Lake Manitoba & Lake St. Martin Outlet Channels Project

Aquatic Environment Monitoring, Fall 2020
Lake Whitefish Spawning Movements

REPORT

Prepared for Manitoba Transportation and Infrastructure
By North/South Consultants Inc. • 83 Scurfield Blvd. • Winnipeg, MB • R3Y 1G4

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A Data Report Prepared for

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By:

North/South Consultants Inc.

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EXECUTIVE SUMMARY

North/South Consultants Inc. (NSC) was retained by Manitoba Transportation and Infrastructure (MTI) to collect supplemental data with respect to the aquatic environment in support of the Lake Manitoba and Lake St. Martin Outlet Channel Project (the Project). An Aquatic Effects Monitoring Program (AEMP) was developed in 2020 to provide a plan for monitoring the effects of the Project on the aquatic environment, focusing on key issues identified in the Environmental Impact Statement (EIS). The AEMP identified the need for the collection of data to supplement existing information that had been presented in the EIS.

It has been long recognized that a large number of Lake Whitefish move annually from Lake Winnipeg to Lake St. Martin via the Dauphin River to spawn during fall. However, the number of whitefish that move up the Dauphin River has not been documented, nor have spawning areas in the upper Dauphin River been identified. It is known that whitefish spawn in the Narrows between the north and south basins of Lake St. Martin, but other areas of the lake may also provide spawning habitat for whitefish. Further, it is not known whether migrating Lake Whitefish from Lake Winnipeg move into the Fairford River to spawn or move upstream past the Fairford River Water Control Structure.

This study was initiated to provide insight into the movements of spawning Lake Whitefish moving from Lake Winnipeg into the Dauphin River to known spawning areas at the Narrows in Lake St. Martin and possibly areas farther upstream, including the Fairford River. Acoustic telemetry was used to track the movements of 51 individual fish tagged in the lower and upper Dauphin River during September and October 2020. Results presented here provide a summary of monitoring conducted until early December 2020. It is anticipated that additional data will become available in spring 2021 and results presented here will be updated. Results from the acoustic telemetry study support and better define Lake Whitefish spawning investigations planned in the AEMP.

The following conclusions can be drawn from telemetry results to date:

i) September and October discharge on the Dauphin and Fairford rivers during 2020 was lower than median percentile flows observed during 1977-2019.

ii) Lake Whitefish moved into the lower Dauphin River during early September during 2020 but upstream movements to Lake St. Martin did not begin until early October.

iii) Lake Whitefish tagged in the lower Dauphin River in September returned to Sturgeon Bay shortly after being tagged and had not returned to the Dauphin River by late October.

iv) Lake Whitefish tagged in the upper Dauphin River in early October moved to the Lake St. Martin Narrows. At least one tagged fish moved into the Fairford River and another moved into Birch Bay in southern Lake St. Martin.

TABLE OF CONTENTS

LIST OF TABLES

Page

LIST OF FIGURES

ACRONYMS

AEMP	Aquatic Effects Monitoring Program
EIS	Environmental Impact Statement
FRWCS	Fairford River Water Control Structure
LMOC	Lake Manitoba Outlet Channel
LSMOC	Lake St. Martin Outlet Channel
MTI	Manitoba Transportation and Infrastructure
NSC	North/South Consultants Inc.

1.0 INTRODUCTION

North/South Consultants Inc. (NSC) was retained by Manitoba Transportation and Infrastructure (MTI) to collect supplemental data with respect to the aquatic environment in support of the Lake Manitoba and Lake St. Martin Outlet Channel Project (the Project). The proposed Project is designed to manage flood waters on Lake Manitoba and Lake St. Martin by providing a channel by which flood waters can be conveyed, in addition to the natural outflow via the Fairford and Dauphin rivers (Figure 1). The Project consists of two outlet channels that are intended to work together:

- The 24 km Lake Manitoba Outlet Channel (LMOC) will work in tandem with the existing water control structure on the Fairford River (the Fairford Water Control Structure or FRWCS) to help regulate water levels and mitigate flooding on Lake Manitoba; and
  - The 24 km Lake St. Martin Outlet Channel (LSMOC) will restore a more natural water regime to Lake St. Martin and will also provide flood protection by mitigating increased inflows from operation of the FRWCS, as well as additional inflows from the planned LMOC.

An Aquatic Effects Monitoring Program (AEMP) was developed in 2020 to provide a plan for monitoring the effects of the Project on the aquatic environment, focusing on key issues identified in the Environmental Impact Statement (EIS). The specific objectives of the AEMP were to:

- Verify the predicted effects presented in the surface water quality and fish and fish habitat sections of the EIS;
- Determine the effectiveness of mitigation measures;
- Assess the need for additional mitigation measures if initial measures are not adequate;
- Determine the effectiveness of any additional/adapted measure(s); and
- Confirm compliance with regulatory requirements relevant to surface water quality and fish and fish habitat set out in the Project approvals (e.g., Manitoba Environment Act License; Fisheries Act Authorization).

The AEMP identified the need for the collection of data to supplement existing information that had been presented in the EIS.

It has been long recognized that a large number of Lake Whitefish (*Coregonus clupeaformis*) move annually from Lake Winnipeg to Lake St. Martin via the Dauphin River to spawn during fall (Stone 1965; Cook and MacKenzie 1979; Kristofferson and Clayton 1990; NSC 2016). However, the number of whitefish that move up the Dauphin River has not been documented, nor have spawning areas in the upper Dauphin River been identified. It is known that whitefish spawn in the Narrows between the north and south basins of Lake St. Martin, but other areas of the lake may also provide spawning habitat for whitefish. Further, it is not known whether migrating Lake Whitefish from Lake Winnipeg move into the Fairford River to spawn or move upstream past the Fairford River Water Control Structure (FRWCS).

Operation of the LSMOC has the potential to affect the magnitude of the Lake Whitefish migration through the Dauphin River by altering flow patterns and attracting fish to the outlet of the LSMOC in Sturgeon Bay or by altering the location or suitability of spawning habitat within Lake St. Martin.

Documenting the movements of individual fish through the system and enumerating the number of Lake Whitefish that move up the Dauphin River may provide answers to some of these questions and will provide information against which future monitoring results can be compared. As part of the AEMP, investigations are planned to determine the extent to which, if any, operation of the channels affects Lake Whitefish spawning in the Dauphin River, Lake St. Martin, and the Fairford River.

This report provides methods and results of an acoustic telemetry study initiated during September 2020 to document the movements of individual Lake Whitefish as they move from Sturgeon Bay on Lake Winnipeg through the Dauphin River and Lake St. Martin during their fall spawning migration. The telemetry study presented here is part of an integrated series of studies (see NSC 2022a) intended to address some of the unanswered questions regarding Lake Whitefish ecology in the Lake St. Martin area. Acoustic telemetry results from mid-September to early December 2020 are reported here. It is anticipated that additional data will become available in spring 2021 and results presented here will be updated. Results from this study will support and better define Lake Whitefish spawning investigations planned in the AEMP.

2.0 METHODS

2.1 STUDY DESIGN

Acoustic telemetry methods were used to monitor the movements of individual adult Lake Whitefish moving upstream from Sturgeon Bay to spawning areas in the upper Dauphin River, Lake St. Martin, and possibly the Fairford River during fall. The basic study design was to capture adult Lake Whitefish in the lower-most reaches of the Dauphin River and surgically implant acoustic transmitters into them. An array of acoustic transmitters strategically deployed in the Dauphin River, Lake St. Martin, and the Fairford River were used to track the movements of tagged fish once acoustic tags had been implanted. Acoustic receivers were deployed in locations to:

i) document tagged whitefish movements through the study area;

ii) determine whether tagged whitefish concentrate in known spawning areas in Lake St. Martin (i.e., the Narrows);

iii) determine whether tagged whitefish move into areas where effects related to LMOC or LSMOC operation may affect whitefish spawning (i.e., north basin of Lake St. Martin near the inlet to the LSMOC; Birch Bay in southern Lake St. Martin near the outlet of the LMOC);

iv) determine whether tagged Lake Whitefish move into the Fairford River during fall and, if so, determine whether they ascend upstream past the FRWCS; and

v) determine when tagged whitefish return to Sturgeon Bay from upstream areas.

2.2 DATA COLLECTION

2.2.1 Physical Environment

2.2.1.1 Water Temperature

Water temperature loggers manufactured by the Onset Corporation (HOBO Water Temperature Pro v2; Model U22-001) were installed at five locations throughout the study area at the beginning of fall field investigations (Table 1). Locations included the following:

i) the lower Dauphin River near Sturgeon Bay;

ii) the Dauphin River outlet at Lake St. Martin;

iii) the Lake St. Martin Narrows;

iv) the south basin of Lake St. Martin (in Birch Bay); and

v) the Fairford River.

The loggers were attached to concrete moorings so that they sat ~20 cm above the bottom of the river/lake. The loggers were operated continuously throughout fall 2020 and were programmed to record water temperature at one-hour intervals. Loggers were retrieved at the end of the fall field program. Data were downloaded from the logger using software provided by the logger manufacturer.

2.2.1.2 Discharge

Mean daily discharge data for the Fairford River (Station 05LM001) during September and October 2020 were provided by the Water Survey of Canada (2020). Mean daily discharge data for the Dauphin River (Station 05LM006) during September and October 2020 were provided by the Water Survey of Canada (2021). Historic data (1977-2019) were also downloaded for both rivers.

2.2.2 Acoustic Telemetry

2.2.2.1 Acoustic Receiver Deployment and Retrieval

Eighteen acoustic receivers were deployed throughout the Dauphin River, Lake St Martin and the Fairford River during fall 2020. Locations included the following:

- Two receivers in the lower Dauphin River immediately upstream of Sturgeon Bay to document movements of tagged fish into Sturgeon Bay (DR at Sturgeon Bay; DR at Community);
- Two receivers in the lower half of the Dauphin River to document the progress of upstream movements and determine if tagged fish do not ascend the Dauphin River to Lake St. Martin (Upstream of Big Rapids; Big Bend);
- Two receivers in the upper Dauphin River immediately downstream of Lake St. Martin to determine when tagged fish leave the Dauphin River (DR-2 DS; DR Inlet to LSM);
- Two receivers in the eastern portion of the Lake St. Martin north basin to determine if tagged fish concentrate in the vicinity of the entrance to the LSMOC (LSM North Basin 1; LSM North Basin 2);
- Four receivers immediately to the south of the Lake St. Martin Narrows to determine if tagged fish concentrate in an area known to be used for spawning by whitefish (LSM Narrows 1; LSM Narrows 2; LSM Narrows 3; LSM Narrows 4);
- Three receivers in Birch Bay in the south basin of Lake St. Martin to determine if tagged fish concentrate in the vicinity of the LMOC outlet (LSM South Basin 1; LSM South Basin 2; LSM South Basin 3);
- One receiver in the Fairford River at Lake St Martin to determine if tagged fish enter the Fairford River (Fairford at LSM);
- One receiver downstream of the FRWCS to determine if tagged fish ascend the Fairford River to the FRWCS (DS of FRWCS); and

- One receiver upstream of the FRWCS to determine if tagged fish ascend the fishway at the FRWCS (US of FRWCS).

Receivers deployed in shallow water and subject to loss or damage due to ice formation and breakup were removed at the end of the fall monitoring program. Receivers deployed in deeper water were left in place for the winter. Three receivers were deployed in Sturgeon Bay to determine if and when tagged whitefish returned from upstream areas to Lake Winnipeg. These were left in place and will be retrieved during spring 2021. Additional information for receivers deployed during fall and winter is provided in Table 2 and Figure 2.

Vemco VR2W® acoustic receivers were used to monitor the movements of acoustically tagged fish. Each receiver consisted of an omnidirectional hydrophone and lithium ion battery (15-18 month battery life) enclosed in a watertight PVC casing. Each tag code sequence received by the receiver is time-stamped and logged to the internal memory. Receivers were attached to moorings consisting of a 20-25 kg rectangular concrete base and an embedded 45 cm length of re-bar oriented perpendicular to the river/lake bottom, to which the receiver was secured using hose clamps. To facilitate retrieval during open water, moorings were either tied to shore or a 15 x 25 cm surface float, depending on the conditions of the deployment location. Receivers deployed during winter used the same base, but were attached to a float that remained approximately 2.5 m beneath the water surface to avoid entrainment in ice, and potential loss or damage due to ice movement and break up.

The location of each receiver was recorded using a Garmin 78® GPS receiver (Garmin Limited, Olathe, Kansas) and water depth was measured. Upon retrieval, Vemco's VUE® software was used to download data recorded by the receivers.

2.2.2.2 Fish Capture

Fish were captured in the Dauphin River using a combination of hoop nets and boat electrofishing. Hoop nets were constructed of 6.45 cm^2 nylon mesh, with mouth openings of 1.2 m in diameter and wings of varying length. The hoop nets were oriented to capture fish moving upstream and were checked daily. Boat electrofishing was conducted with a Smith-Root APEX electrofisher with dual boom Smith-Root UAA-6 Umbrella anodes (0.91 m diameter) mounted two meters apart on the bow of an aluminum jetboat. Additional details are provided in NSC (2022b).

Initially, fish were captured and tagged in the lower Dauphin River at a location approximately 3.0 km upstream of Sturgeon Bay (Figure 2). At the end of September, a secondary capture and release location was established in the upper Dauphin River about 3 km downstream of Lake St. Martin (Figure 2).

All fish captured in the hoop nets and by electrofishing were enumerated by species, measured for fork length (± 1 mm) and round weight (± 25 g) and released back into the Dauphin River. All Lake Whitefish were examined externally to determine sex and spawning condition and were tagged with an individually numbered Floy® tag (Floy Tag and Manufacturing Inc., Seattle, Washington). Selected whitefish were retained for acoustic transmitter implantation as described below. Although hoop nets were checked daily, Lake Whitefish were occasionally retained in the hoop nets for an additional 24 hrs after capture if the biologist responsible for surgical implantations was unavailable.

2.2.2.3 Acoustic Transmitter Implantation

Vemco V13-1L® acoustic transmitters (Vemco, Halifax, Nova Scotia) were used in this study. This transmitter model is 13 mm in diameter, 36 mm in length, and has a weight in air of 11 g. Programmed to emit its unique coded signal every 100 – 180 seconds (random interval), each transmitter had an estimated tag life of 1,734 days (4.8 years). Each tag was tested for functionality prior to the beginning of the field program. Fifty transmitters were implanted during this study, although one transmitter was implanted into a second fish after the first recipient was harvested by a commercial fisherman.

There was variation in the transfer/sampling/holding/surgical implantation routine, as dictated by logistics and quantities of fish captured over time. In general, Lake Whitefish destined for acoustic transmitter implantation were transferred to ~500 L holding tanks, measured for size and spawning condition attributes as described above, and Floy tagged prior to transmitter implantation.

The acoustic tagging procedure followed well-established methods (Barth et al. 2011; McDougall et al. 2013) except that most fish were not anesthetized prior to surgery. Initially, anesthetic was used (an ~5 second exposure to a dilute clove oil/ethanol/water solution [1 ml:9 ml:80 L]; adapted from Anderson et al. 1997) but this step was eliminated from the procedure after observing slow-recovery characteristics in the first two Lake Whitefish implanted with acoustic tags. Similarly, anesthetic was not used when Lake Whitefish were tagged during an acoustic telemetry on the Burntwood River (C. Hrenchuk, North/South Consultants Inc., pers. comm.).

To implant the acoustic transmitter, the fish was placed ventral side up on V-shaped surgery table and river/lake water was irrigated over its gills via an automatic live well pump. An ~2 cm incision was made in the abdomen and parallel to the midline of the fish; an acoustic transmitter was inserted through the incision. The transmitter was then pushed towards the head of the fish to reduce pressure on the incision. Two or three Prolene® non-absorbable sutures (Ethicon Incorporated, Markham, Ontario) with reverse cutting needles (2-0) were used to close the incision. Disinfectant (Germex®, Bimeda-MTC Animal Health Incorporated, Cambridge, Ontario) was applied to the incision site, and the fish was placed back in the holding tank to recover. Surgery time was consistently <4 minutes. The surgery process was repeated until all fish in the batch were sampled.

After surgery, fish remained in the holding tanks for 15-30 minutes until they had recovered (i.e. maintaining equilibrium and swimming strongly within the tank). Releases generally occurred within 200 m of the fish's capture location. However, one batch of fish (n=14) was transferred in large coolers filled with river water to a location ~3.3 km upstream of their capture location to avoid possible predation by pelicans foraging in an area just upstream of the capture location.

2.3 DATA PROCESSING

The presence of large numbers of acoustic transmitters in a small area can cause transmission code collisions and occasionally result in false detections (Pincock 2008). This was taken into consideration during the planning phases of this project; programing schemes were selected so that transmitters would emit their coded signals every 100-180 seconds, as shorter intervals might have caused problems in situations where fish were highly congregated (e.g. spawning). Despite the proactive approach to minimizing false detections, this was still expected to occur occasionally. Therefore, a standard filtering practice was employed during data processing.

As an initial first filtering step, a unique transmitter was required to be detected twice by a given receiver within a 1-hour interval for the detections to be deemed valid as suggested by the manufacturer (Pincock 2008). It should be noted that most of the detections removed via this procedure will actually be "valid", but the inclusion of "false" detections result in more errors in interpretation of acoustic telemetry datasets than erroneous removal of a small number of "valid" detections. After this initial filtering step, data were also examined manually considering all spatiotemporal data available for the tag in question, the rationale being that chance events can occasionally result in false detections occurring in close enough temporal proximity for them to pass the initial filtering step. Improbable paired detections based on timing and/or location were also searched for.

As all detections of tagged Lake Whitefish during the primary monitoring period (Sept 20 - October 19, 2020) occurred in relation to the primary flow axis of the Fairford River - Lake St. Martin - Dauphin River system, movements were analyzed in terms of river kilometer distance (rkm). The mouth of the Dauphin River at Sturgeon Bay was considered rkm 0 (Figure 2). To facilitate this analysis, each individual receiver's rkm distance from the Dauphin River mouth was measured by tracing the path of the Dauphin River channel, through Lake St. Martin and up the Fairford River using Garmin Mapsource®. As all receivers were deployed upstream of Sturgeon Bay, they were all assigned positive rkm distances. A positioning algorithm, adapted from McDougall et al. (2013), was used to calculate the average detection distance of each individual fish, based on a 4-hour interval according to the following equation:

$$\overline{D}_{\Delta t} = \sum_{i=1}^{n} R_i \, D_i \div \sum_{i=1}^{n} R_i$$

Where n is the number of receivers in the array, R_i is the number of detections at the i^{th} receiver during the time period Δt, and D_i is the linear river kilometre distance of the i^{th} receiver from the mouth of Sturgeon Bay.

It should be noted that rkm distances between locations tend to exceed "as the crow flies" distance.

2.4 DATA ANALYSIS

2.4.1 Detection Summary and Fish Status

Analysis of acoustic telemetry data is complicated when the status of tagged individuals is uncertain. A tagged fish might not be detected by an acoustic receiver because it suffered mortality outside of the detection range, or it could be alive but simply remain out of detection range of any receivers for lengthy intervals. Conversely, a tagged fish might be detected repeatedly by a single receiver because they have suffered mortality (or tag loss) within detection range, or it might be alive but never leave the detection range of the receiver. While the latter situation was not observed in this study, a proportion of the Lake Whitefish tagged were never detected by an acoustic receiver. Post-tagging mortality, tag-loss or predation (e.g. by pelicans or river otters) are conceivable for these fish, so they were considered "undetected" and were omitted from certain summaries. However, it should be noted that subsequent monitoring may provide information to indicate that these undetected fish are alive and detectable, requiring recalculation of the data summaries presented here.

Unreported harvest and premature tag deactivation can also cause uncertainty regarding the classification of status. For this reason, efforts were made to inform commercial fishers and subsistence harvesters of the research being conducted and request that captured fish with Floy tags or acoustic transmitters be reported.

2.4.2 Movement Summaries

Graphical detection summaries of fish movements were generated using the 4-hour distance algorithm, with date/time plotted on the X-axis and detection distance (rkm) plotted on the Y-axis. For reference, tagging date/times and release locations are also included.

The breakdown of minimum (downstream) and maximum (upstream) detection distances for tagged fish were tabulated by release location (i.e., distance in rkm).

3.0 RESULTS

The field program was initiated on September 9, when the first acoustic receivers were deployed in the study area. Fall monitoring continued until the third week of October, when cold air temperature and ice formation resulted in the cessation of the fall field program. Most acoustic receivers were removed by October 20, although some could not be retrieved until after freeze up in early December. A small number of receivers were re-deployed in Birch Bay and Sturgeon Bay and left in place for the winter of 2020/2021.

3.1 PHYSICAL ENVIRONMENT

3.1.1 Water Temperature

Water temperature data were collected throughout the duration of the fall field program. Logger deployment and retrieval dates are provided in Table 1. Monitoring start and end dates varied by location, but a general synchronicity among the water temperature trends observed at different locations is evident, as are pronounced day/night fluctuations presumably attributable to solar heating (Figure 3). In general, water temperature was 12-14^{o}C at the onset of the monitoring program and decreased to approximately 8^{o}C by October 13. Cold air temperature resulted in an abrupt decline to near 0^{o}C water temperature by October 17 (Figure 3). Ice formation resulted in termination of the field program on October 21.

While most temperature loggers were removed by October 21, the logger deployed in Birch Bay remained in place until December 8, 2020 and illustrates the effects of ice formation on water temperature (Figure 4).

3.1.2 Discharge

Discharge on the Fairford River fluctuated between 25 and 54 m^3/s throughout the study period, lower than median discharge conditions recorded in September and October during 1977-2019 (56-99 m^3/s; Table 2; Figure 5). Flows recorded in the Fairford River in September 2020 were equal to the 33-48 percentile flows observed in September during 1977-2019; flows in October were equal to the 21-47 percentile flows observed during the same month in 1977-2019 (Table 2; Figure 5).

Dauphin River discharge ranged from 40-63 m^3/s during September and October, also lower than median discharge conditions recorded in September and October during 1977-2019 (66-123 m^3/s; Table 2; Figure 6). September flows in 2020 were equal to the 25-41 percentiles flows recorded in September during 1977-2019; October flows were equal to the 33-41 percentile flows in 19177-2019 (Table 2; Figure 6).

Reflecting the low flow conditions on the Fairford and Dauphin rivers, water levels throughout the study area were generally much lower than observed during 2011-2015 field investigations. For the duration of the fall 2020 telemetry study, the Dauphin River was not navigable by motorized boat between ~ rkm 4 and 10 (known locally as Big Rapids), as well as in numerous other areas farther upstream. In the lowermost ~300 m of these rapids, the field crew estimated (from shore) that water depth was consistently 0.3 m deep or less. Even with the relatively turbid water characteristic of the Dauphin River at the time of the study, the river bottom could be clearly seen throughout the entire ~300 m reach at the lower end of the rapids.

3.2 ACOUSTIC RECEIVER DEPLOYMENT AND RETRIEVAL

A total of 18 acoustic receivers were deployed throughout the study area during fall 2020. Most (n = 13) were in place by mid-September. The remaining five were installed in the later part of September and early October to provide better sampling coverage in areas of shallow water. A summary of information related to acoustic receiver deployment and retrieval is presented in Table 3. Receiver locations are illustrated in Figure 2.

Early ice formation ended the fall field program in mid-late October and 11 of the receivers were removed by October 20. Two receivers in the Fairford River were removed on October 27; the remaining five receivers could not be retrieved due to ice conditions and their surface floats were frozen into the ice. Three of these were retrieved during a brief field program in early December by locating the receiver’s surface float in the ice and carefully chopping a hole around the float and attachment line. The receiver and base were then lifted to the surface. Surface floats could not be located for two receivers deployed in Birch Bay; effort will be made to retrieve those receivers following ice break up in spring 2021.

After retrieval during fall 2020, three receivers were re-deployed in an array around the Dauphin River mouth in Sturgeon Bay to record the movements of tagged fish returning to Lake Winnipeg after ice formation (Table 3; Figure 2). Additionally, the receiver retrieved in Birch Bay during December was re-deployed for the winter. Other than these locations, water depth was not sufficient in most other parts of the study area to safely deploy receivers without the potential for receiver loss due to ice scour. The receivers in Sturgeon Bay and Birch Bay will be retrieved during spring 2021.

3.3 LAKE WHITEFISH CAPTURE AND ACOUSTIC TRANSMITTER IMPLANTATION

Hoop nets proved to be a viable method for capturing Lake Whitefish in sufficient condition to survive the surgery process, and 47 of 51 Lake Whitefish tagged in this study were captured in hoop nets; the remaining four tagged fish were captured during boat electrofishing sampling. It should be noted that only hoop nets deployed in the lower Dauphin River (i.e., near rkm 3.0; Figure 2) captured Lake Whitefish during September; hoop nets deployed further upstream did not capture any whitefish until October. Additional details of fish capture and sampling effort are provided in NSC (2022a).

The first five Lake Whitefish were tagged and released at rkm 3.0 (Figure 2) on September 20 (Table 4). Fish were released after dark to reduce the risk of predation by pelicans foraging in the area. All of the tagged Lake Whitefish were swimming strongly following release. Subsequent fish releases occurred during mid-day as pelican feeding behaviour at the site occurred predominantly at night, release on September 21 (n=5) and September 24 (n=5) occurred during midday.

After tagging the first fifteen Lake Whitefish at rkm 3.0, it was questioned whether Lake Whitefish in the lower Dauphin River would a) be motivated to ascend through a long set of rapids starting immediately upstream of the tagging site given that known spawning habitat occurs in the middle of the rapids (mouth of Buffalo Creek; NSC 2016), and b) what proportion of those motivated to ascend would be successful, given the large quantity of pelicans feeding in the rapids. Consequently, nine whitefish captured and tagged at rkm 3.0 were transported in the coolers filled with river water upstream by truck. These were released rkm 6.3, more than two km upstream of pelican concentrations.

After September 26, remaining acoustic tags were applied to Lake Whitefish captured in the middle (n = 1) to upper (n = 26) portions of the Dauphin River (Table 4). The rationale was that if only a small proportion of Lake Whitefish entering the Dauphin River were motivated to ascend the rapids, determining how Lake Whitefish utilize the upper portions of the study area for spawning would be better approached by focusing acoustic tagging efforts on fish that had successfully ascended through the lower Dauphin River.

Lake Whitefish were rarely caught in hoop nets set near the Big Bend (rkm 23; Figure 2) or the upper Dauphin River near Lake St Martin (rkm 48.0; Figure 2) prior to October 4 (NSC 2022a). Whitefish catches increased dramatically by October 5, and 27 were tagged from October 6 to October 9. Most (n = 26) at the upper Dauphin River site (rkm 48.0) while a single fish was captured and released at the Big Bend (rkm 23).

Biological and tag information for all tagged Lake Whitefish is provided in Table 4 and Figure 7.

3.4 MOVEMENT MONITORING: SEPTEMBER 20 – OCTOBER 21, 2020

3.4.1 Detection Summary and Fish Status

Forty-seven of 51 (92.2%) Lake Whitefish implanted with acoustic transmitters were detected by acoustic receivers during fall 2020 (Table 4). After filtering to remove potential false detections, the median number of detections logged was 73 (range: 6 – 2,395). All detections occurred by receivers deployed in relation to the primary flow axis (Table 3; Figure 2).

Four of 51 (7.8%) Lake Whitefish implanted with acoustic transmitters were not detected (Table 4). One of these was tagged and released at rkm 3 on September 24, and three were from the batch of nine captured at rkm 3.0 and transported upstream by truck to rkm 6.3 prior to release on September 26 (Table 4). These four fish are assumed to have perished shortly after tagging.

3.4.2 Commercial Mortality

As of February 2021, two Lake Whitefish implanted with acoustic transmitters during this study have been harvested in commercial fisheries based on the return of tags by commercial fishers.

The first Lake Whitefish taken by a commercial fisher was tagged at rkm 3 on September 21 (Table 3). Both its acoustic tag (#53288a) and Floy® tag (116384) were returned following its capture on Lake Winnipeg, ~2 km north of the Dauphin River mouth on September 24. The fish had been last detected by the acoustic receiver deployed at rkm 0 (DR Sturgeon Bay) on September 23, 2020. It should be noted that following return by the commercial fisher, the acoustic tag was implanted into another Lake Whitefish (referred to as #52388b; Table 3).

The second Lake Whitefish (Floy® tag 119348; acoustic tag #53260) captured in the commercial fishery was tagged at the upper Dauphin River site (rkm 48) on October 9 (Table 3). The fish was recaptured south of the Lake St. Martin Narrows on December 9 at a location approximately 1.6 km from the old Lake St. Martin community. The fish had last been detected in the Lake St. Martin Narrows (rkm 66.9; Lake St. Martin Narrows 4) on October 19, the last day that receivers were in place in the area.

3.4.3 Movement Summaries

Notably, none of the 24 fish tagged and released in the lower Dauphin River (i.e., at either rkm 3.0 or 6.3) were detected by receivers deployed upstream of their release site (Table 3; Figure 8). While three fish released at rkm 6.3 were never detected and are therefore presumed dead, the other six released at rkm 6.3 were detected by the receiver deployed downstream at the Dauphin River community (rkm 1.9; Tables 4 and 5). Further, five of those six were detected by the receiver deployed at the entrance to Sturgeon Bay (rkm 0). Similarly, 14 of 15 (93.3%) of the Lake Whitefish released at rkm 3 were detected at the receiver deployed at rkm 0 (Tables 4 and 5). The 15th fish tagged at rkm 3.0 was not detected after tagging and is presumed dead. The majority (14 of 20 fish detected after tagging) of whitefish moved downstream out of the Dauphin River the day after being tagged and all but two fish remained in the river for more than 5 days after tagging (Figure 9). These results indicate that all whitefish tagged in the lower Dauphin River moved downstream and into Sturgeon Bay subsequent to tag implantation. However, it is important to note that Lake Whitefish were not captured in the upper Dauphin River until early October and, consequently, it is possible that whitefish tagged in the lower Dauphin River during September returned to the Dauphin River in late October to move upstream.

In contrast, whitefish tagged farther upstream in the Dauphin River tended not to move downstream after being tagged. The lone Lake Whitefish tagged at the Big Bend (rkm 23.2) was subsequently detected in the upper Dauphin River (rkm 48.0) and south of the Lake St. Martin Narrows (rkm 70.8; Tables 4 and 5; Figures 2 and 8). Twenty four of 26 whitefish tagged and released at the upper Dauphin River site (rkm 48.0) did not move downstream from their release location (minimum detection distance of rkm 47.7 or rkm 48.3 indicating that they were not detected in receivers farther downstream; Table 4; Figures 2 and 8). Of these, 14 tagged fish were subsequently detected by receivers located farther upstream (receivers at rkm 66.9, 68.3, 70.8, and 91.5; Table 5; Figures 2 and 8). Most (11 of 14) advanced upstream to the south of the Lake St. Martin Narrows (rkm 70.8) and one tagged fish moved into the lower Fairford River (rkm 91.5; Table 5; Figures 2 and 8). Nine fish released at the upper Dauphin River site were last detected at the release location (rkm 48.0; Figure 2). However, the last detection for all of these fish was the same day or the day after the fish was tagged and it is possible that these fish remained in the local area while recovering from transmitter implantation surgery and had not yet moved far enough from the release site to be detected by receivers upstream or downstream of the release site.

Only two of 27 Lake Whitefish tagged and released at the upper Dauphin River site (rkm 48) displayed substantial downstream movements. One fish was detected at Sturgeon Bay (rkm 0) seven days after it was tagged and released while the other was last detected at the Big Bend (rkm 24.5, approximately 24 km downstream of the release site at rkm 48.0) the day after it was tagged and released (Table 4; Figures 2 and 8).

3.5 MOVEMENT MONITORING: OCTOBER 21 – DECEMBER 11, 2020

Movement data collected after October 21 was taken from three receivers retrieved during December 8-11. These included two in the north basin of Lake St. Martin and a single receiver from Birch Bay in southern Lake St. Martin (Table 2; Figure 2). No tagged fish were detected on the receivers retrieved from the north basin of Lake St. Martin. However, a single tagged Lake Whitefish (#53264, 420 mm FL) was detected on the receiver retrieved from Birch Bay. This fish was detected 520 times between October 26 and 27, and then three times on October 31.

4.0 SUMMARY

This study was initiated to provide insight into the movements of spawning Lake Whitefish moving from Lake Winnipeg into the Dauphin River to known spawning areas at the Narrows in Lake St. Martin and possibly areas farther upstream, including the Fairford River. Acoustic telemetry was used to track the movements of individual fish tagged in the lower and upper Dauphin River during September and October 2020. Results presented here provide a summary of monitoring conducted until early December 2020.

Acoustic transmitters were surgically implanted into 51 Lake Whitefish during fall 2020. Two fish were harvested in the Sturgeon Bay commercial fishery shortly after it was tagged. The commercial fisher returned the transmitter and the transmitter was implanted into a second fish. Results of movement monitoring until December 8 include the following:

i) All Lake Whitefish tagged in the lower Dauphin River (at 3.0 and 6.3 rkm) and subsequently detected by acoustic receivers had moved downstream and into Sturgeon Bay after being tagged. Most returned to the bay within two days of being tagged. These fish were tagged during the latter part of September, but whitefish were not captured in the upper Dauphin River until the first week of October, suggesting that upstream movements had not begun when whitefish were tagged in the lower Dauphin River. None of the fish tagged in the lower Dauphin River had returned to the river prior to the removal of acoustic receivers on October 20. Acoustic receivers re-deployed in Sturgeon Bay across the mouth of the Dauphin River on October 22 may provide information illustrating the return of these fish to the Dauphin River later in fall 2020.

ii) All Lake Whitefish tagged in the mid- (24.5 rkm) or upper Dauphin River (48.0 rkm) were subsequently detected. Sixteen of 27 tagged fish had moved upstream and were detected by receivers in Lake St. Martin. Nine fish remained in the immediate vicinity of the release site in the upper Dauphin River, but acoustic receivers were removed on October 19, shortly after they were tagged. It may be that these fish were holding near the release site while recovering from surgery and moved upstream after receivers had been removed. Only two fish tagged in the upper Dauphin River moved downstream after being released.

iii) All 16 Lake Whitefish that moved into Lake St. Martin from the upper Dauphin River were detected at the Narrows, located between the north and south basins of Lake St. Martin. No tagged whitefish were detected by receivers set in the vicinity of the inlet to the LSMOC in the north basin of Lake St. Martin. Those receivers were removed on December 11, suggesting tagged whitefish had not moved into that area of the lake.

iv) One of the whitefish detected at the Narrows was subsequently detected in the lower Fairford River on October 19, the day the receiver was removed at that location.

v) Another whitefish was detected at a receiver in Birch Bay located within a few kilometers of the LMOC outlet. The receiver was downloaded and replaced on December 8, but the fish was only detected from October 26-31. Two receivers deployed in Birch Bay could not be retrieved during 2020. It is anticipated that these receivers will be received during spring 2021 and may provide additional information about use of Birch Bay by whitefish tagged in the Dauphin River.

Environmental conditions affected the monitoring program during fall 2020. Lake Whitefish in the Dauphin River generally spawn at the end of October/beginning of November (NSC 2016). Cold air temperature and early ice formation in fall 2020 resulted in the termination of most monitoring activities prior to the expected timing of the Lake Whitefish spawn. The capture of Lake Whitefish in pre-spawning condition in the Fairford River and lower Dauphin River (NSC 2022b) on October 23 indicated that spawning by whitefish had not been initiated prior to the cessation of monitoring (i.e., removal of most acoustic receivers) in late October. As a result, final pre-spawn movements by whitefish may not have been captured during fall 2020.

Further, low flow conditions in the Dauphin River (Table 2) may have affected Lake Whitefish movements through the lower Dauphin River. Waters in the vicinity of the confluence between the Dauphin River and Buffalo Creek generally held Lake Whitefish through each fall during 2011-2014 and whitefish spawned in the area (NSC 2016). During fall 2020, flow and consequently water depth in this area (estimated at <0.3 m) was considerably less than during the 2011-2014 period and it is doubtful whether Lake Whitefish held in the area or spawned there. Further, the shallow water in the Dauphin River may have acted as a temporary hindrance to upstream movements by fish.

However, Lake Whitefish did become much more abundant in the upper Dauphin and Fairford rivers during early to mid-October (NSC 2022b). While it is possible that Lake Whitefish in the upper Dauphin River moved downstream into the river from Lake St. Martin, downstream spawning movements are rare and it is more likely that these fish were moving upstream to Lake St. Martin from Sturgeon Bay. Similarly, the large concentrations of pre-spawn Lake Whitefish observed in the Fairford River during fall 2020 (NSC 2022b) could have been comprised of whitefish resident to Lake St. Martin. However, the movement of an acoustically tagged whitefish from the lower Dauphin River to the Fairford River provides some evidence to suggest that at least some of the Lake Whitefish in the Fairford River may have arrived from Sturgeon Bay.

Use of Birch Bay by Lake Whitefish has largely been undocumented. Brief field investigations conducted during fall 2015 reported the capture of adult Lake Whitefish near the LMOC outlet (AAE Technical Services 2016). However, field investigations in spring 2016 reported the capture of fish larvae but no larval whitefish (AAE Technical Services 2016). A tagged adult Lake Whitefish detected in Birch Bay over a four-day period coinciding with the general spawning period for whitefish in the region may provide additional evidence of spawning in the area. Acoustic receivers deployed through winter 2020/2021 may provide additional information regarding tagged whitefish in Birch Bay. Further, a larval fish sampling program in Birch Bay scheduled for spring 2021 may provide additional insight into whitefish spawning in the area.

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Table 1. The location, deployment date, and retrieval date for temperature loggers installed in the Lake St. Martin study area, fall 2020.

Logger Name	Location		Depth (m)	Deployment Date	Retrieval Date
	Easting	Northing			
DR Inlet to LSM	546388	5743924	2	Sep-10	Oct-19
LSM Narrows 1	539317	5730999	2	Sep-23	Oct-19
Fairford Mid	519624	5715350	1	Sep-11	Oct-27
LSM North Basin 2	555585	5736889	1	Sep-12	Dec-11
LSM South Basin 1	534478	5704389	2.2	Sep-10	Dec-08

1 - UTM coordinates; NAD 83 Zone 14U

Table 2. Mean daily flow and percentile flow conditions for the Fairford and Dauphin Rivers during September and October, 2020.

Waterbody	2020 Mean Daily Discharge (m^3/s)		Median Daily Discharge (m^3/s) [1]		2020 Daily Percentile Flow [2]	
	Mean	Range	Mean	Range	Mean	Range
Fairford River						
September 2-30	41	32-54	73	56-99	41	33-48
October 1-27	35	25-41	75	62-87	32	21-47
Dauphin River						
September 2-30	53	42-63	99	81-123	37	25-41
October 1-27	46	39-53	73	66-85	35	33-40

1 - daily median flow (i.e., 50th percentile flow) based on mean daily discharge calculated from 1977-2019 Water Survey of Canada data for the Fairford River (Station 05LM001) and Dauphin River (Station 05LM006)

2 - daily percentile flow condition calculated based on mean daily discharge calculated from 1977-2019 Water Survey of Canada data for the Fairford River (Station 05LM001) and Dauphin River (Station 05LM006)

Table 3. The location, deployment date, and retrieval date for acoustic receivers in the Lake St. Martin study area, fall 2020.

Receiver Name	Location [1]		Distance (rkm)	Water Depth (m)	Deployment Date	Interim Download	Retrieval Date
	Easting	Northing					
Fall Receivers							
DR Sturgeon Bay	564786	5757052	0	3.0	Sep-09	-	Oct-20
DR Community	564030	5755949	1.9	2.0	Sep-09	-	Oct-20
US Big Rapids	554870	5758937	13.0	1.0	Sep-09	-	Oct-20
DR Big Bend	546058	5761410	24.5	1.0	Sep-09	-	Oct-20
DR-2 DS	546661	5744344	47.7	1.0	Oct-06	-	Oct-19
DR Inlet to LSM	546388	5743924	48.3	2.0	Sep-10	-	Oct-19
LSM Narrows 4	542029	5733659	66.9	0.5	Oct-08	-	Oct-19
LSM Narrows 3	540860	5732724	68.3	1.2	Sep-23	-	Oct-19
LSM Narrows 2	541637	5731248	68.8	1.7	Sep-23	-	Oct-19
LSM Narrows 1	539317	5730999	70.8	2.0	Sep-23	-	Oct-19
Fairford at LSM	527198	5717552	91.5	1.1	Sep-10	-	Oct-19
DS of FRWCS	519624	5715350	106.0	1.0	Sep-11	Oct-21	Oct-27
US of FRWCS	518282	5714799	108.0	0.8	Sep-11	Oct-21	Oct-27
LSM North Basin 1	555304	5737502	n/a	1.0	Sep-12	-	Dec-11
LSM North Basin 2	555585	5736889	n/a	1.0	Sep-12	-	Dec-11
LSM South Basin 2	533481	5707485	n/a	3.8	Sep-10	-	TBD [2]
LSM South Basin 3	534542	5707482	n/a	3.6	Sep-10	-	TBD [2]
LSM South Basin 1	534478	5704389	n/a	2.2	Sep-10	-	Dec-08
Winter Receivers							
LSM South Basin 1	534478	5704389	n/a	2.2	Dec-8	-	TBD [2]
Sturgeon Bay 1	565281	5757316	n/a	4.1	Oct-22	-	TBD [2]
Sturgeon Bay 2	565050	5757454	n/a	2.7	Oct-22	-	TBD [2]
Sturgeon Bay 3	565611	5757051	n/a	3.6	Oct-22	-	TBD [2]

1 - UTM coordinates; NAD 83 Zone 14U

2 - Receivers to be retrieved in spring 2021

Table 4. Summary of acoustic transmitter application and telemetry data for Lake Whitefish tagged in the Lake St. Martin study area, fall 2020. Grey shaded cells denote fish which received the same acoustic transmitter (following mortality of the 1st fish that received the transmitter, it was implanted into the 2nd). Bold text denote fish that were commercial mortalities.

Capture Date	Capture Method [1]	Floy® Tag no.	Acoustic Tag no.	Length (mm)	Weight (g)	Release Date	Release Distance (rkm)	Number of Valid Detections	First Detection Date	Last Detection Date	Min/Max Detection Distances (rkm)	Status Comments
20-Sep	HN-1	116376	53293	420	1200	20-Sep	3	51	21-Sep	21-Sep	0/1.9	-
20-Sep	HN-1	116377	53290	496	2000	20-Sep	3	2228	21-Sep	25-Sep	0/1.9	-
20-Sep	HN-1	116378	53291	436	1350	20-Sep	3	52	21-Sep	21-Sep	0/1.9	-
20-Sep	HN-1	116379	53292	425	1300	20-Sep	3	57	21-Sep	21-Sep	0/1.9	-
20-Sep	HN-1	116380	53294	432	1300	20-Sep	3	251	21-Sep	20-Oct	0/1.9	-
21-Sep	HN-1	116381	53289	420	875	21-Sep	3	128	22-Sep	22-Sep	0/1.9	-
21-Sep	HN-1	116382	53285	450	1300	21-Sep	3	48	22-Sep	22-Sep	0/1.9	-
21-Sep	HN-1	116383	53287	415	850	21-Sep	3	42	22-Sep	22-Sep	0/1.9	-
21-Sep	HN-1	116384	53288a	434	1350	21-Sep	3	180	22-Sep	23-Sep	0/1.9	mortality [2]
21-Sep	HN-1	116385	53286	432	1050	21-Sep	3	574	22-Sep	26-Sep	0/1.9	-
24-Sep	HN-1	116386	53283	435	1000	24-Sep	3	2401	25-Sep	03-Oct	0/1.9	-
24-Sep	HN-1	116387	53281	470	1600	24-Sep	3	-	-	-	-	undetected
24-Sep	HN-1	116389	53280	455	1400	24-Sep	3	55	25-Sep	25-Sep	0/1.9	-
24-Sep	HN-1	116391	53282	425	1100	24-Sep	3	31	25-Sep	25-Sep	0/1.9	-
24-Sep	HN-1	116392	53284	475	1650	24-Sep	3	677	25-Sep	27-Sep	0/1.9	-
25-Sep	HN-1	116396	53274	432	1050	26-Sep	6.3	42	27-Sep	27-Sep	0/1.9	-
26-Sep	HN-1	116397	53276	475	1750	26-Sep	6.3	-	-	-	-	undetected
26-Sep	HN-1	116398	53270	450	1325	26-Sep	6.3	92	27-Sep	27-Sep	0/1.9	-
26-Sep	HN-1	116399	53278	392	700	26-Sep	6.3	-	-	-	-	undetected
26-Sep	HN-1	119326	53275	455	1400	26-Sep	6.3	39	27-Sep	27-Sep	0/1.9	-
26-Sep	HN-1	119327	53272	415	950	26-Sep	6.3	6	27-Sep	27-Sep	1.9/1.9	-
26-Sep	HN-1	119329	53277	450	1400	26-Sep	6.3	-	-	-	-	undetected
26-Sep	HN-1	119330	53273	385	850	26-Sep	6.3	40	27-Sep	27-Sep	0/1.9	-

Table 4. (continued).

Capture Date	Capture Method [1]	Floy® Tag no.	Acoustic Tag no.	Length (mm)	Weight (g)	Release Date	Release Distance (rkm)	Number of Valid Detections	First Detection Date	Last Detection Date	Min/Max Detection Distances (rkm)	Status Comments
26-Sep	HN-2	119331	53271	425	1400	26-Sep	6.3	33	27-Sep	27-Sep	0/1.9	-
05-Oct	HN-2	116480	53269	503	2100	06-Oct	48	29	06-Oct	07-Oct	24.5/48.3	-
05-Oct	HN-2	116481	53267	470	1600	06-Oct	48	8	06-Oct	06-Oct	47.7/47.7	-
05-Oct	HN-2	116482	53268	435	1100	06-Oct	48	51	07-Oct	13-Oct	48.3/70.8	-
05-Oct	HN-2	116483	53266	395	900	06-Oct	48	24	06-Oct	06-Oct	47.7/47.7	-
05-Oct	HN-3	119335	53265	440	1150	06-Oct	23.2	278	14-Oct	17-Oct	47.7/70.8	-
09-Oct	HN-2	116487	53253	475	1750	09-Oct	48	35	09-Oct	16-Oct	47.7/48.3	-
09-Oct	HN-2	116489	53258	451	1400	09-Oct	48	7	09-Oct	09-Oct	47.7/47.7	-
09-Oct	HN-2	116490	53279	422	1050	09-Oct	48	764	10-Oct	20-Oct	47.7/66.9	-
09-Oct	HN-2	116491	53263	403	1000	09-Oct	48	179	09-Oct	19-Oct	47.7/70.8	-
09-Oct	HN-2	116494	53247	432	1150	09-Oct	48	952	10-Oct	19-Oct	47.7/91.5	-
09-Oct	HN-2	116495	53256	442	1350	09-Oct	48	594	09-Oct	11-Oct	47.7/48.3	-
09-Oct	HN-2	116496	53262	445	1050	09-Oct	48	11	09-Oct	09-Oct	47.7/47.7	-
09-Oct	HN-2	116497	53288b	443	1400	09-Oct	48	208	10-Oct	17-Oct	48.3/70.8	
09-Oct	HN-2	116498	53259	442	1550	09-Oct	48	50	09-Oct	17-Oct	48.3/70.8	-
09-Oct	HN-2	116499	53248	450	1450	09-Oct	48	33	10-Oct	10-Oct	47.7/48.3	-
09-Oct	HN-2	119343	53264	420	900	09-Oct	48	123	09-Oct	17-Oct	47.7/70.8	-
09-Oct	HN-2	119344	53251	446	1400	09-Oct	48	180	10-Oct	16-Oct	0/47.7	-
09-Oct	HN-2	119346	53261	445	1500	09-Oct	48	503	09-Oct	19-Oct	47.7/70.8	-
09-Oct	HN-2	119347	53255	390	850	09-Oct	48	157	09-Oct	15-Oct	48.3/70.8	-
09-Oct	HN-2	119348	53260	445	1400	09-Oct	48	73	09-Oct	19-Oct	47.7/66.9	mortality [3]
09-Oct	HN-2	119349	53254	427	1050	09-Oct	48	221	09-Oct	15-Oct	48.3/70.8	-
09-Oct	HN-2	118598	53250	433	1050	09-Oct	48	116	10-Oct	20-Oct	47.7/68.3	-
09-Oct	HN-2	118597	53249	424	1050	09-Oct	48	56	10-Oct	14-Oct	47.7/48.3	-
09-Oct	E-fishing	118511	53257	404	975	09-Oct	48	235	09-Oct	17-Oct	47.7/70.8	-

Table 4. (continued).

Capture Date	Capture Method [1]	Floy® Tag no.	Acoustic Tag no.	Length (mm)	Weight (g)	Release Date	Release Distance (rkm)	Number of Valid Detections	First Detection Date	Last Detection Date	Min/Max Detection Distances (rkm)	Status Comments
09-Oct	E-fishing	118507	53252	482	1575	09-Oct	48	298	10-Oct	17-Oct	48.3/70.8	-
09-Oct	E-fishing	118510	53246	394	950	09-Oct	48	14	10-Oct	10-Oct	48.3/48.3	-
09-Oct	E-fishing	118508	53245	412	1100	09-Oct	48	285	10-Oct	10-Oct	47.7/48.3	-

1 - HN-1 = hoop net set at 562830E 5755138N (UTM, NAD83); HN-2 = hoop net set at 546399E 5744259N (UTM, NAD83); HN-3 = hoop net set at 547122E 5761008N (UTM, NAD83); E-fishing = boat electrofishing in the Dauphin River at HN-2.

2 - Commercial mortality - captured on September 24, 2020, approximately 2 km north of the Dauphin River mouth on Sturgeon Bay. Both acoustic transmitter and Floy tag were returned.

3 - Commercial mortality - captured on December 9, 2020, south of the Lake St. Martin Narrows approximately 1 mile from the old Lake St. Martin community site. The acoustic transmitter was returned.

Table 5. Minimum (downstream) detection distance summary for Lake Whitefish acoustically tagged in the Lake St. Martin study area, fall 2020.

Release Distance (rkm)	Minimum Detection Distance via VR2W Receivers (rkm)	Fish count
3	0	14 [1]
	undetected	1
6.3	0	5
	1.9	1
	undetected	3
23.2	47.7	1
48	0	1
	24.5	1
	47.7	17
	48.3	7

1 - one of the Lake Whitefish released at rkm 3 was captured in a commercial fishing net on September 24. This presents a temporal bias because this mortality occurred prior to the conclusion of the fall monitoring period.

Table 6. Maximum (upstream) detection distance summary for Lake Whitefish acoustically tagged in the Lake St. Martin study area, fall 2020.

Release Distance (rkm)	Maximum Detection Distance via VR2W Receivers (rkm)	Fish count
3	1.9	14 [1]
	undetected	1
6.3	1.9	6
	undetected	3
23.2	70.8	1
48	47.7	5
	48.3	7
	66.9	2
	68.3	1
	70.8	10
	91.5	1

1 - one of the Lake Whitefish released at rkm 3 was captured in a commercial fishing net on September 24. This presents a temporal bias because this mortality occurred prior to the conclusion of the fall monitoring period.

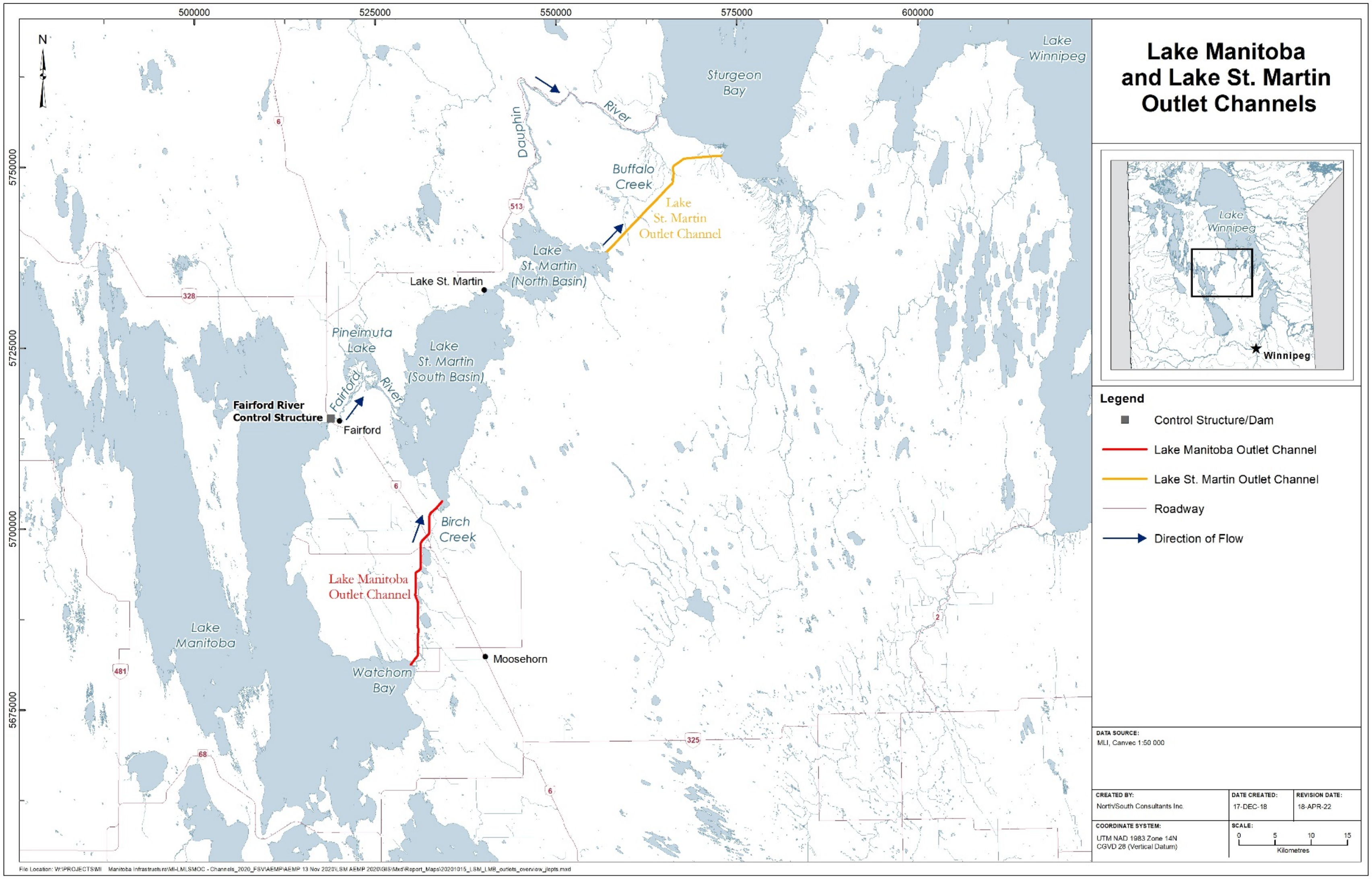

Figure 1. Location of Lake Manitoba and Lake St. Martin Outlet Channels and other waterbodies referenced in the AEMP.

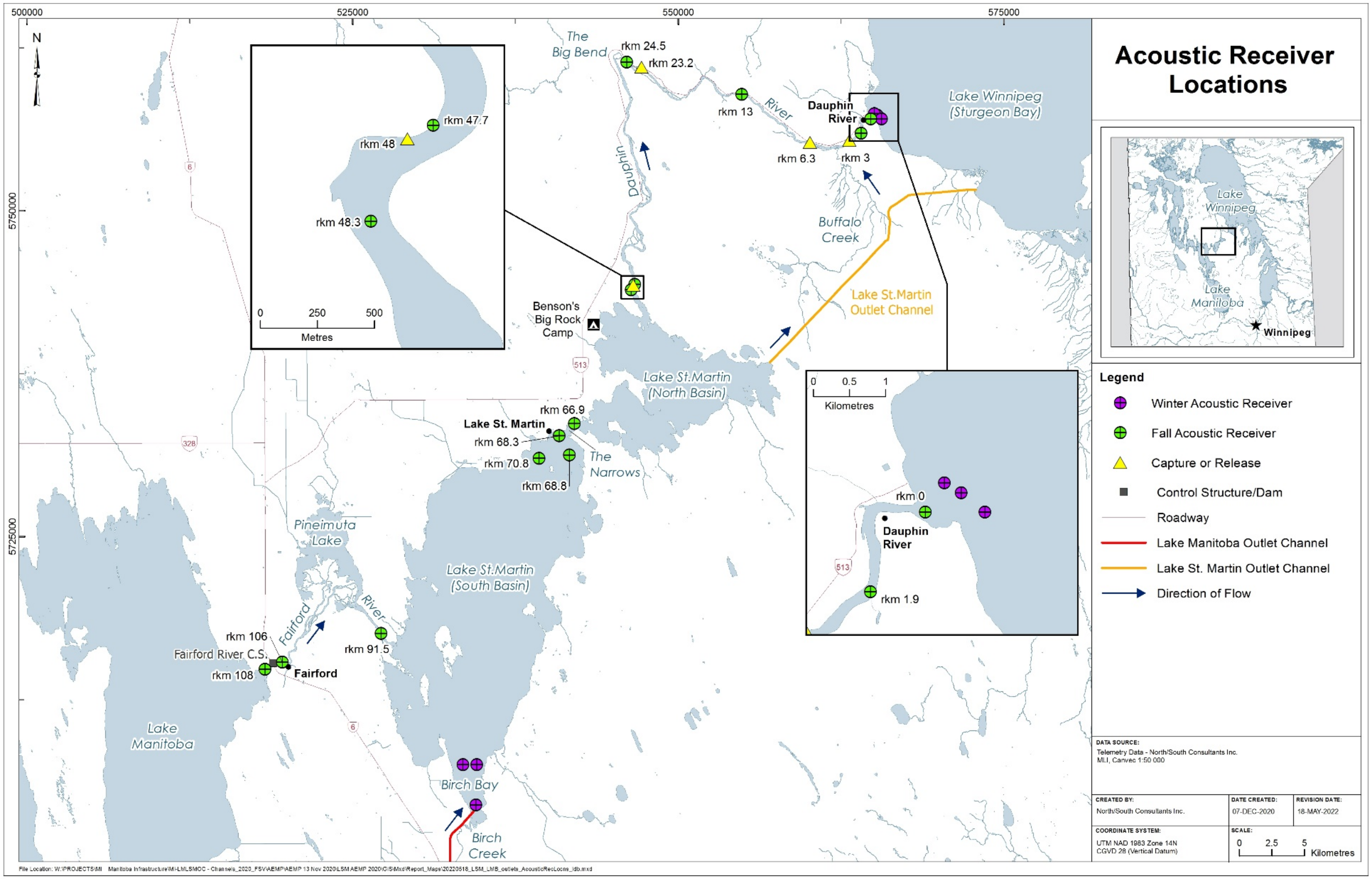

Figure 2. The Lake St. Martin acoustic telemetry study area, including sites where Lake Whitefish capture or release occurred and locations of acoustic receivers deployed during fall 2020 and winter 2020/2021.

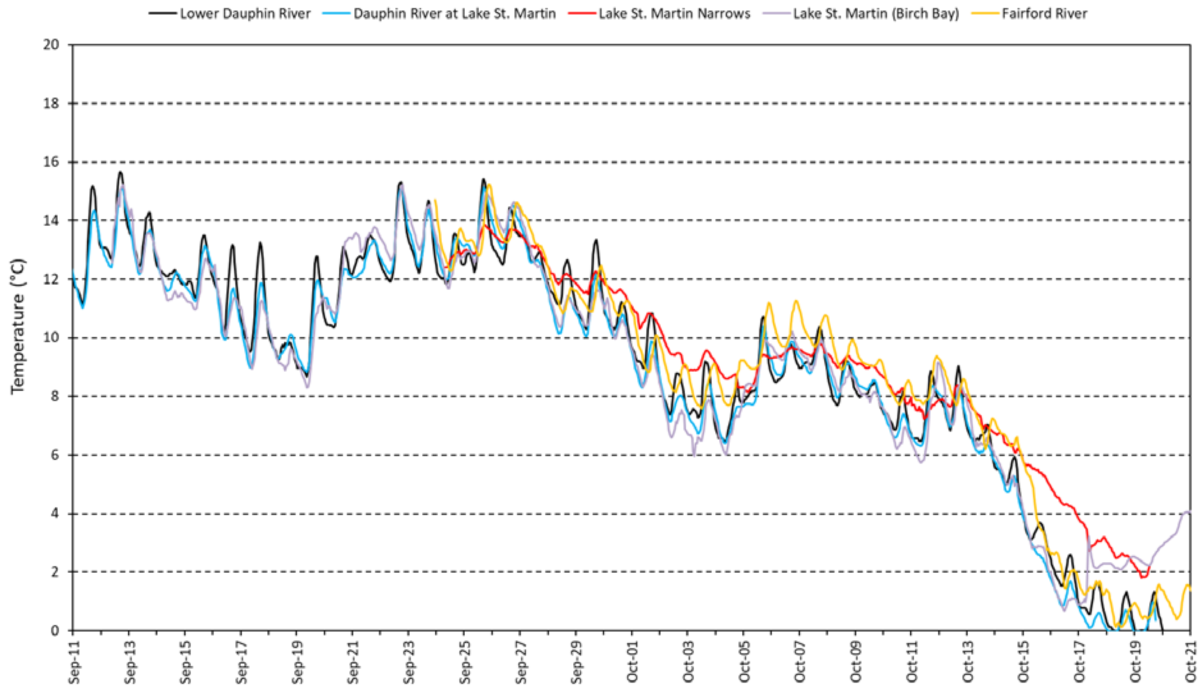

Figure 3. Water temperature data from the Lake St. Martin study area, fall 2020.

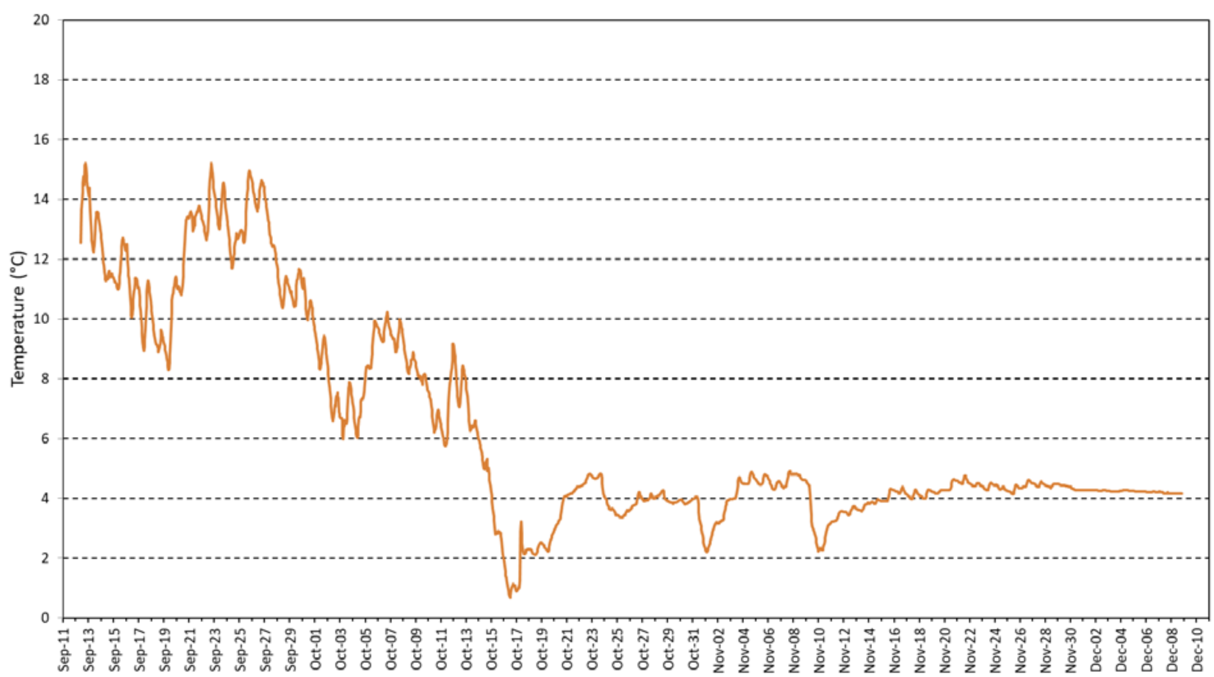

Figure 4. Water temperature data from Birch Bay in southern Lake St. Martin, fall 2020.

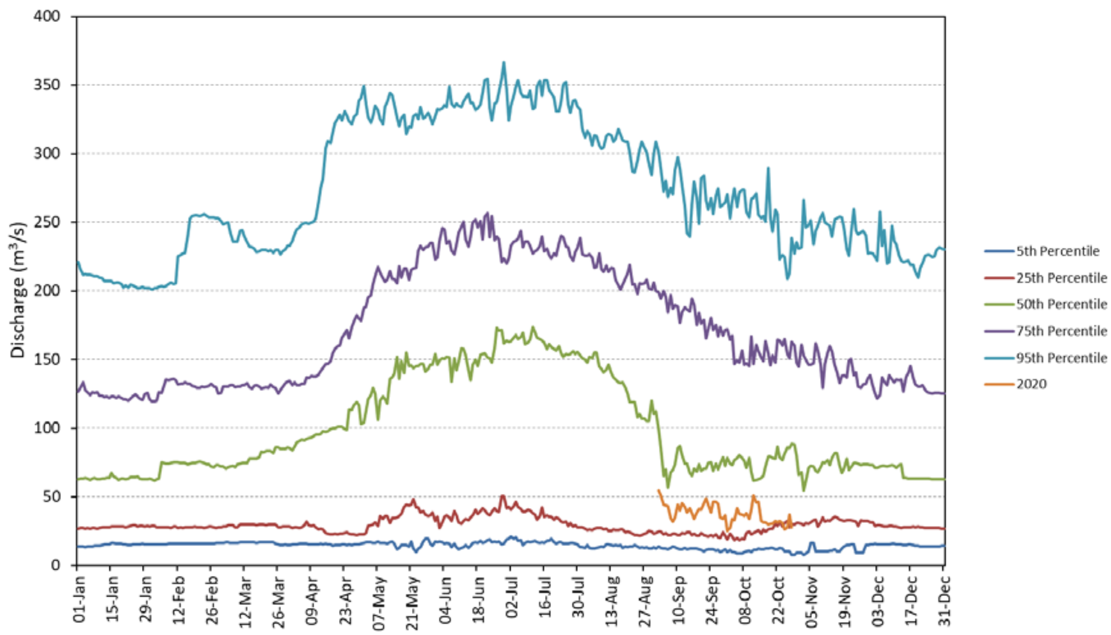

Figure 5. Percentile flow conditions (1977-2019) and mean daily discharge in the Fairford River, fall 2020. Data provided by Water Survey of Canada (Station 05LM001).

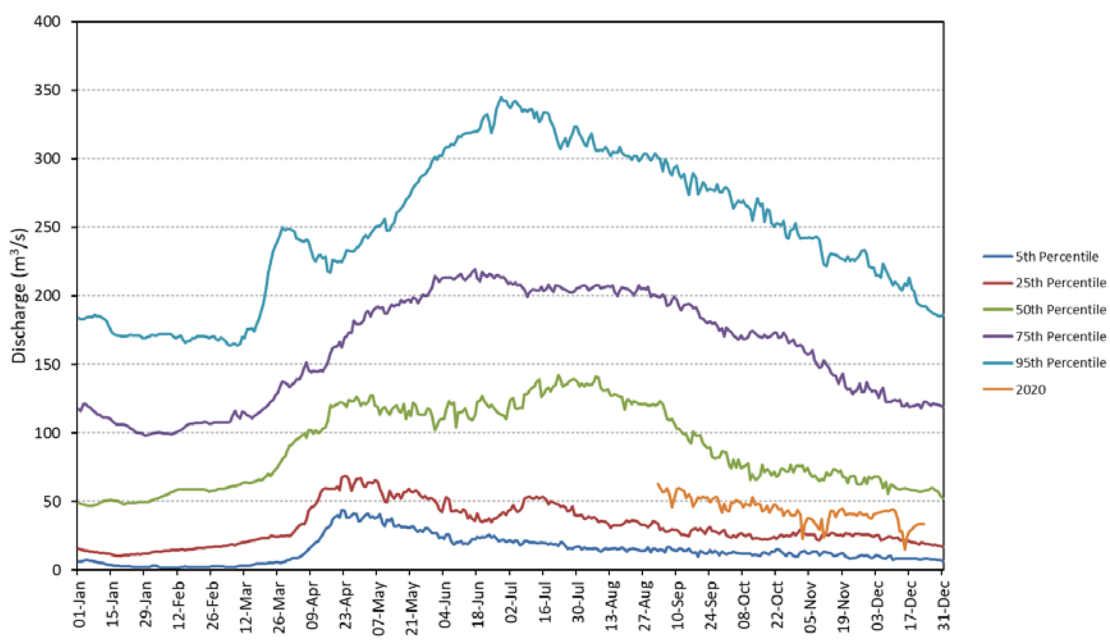

Figure 6. Percentile flow conditions (1977-2019) and mean daily discharge on the Dauphin River, fall 2020. Data provided by Water Survey of Canada (Station 05LM006).

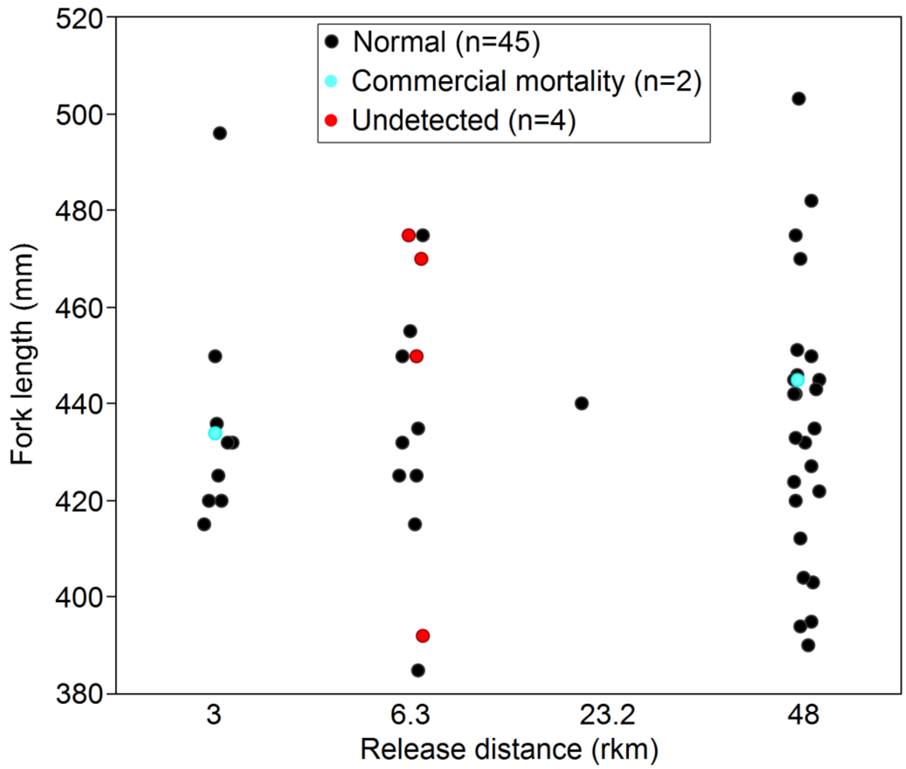

Figure 7. Summary of fork length of Lake Whitefish by release distance.

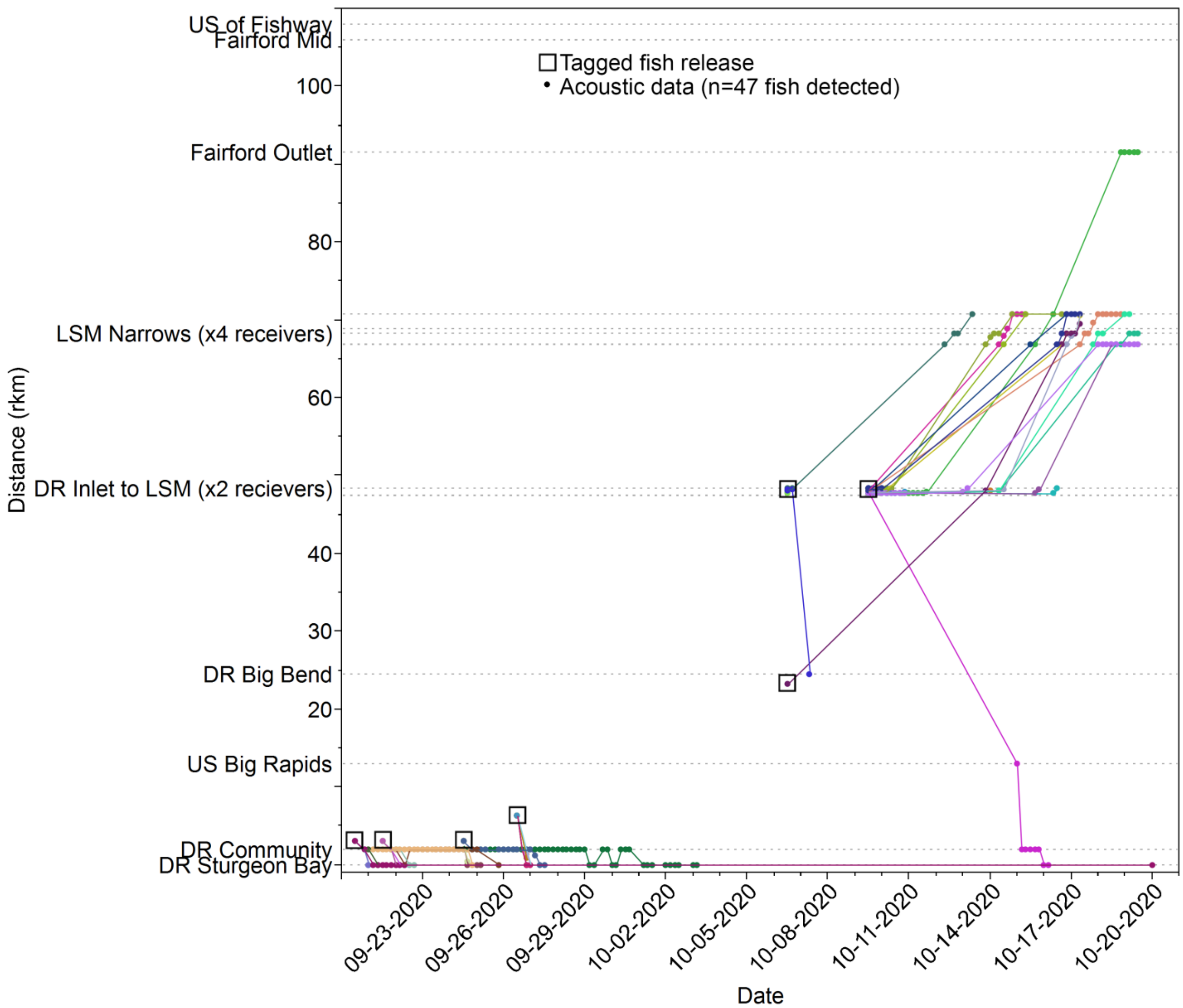

Figure 8. Graphical summary of Lake Whitefish movements based on a 4-hour algorithm output. Locations of receivers are shown using dotted lines, and reflect the river kilometer distances at which they were deployed. Date/times and locations of fish releases are also shown using black squares. In total, 47 of 51 Lake Whitefish tagged during the current study were detected during fall 2020 monitoring using acoustic receivers.

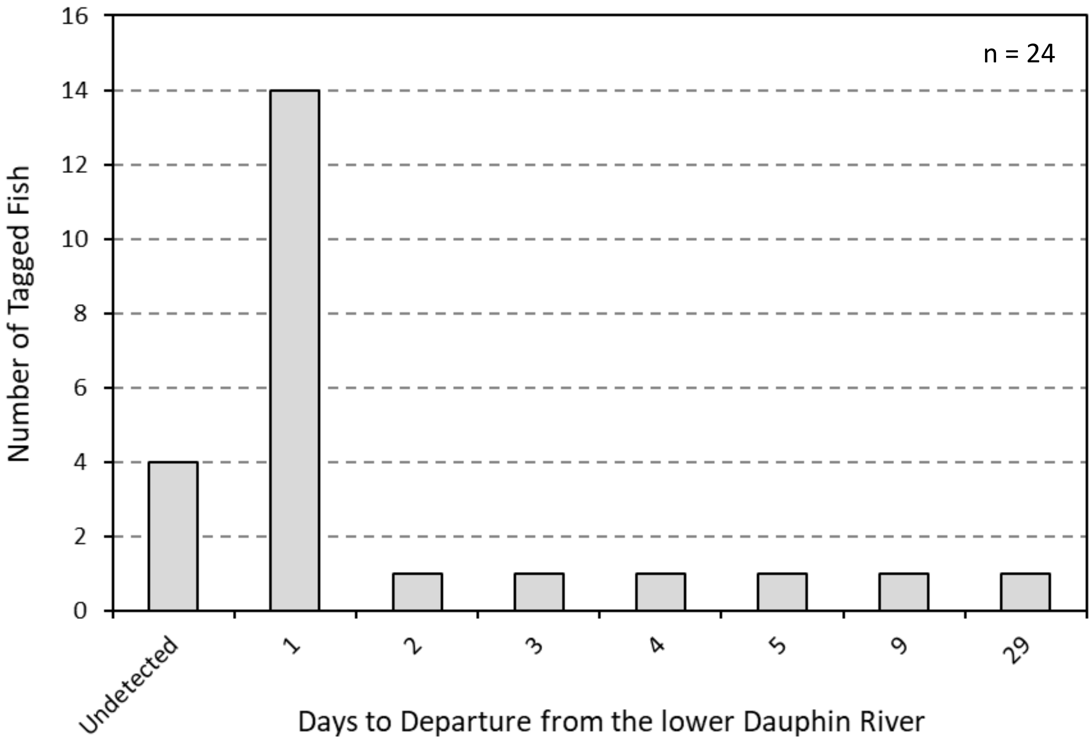

Figure 9. The number of days after transmitter implantation that tagged Lake Whitefish moved out of the lower Dauphin River and into Sturgeon Bay.

Lake Manitoba & Lake St. Martin Outlet Channels Project

Aquatic Environment Monitoring, Fall 2020 to Spring 2021 - Water Quality

REPORT

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