

Tracking Rainbow Trout Movement in the Saugeen River Before and After Removal of the Truax Dam

- Winter 2022 Update Report -

For many years, the Truax Dam in Walkerton, Ontario, was considered to be a significant barrier that blocked upstream movement of the Saugeen River fish community. In August 2019, 100 years after it was constructed, the dam was removed to increase river connectivity and enhance fish passage. In partnership with Bruce Power, Biotactic is conducting a multi-faceted long-term monitoring project to determine the impact of this removal project on the fish community. One component is a radiotelemetry study designed to better understand the seasonal patterns and movement rates of Rainbow Trout migrating from Lake Huron through the Saugeen River watershed and how these have changed after dam removal. The following is a summary of the radiotelemetry study findings to-date.

Since 2018, 50 adult Rainbow Trout have been captured each spring (April) and fall (October) in the Denny's Dam fishway trap by volunteers from the Ontario Steelheaders and the Lake Huron Fishing Club. Fish are electro-sedated, sexed, noted for origin (wild/hatchery) and measured for length, weight and girth. Each fish is then externally tagged near the dorsal fin with an anchor tag and surgically implanted with a digital radio-transmitter. Fish are allowed to recover and are released upstream of the dam to continue their migration. Both the anchor and radio-tag have unique codes, allowing individual fish to be tracked for up to three years.

Fish are continuously tracked as they naturally move through the Saugeen River. Seven fixed receiver stations are located at key points upstream and downstream of Denny's, Truax, Carrick and Maple Hill Dams. During mobile surveys, fish are also tracked by land (by truck or foot) and air (by small-aircraft). Tracking during the spring takes place from March to June and during the fall/winter from October to March of the following year. To-date 318 fish have been tagged. No fish were able to be tagged spring 2020 due to COVID-19 restrictions and 18 fish were tagged fall 2021 using tags returned to Biotactic from anglers. An additional 50 fish will be tagged in spring 2022.

Before Dam Removal

Three seasons were monitored, and 150 fish were tagged during the pre-dam removal period that included spring 2018, fall 2018 and spring 2019.

Spring

A total of 43 spring-tagged fish (86%) were tracked in spring 2018 and 44 (88%) were tracked in spring 2019. Not all fish migrated upstream with 10 and 12 fish, respectively, remaining downstream of Denny's Dam throughout the monitoring period. A further 6 and 4 fish did not arrive in Walkerton and travelled between 0.18–74.1 km upstream within the Saugeen River.

A total of 27 fish in spring 2018 and 28 fish in spring 2019 arrived at the Truax Dam in Walkerton. These fish required an average of 150 hrs (just over 6 days) to travel 77 km from Denny's Dam. Once arrived, fish were delayed for an average of 28.5 hrs while



Surgical implantation- fish are electro-sedated, a small incision is made, the radio-tag is inserted in the body cavity, and the incision is closed with a suture.



Radio-telemetry- a combination of fixed receiver stations, land-based and aerial tracking are used each season to re-locate individual fish and follow their movement throughout the Saugeen River watershed.

attempting to pass the dam. Of the combined 55 fish, only 34 (62%) ultimately passed upstream of the Truax Dam. Thirty-one (91%) of the fish that passed upstream of Truax Dam were also able to pass Carrick Dam.

A combined 25 fish eventually arrived at Maple Hill Dam where they were delayed for an average of 49.5 hrs downstream while attempting to pass upstream. A total of 13 fish (52%) across spring 2018 and 2019 ultimately passed upstream, where they spent an average of 341 hrs before returning downstream.

Across these two seasons, 2 fish were detected in the Teeswater River, 3 in the Beatty Saugeen River, 1 below Hanover Dam and 6 in Otter Creek. A total of 5 fish were harvested and removed from the dataset: 1 each downstream of Denny's Dam, in Stoney Creek, MacGregor Point as well as reports from Michigan and Wisconsin.

Fall

A total of 43 fall-tagged fish (86%) were tracked in fall 2018. Not all fish migrated upstream to Walkerton: 4 remained downstream of Denny's Dam and 22 travelled a maximum of 3.89–75.88 km upstream within the Saugeen River in the monitoring period.

Seventeen fish ultimately arrived at the Truax Dam after requiring an average of 666 hrs (nearly 28 days) to travel 77 km from Denny's Dam. Movement in the fall was therefore 4.5 times slower than in the spring. Once arrived, fall-run fish were delayed for an average of 894 hrs while attempting to pass further upstream. This delay was over 30 times greater than spring-run fish.

Only 3 fish (18%) passed the Truax Dam during the fall/winter and no fish were able to pass Carrick Dam. A total of 3 fish were harvested, 2 downstream of Denny's Dam and 1 in Walkerton.

Fall-tagged fish displayed a different level of motivation in the spring (2019), with the amount of downstream delay decreased and the amount of passage increased. An additional 17 fall-run fish arrived at the Truax Dam during the spring. A total of 29 fish were detected downstream and were delayed for an average of 232.5 hrs while attempting to pass. Twenty-one fish (72%) passed Truax Dam and 15 (71%) fish also passed Carrick Dam.

A total of 13 fish arrived at Maple Hill Dam and were delayed downstream for an average of 22 hrs. Eleven fish (85%) ultimately passed and spent an average of 549 hrs upstream before returning downstream. Three fish were detected in the Beatty Saugeen River, 1 in Meux Creek and 2 in Otter Creek; 1 fish was harvested downstream of Denny's Dam.

Since they were already in the system, fall-run fish appear to have had a head start on spawning relative to spring-run fish. Spring fish passed upstream of Maple Hill Dam between April 30–May 9 in 2018 and May 3–8 in 2019, while fall fish passed between April 13–24.

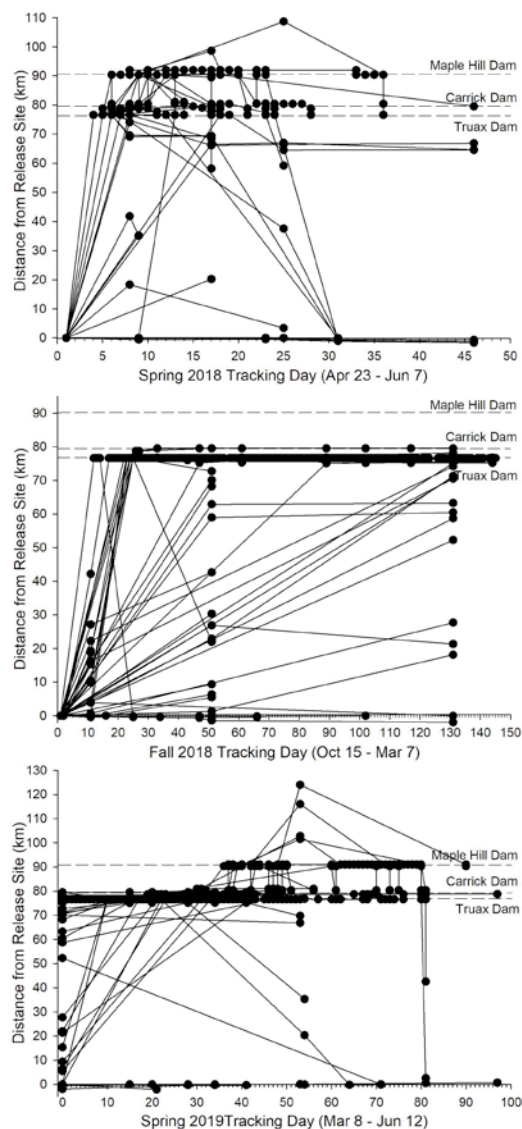
After Dam Removal

The Truax Dam was removed in August 2019. The first post-removal season was 2 months later in fall 2019. Additional seasons during this period include spring 2020, fall 2020, spring 2021 and fall 2021. Note no tagging could be completed spring 2020 and only previously tagged fish were tracked. An additional 50 fish will be tagged spring 2022 to provide a replicate for 2021 spring-run fish. Fall 2021 findings will be presented in a subsequent summary.

Spring

A total of 47 spring-tagged fish (94%) were tracked in spring 2021. Nine fish remained downstream of Denny's Dam and 19 fish travelled a maximum of 0.03–71.74 km upstream within the Saugeen River and did not arrive in Walkerton.

Nineteen fish arrived at the footprint of the former Truax Dam after requiring an average of 150 hrs to travel the 77 km from



Comparison of fish movement before dam removal showing spring-tagged fish in spring (top), fall-tagged fish in fall (middle) and fall-tagged fish in spring (bottom).

Denny's Dam. After arrival, fish were delayed downstream of the footprint for an average of only 11.5 hrs, 2.5 times less than before the dam was removed. Sixteen fish (84%) ultimately passed the footprint and 11 fish (69%) also passed Carrick Dam.

Only 6 fish eventually arrived at Maple Hill Dam where they were delayed for an average of 34 hrs while attempting to pass upstream. Four fish (67%) were ultimately successful and spent an average of 269 hrs upstream before returning downstream. One fish was detected below the Hanover Dam, 1 in Deer Creek and 1 in the North Saugeen River; 2 fish were harvested downstream of Denny's Dam.

Not only did downstream delay at the Truax Dam footprint decrease and passage increase after removal, but the rate of upstream movement of fish after they passed the footprint through to Carrick and Maple Hill Dams also increased. This appears to be

related to the decrease in energy expenditure and time spent downstream while attempting to pass the location of the Truax Dam (footprint). Fish required an average of 65 hrs to arrive at the Maple Hill Dam after passing the Truax Dam in spring 2018 and 2019. In spring 2021 fish required an average of only 26 hrs after passing the footprint to travel this distance (13.5 km) upstream.

Fall

A total of 46 fall-tagged fish (92%) were tracked in fall 2019 and 42 (84%) were tracked in fall 2020. Twenty-one fish in 2019 and 11 in 2020 remained downstream of Denny's Dam throughout the monitoring period. A further 15 and 13 fish, respectively, did not arrive in Walkerton and instead travelled between 0.10–75.02 km upstream within the Saugeen River.

A total of 10 fish in fall 2019 and 18 fish in 2020 arrived at the Truax footprint in Walkerton. These fish required an average of 2068 hrs to travel the 77 km from Denny's Dam. Once arrived, fish were delayed for an average of 74.5 hrs while attempting to pass the footprint. This delay was almost 4 times less than before the dam was removed. Fish continued to occupy deep pool habitat that remained downstream of the footprint.

Of the combined 28 fish, 23 (82%) ultimately passed the footprint, 4.5 times more than prior to the Truax Dam removal. Like fall 2018, no fish passed Carrick Dam in fall 2019. Fish were able to pass this dam in fall 2020 with 10 fish (63%) passing Carrick and 8 arriving at Maple Hill Dam. These fish were delayed for an average of 1035.5 hrs while attempting to pass with 4 fish (50%) ultimately successful. All fish remained upstream for the duration of the fall monitoring season. Fish were also able to pass Carrick and Maple Hill Dams in fall 2021.

Across fall 2019 and 2020 1 fish was detected in the Teeswater River and 4 in Otter Creek. A total of 13 of all fall-tagged fish were harvested and removed from the dataset: 10 downstream of

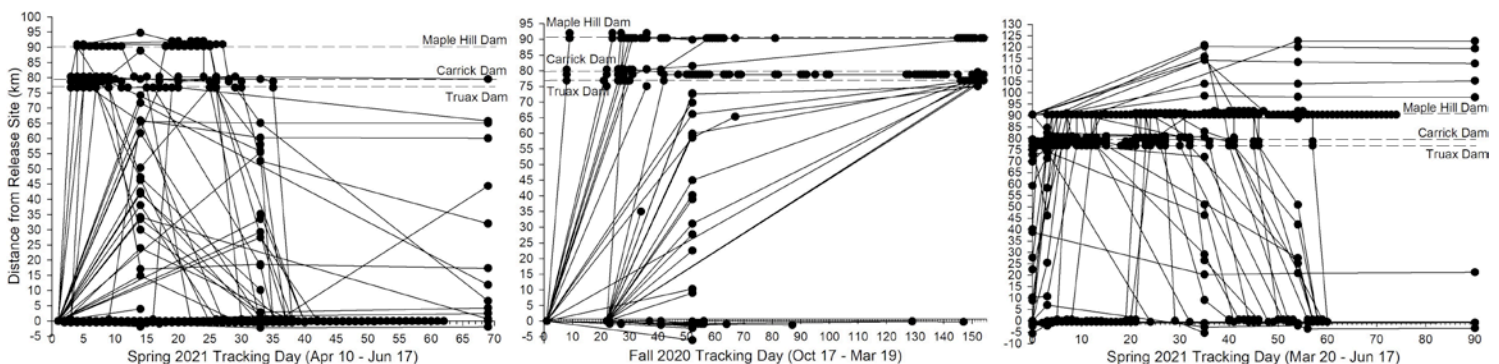
Denny's Dam, 1 in the town of Paisley and 2 in Walkerton.

Again, fall-tagged fish displayed a different level of motivation than those fish tagged in the spring. An additional 22 fall-run fish and 16 fall-run fish arrived at the Truax footprint during the spring 2020 and 2021 monitoring periods, respectively. A total of 47 fish were detected downstream and were delayed for an average of 15.5 hrs while attempting to pass; 15 times less delay than fall fish in spring prior to the dam removal. Forty-three fish (91%) passed the footprint and 45 out of 49 fish (92%) also passed Carrick Dam. This is 1.3 times greater than before the dam was removed.

A total of 44 fish arrived at the Maple Hill Dam and were delayed downstream for an average of 63.5 hrs. Twenty-nine fish (85%) ultimately passed and spent an average of 488 hrs upstream before returning downstream. Across these 2 seasons, 12 of all non-spring tagged fish were detected in the Beatty Saugeen River, 1 in Deer Creek and 6 in Otter Creek. One fish was harvested downstream of Denny's Dam and 2 fish were harvested in Michigan. Two tags were found on area beaches, 1 in Southampton and 1 in Goderich.

Since they were already in the system, fall-run fish again appeared to have a head start on spawning compared to spring-run fish post-dam removal. Spring fish passed upstream of Maple Hill Dam between April 13–14 in 2021 while fall fish passed between March 23–April 10 in 2021. Interestingly, passage of fall fish occurred between March 26–May 16 in 2020.

Again, not only was delay decreased and passage increased, but fall-run fish were also able to travel upstream of the Truax footprint at a faster rate after dam removal. Fish required an average of 321 hrs to arrive at Maple Hill Dam after passing the Truax Dam in spring 2019. Across spring 2020 and 2021 fish required an average of only 87.5 hrs to reach Maple Hill Dam after passing the Truax footprint.



Comparison of fish movement after dam removal showing spring-tagged fish in spring (left), fall-tagged fish in fall (middle) and fall-tagged fish in spring (right).

Summary

- Removal of the Truax Dam has decreased the amount of downstream delay and increased the passage of fish at this location.
- Movement and dam passage upstream of the Truax footprint has also increased as a function of the removal of the dam.
- Spring-run and fall-run fish display different levels of motivation during their upstream migration.
- Fall-run fish overwinter within the watershed, often downstream of Walkerton, and migrate upstream to spawn in the spring, likely reaching areas earlier than spring-run fish just entering the watershed.

Monitoring period Fish tracking group		Spring		Fall	Truax Dam Removed	Spring		Fall
		S'18 & S'19	F'18	F'18		S'21	F'19 & F'20	F'19 & F'20
Sample size (n)	(# fish tagged or remaining)	100	47	50		50	93	100
Sample size (n)	(# relocated)	87	40	43		47	76	88
Denny's Dam	(# not migrating upstream)	22	6	4		9	8	32
Truax Dam	(# arrived at Truax)	55	29	17		19	47	28
	(# passed upstream)	34	21	3		16	43	23
	(% passage)	62	72	18		84	91	82
	(average delay, hrs)	28.5	232.5	894		11.5	15.5	74.5
Carrick Dam	(# arrived at Carrick)	34	21	2		16	45	23
	(# passed upstream)	31	15	0		11	49	10
	(% passage)	91	71	0		69	92	43
Maple Hill Dam	(# arrived at Maple Hill)	25	13	-		6	44	8
	(# passed upstream)	13	11	-		4	29	4
	(% passage)	52	85	-		67	85	50
Tributaries	(# relocated)	T-2, OC-6, 1-H, BS-3	OC-2, MC-1, BS-3	-		DC-1, NS-1, H-1	DC-1, OC-6, BS-11	T-1, OC-4
Harvested	(#)	5	1	3		2	1	7

Abbreviations: S-spring, F-fall, T-Teeswater, NS-North Saugeen River, DC-Deer Creek, OC-Otter Creek, H-Hanover Dam, MC-Meux Creek, BS-Beatty Saugeen River

Additional Points of Interest

• Rainbow Trout/Steelhead are iteroparous and are thought to return (home) to natal streams to spawn 3-4 times throughout their lifespan. Relatively few radiotagged Rainbow Trout have returned to the Saugeen River in subsequent years. Of the 200 fish tagged from spring 2018 – fall 2019 approximately 17% were tracked after appearing to have returned to Lake Huron. Some fish first returned 2+ years after they were tagged. Note that the 2 fixed receiver stations in the vicinity of Denny's Dam were first installed spring 2021 for the exact purpose of providing more information regarding the timing and proportion of fish returning to and re-entering the Saugeen River from Lake Huron each season. These receivers will also allow Biotactic to perform an evaluation of the efficiency of the Denny's Dam fishway, with antennas located at key areas to determine how many tagged fish approach, enter and exit the fishway.

• The increased movement of Rainbow Trout through the Saugeen River post Truax Dam removal is also supported by additional components of the larger long-term monitoring project. Videographic surveys are conducted within Otter Creek, the first coldwater tributary upstream of the Truax footprint, as well as at the Maple Hill Dam fishway. Surveys have been conducted since 2018 in the spring and fall. Movement of fish into Otter Creek has increased by 203% in the spring and by 148% in the fall since the dam was removed. Upstream passage at the Maple Hill Dam fishway has increased by 180% in the spring and by 979% in the fall post-removal. Redd counts are also conducted in Otter Creek in the spring and fall to monitor Rainbow Trout and Chinook Salmon spawning, respectively. The number of redds has increased by an average of 177% in the spring and 156% in the fall since the Truax Dam was removed indicating that fish now have increased access to this tributary. A large spike in observed redds and numbers of Chinook Salmon was found in fall 2021.

• Each radiotelemetry dataset has been animated so that the movement of individual fish throughout the Saugeen River watershed can be visualized. The movement of fish is based on real radio tracking data that is coupled with changes in environmental conditions in the river. Animations of the spring 2018, fall 2018 and spring 2019 baseline pre-dam removal phases and fall 2019, spring 2020 and fall 2020 post-dam removal phases can be found on Biotactic's website as well as on our social media platforms. Animations of the spring 2021 and subsequent datasets will be available as they are produced.

Click on the following thumbnails to be re-directed to our website for:



Results from Videographic Surveys

biotactic.com/videographic-surveys-saugeen-river



Results from Redd Counts

biotactic.com/salmonid-redd-counts-in-the-saugeen-river



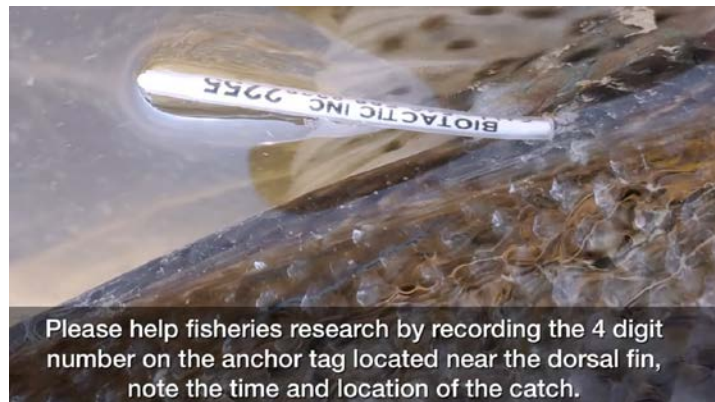
Animated Radiotelemetry Datasets

biotactic.com/migratory-patterns-of-rainbow-trout

A Note to Anglers

We would like to sincerely thank all anglers who have reported the recapture of a tagged fish. The information provided adds to this valuable dataset and helps us better understand our precious Saugeen River Steelhead. Returned tags from harvested fish can sometimes be re-used and help us keep this study going. For all 18 fish tagged in fall 2021 we used tags returned to Biotactic from angler recaptures!

Tagged fish have a white anchor tag near the dorsal fin and will have a black wire (antenna) extending from the side of the body near the anal fin. If you catch a tagged fish, regardless of whether it is released or harvested, please make note of the 4 digit number code on the anchor tag or alpha numeric code on the radio-tag and let us know where and when the fish was caught so we can include this information in the dataset. A reward is available and anglers will be provided with information on the tracked movements of the specific fish they caught.



Please help fisheries research by recording the 4 digit number on the anchor tag located near the dorsal fin, note the time and location of the catch.

Click to watch a short video that describes this project on YouTube

youtu.be/ITL_D2-mob8