WISCONSIN DEPARTMENT OF NATURAL RESOURCES

Root River Steelhead Facility
Fall 2022 and Spring 2023

August 2025

Photo credit: Wisconsin DNR

WRITTEN BY
LAURA SCHMIDT
DNR Fisheries Management
Southern Lake Michigan Fisheries Work Unit
600 E. Greenfield Ave.
Milwaukee, WI 53204

Summary – A total of 3,088 Chinook salmon, 4,787 coho salmon, 460 steelhead and 2 brown trout were examined during fall 2022 and spring 2023 at the Root River Steelhead Facility (RRSF). A total of 793 coho were spawned, and approximately 1,208,186 coho eggs were collected for our hatcheries.

The fall 2022 return of 3,088 Chinook salmon was 40% above the ten-year average return. The fall 2022 return of 4,787 coho salmon was the highest return seen at the weir since 1998. The fall 2022 return of 10 steelhead was 40% below the ten-year average. Two brown trout were encountered in the facility in the fall, which is typically shut down for the season before the majority of brown trout are in the Root River.

The spring 2023 return of steelhead was a total of 450, which was 48% below the ten-year average. A total of 291 steelhead were spawned, and a total of 532,688 eggs were collected.

The number of fish captured at RRSF is a subset of the seasonal migration in the Root River. RRSF does not stop every fish in the river, as they are able to move upstream past the facility before it is operational in early spring and fall, and some fish are able to bypass the facility during the sampling season when the river is at high flows. In 2023, high flows throughout March due to rain and snow melt allowed some fish to move upstream past the facility during the sampling season.

In the fall of 2022 at RRSF the standard weight of a 30-inch Chinook salmon was 9.9 pounds, which was slightly higher than the previous year, and about the same as the ten-year average (Figure 1). The standard weight for a 22-inch coho salmon, which has remained mostly stable over the past ten years, was 3.7 pounds. The standard weight for a 22-inch steelhead was 3.6 pounds, which was the same as the ten-year average. The standard weight for brown trout was not calculated due to low returns.

The following tables and figures report the results of data collected at the RRSF during the fall of 2022 and spring 2023. These data contribute to a long-term index of Chinook, coho and steelhead populations in the Root River and are collected to fulfill three objectives: 1) track the abundance of salmonid returns, 2) measure the growth and condition of each species and/or strain, and 3) estimate return rate of each species. For a complete description of methods and calculations, see Thompson and Eggold (2007).

REFERENCES

Thompson, J. and B. Eggold. 2007. Root River Steelhead Facility, Fall 2006 and Spring 2007. Publication number PUB-FH-836 2007. Wisconsin Department of Natural Resources, Milwaukee, Wisconsin. 22 pages.

Table 1. Summary of Chinook salmon, coho salmon, steelhead and brown trout captured at the Root River Steelhead Facility during 2013 to 2023.

HARVEST YEAR	HARVESTED	PASSED UPSTREAM	MISC. SAMPLES	TOTAL
Chinook Salmon				
Fall 2013	486	1,070	392	1,948
Fall 2014	533	1,646	44	2,223
Fall 2015	384	880	45	1,309
Fall 2016	518	1,375	152	2,045
Fall 2017	696	1,542	524	2,762
Fall 2018	794	326	5	1,125
Fall 2019	578	818	36	1,432
Fall 2020	727	2,889	311	3,927
Fall 2021	417	1,635	122	2,174
Fall 2022	23	2,905	160	3,088
Coho Salmon				
Fall 2013	216	1,281	169	1,666
Fall 2014	60	1,295	33	1,388
Fall 2015	60	1,351	25	1,436
Fall 2016	60	1,324	133	1,517
Fall 2017	66	2,290	180	2,536
Fall 2018	61	2,397	29	2,487
Fall 2019	60	1,117	38	1,215
Fall 2020	30	1,508	14	1,552
Fall 2021	39	2,263	38	2,340
Fall 2022	40	4,693	54	4,787
Steelhead				
Fall 2013	0	7	0	7
Spring 2014	120	852	7	979
Fall 2014	0	11	0	11
Spring 2015	60	711	3	774
Fall 2015	0	9	0	9
Spring 2016	60	1,293	0	1,353
Fall 2016	0	43	0	43
Spring 2017	120	774	1	895
Fall 2017	0	9	0	9
Spring 2018	62	990	0	1,052
Fall 2018	0	20	0	20
Spring 2019	91	651	0	742
Fall 2019	8	13	0	21
Spring 2020	18	110	0	128
Fall 2020	8	2	0	10
Spring 2021	167	429	0	596
Fall 2021	40	15	0	55
Spring 2022	222	1,408	8	1,638
Fall 2022	9	1	0	10
Spring 2023	151	299	0	450
Brown Trout				
Fall 2013	0	166	1	167
Fall 2014	13	174	5	192
Fall 2015	0	52	34	86
Fall 2016	0	11	5	16
Fall 2017	0	12	3	15
Fall 2018	0	80	0	80
Fall 2019	0	9	0	9
Fall 2020	0	2	0	2
Fall 2021	0	12	0	12
Fall 2022	0	2	0	2

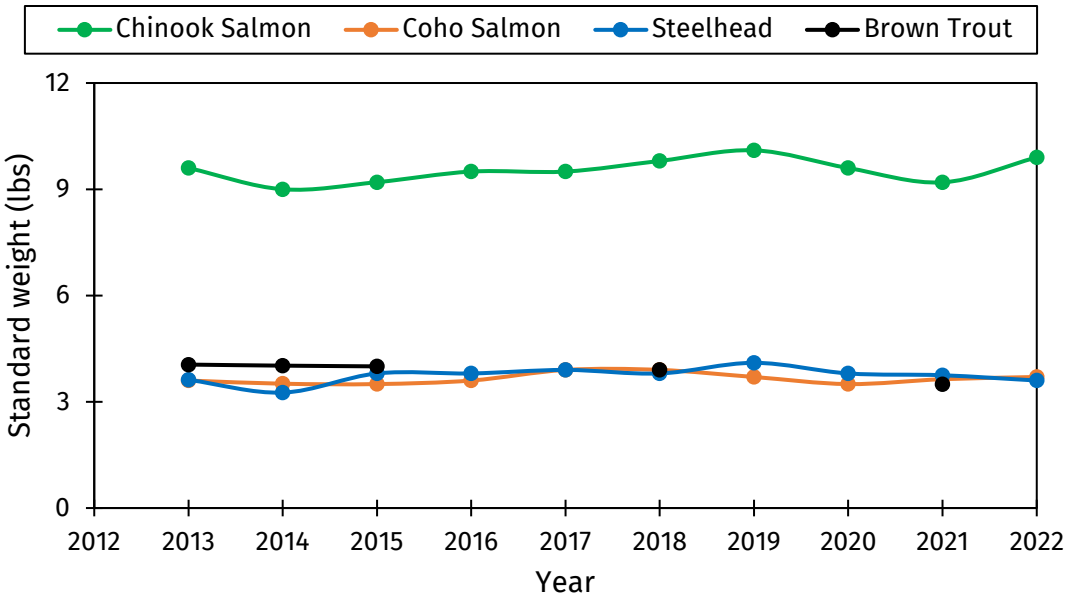

Figure 1. Standard weight for the major salmonid species returning to the Root River Steelhead Facility from 2012 to 2022. For brown trout, breaks in the graph represent years where returns were too low to estimate standard weight.

CHINOOK SALMON

In fall 2022, 94% of Chinook salmon handled were passed upstream of the dam after processing (Table 1).

Analysis of length-weight data (Table 6) revealed that average length (33.2 inches) and weight (14.3 pounds) of returning Chinook salmon increased from the previous year and were above the ten-year average. The standard weight (9.9 pounds) was higher than the previous fall (9.2 pounds) and was slightly higher than the ten-year average (9.5 pounds).

From 2011-2017, the U.S. Fish and Wildlife Service's mass-marking program marked all Chinook salmon stocked into Lake Michigan with an adipose clip and coded-wire tag (CWT). In addition, from 2015-2018, the Wisconsin DNR conducted a study to evaluate net pens, a collaborative project where fishing clubs hold Chinook salmon in net pens to acclimate them to the rivers. 2022 was the final fall where Chinooks were sub-sampled to collect CWTs, because the last year-class of tagged fish were age 4. Thirteen tags were recovered from Chinooks in fall 2022, all of which were age 4 fish stocked directly into the Root River.

From 2012-2022, a total of 4,822 tags were recovered from Chinook salmon, providing insight into the age structure and growth rates of Chinook returning to the river. For detailed descriptions and results, please refer to the Root River Steelhead Facility Fall 2020 and Spring 2021 report.

Based on an age-length key developed from these known-age Chinook, in fall 2022, age 1 fish comprised approximately 13% of the return, age 2 fish comprised approximately 41% of the return, age 3 fish were 44% of the return, and age 4 fish were just under 2% of the return (Table 2). Approximately 85% of the return was fish ages 2 or 3. In six of the ten years where coded-wire tags were collected, at least 80% of the sampled Chinooks were ages 2 or 3; in the remaining years, age 1s showed up in higher numbers (Table 3).

Table 2. Estimated age composition of Chinook salmon (sexes combined) examined at the Root River Steelhead Facility in fall 2022. Age is based on an age-length key developed from known-age Chinook salmon from 2012-2021.

YEAR OF RETURN	PERCENT AGE COMPOSITION							NUMBER USED IN ANALYSIS
	0	1	2	3	4	5	6	
2022	0.3%	13.4%	40.9%	43.7%	1.8%	0.0%	0.0%	1,526

Table 3. Age composition of known-age coded-wire tagged Chinook salmon (sexes combined) examined at the Root River Steelhead Facility during fall, 2012 through 2021. Note: 2022 is excluded from the table due to the low number of tagged Chinooks in the lake.

YEAR OF RETURN	NUMBER AT AGE							TOTAL NUMBER
	0	1	2	3	4	5	6	
2012	-	26.8%	73.2%	-	-	-	-	183
2013	0.2%	50.2%	22.4%	27.2%	-	-	-	460
2014	0.8%	4.2%	59.9%	33.6%	1.5%	-	-	476
2015	2.7%	8.3%	14.0%	74.7%	0.3%	-	-	372
2016	1.3%	53.2%	14.3%	26.2%	5.0%	-	-	477
2017	-	52.1%	35.4%	12.0%	0.4%	-	-	675
2018	-	20.0%	50.1%	29.5%	0.4%	-	-	721
2019	-	14.0%	53.8%	31.6%	0.4%	0.2%	-	513
2020	-		40.1%	58.7%	1.0%	-	0.2%	601
2021	-	-	0.3%	96.4%	3.3%	-	-	331

Coded-wire tag data also revealed a large overlap in length-at-age for tagged Chinook salmon returning to the weir (Figure 2, Figure 3). In some years (2012, 2015, and 2019), age-1 Chinooks were on average 5-8 inches smaller than older fish, which

could possibly be explained by alewife year-class strength. However, in most years, length could not be used as an indicator of age.

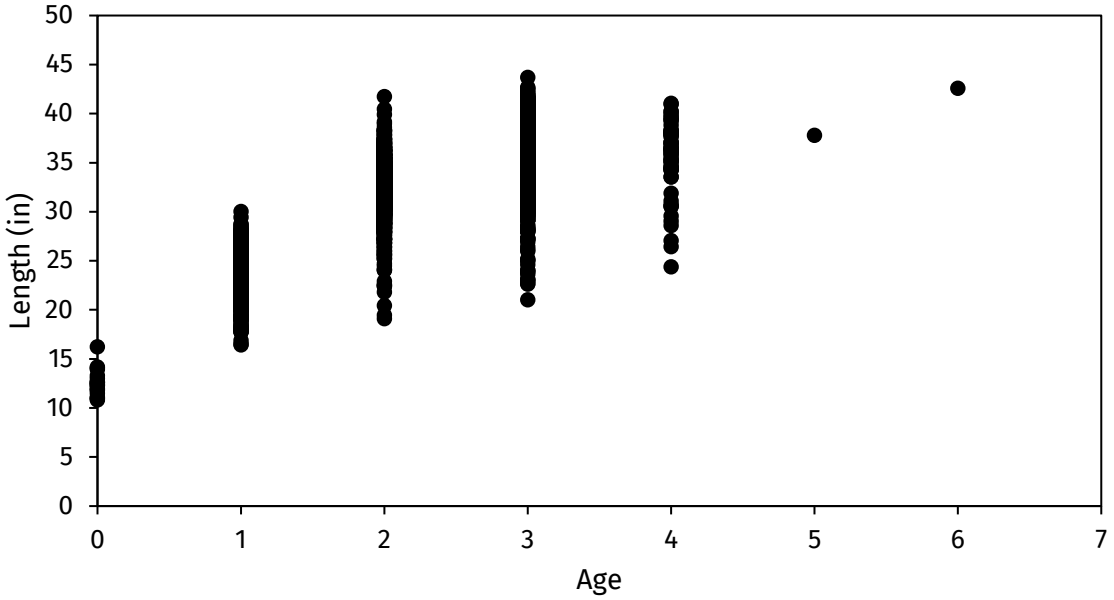

Figure 2. Length-at-age of coded-wire tagged Chinook salmon recovered at RRSF from 2012-2021.

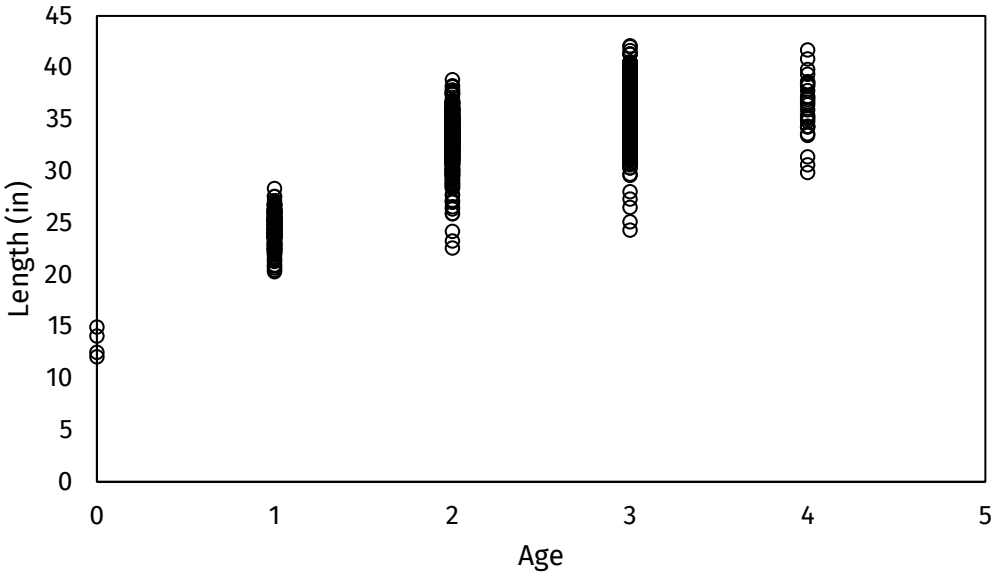

Figure 3. Estimated length-at-age of Chinook salmon captured at RRSF during fall 2022, based on age-length key developed from known-age Chinook salmon from 2012-2021.

COHO SALMON

In fall 2022, 98% of coho salmon handled were passed upstream of the dam after processing (Table 1).

Analysis of length-weight data (Table 6) revealed that average length (28.6 inches) and average weight (8.8 pounds) increased substantially from the previous year. The standard weight (3.7 pounds) was slightly higher than the previous fall (3.6 pounds) and was slightly higher than the ten-year average.

The age composition (based on length-frequencies) indicated that the 2022 run was comprised of 5% age 1+ and 95% age 2+ coho salmon (Table 3).

Table 4. Estimated age composition of coho salmon (sexes combined) examined at the Root River Steelhead Facility during fall, 2012 through 2022. Ages were assigned by length-frequency of measured fish.

YEAR OF RETURN	PERCENT AGE COMPOSITION		NUMBER USED IN ANALYSIS	TOTAL RETURN
	1+	2+		
2012	21%	79%	715	849
2013	5%	95%	786	1,666
2014	6%	94%	1,353	1,388
2015	9%	91%	1,161	1,436
2016	29%	71%	1,042	1,517
2017	5%	95%	1,249	2,536
2018	5%	95%	1,746	2,487
2019	15%	85%	1,178	1,215
2020	10%	90%	1,061	1,551
2021	36%	64%	1,841	2,340
2022	5%	95%	1,669	4,787

STEELHEAD

In fall 2021, one of the 10 steelhead captured was passed upstream of the dam after processing (Table 1). The remainder were kept for coded-wire tag analysis, described below.

All steelhead that are stocked into the broodstock rivers (the Root and Kewaunee Rivers) are marked with differential fin clips to identify strain for purposes of spawning. Prior to 2017, each strain (Chambers Creek and Ganaraska) was given fin clips on a 3-year rotational basis to assist in estimating age composition.

In 2018, after completion of the Chinook salmon study, the U.S. Fish and Wildlife Service's mass-marking program began marking all rainbow trout stocked into Lake Michigan with an adipose-clip and coded-wire tags, which will provide data for analysis of movement, growth rates, and estimates of natural reproduction.

To simplify the mass marking process, in which all steelhead are adipose-clipped through the USFWS mass marking trailer but broodstock fish are hand-clipped for strain identification, a standard fin clip per strain was chosen. As the years of data collection continue, a length-age key will be developed to estimate ages of returned fish to the weir.

In addition to the adipose-clip, broodstock Chambers Creek strain steelhead were given a left maxillary clip (ALM) and broodstock Ganaraska strain steelhead were given a left ventral clip (ALV). Broodstock fish stocked in 2021 did not have an adipose-clip due to the COVID-19 pandemic.

Skamania strain steelhead, a fall-run strain, were stocked in 2018 and 2019 (2017 and 2018 year-classes) after obtaining eggs from Indiana. These fish were given an adipose-clip and right maxillary-clip (ARM) for identification in the field.

Of the 10 steelhead processed in fall 2022, 6 were Skamania strain, 2 were Chambers Creek strain, 1 was the "Michigan" strain stocked in the state of Indiana, and the remaining one was unclipped and presumed to be wild or an unclipped stray. One fish was an age-4 Skamania stocked into the Root River in 2019. The remainder of fish that CWTs were recovered from were age 3.

In spring 2023, 67% of steelhead handled were passed upstream of the dam after processing (Table 1). Most harvested steelhead were kept for coded-wire tag analysis.

Analysis of length-weight data (Table 6) revealed that average length (25.4 inches) and average weight (5.9 pounds) of returning steelhead were higher than the previous year. The standard weight (3.6 pounds) was only slightly lower than the previous spring, and about the same as the ten-year average.

Of the 450 steelhead processed, 253 (56%) were Chambers Creek strain marked with ALM or LM-only clips. 147 steelhead (33%) were Ganaraska strain fish marked with ALV or LV-only clips. Twenty fish (4.4%) were unclipped and presumed to be wild or unclipped strays. One fish was Skamania strain marked with an ARM clip. The remaining 29 fish (6.4%) were adipose-only, identifying them in the field as strays.

Over half (81%) of steelhead that were collected for analysis (n=100) were broodstock stocked into the Root River (Figure 4). The remaining strays were primarily from Wisconsin waters, with only a few fish returning from other states (one each from Illinois and Indiana). In figure 4, the "WI small tribs" location includes all small tributaries along the Wisconsin shoreline that are stocked with steelhead. The "WI South Large Rivers" location includes the Root River, the Kinnickinnic/Milwaukee Rivers, the Sheboygan River and the Manitowoc River. The "WI North Large Rivers" location includes the Kewaunee River, the Branch River, the East and West Twin Rivers and the Ahnapee River. For more detailed information, please refer to [Wisconsin's Lake Michigan stocking summary].

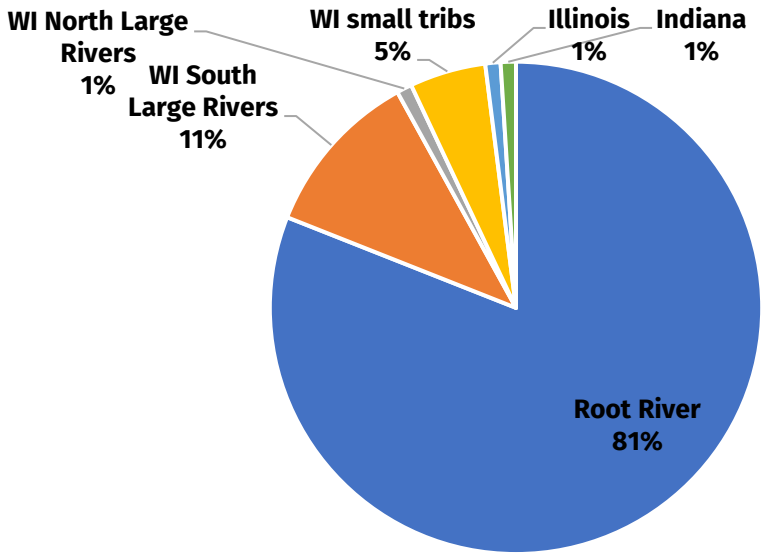

Figure 4. Stocking locations of CWT Steelhead returning to the Root River weir in spring 2023.

Although fish stocked into the Root River comprised a higher percentage of the return in spring 2023 compared to 2021 (Table 5), overall, in both years most returns were from southern Lake Michigan rivers, including the Root River.

Table 5. Stocking locations of CWT Steelhead returning to the Root River in the spring by year.

	STOCKING LOCATION							
YEAR OF RETURN	ROOT RIVER	WI SOUTH LARGE RIVERS	WI NORTH LARGE RIVERS	WI SMALL TRIBS	MICHIGAN	ILLINOIS	INDIANA	NUMBER OF CWTS
2021	66.4%	16.8%	0.7%	15.4%	0.7%	0.0%	0.0%	150
2023	81.0%	11.0%	1.0%	5.0%	0.0%	1.0%	1.0%	100

Preliminary results from known-age steelhead allow for early analysis of growth rates (Figure 5). In 2023, age 2 steelhead ranged from 16-19 inches, age 4 steelhead ranged from 19-31 inches, and age 5 steelhead ranged from 26-31 inches, demonstrating a significant overlap in length among older age fish. Note that the 2020 year-class, stocked in 2021, was not coded-wire tagged due to the COVID-19 pandemic, explaining the lack of age-3 tagged fish in the figure below.

In addition, as in 2021, there appears to be significant overlap in length-at-age between strains.

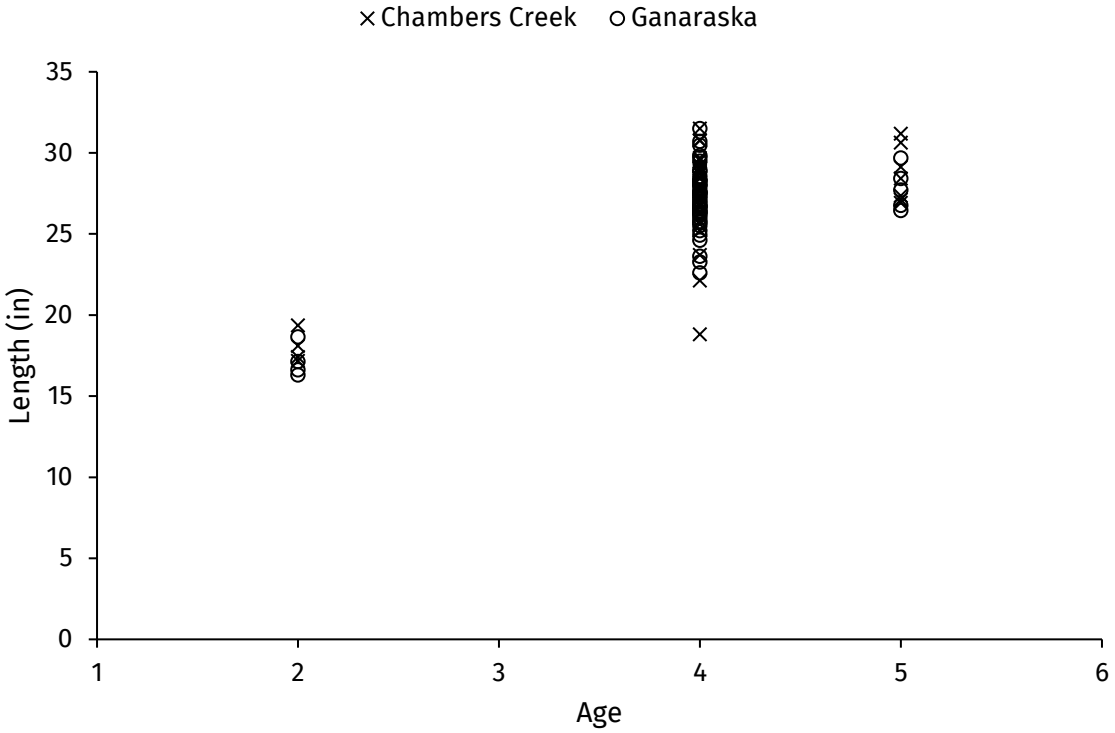

Figure 5. Length-at-age of coded-wire tagged steelhead (Chambers Creek and Ganaraska only) recovered at RRSF in spring 2023.

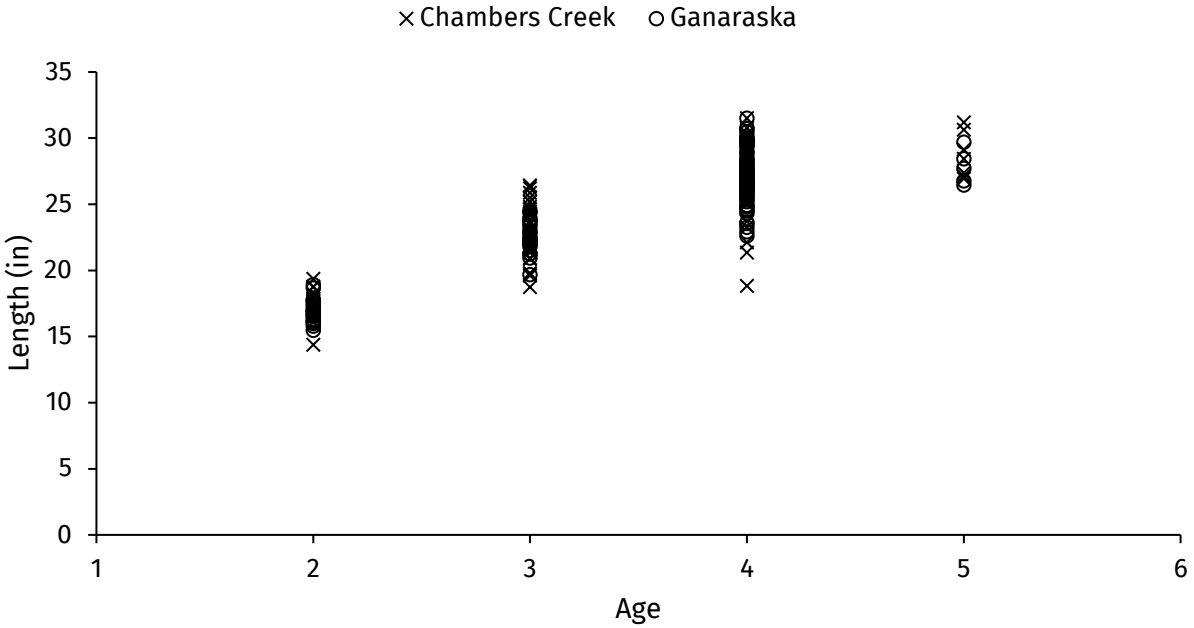

Figure 6. Length-at-age of coded-wire tagged steelhead (Chambers Creek and Ganaraska only) recovered at RRSF in spring 2021 and spring 2023.

Table 6. Average weight, average length, standard weight (predicted weight at a given length based on a length-weight regression) and trophy weight (95th percentile) for the major salmonid species returning to the Root River Steelhead Facility from fall 2012 to spring 2023. The lengths used for the calculation of standard weight are: 30 inches for Chinook, 22 inches for coho, 22 inches for steelhead and 20 inches for brown trout. Note: brown trout are not listed due to low returns.

SEASON	NUMBER USED IN ANALYSIS	AVERAGE WEIGHT (POUNDS)	AVERAGE LENGTH (INCHES)	STANDARD WEIGHT	TROPHY WEIGHT
CHINOOK SALMON					
2012-13	694	10.6 ± 3.4	31.5 ± 3.9	8.6	16.0
2013-14	1,085	12.5 ± 6.2	31.6 ± 5.8	9.6	21.5
2014-15	945	11.8 ± 3.0	32.2 ± 3.2	9.0	16.4
2015-16	920	11.7 ± 3.7	31.6 ± 4.2	9.0	16.9
2016-17	870	10.1 ± 5.3	29.5 ± 5.4	9.5	19.1
2017-18	868	11.1 ± 5.3	30.3 ± 5.0	9.5	19.1
2018-19	852	13.8 ± 6.0	32.6 ± 5.6	9.8	22.5
2019-20	1,415	15.3 ± 5.6	33.6 ± 4.5	10.1	24.6
2020-21	1,739	16.7 ± 5.5	34.9 ± 4.3	9.6	24.9
2021-22	1,521	13.1 ± 5.9	32.4 ± 5.6	9.2	22.0
2022-23	1,525	14.3 ± 5.0	33.2 ± 4.4	9.9	21.7
COHO SALMON					
2012-13	715	4.0 ± 1.7	22.4 ± 3.8	3.5	6.4
2013-14	786	8.2 ± 2.4	28.1 ± 3.4	3.6	11.3
2014-15	1,353	6.2 ± 1.8	25.9 ± 3.3	3.5	8.6
2015-16	1,161	4.5 ± 1.5	23.3 ± 2.9	3.5	7.0
2016-17	1,042	5.2 ± 2.8	23.8 ± 5.0	3.6	9.4
2017-18	1,249	8.3 ± 2.4	27.7 ± 3.2	3.9	11.6
2018-19	1,742	7.8 ± 2.4	26.9 ± 3.3	3.8	11.2
2019-20	1,177	7.4 ± 3.2	26.5 ± 4.7	3.7	11.6
2020-21	1,061	6.9 ± 2.8	26.2 ± 4.3	3.5	10.9
2021-22	1,841	4.3 ± 2.5	22.1 ± 4.7	3.6	8.3
2022-23	1,667	8.8 ± 2.7	28.6 ± 3.6	3.7	12.3
STEELHEAD					
2012-13	315	4.5 ± 2.1	23.2 ± 4.3	3.6	7.7
2013-14	605	5.6 ± 2.5	24.6 ± 4.3	3.6	9.6
2014-15	779	4.1 ± 1.9	22.6 ± 3.9	3.3	7.6
2015-16	1,047	4.9 ± 1.9	24.0 ± 2.2	3.8	7.3
2016-17	933	6.6 ± 2.2	25.9 ± 3.5	3.8	9.8
2017-18	1,044	6.9 ± 2.1	26.3 ± 2.9	3.9	10.8
2018-19	747	6.7 ± 2.5	25.7 ± 3.4	3.8	11.1
2019-20	143	6.2 ± 2.8	24.9 ± 4.6	4.1	10.3
2020-21	596	4.2 ± 2.5	22.0 ± 4.2	3.8	8.8
2021-22	1,685	5.5 ± 2.1	24.6 ± 3.3	3.7	9.4
2022-23	460	5.9 ± 2.3	25.4 ± 3.7	3.6	9.7

APPENDIX A. ROOT RIVER STOCKING NUMBERS

Table A-1. Number of fingerling Chinook salmon stocked in the Root River during 2013-2022. Chinook salmon were marked with an adipose clip and coded-wire tag from 2011 through 2018, and with an adipose clip in 2019. Fish were not marked in 2020 due to the COVID-19 pandemic. Marking with an adipose clip resumed in 2021.

YEAR STOCKED	TOTAL NUMBER	STRAIN	FINCLIP
2013	75,046	Lake Michigan	A-CWT
2014	76,933	Lake Michigan	A-CWT
2015	52,120	Lake Michigan	A-CWT (regular stocking)
	25,640	Lake Michigan	A-CWT (net pen stocking)
2016	50,918	Lake Michigan	A-CWT (regular stocking)
	25,352	Lake Michigan	A-CWT (net pen stocking)
2017	7,467	Lake Michigan	A (regular stocking)
	43,561	Lake Michigan	A-CWT (regular stocking)
	31,300	Lake Michigan	A-CWT (net pen stocking)
2018	51,383	Lake Michigan	A-CWT (regular stocking)
	32,748	Lake Michigan	A-CWT (net pen stocking)
2019	42,626	Lake Michigan	A (regular stocking)
	42,079	Lake Michigan	A (net pen stocking)
2020	101,919	Lake Michigan	None
2021	101,329	Lake Michigan	A
2022	53,040	Lake Michigan	A (regular stocking)
	32,823	Lake Michigan	A (net pen stocking)

Table A-2. Number of coho salmon stocked in the Root River during 2013 – 2022.

YEAR STOCKED	TOTAL NUMBER	STRAIN	FINCLIP	AGE
2013	83,608	Lake Michigan	None	Spring yearling 1+
2014	79,080	Lake Michigan	None	Spring yearling 1+
2015	83,015	Lake Michigan	None	Spring yearling 1+
	10,008	Lake Michigan	None	Fall fingerling 0+
2016	60,021	Lake Michigan	None	Spring yearling 1+
	10,010	Lake Michigan	None	Fall fingerling 0+
2017	76,432	Lake Michigan	None	Spring yearling 1+
	13,001	Lake Michigan	None	Fall fingerling 0+
2018	76,241	Lake Michigan	None	Spring yearling 1+
2019	76,609	Lake Michigan	None	Spring yearling 1+
2020	73,702	Lake Michigan	None	Spring yearling 1+
	26,182	Lake Michigan	None	Fall fingerling 0+
2021	101,509	Lake Michigan	None	Spring yearling 1+
2022	79,932	Lake Michigan	None	Spring yearling 1+

Table A-3. Number of yearling steelhead stocked in the Root River during 2013-2022. Steelhead stocked into Lake Michigan in 2021 were not adipose-clipped or coded-wire tagged due to the COVID-19 pandemic.

YEAR STOCKED	TOTAL NUMBER	STRAIN	FINCLIP
2013	26,995	Chambers Creek	LM
	27,116	Ganaraska	ALV
2014	27,118	Chambers Creek	ALM
	29,535	Ganaraska	ARV
2015	31,389	Chambers Creek	LMLV
	31,459	Ganaraska	BV
2016	27,134	Chambers Creek	LM
	28,218	Ganaraska	ALV
2017	28,085	Chambers Creek	ALM
	27,048	Ganaraska	ARV
2018	30,293	Chambers Creek	ALM
	26,252	Ganaraska	ARV
	34,027	Skamania	ARM
2019	34,511	Skamania	ARM-CWT
	8,503	Chambers Creek	A-CWT
	32,034	Chambers Creek	ALM-CWT
	33,884	Ganaraska	ALV-CWT
2020	32,191	Chambers Creek	ALM-CWT
	34,467	Ganaraska	ALV-CWT
2021	33,207	Chambers Creek	LM
	33,176	Ganaraska	LV
2022	28,361	Chambers Creek	ALM-CWT
	29,686	Ganaraska	ALV-CWT
	17,644	Skamania	A-CWT

Table A-4. Number of brown trout stocked in the Root River during 2013-2022.

YEAR STOCKED	TOTAL NUMBER	STRAIN	FINCLIP
2013	30,561	Seeforellen	ALM
2014	32,100	Seeforellen	ALV
2015	42,743	Seeforellen	ALP
2016	31,690	Seeforellen	ARP
2017	19,122	Seeforellen	A (regular stocking)
	9,383	Seeforellen	A (net pens)
2018	31,448	Seeforellen	A
2019	31,736	Seeforellen	A
2020	32,066	Seeforellen	A
	4,996	Seeforellen	None-fall fingerling
2021	34,160	Seeforellen	ARV
2022	34,074	Seeforellen	A