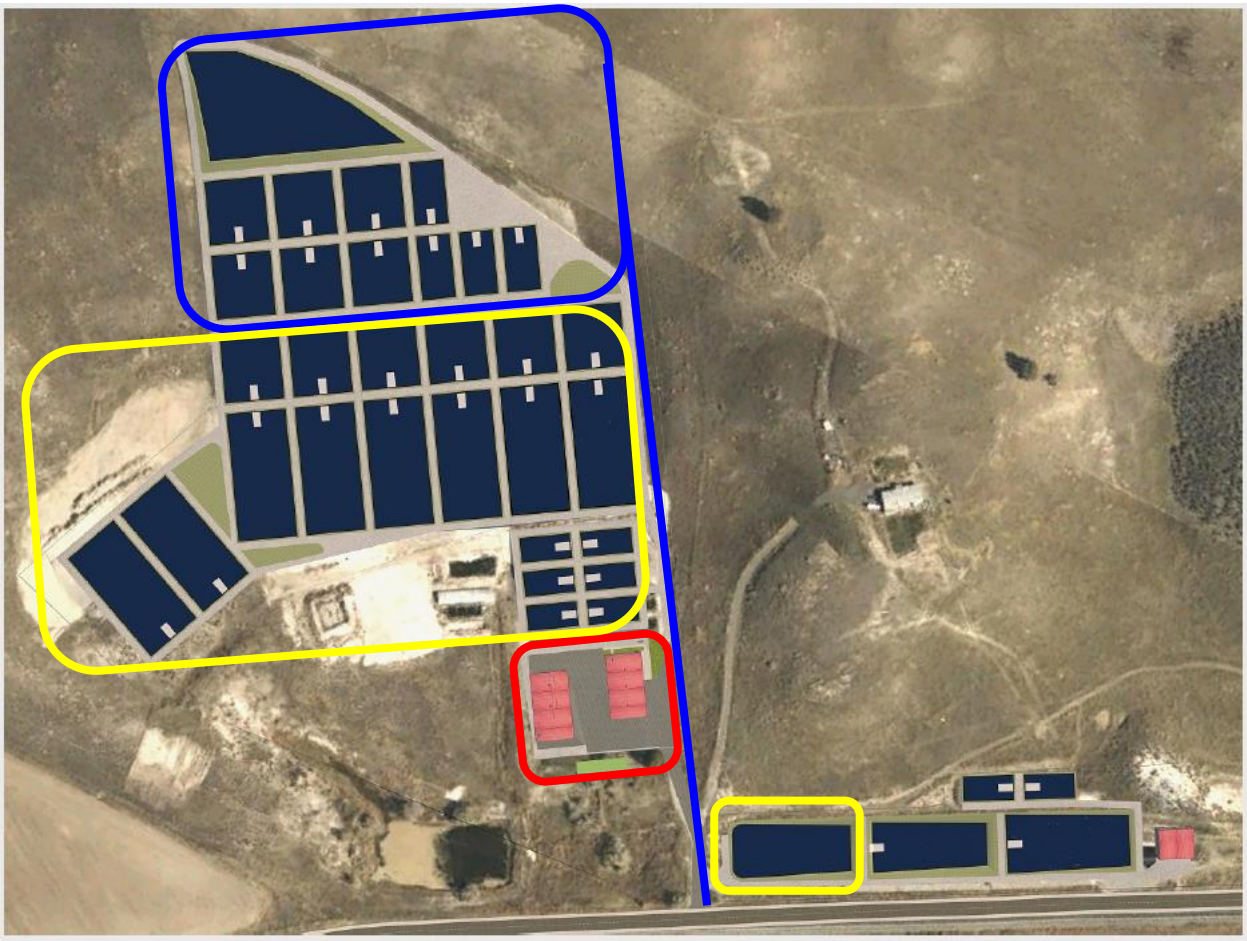

Figure 10 – Conceptual aerial overlay of the full buildout of the Klamath Falls National Fish Hatchery. Phase 1 construction (blue) will include a 1.0-acre influent retention pond at the top, followed by six 0.25-acre and four 0.12-acre fry and fingerling ponds in the Tier-1 series of juvenile ponds below. Phase 2 construction (red) will include the maintenance building and the hatchery building and office. Phase 3 construction (yellow) will include six 0.25-acre and eight 0.5-acre juvenile production ponds in the Tier-2 series below the Tier-1 series, followed by six 0.12-acre broodstock ponds below that, and lastly the 0.5-acre effluent retention pond. Future phases of construction will also include two 0.12-acre and two 0.5-acre quarantine ponds on the lower lease parcel by the road.

Hatchery Research

2022 Klamath Sucker 2nd Season Feed Study

In March of 2022, approximately 600 10-month old suckers were stocked into each 24 0.03-acre ponds in the B-series, for a total of 14,400 fish, all of which were measured for size at the time of stocking. Half of these fish, in 12 ponds, were PIT tagged in the fall of 2021 and half were PIT tagged in March of 2022, just prior to stocking ponds. Ponds were split into four different treatment groups, in triplicates of fall tagged fish and spring tagged fish. In May of 2022 suckers were transitioned from the Purina Aquamax diets fed previously to four different feed types, the Skretting Bozeman diet for June Sucker (Ponds B1-6), the Rangen Shrimp 40/5 diet (Ponds B7-12), the Star Milling Bozeman diet for Razorback Sucker (Ponds B13-18), and the Rangen EXTR 450 diet (Ponds B19-24). The ponds were fed at 2.0% body weight through May and June and then at 3.0% body weight from July through September. The fish were harvested from the ponds in October of 2022 and were enumerated and measured for size and condition. Data will be processed and summarized into a report. Study objectives include assessing differences in growth and survival differences among treatment groups.

2022 Larval Drift Genetics Analysis

A pilot study was started in spring of 2022 to assess the genetics of the Williamson River larval fish that drift down the river and eventually end up in UKL as well as the genetics of the KFNFH collected fish. This analysis is investigating the hypothesis that LRS come down the drift earlier then SNS, along with other unknowns including the amount of hybridization among SNS, LRS, and Klamath Largescale Suckers, how the genetic composition changes over time, and the genetic makeup at KFNFH. Larvae collected from the Williamson River are the source for the KFNFH rearing program fish and this study was conducted as part of the main collection for the hatchery. Once fish were brought back to the hatchery 1% of the collection was euthanized with an overdose of MS222 and preserved in ethyl alcohol for genetic analysis. Larvae were collected throughout the larval drift, from 5/16 to 6/22/22; larvae were not sacrificed for genetics every day due to limited numbers of sample vials. Samples were cataloged and sent to USFWS Abernathy Fish Technology Center in Longview, Washington for genetic analysis. Results are expected February 2023. Preliminary results will be assessed to refine future methodology. This study is expected to continue for several years to better understand the genetic makeup and timing of larval drift.

Klamath Sucker Production Cycle Feed Study

A long-term feed trial initiated this year is comparing four commercially available diets: Bozeman Razorback sucker diet, Bozeman June sucker diet, Rangen Shrimp diet, and Rangen Sturgeon diet. These were selected based off previous trials conducted using Lost River suckers. Total length, weight, and survival will be analyzed multiple times throughout the trial. This trial started at the larval stage at age 21 days, reared on a custom partially recirculating system fed mashed diets for 21 days and moved to 0.03 acre ponds to be reared the remaining 16 months. Due to the spawning difference of Lost River and shortnose suckers, one set of replicates, used larvae collected a week later in hopes to capture shortnose larvae. This trial wants to analyze the performance of the feed on both species.

PIT Tag Detection

Recovery Team staff are currently summarizing and analyzing PIT tag detection data gathered on the US Geological Survey remote arrays that are located in various places within the Upper Klamath Basin. Such future analysis will likely inform whether there are optimal locations, seasons, and/or sizes of captively reared suckers to stock that will promote the highest survivability post repatriation into the wild. Since the inception of stocking PIT tagged suckers within the basin, through April of 2022 when the last data release occurred, a total of 1,312 unique SARP fish have been detected on remote arrays within the basin. For more information on how many unique fish have been detected during each release year, please see **Table 6**.

Table 6 – This shows the number of individual passive integrated transponder (PIT) tagged suckers released by the Klamath Falls National Fish Hatchery and detected on remote arrays within the Upper Klamath Lake Basin for each release and detection year through April of 2022 as the last data release.

	Detection Year								
	2014	**2015**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	
Release Year									**Release Year Total**
2013	1	1	0	0	0	0	0	0	**2**
2017	0	0	28	26	13	10	9	10	**96**
2018	0	0	0	105	52	36	35	27	**255**
2019	0	0	0	0	38	33	39	23	**133**
2020	0	0	0	0	2	324	300	20	**646**
2021	0	0	0	0	0	0	34	47	**81**
2022	0	0	0	0	0	0	0	99	**99**
Dectection Year Total	**1**	**1**	**28**	**131**	**105**	**403**	**417**	**226**	**1312**

Recommendations and/or Plans for Future Work

- Hatchery production during fiscal year 2023 will only be done in the 22 0.03-acre P-series and the four 0.25-acre A-series ponds, since the 24 0.03-acre B-series ponds will be demolished as early as March or April of 2023. The demolition of the B-series ponds will accommodate Phase 2 construction efforts of the new hatchery building, maintenance building, and feed and chemical storage buildings. Phase 1 construction efforts of the four new 0.12-acre and six new 0.25-acre ponds are not anticipated to be online and functional until the Spring of 2024, when additional demolition of the four A-series ponds and eight of the P-series ponds will be done to allow Phase 3 construction to commence.
- Extended grow out of suckers will continue at the Agency Lake and Gerber Reservoir net pens, pending adequate water availability and quality. Stocking suckers at suitable off channel rearing locations will also be done as excess fish inventory and water quality and availability warrant such efforts.
- Starting in the Spring of 2023, the staff will cease taking genetic samples on every fish stocked for repatriation. After consultation internally within our office, with Abernathy NFH&TC Geneticists, with regional staff, and with external partners within the Basin, it has been decided that genetic sampling will only be conducted when there is a need for such information to be gathered, such as when new broodstock are incorporated into the hatchery population or when wild spawning efforts are conducted. This will reduce costs and accelerate fish processing time as we scale up production and distribution efforts in the future.
- Efforts will continue with the multiyear feed trial study that is being conducted to assess growth and fish condition relative to food type through the calendar year of 2023. This will be summarized into a technical report and may be drafted into a peer reviewed manuscript once the work is completed.
- During the spawning event of the East Springs population of Lost River Sucker, staff will work with USGS to collect adult LRS for artificial spawning of paired crosses to produce fish for incorporation to the hatchery broodstock population. Genetic samples will be collected for parentage marker analysis and gametes will be incubated at the KFNFH using Sprague River water to hatch and raise viable larvae. In addition to this effort, the following research will be conducted to maximize the gains from this work:
    - Incubation trials will be conducted at the hatchery using the geothermal water source with a variety of types of conditioning of the water chemistry to assess incubation and hatching success.
    - Additional fry that are not needed for broodstock fish will be reared in a variety of intensive operations to determine if such method can be used for long term growout, beyond the early juvenile stages. This will likely entail using partial reuse aquaculture systems (pRAS) to minimize the consumption of the hatchery water supply.
- Wild larval collection efforts will target between 30,000-50,000 fish during the drift from the Williamson River in May and June of 2023. These larval suckers will be reared in several ways to assess growth and survival during the early rearing process. First, a small study will compare the short and long term growth patterns of fry stocked into fertilized ponds immediately following the prophylactic treatment (4-6 days after collections), relative to the current practice where suckers are raised intensively to feed train on artificial diets for 30-40 days after collections.

Thereafter, additional fish could be reared in a variety of intensive operations to determine if such methods can be used for long term growout, beyond the early rearing stages. Finally, additional fish could be used in off channel fry stockings, as well as transfers to the Klamath Tribes Hatchery for growout if the need arises.