WISCONSIN DEPARTMENT OF NATURAL RESOURCES

Root River Steelhead Facility
Fall 2020 and Spring 2021

February 2025

Photo credit: Wisconsin DNR

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Summary – A total of 3,927 Chinook salmon, 1,552 coho salmon, 606 steelhead and two brown trout were examined during fall 2020 and spring 2021 at the Root River Steelhead Facility (RRSF). A total of 422 coho and 601 Chinook were spawned, and approximately 2,791,566 eggs were collected for our hatcheries.

The fall 2020 return of 3,927 Chinook salmon was the highest return seen at the Root River since 2006, when 10,318 Chinook returned to the weir. In addition, the fall 2020 return was 89% above the ten-year average return. The fall 2020 return of coho salmon fell within 5% of the ten-year average. Although the fall 2020 return of brown trout was the lowest on record, the facility is typically shut down for the season before the majority of brown trout are in the Root River.

The spring 2021 return of steelhead was a total of 596 fish. Although the 2021 return was lower than previous years, it fell within 15% of the 10-year average return. A total of 236 steelhead were spawned, and a total of 443,467 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 2021, high flows on the Root River for much of the early spring as a result of snow melt and heavy rain delayed start up of the facility, and it is probable that steelhead were moving upstream before the facility was running.

In the fall of 2020 at RRSF the standard weight of a 30-inch Chinook salmon was 9.6, which was slightly lower than the previous year, but 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 3.5 pounds. The standard weight for a 22-inch steelhead was 3.8 pounds, which was slightly lower than the previous year but slightly higher than the ten-year average. We did not encounter enough brown trout at RRSF to calculate a standard weight.

The following tables and figures report the results of data collected at the RRSF during the fall of 2020 and spring 2021. 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 2011 to 2021.

HARVEST YEAR	HARVESTED	PASSED UPSTREAM	MISC. SAMPLES	TOTAL
Chinook Salmon				
Fall 2011	117	1,798	206	2,121
Fall 2012	201	1,462	167	1,830
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
Coho Salmon				
Fall 2011	240	1,258	130	1,628
Fall 2012	153	659	37	849
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
Steelhead				
Fall 2011	0	18	0	18
Spring 2012	116	113	3	232
Fall 2012	0	16	2	18
Spring 2013	120	179	2	301
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
Brown Trout				
Fall 2011	0	57	4	61
Fall 2012	0	112	22	134
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

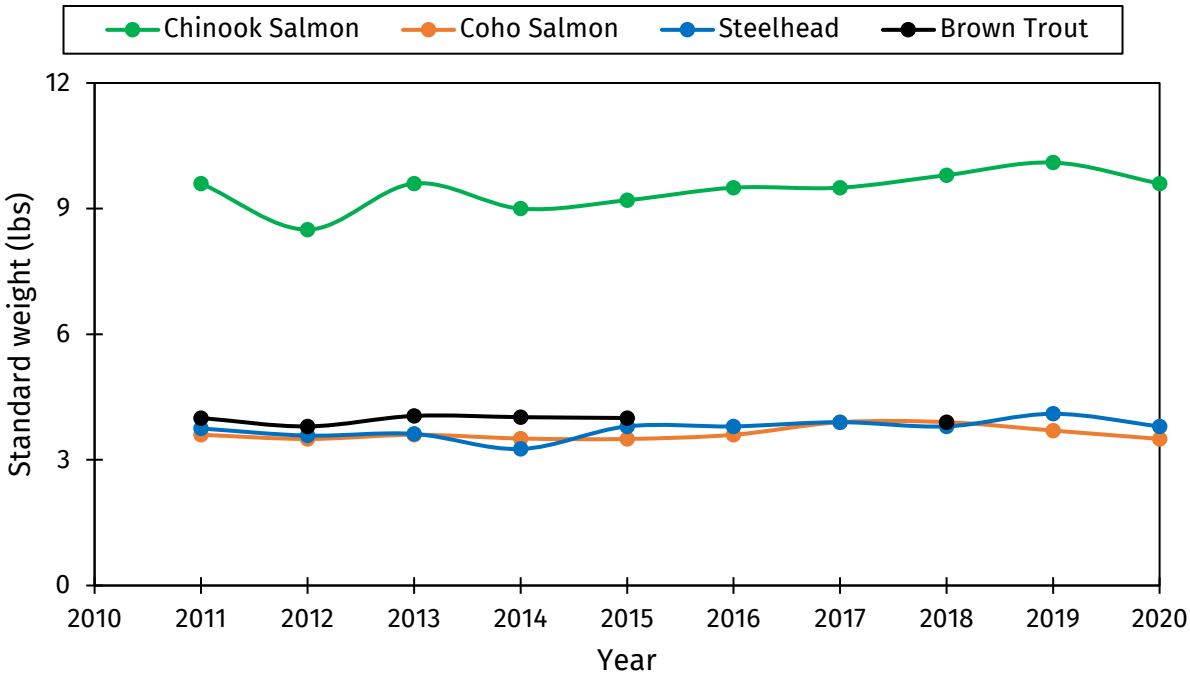

Figure 1. Standard weight for the major salmonid species returning to the Root River Steelhead Facility from 2011 to 2020. For brown trout, breaks in the graph represent years where returns were too low to estimate standard weight.

CHINOOK SALMON

In fall 2020, 74% of Chinook salmon handled were passed upstream of the dam after processing (Table 1). Of the fish not passed upstream, the majority were kept for coded-wire tag collection.

Analysis of length-weight data (Table 4) revealed that average length (34.9 inches) and weight (16.7 pounds) of returning Chinook salmon increased from the previous year, and were the highest they've been in ten years. The standard weight (9.6 pounds) was only slightly lower than the previous fall (10.1 pounds) and was about the same as the ten-year average.

Throughout the fall season, Chinook salmon were sub-sampled as part of two going studies. 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) for analysis of movement patterns of Chinooks in the lake, growth rates, natural reproduction, and "straying", when a mature fish returns to a stream other than the one where it was originally stocked.

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. Chinook salmon in the Kewaunee and Root Rivers were differentially marked with coded-wire tags. Chinook stocked directly into the rivers and into net pens received different CWT numbers, and analysis of these tags will help evaluate whether or not Wisconsin's collaborative net pen projects are having a positive impact on post stocking survival.

Tags were recovered from 692 coded-wire tagged Chinooks at RRSF in fall 2020.

From 2012-2020, a total of 4,478 tags were recovered from Chinook salmon, which provides insight into the age structure of Chinook returning to the river. On average, 73% of tagged Chinook that were sampled were ages 2 or 3 (Table 2). In some years, a high number of age-1 Chinooks returned (2016, 2017). In 2020, no age 1 Chinooks were sampled because there were no tagged age-1 fish, and 99% of the 601 tags collected were from Chinooks ages 2 and 3.

Table 2. Age distribution of coded-wire tagged Chinook salmon (sexes combined) examined at the Root River Steelhead Facility during fall, 2012 through 2020.

	NUMBER AT AGE							TOTAL NUMBER
YEAR OF RETURN	0	1	2	3	4	5	6	
2012	-	49	134	-	-	-	-	183
2013	1	231	103	125	-	-	-	460
2014	4	20	285	160	7	-	-	476
2015	10	31	52	278	1	-	-	372
2016	6	254	68	125	24	-	-	477
2017	-	352	239	81	3	-	-	675
2018	-	144	361	213	3	-	-	721
2019	-	72	276	162	2	1	-	513
2020	-	-	241	353	6	-	1	601

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.

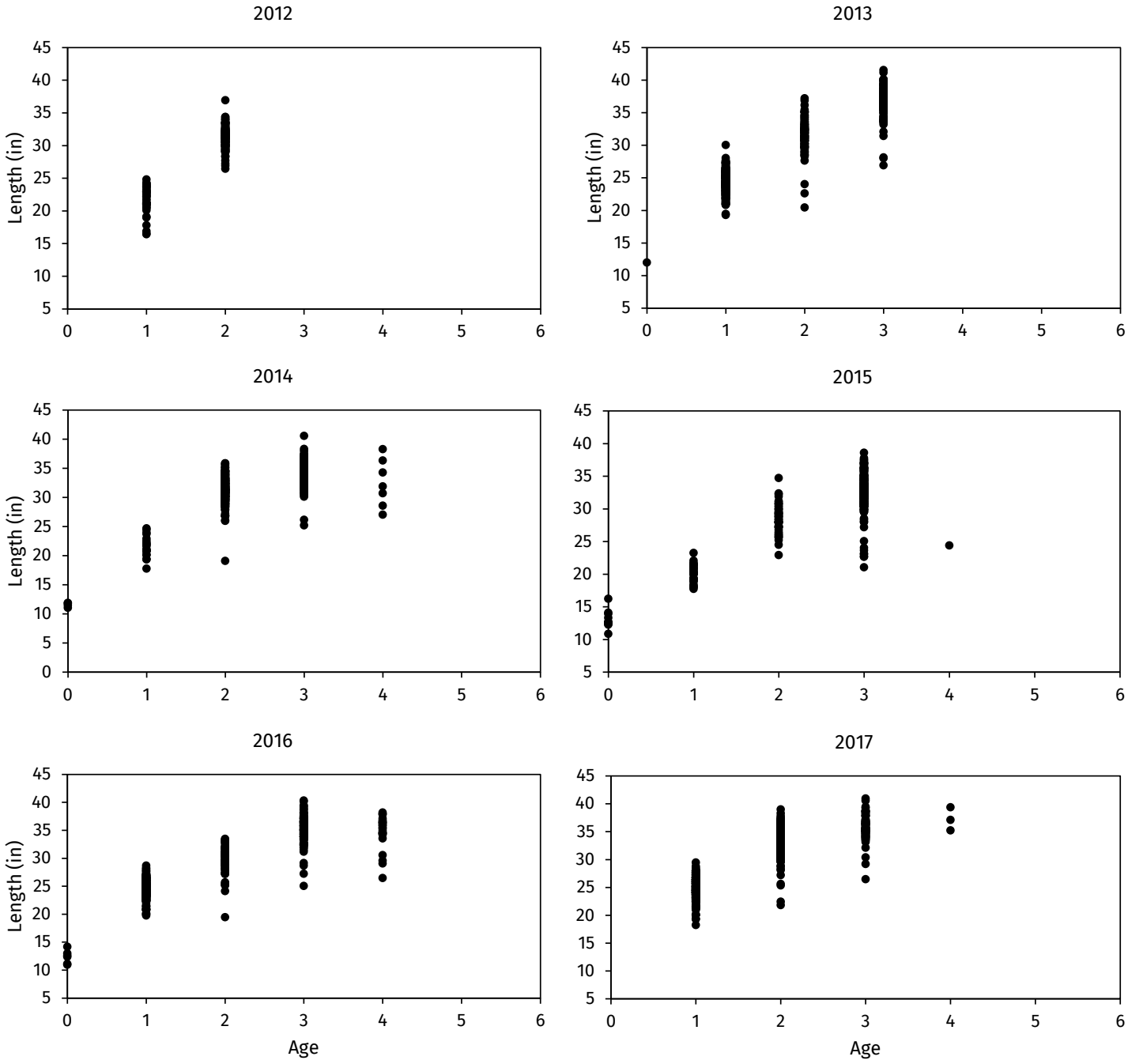

Figure 2. Length-at-age of coded-wire tagged Chinook salmon recovered at RRSF from 2012-2017.

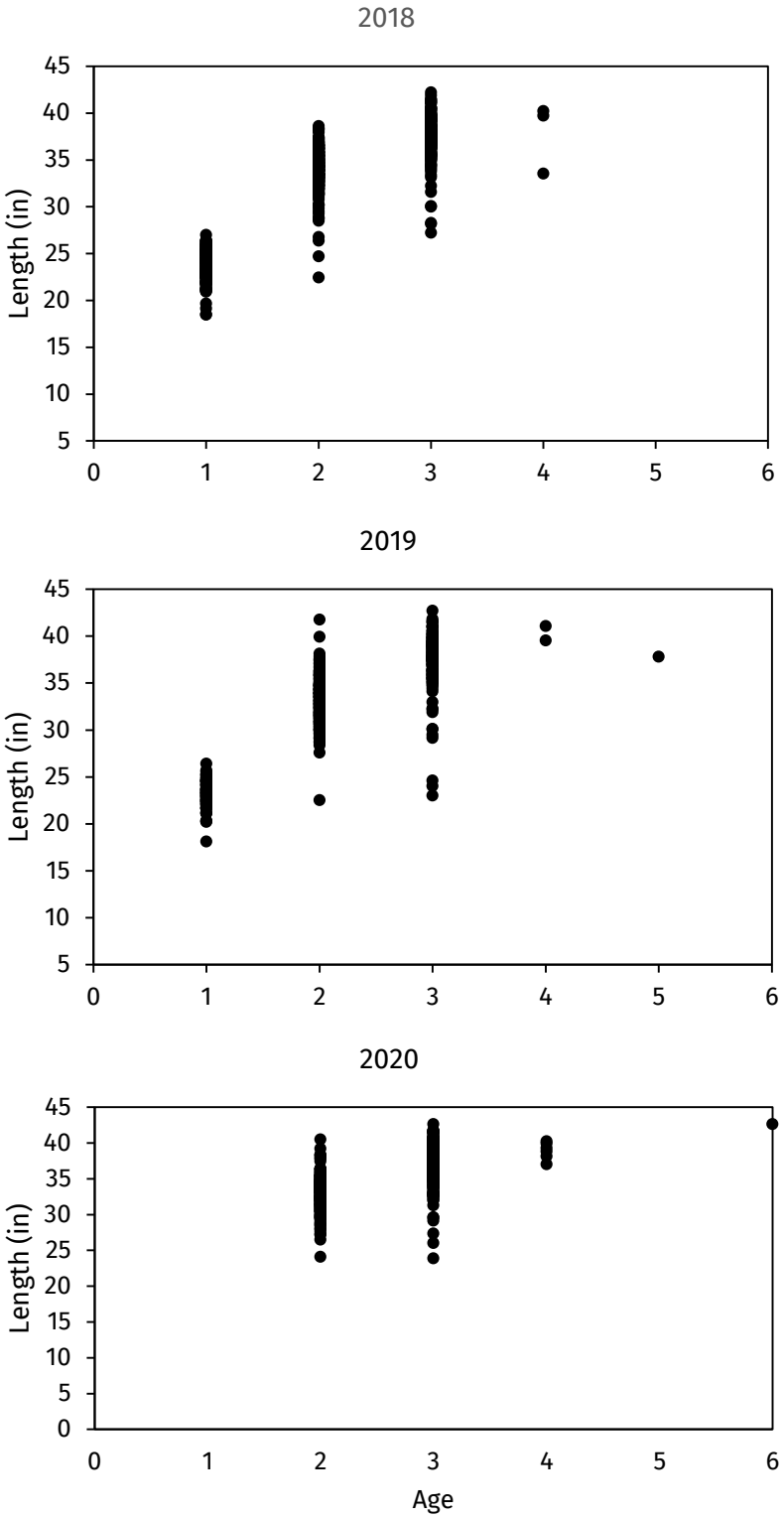

Figure 3. Length-at age of coded-wire tagged Chinook salmon recovered at RRSF from 2018-2020.

Coded-wire tag returns also show relatively low rates of "straying" by Chinook salmon into the Root River during the fall spawning run. Not all Chinooks stocked into the Root River by the Wisconsin DNR from 2012-2020 received a unique CWT lot code, primarily due to constraints in hatchery space. In Figures 4 and 5, the "WI South" location includes the Root River, Racine Harbor, Milwaukee Harbor, Port Washington, Sauk Creek, and the Sheboygan River. The "WI North" location includes the Manitowoc River, the East Twin River, and the West Twin River. From 2012-2015, over 40% of tagged Chinooks that were recovered were stocked into the Root River (Figure 4). Almost 20% were stocked in the Pike River. The Pike River can become sandblocked, in which case these fish return to other streams, such as the Root River.

The Root River, Pike River, and Wisconsin south locations combined comprise 88.4% of Chinook returns.

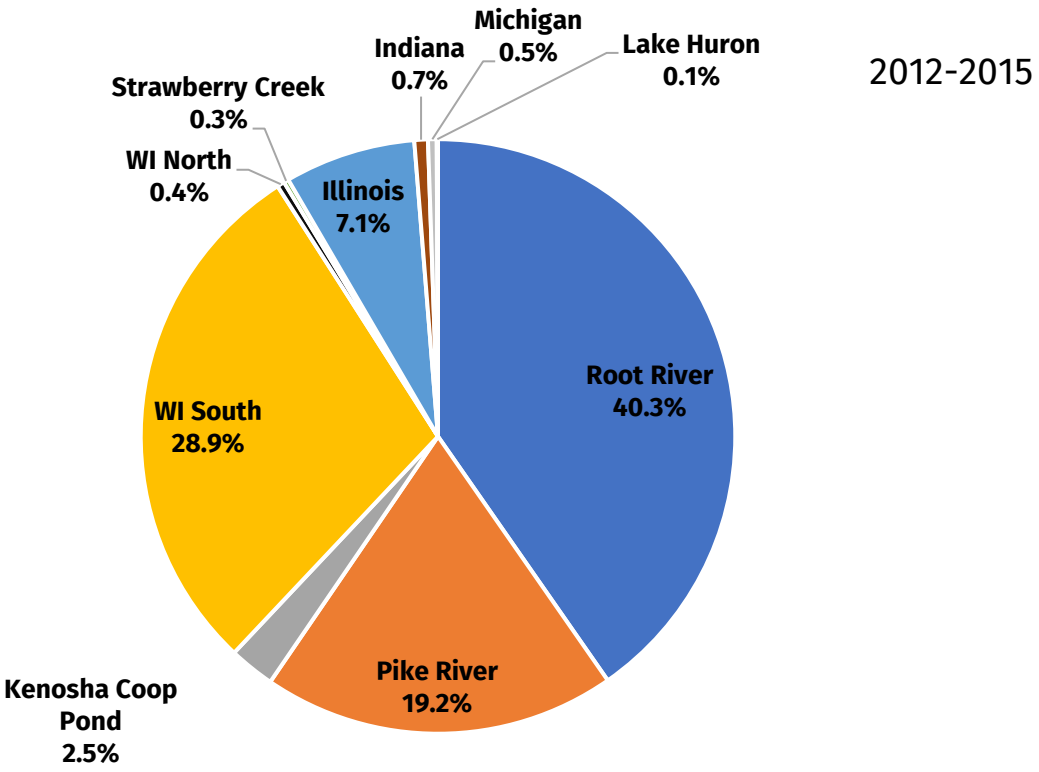

Figure 4. Stocking locations of tagged Chinooks sampled at RRSF from 2012-2015.

From 2016-2020, the Root River, Pike River, and Wisconsin south locations combined comprised almost 97% of sampled Chinook returns (Figure 5). This includes Chinook that were stocked directly into the Root River, and those that were stocked into net pens.

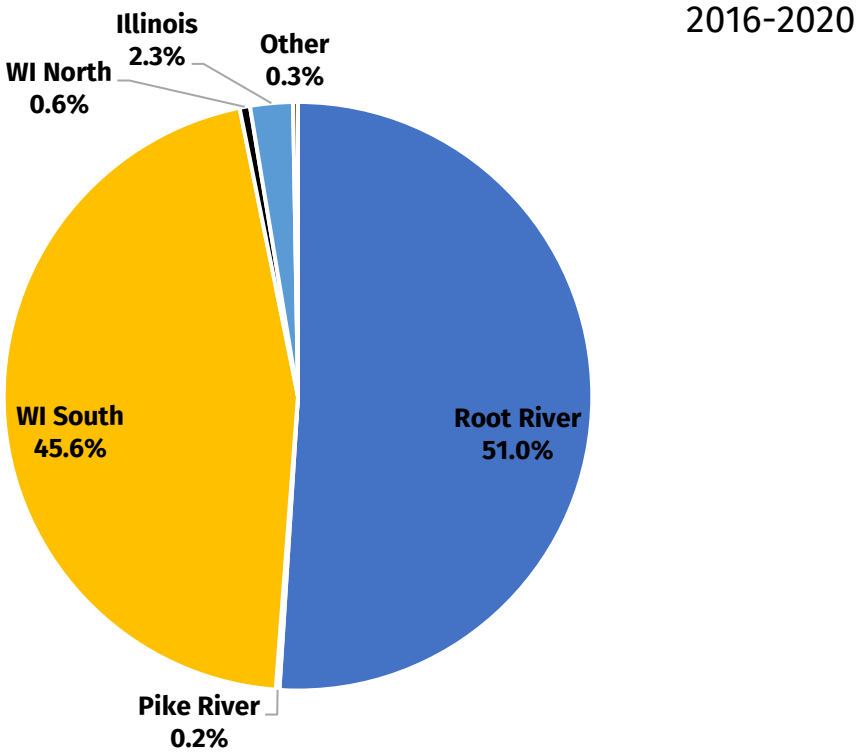

Figure 5. Stocking locations of tagged Chinooks returning to the Root River weir from 2016-2020.

Overall, from 2016-2020, the results of the DNR's net pen study were mixed (Figure 6). The figure below shows the recovery rate (number of fish recovered per number stocked) of Chinook stocked into the Root River or into net pens by year-class. Chinook salmon were tagged in 2015, but first returned to the Root River in 2016. The 2015 and 2016 year-classes stocked directly into the Root River returned at a higher rate than those stocked in net pens. For the 2017 year-class, the return rate was basically the same. For the 2018 year-class, fish stocked directly into net pens returned at a slightly higher rate.

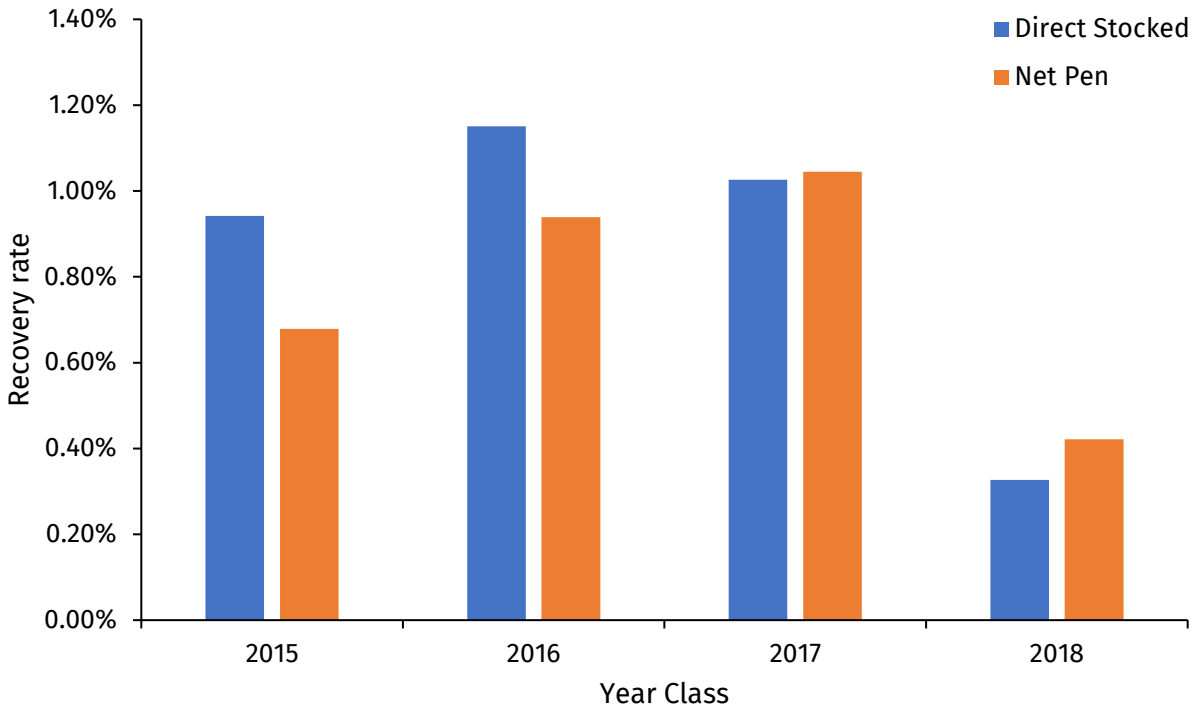

Figure 6. Comparison of tagged Chinooks recovered at RRSF that were direct stocked into the Root River (blue bars) and stocked into net pens (orange bars).

COHO SALMON

In fall 2020, 97% of coho salmon handled were passed upstream of the dam after processing (Table 1).

Analysis of length-weight data (Table 4) revealed that average length (26.2 inches) of returning coho was about the same as the previous year, while average weight (6.9 pounds) was lower than the previous year. The standard weight (3.5 pounds) was only slightly lower than the previous fall (3.7 pounds) and was about the same as the ten-year average.

The age composition (based on length-frequencies) indicated that the 2020 run was comprised of 10% age 1+ and 90% age 2+ coho salmon (Table 3).

Table 3. Estimated age composition of coho salmon (sexes combined) examined at the Root River Steelhead Facility during fall, 2011 through 2020. Ages were assigned by length-frequency of measured fish.

YEAR OF RETURN	PERCENT AGE COMPOSITION		NUMBER USED IN ANALYSIS	TOTAL RETURN
	1+	2+		
2011	6%	94%	761	1,628
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

STEELHEAD

In spring 2021, 72% of steelhead handled were passed upstream of the dam after processing (Table 1). Most harvest steelhead were kept for coded-wire tag analysis, described below.

Analysis of length-weight data (Table 4) revealed that average length (22.0 inches) and average weight (4.2 pounds) of returning steelhead were lower than the previous year. The standard weight (3.8 pounds) was also lower than the previous spring, but was slightly higher than the ten-year average.

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) were 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 spring 2021, tags were recovered from 167 steelhead at RRSF. Steelhead were collected based on a sub-sampling protocol developed with the U.S. Fish and Wildlife Service aimed at collecting males and females from the Chambers Creek, Ganaraska, and unknown strains within defined length bins to provide further data on growth.

Of the 596 steelhead processed, 17 (2.9%) were unclipped and presumed to be wild or unclipped strays. 190 steelhead (31.9%) were Chambers Creek strain marked with an adipose and left maxillary clip, identifying them as stocked into the Root River. 226 (37.9%) were Ganaraska strain. The remaining 163 fish (30%) were adipose-only, identifying them in the field as strays.

This is fairly consistent with results from coded-wire tagged steelhead that were collected at the weir (Figure 7). Steelhead CWT lot codes were defined differently than Chinook salmon. In particular, the DNR is interested in evaluating survival of steelhead stocked into small tributaries compared to those stocked in large rivers. In figure 7, the "WI small tribs" location includes all small tributaries along the

Wisconsin shoreline that are stocked with steelhead, including the Pike River, Oak Creek, Sauk Creek, the Pigeon River, Silver Creek, Fischer Creek, Whitefish Bay Creek, Heins Creek, Hibbard Creek, and Stony Creek. 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.

Over half (66%) of steelhead that were collected for analysis were broodstock stocked into the Root River. The remaining strays were primarily from Wisconsin waters, either the southern large rivers, or small tributaries, with only a few fish returning from Michigan waters.

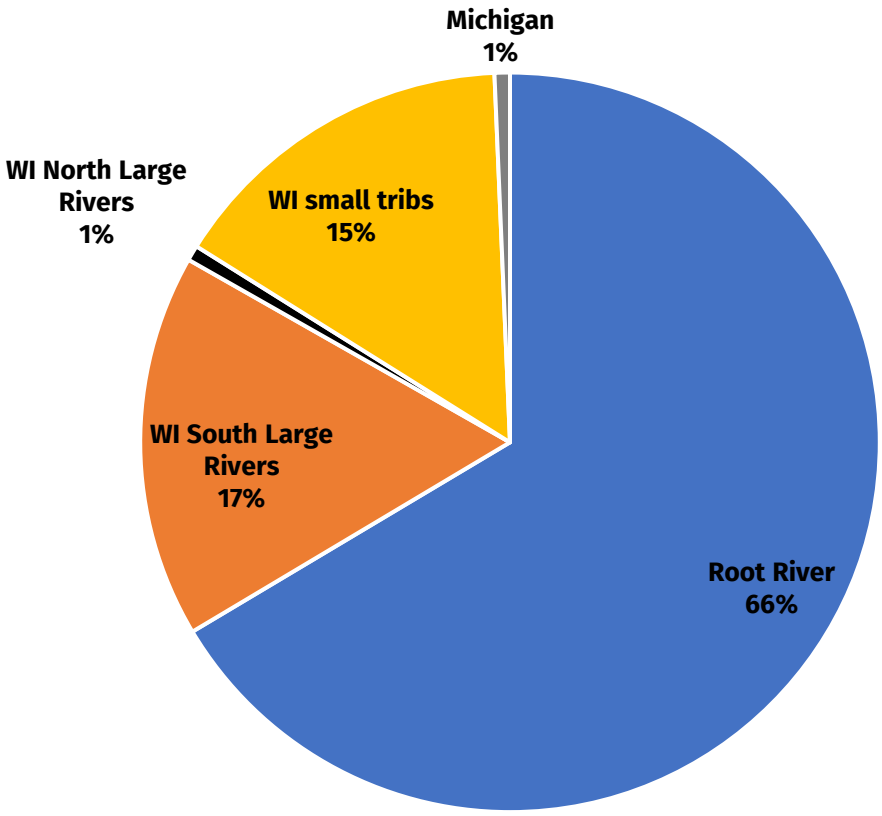

Figure 7. Stocking locations of CWT Steelhead returning to the Root River weir in spring 2021.

Analysis of growth is limited, as the oldest coded-wire tagged fish in the system were age 4 in spring of 2021. Still, preliminary results allow for early analysis of growth rates. In 2021, the oldest tagged steelhead in Lake Michigan were age 4, stocked in 2018 as yearlings. Age 2 steelhead ranged from 14-19 inches, age 3 steelhead ranged

from 19-26 inches, and age 4 steelhead ranged from 21-30 inches. In addition, there appears to be significant overlap in length-at-age between strains (Chambers and Ganaraska).

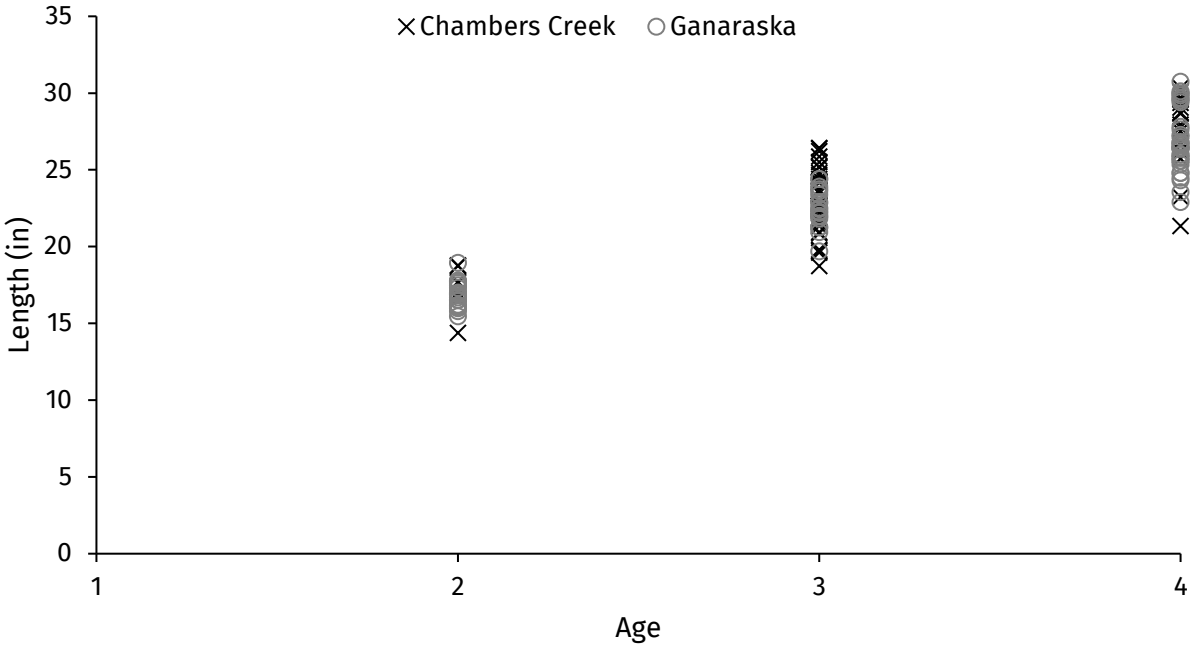

Figure 8. Length-at age of coded-wire tagged steelhead recovered at RRSF in spring 2021.

Table 4. 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 2011 to spring 2021. 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: Fall 2016, Fall 2017, and Fall 2019 were omitted for brown trout due to low returns.

SEASON	NUMBER USED IN ANALYSIS	AVERAGE WEIGHT (POUNDS)	AVERAGE LENGTH (INCHES)	STANDARD WEIGHT	TROPHY WEIGHT
Chinook Salmon					
2011-12	564	10.9 ± 5.0	30.3 ± 5.0	9.6	18.5
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
Coho Salmon					
2011-12	786	7.4 ± 2.3	26.9 ± 3.7	3.6	10.3
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
Steelhead					
2011-12	247	5.7 ± 1.8	25.4 ± 2.8	3.7	8.9
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

APPENDIX A. ROOT RIVER STOCKING NUMBERS

Table A-1. Number of fingerling Chinook salmon stocked in the Root River during 2011-2020. 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.

YEAR STOCKED	TOTAL NUMBER	STRAIN	FINCLIP
2011	20,154	Lake Michigan	A-CWT
2012	112,616	Lake Michigan	A-CWT
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

Table A-2. Number of coho salmon stocked in the Root River during 2011 – 2020.

YEAR STOCKED	TOTAL NUMBER	STRAIN	FINCLIP	AGE
2011	68,934	Lake Michigan	None	Spring yearling 1+
	10,675	Lake Michigan	A-CWT	Spring yearling 1+
2012	75,153	Lake Michigan	None	Spring yearling 1+
	10,968	Lake Michigan	A-CWT	Spring yearling 1+
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+

Table A-3. Number of steelhead stocked in the Root River during 2011-2020.

YEAR STOCKED	TOTAL NUMBER	STRAIN	FINCLIP
2011	28,104	Chambers Creek	ALM
	27,015	Ganaraska	ARV
2012	26,998	Chambers Creek	LMLV
	27,031	Ganaraska	BV
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

Table A-4. Number of brown trout stocked in the Root River during 2011-2020.

YEAR STOCKED	TOTAL NUMBER	STRAIN	FINCLIP
2011	28,726	Seeforellen	ARM
2012	29,695	Seeforellen	ARV
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