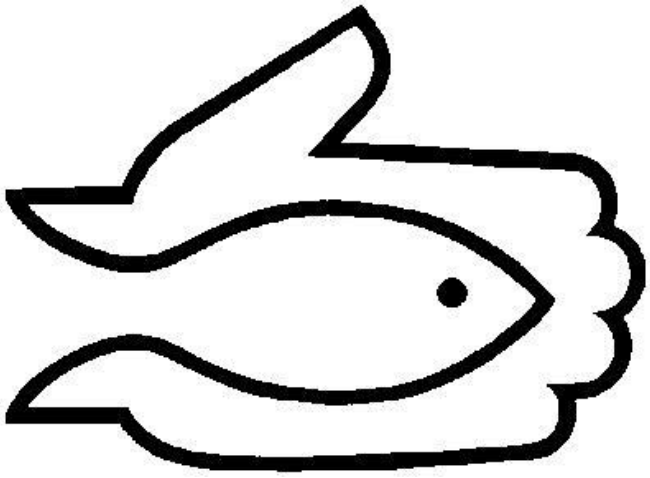
Project
09 - 053

Walleye Telemetry on the Swan River & Whitefish Lake

Swan Valley Sport Fishing Enhancement Inc.



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Swan Valley Sport Fishing Enhancement Inc.

PROJECT PARTNERS:

Water Stewardship

fisheriesenhancement fund

Swan Lake Watershed Conservation District

Contents

Table of Figures

1. Introduction

The main objective of the study for both the Swan River and Whitefish Lake was to monitor seasonal walleye movement, with the emphasis on spring spawn and habitat requirements. Walleye movement was further analyzed for trends and behaviour throughout the entire study period and compared to past telemetry data. Trends provide information on fish passage, barriers and requirements for habitat. Results and recommendations will be used for future fisheries management on both systems.

A total of twenty-three walleye were tagged and tracked from October 2009 to midsummer of 2010; thirteen on the Swan River and ten on Whitefish Lake. The thirteen walleye in Swan River were tagged during the completion of the Swan River Fisheries and Aquatic Survey (Project 08-002). Tagging for the remaining walleye at Whitefish Lake was initiated by Swan Valley Sport Fishing Enhancement Inc. (SVSFE) following the Whitefish Lake Tributaries Fish and Habitat Survey. It was recommended by AAE Services to conduct telemetry on adult fish during the spawn once restoration efforts were completed on the tributaries.

2. Study Area

Swan River

The Swan River headwaters are located within the Porcupine Hills, and flows northeast to Swan Lake. The drainage area consists of 4230 km^2. Land use/habitat along the Swan River varies from forested landscape, agriculture crop and producer use to residential and wetland areas (Figure 2).

Recreational fishing along the Swan River has diminished over the years with many stories of "**WE USE TO** catch....." Most recent angling success is noted to be in reaches downstream of the Town of Swan River while other areas are under utilized for angling. Although angling opportunities are perceived as poor, recreational pressure compared to other water bodies is also significantly lower. Some anglers who prefer a more pristine atmosphere may not consider the river to be the destined fishing location, but when the perspective is altered to looking from the river out, opinions may change (Figure 1).

Figure 1: Fishing hole and tagging location on the Swan River

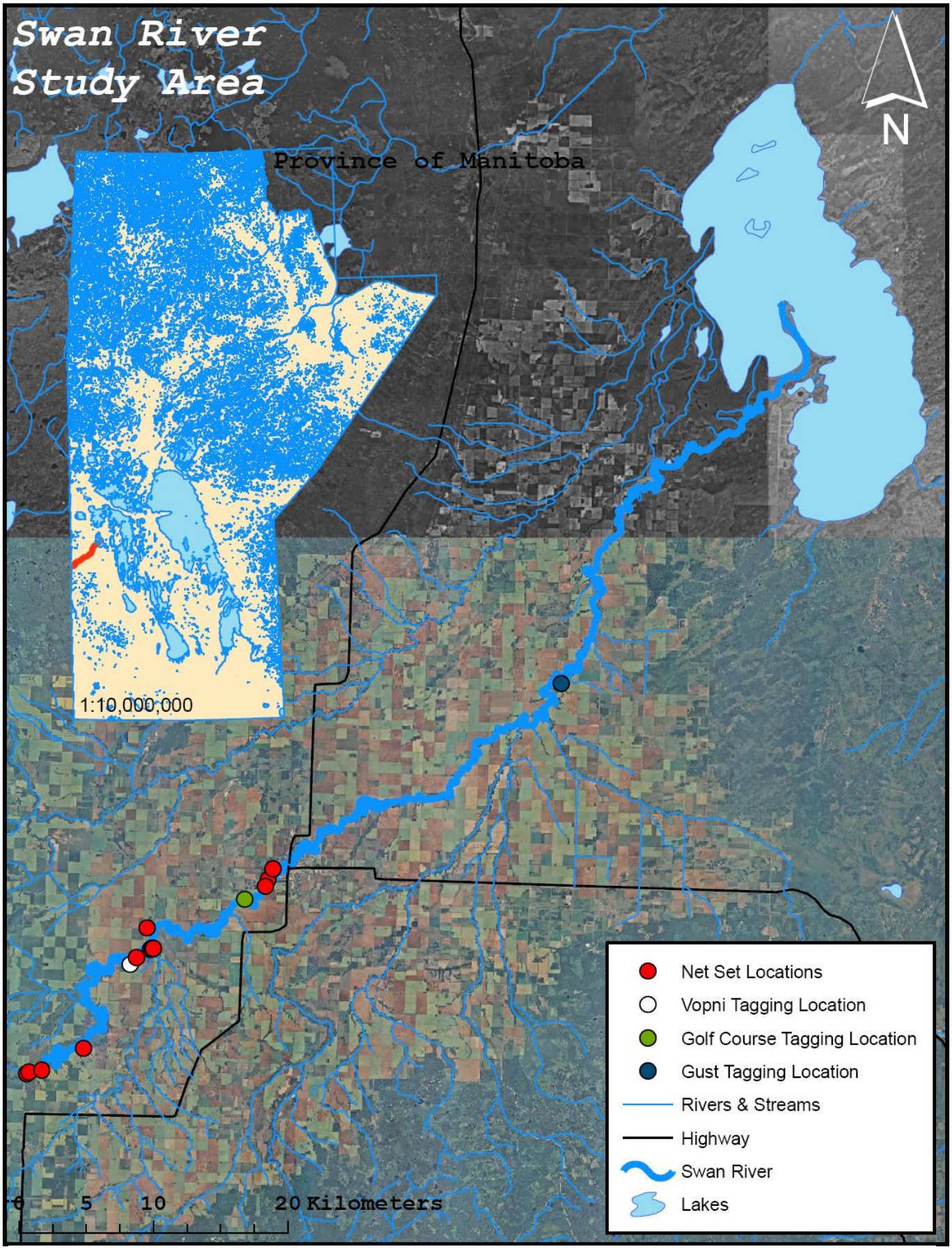


Figure 2: Swan River Study Area

Whitefish Lake

Whitefish Lake is located in the Porcupine Hills and is 675 hectares (Figure 3). Common fish species found within the lake include; walleye (*Sander vitreus*), northern pike (*Esox lucius*), yellow perch (*Perca flavescens*), lake whitefish (*Coregonus clupeaformis*), and burbot (*Lota lota*). The lake is described as a eutrophic lake with high productivity and nutrient rich water and has sustained a fish population through natural reproduction. Whitefish Lake was stocked with lake trout (Salve fontanalis) in 1975, 1978 and 1979, although there is no evidence of trout survival (Yake, 1996). Only once in 1980 was the lake stocked with 300,000 walleye fry.

The lake's morphology contains substrate comprised of primarily gravel, rock and sand along the littoral areas and soft mud and clay within deeper portions (Figure 4).

Whitefish Lake possesses two tributaries; North Creek and Lagoon Creek. Together they possess a combined drainage area of 90km^2. North Creek is approximately 15.8 km long and is located along the north shore while Lagoon Creek is 9.0km in length and located along the east shore. The mouth of Lagoon Creek was developed into a unique marina and fishing area. Whitefish Lake has one main outflow with a dam located along the Saskatchewan-Manitoba border.

Development at Whitefish Lake is located along the east shore and includes a large campground, picnic area, beach and newly constructed cottage development. Recreational angling pressure and fishing quality is of the highest in the area with 91% of 2010 anglers residing locally.

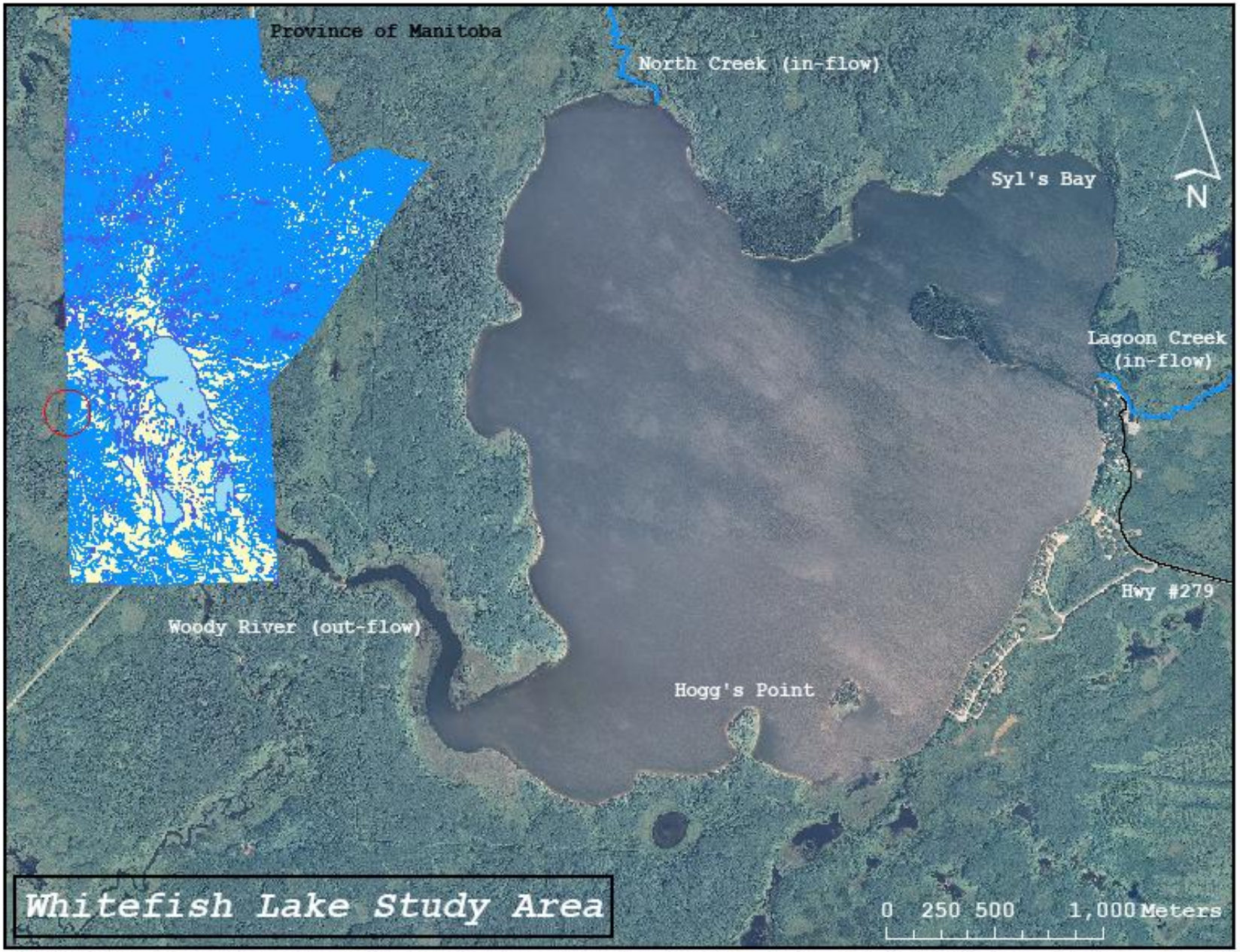


Figure 3: Whitefish Lake Study Area

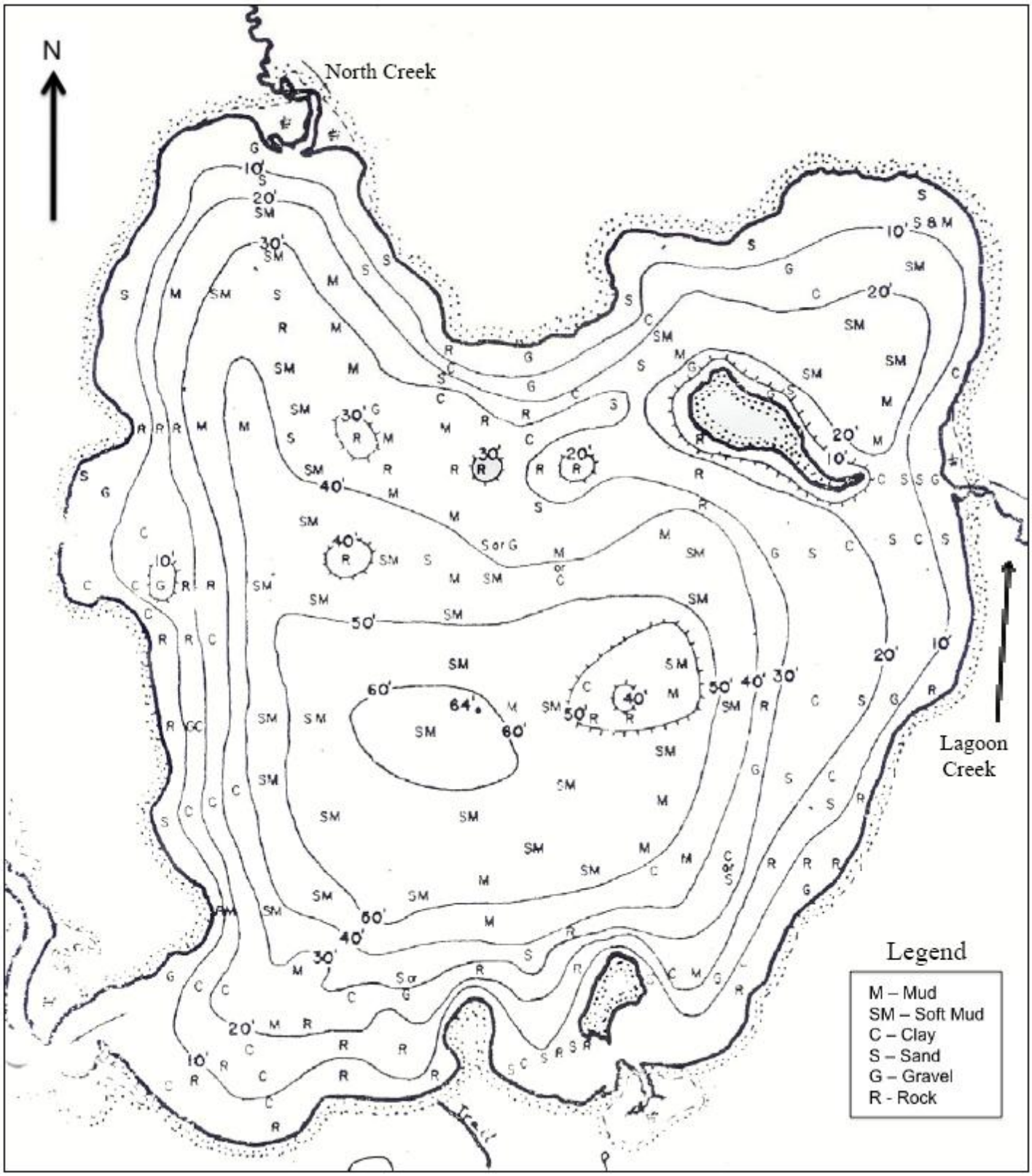


Figure 4: Whitefish Lake's substrate composition and bathymetry

3. Methodology

Tagging

Swan River

From August - October 2009, SVSFE Fisheries technicians completed habitat and fisheries assessments for the Swan River Fisheries and Aquatic Survey Project #08-002. Part of the assessment was to tag 10 walleye on the Swan River with radio telemetry tags. Great effort was taken to sample various reaches of the river. Well known fishing holes were utilized in the downstream reaches from Swan River. Upstream reaches were found to have inconsistent walleye stock and a more intensive approach was needed. Fisheries technicians canoed stretches of river from the Benito bridge on HWY #588 to the Town of Swan River. At pools with depths greater than 1.5 meters (4.5 feet), 3" gill nets were set to capture the walleye (Figure 5). Two locations upstream of Swan River were successful in locating three walleye large enough to be tagged. These locations included upstream of the Vopni Crossing and downstream of the Golf Course Crossing. The remaining ten walleye were tagged at the Gust's location (Figure 6 & 7).

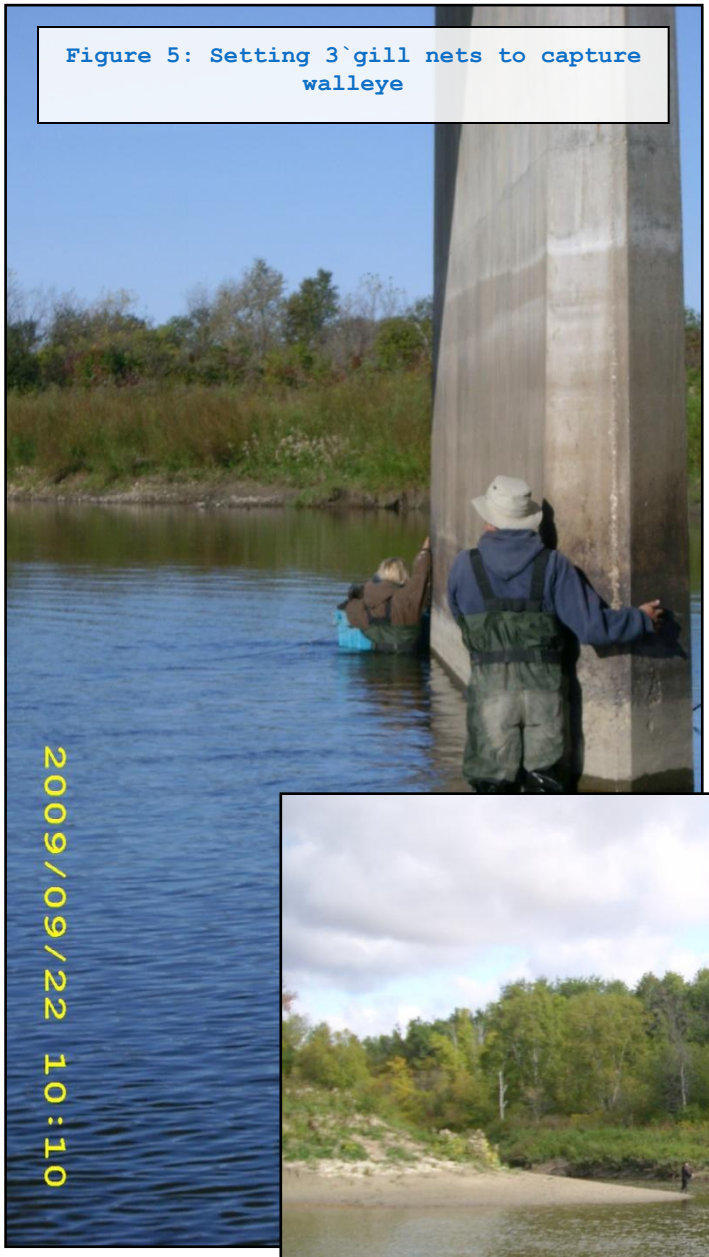


Figure 5: Setting 3`gill nets to capture walleye

Figure 6: Gust`s Tagging Site

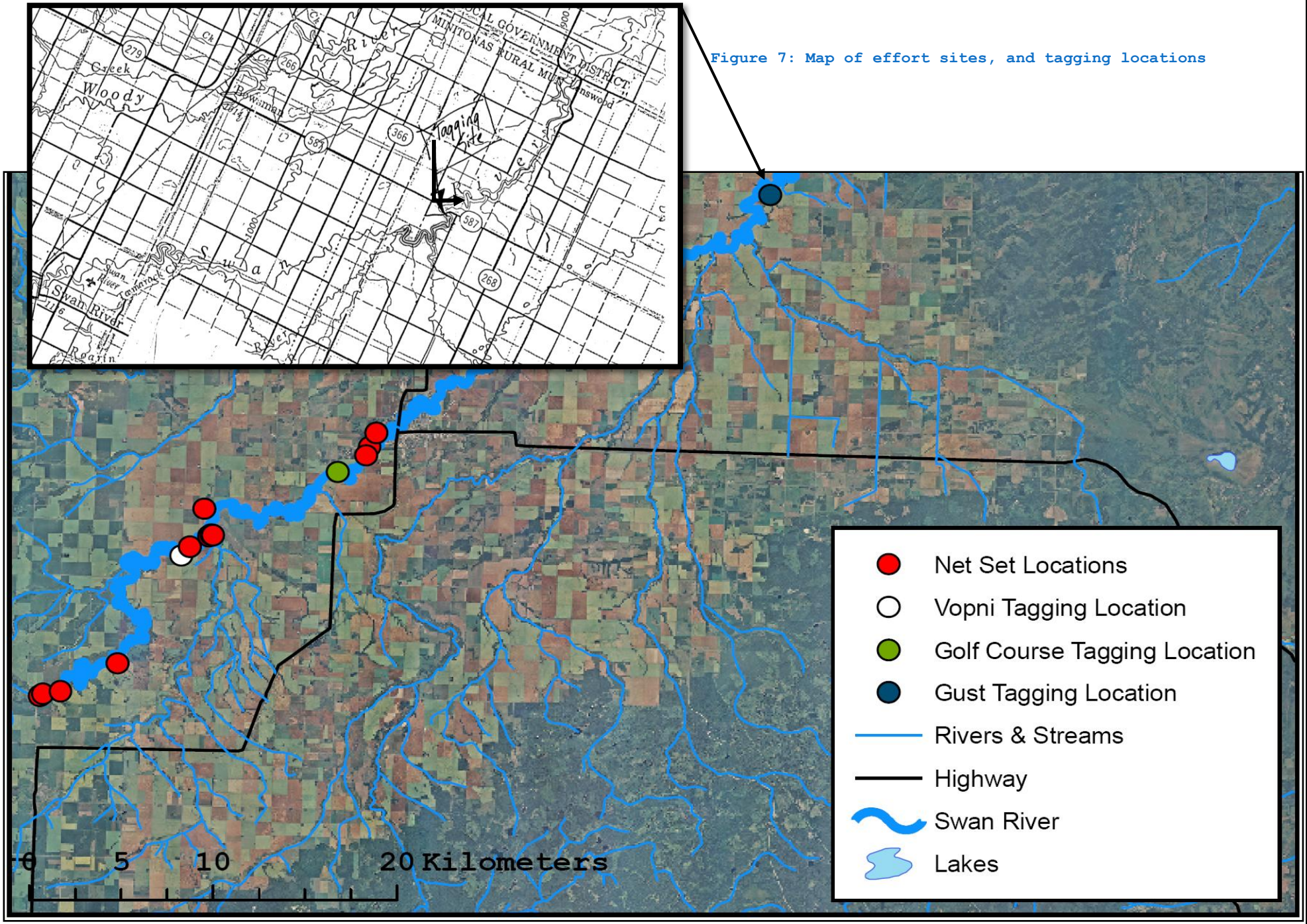


Figure 7: Map of effort sites, and tagging locations

Figure 8: WSD Fisheries Biologist sampling a walleye

The thirteen walleye were sampled for length, weight, and tagged with a radio telemetry tag along their dorsal. The first three dorsal spines were collected for aging (Figure 9 & 10).

Figure 9: Technician with sampled walleye

Whitefish Lake

Funding through Swan Valley Sport Fishing Enhancement group provided additional telemetry tags for ten walleye at Whitefish Lake. Walleye were caught by means of 3" gill nets and angling from August - October 2009. Net locations were randomly selected through littoral zones of the lake. Only five locations were successful in locating walleye (Figure 10).

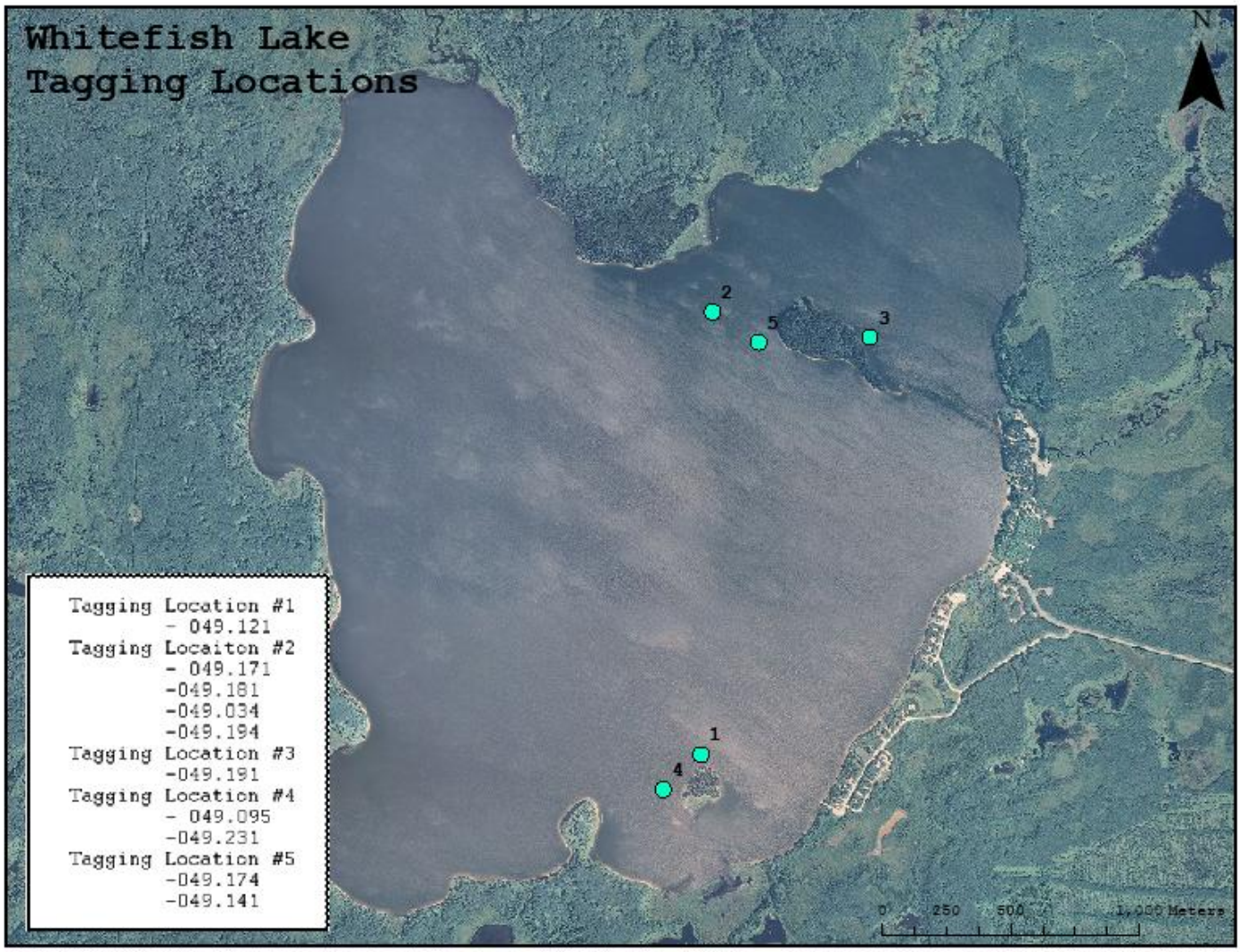


Figure 10: Whitefish Lake Tagging Locations

Target walleye consisted of slot size fish 450 – 700 mm (17.7" - 27.6") to ensure results indicated behaviour of spawning walleye and also for the assurance that anglers would release tagged fish. All walleye were sampled for length, weight, and tagged with a radio telemetry tag along their dorsal (Figure 11). The first three dorsal spines were collected for aging.

Tracking

Figure 11: Technician holding tagged walleye

Walleye tracking on the Swan River and Whitefish Lake began in November. Walleye for both the Swan River and Whitefish Lake were tracked using an ATS R2000 Scientific Receiver (Figure 12). All fish tag numbers were pre-programmed prior to tracking. The receiver was able to scan two frequencies (low and high). Frequencies for each radio telemetry tag are noted in tag numbers; frequency 48 being low and frequency 49 being high. Scan rate was set at 2 or 4 seconds when tracking to ensure a complete rotation of all fish within a short distance. Radio frequency (RF) gain was utilized for precision direction finding and the hoop antenna indicated the direction in which the tagged fish was located. RF gain was decreased to pinpoint a more accurate location.

During winter tracking walleye positions were located within a radius of 100m or less. This was due to weak frequency signal and battery strength caused by colder water temperatures and snow cover.

Figure 12: R2000 Scientific Radio Telemetry Receiver

Tracking during open water seasons produced a stronger signal - therefore further effort was required to distinguish actual fish locations. Technicians would narrow walleye locations within 100 – 500 meters. Consideration was taken for any interference or rebound signals.

Figure 13: Dauphin Air Services arriving at the Swan River municipal Airport

Tracking was conducted by three different methods; snowmobile, aerial flights, and by boat (Figure 13 & 14). Aerial flights were flown at an altitude of approximately 1000 feet. Swan River flight path began at the Swan River Municipal Airport following the river downstream to Swan Lake, and around the perimeter of the lake then back upstream as far as Saskatchewan border.

Figure 14: Technician ready to track telemetry fish

The Whitefish Lake flight path consisted of flying the lake perimeter followed by parallel transects across the lake. Aerial tracking was thorough for both water bodies and included tracking all tributaries and connecting waters (North & Lagoon creek for Whitefish Lake and the Roaring River and Swan Lake for the Swan River). Locating tagged walleye by plane was more successful than other methods during winter conditions, because weaker frequencies were better detected at higher elevations.

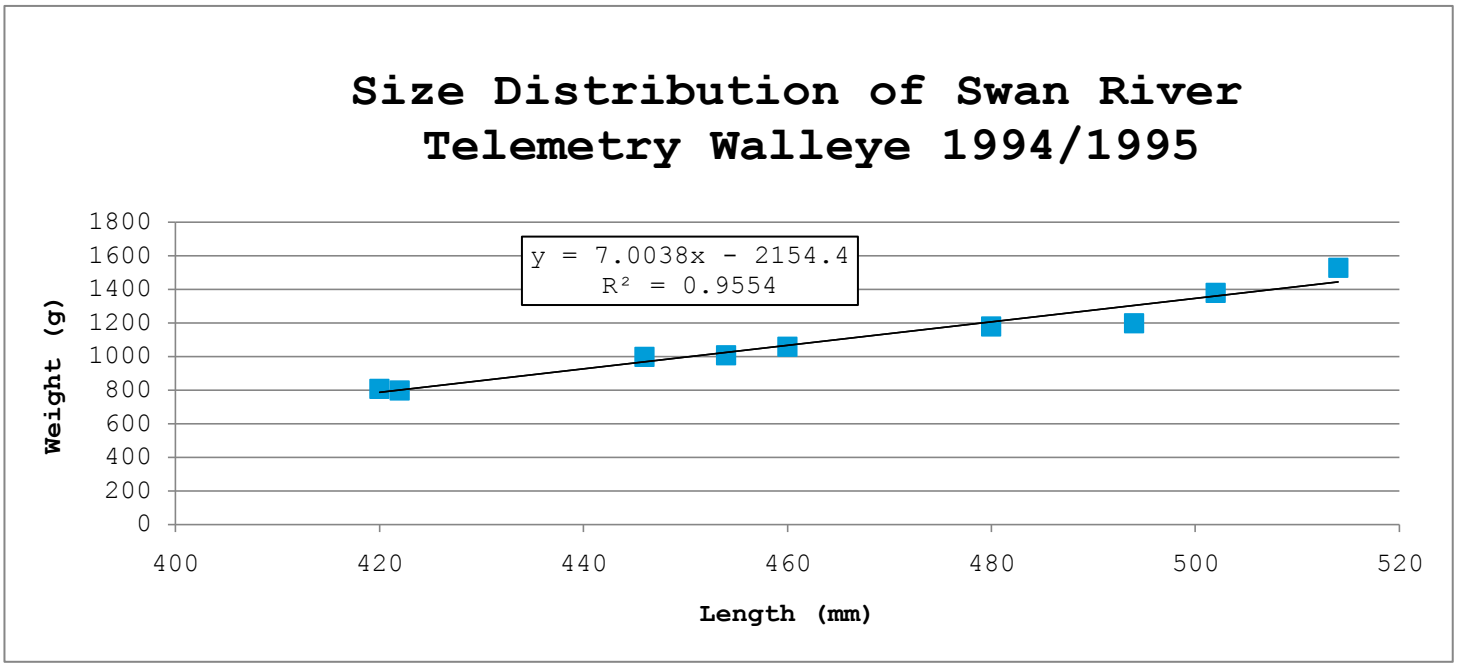
Post Processing

Universal Transverse Mercator (UTM) coordinates were collected for all walleye located throughout study period. Once telemetry tracking was completed all points were uploaded to ArcMap 9.3 to further analyze fish movement and behaviour. Imagery and shapefiles were resourced through Manitoba Land Initiatives (MLI).

4. Swan River

Past Research

In 1994/1995 Swan Valley Sport Fishing Enhancement and Fisheries Branch DNR received funding from Fisheries Enhancement Initiative (FEI) to complete a telemetry study on the Swan River. A total of nine walleye were tagged with radio telemetry tags and tracked from January to May 1995. Walleye ranged from a fork length of 420 – 514 mm (16.5" – 20.2") and a weight of 800 to 1530 g (1.8 – 3.4 lbs).



Six flights were flown to locate the tagged fish. Four tagged fish out of the potential nine were located, with only three indicating movement. The three remaining fish moved upstream from their tagging locations throughout the study period. All tagging locations were upstream and in near proximity of ford crossings. Fish movement was as follows:

049.020 (Figure 15)

This fish was tagged upstream of the golf-course ford crossing south-west of Swan River. 049.020 was located **once** on March 8/1995 upstream from tagging site on the bridge on Road 487.

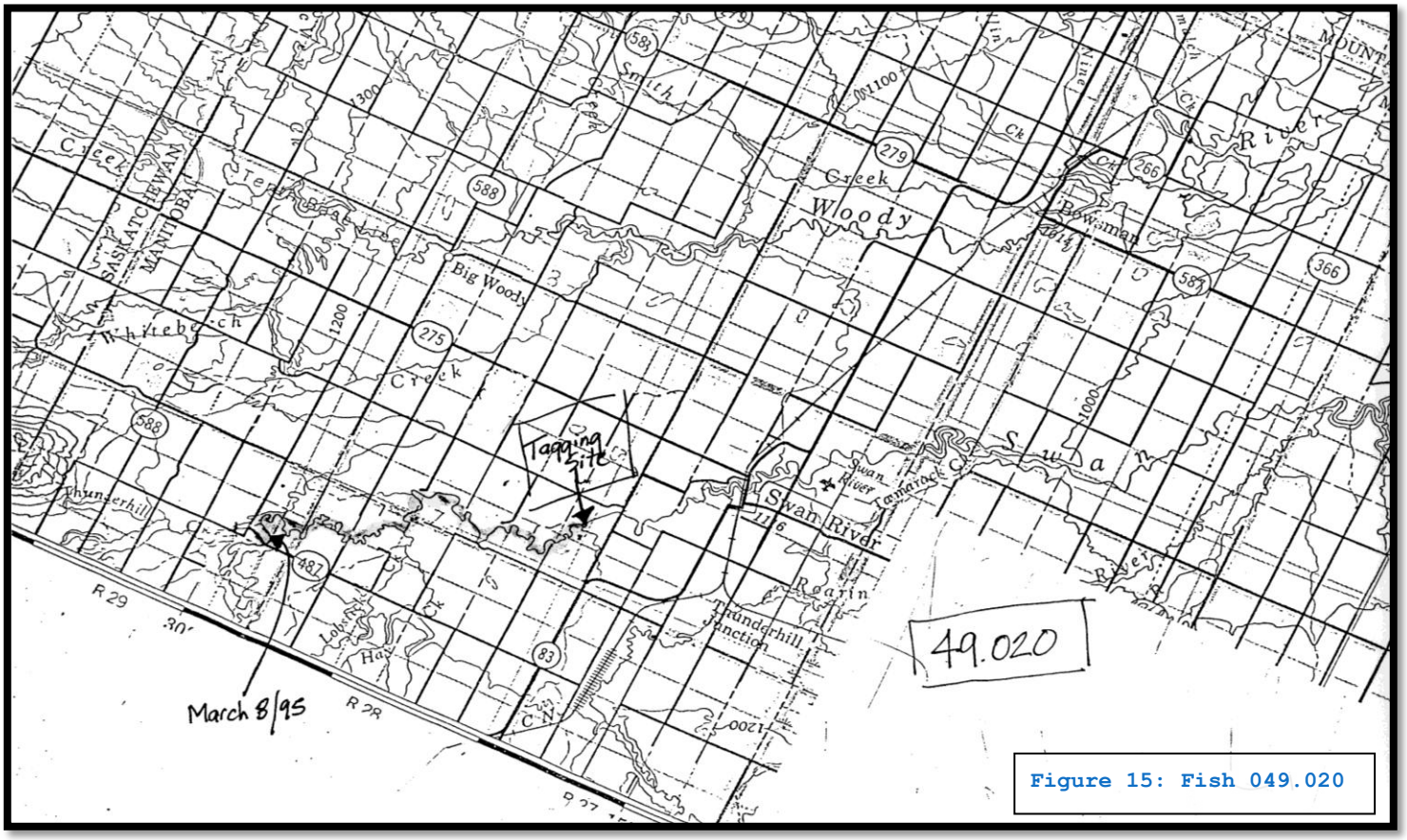


Figure 15: Fish 049.020

049.101 (Figure 16)

Fish was tagged in the same location as previous fish. Fish was located until April 1995 but only inhabited one mile upstream throughout study period.

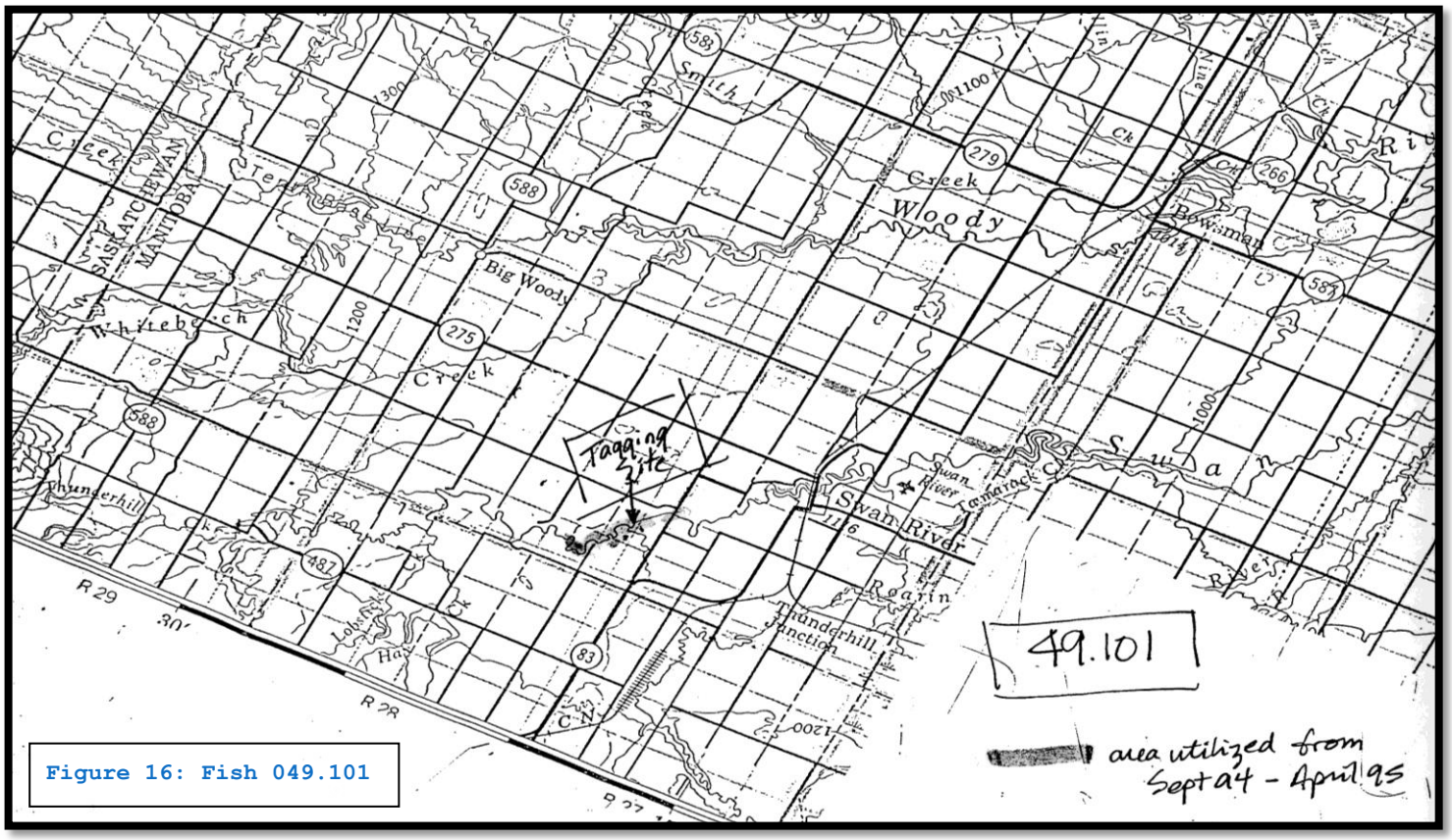
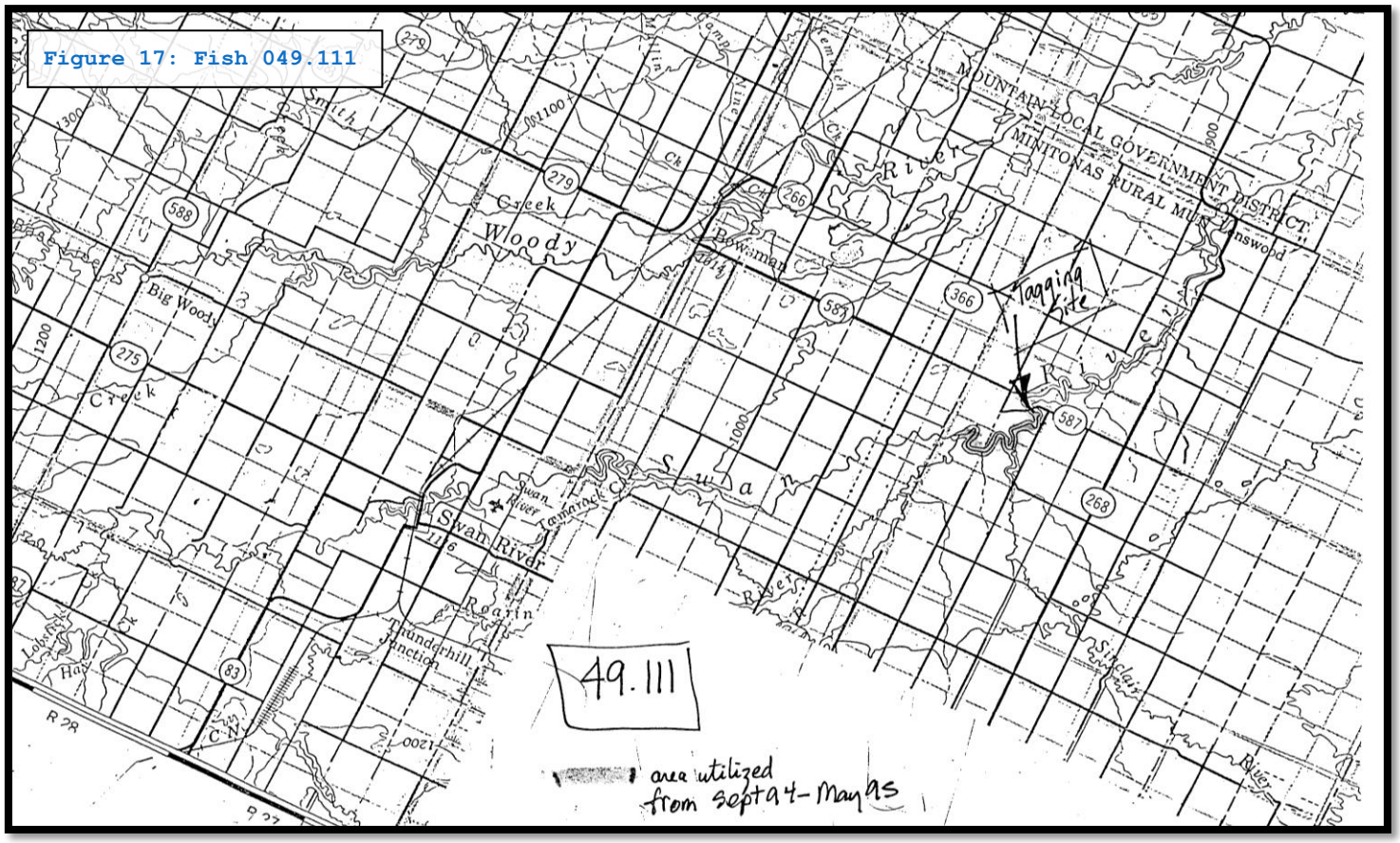


Figure 16: Fish 049.101

049.111 (Figure 17)

This walleye was tagged at the ford crossing on highway 587 east of Bowsman. This was the only fish tagged at this site. Tracked up to May 4/1995 this walleye inhabited the reach of the river between the ford crossing and the mouth of the Roaring River.



The fish were presumed to stay in the river because of more suitable habitat compared to Swan Lake's deadly low winter dissolved oxygen levels. Limited data prevented the survey to explain whether or not walleye become resident in the river after spawn. Good habitat, forages, and over wintering areas will favour a resident walleye population (Yake, 1994/1995). Upstream flights into Saskatchewan showed some reaches of potentially good spawning riffles/habitat, but further work was needed to more fully understand the walleye situation (Yake, 1994/1995). When compared to discharge levels from 1995, it is apparent why walleye locates were sparse. Ice conditions were documented up to April 19th. Following this, discharge levels doubled to a rate of 241 m^3/sec by April 24th. The only walleye found after this occurrence was fish 049.111. This walleye was located near the mouth of the Roaring River. It is suspected the fish could have utilized this tributary during high flows.

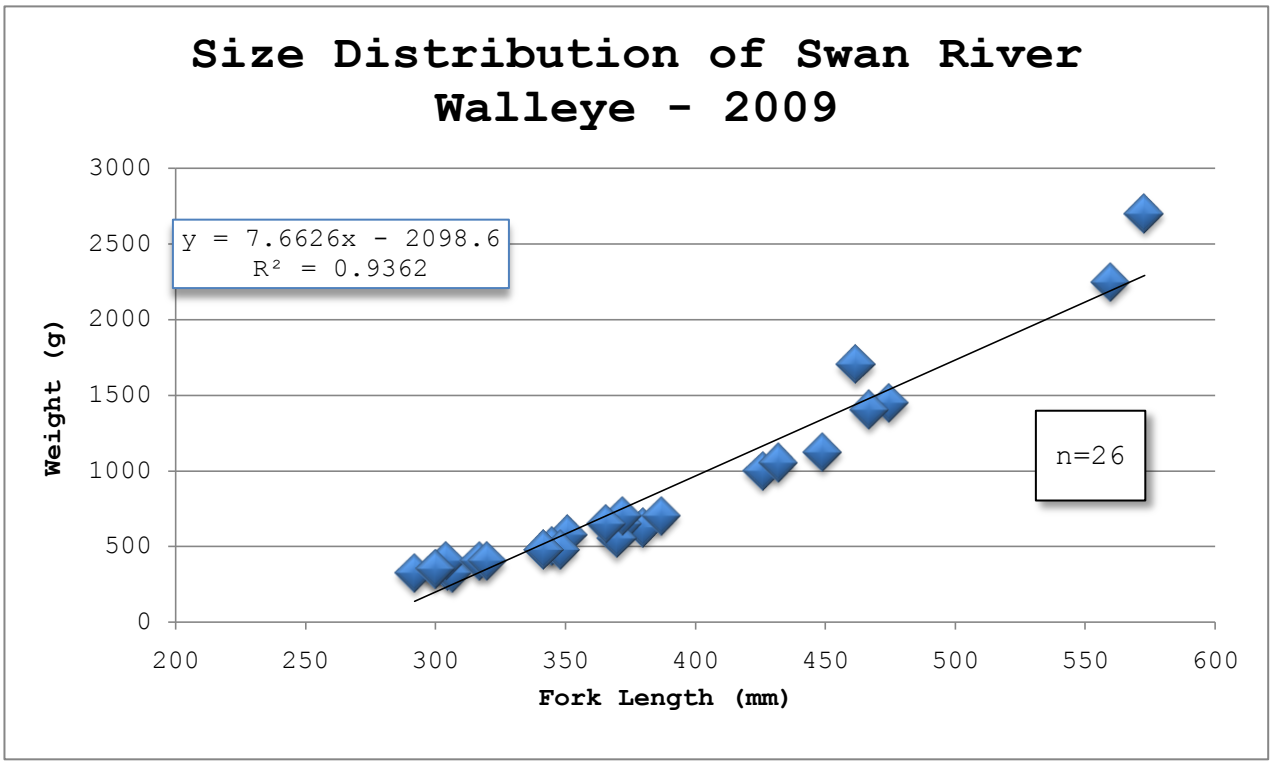
2009/2010 Telemetry Results

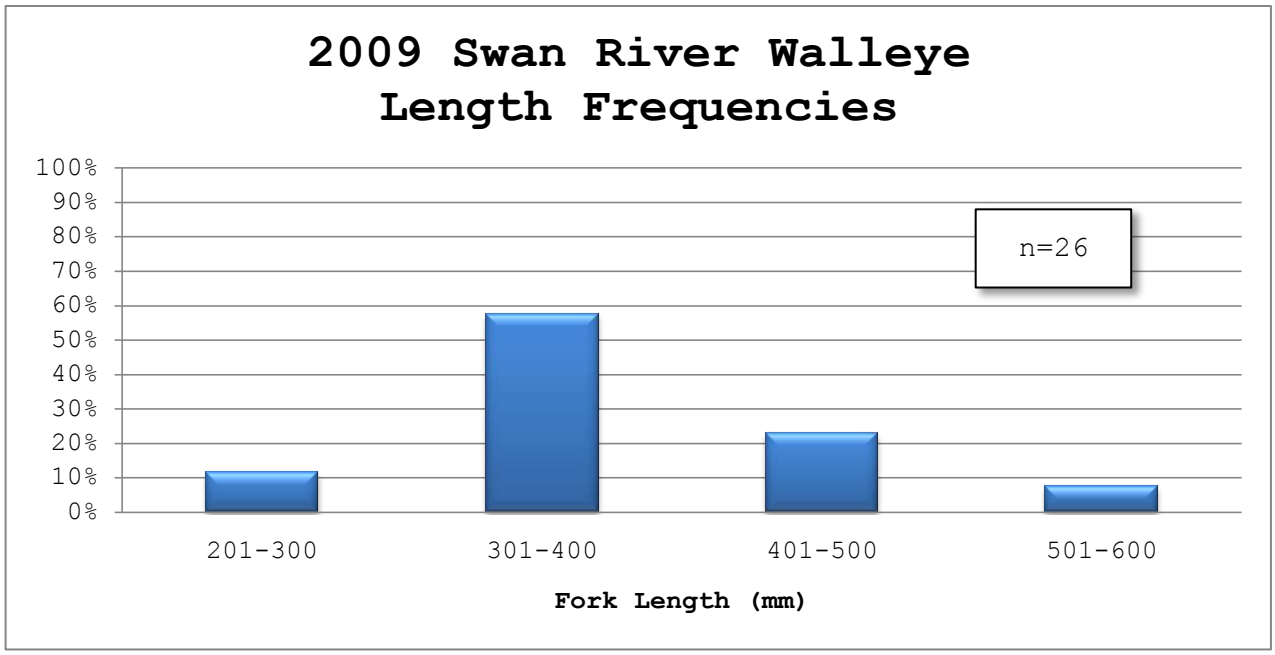
Walleye Biology

Out of 26 walleye caught during the river sampling - 13 walleye were tagged. These walleye ranged from 305 mm to 573 mm (12.0" - 22.6")in fork length and 340 to 2700 g (0.75 - 6.0 lbs) in weight (Table 1).

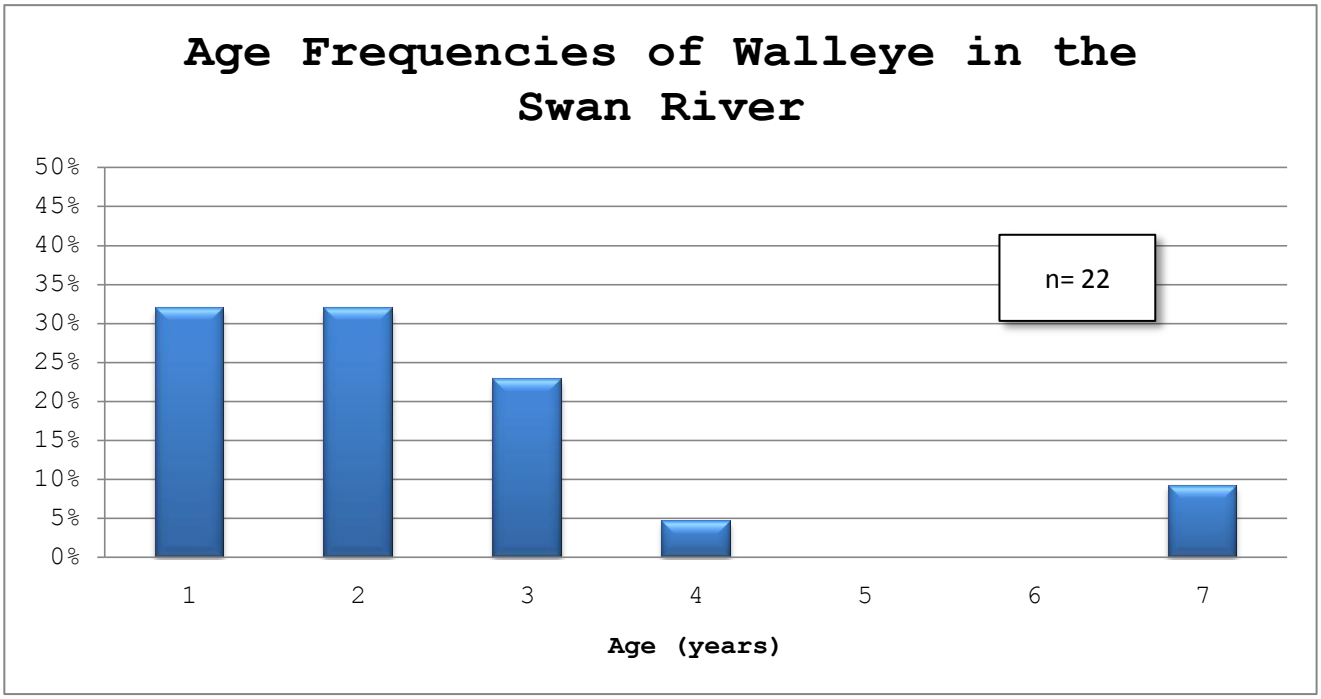
Table 1: Walleye Biology

Fish #	Date Tagged	Fork Length	Weight	Location
049.153	Oct 14/09	305	340	Golf Course
049.104	Oct 14/09	317	400	Golf Course
049.161	Oct 16/09	342	475	Vopni's
049.134	Sept 21/09	348	475	Gust's
048.831	Oct 30/09	372	700	Gust's
049.050	Sept 21/09	380	625	Gust's
049.114	Sept 21/09	426	1000	Gust's
048.151	Oct 30/09	432	1050	Gust's
049.071	Sept 21/09	449	1125	Gust's
048.561	Oct 30/09	467	1400	Gust's
049.271	Oct 30/09	462	1700	Gust's
049.014	Sept 21/09	560	2250	Gust's
048.211	Oct 30/09	573	2700	Gust's





Stocking in the Swan River has been minimal in recent years. Stocking records indicate initial walleye stocking started back in 1934. Between 1934 and 1942 an average of 261,111 walleye fry were stocked annually. Further stocking began again in 1947 to 1950, stocked annually with 1.020.000 eyed walleye eggs. 1995 was the first stocking of 250,000 fry since 1950. This was followed by 650 fingerlings stocked in 2008 and 100,000 fry in 2010. From the walleye sampled in the 2009 fisheries assessment, it is evident that the river walleye population are naturally reproducing, although there is an increase in the year classes 1 to 3. This could be contributed by the fingerling stocking in 2008.



Fish Movement

Tracking walleye on the Swan River started with revisiting the tagging locations and tracking both up and downstream by snowmobile and foot. Fish tagged at both the Vopni and Golf Course locations were located in close proximity of tagging sites during the ice season. Only five walleye from the Gust location were located initially in January (Figure 18). Because of the difficulty in locating the remaining five fish, flights were scheduled with Dauphin Air Services to cover more ground. A total of 5 flights were made on the Swan River between February and July 2010. Flight dates included; February 24, April 11, April 18, April 27 with Dauphin Air and July 28 with Andy Maxwell.

Four out of five walleye from the Gust`s tagging location were found in January and were located upstream from tagging location. Movement was all within 9.5 - 10 km upstream. The remaining walleye only moved 800 meters downstream.

During the month of February eight of the ten walleye tagged at the Gust location were tracked by snowmobile or plane. Five out of the eight walleye remained stationary or moved upstream, while the remaining walleye, found for the first time, were significantly downstream with one at the mouth of river (Figure 19).

March was a difficult time to track on the river due to ice conditions and only two walleye, 048.831 and 049.014 were relocated. Both were beginning to move back downstream near tagging location (Figure 20).

Figure 18: Swan River Seasonal Movement – January

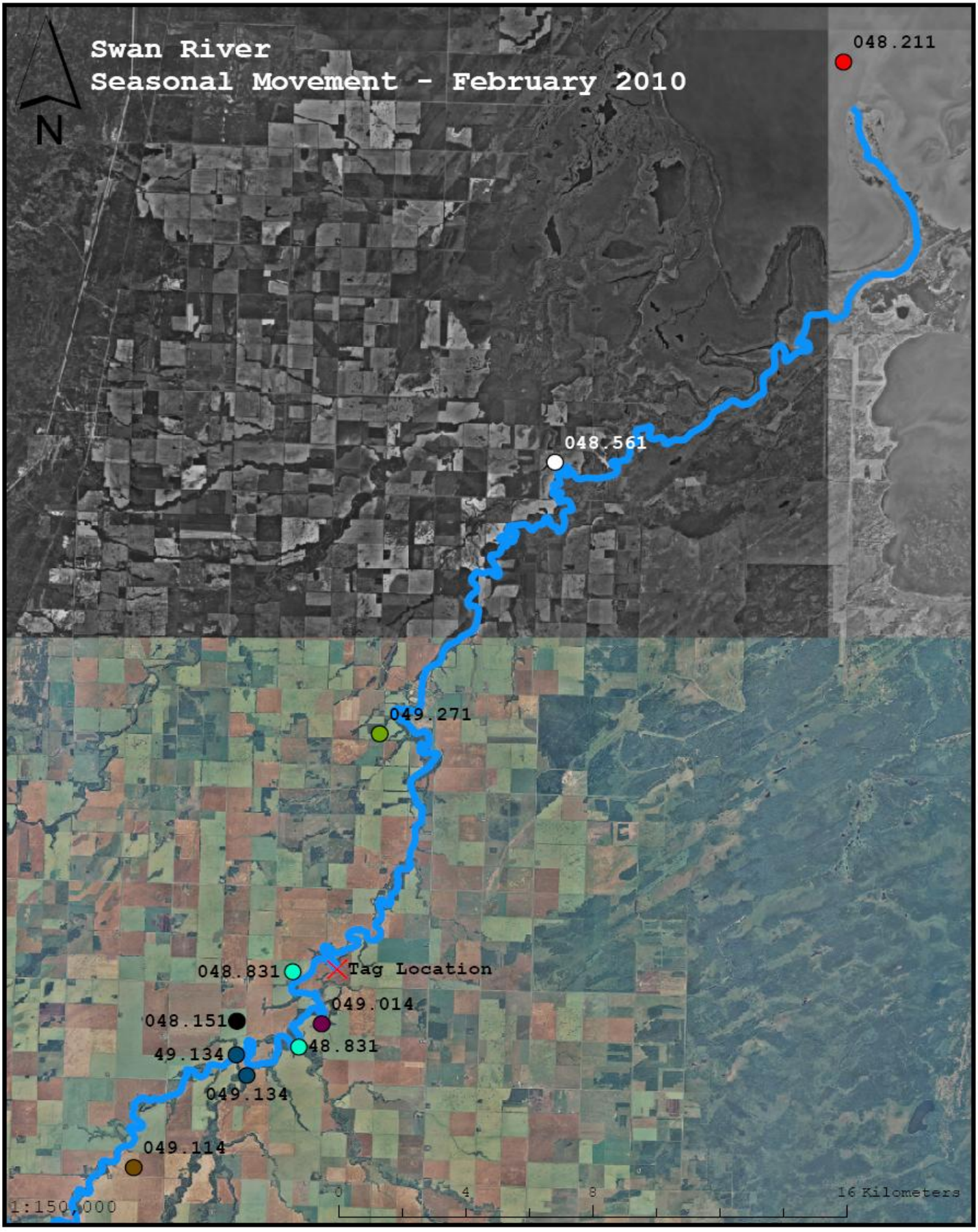


Figure 19: Swan River Seasonal Movements - February

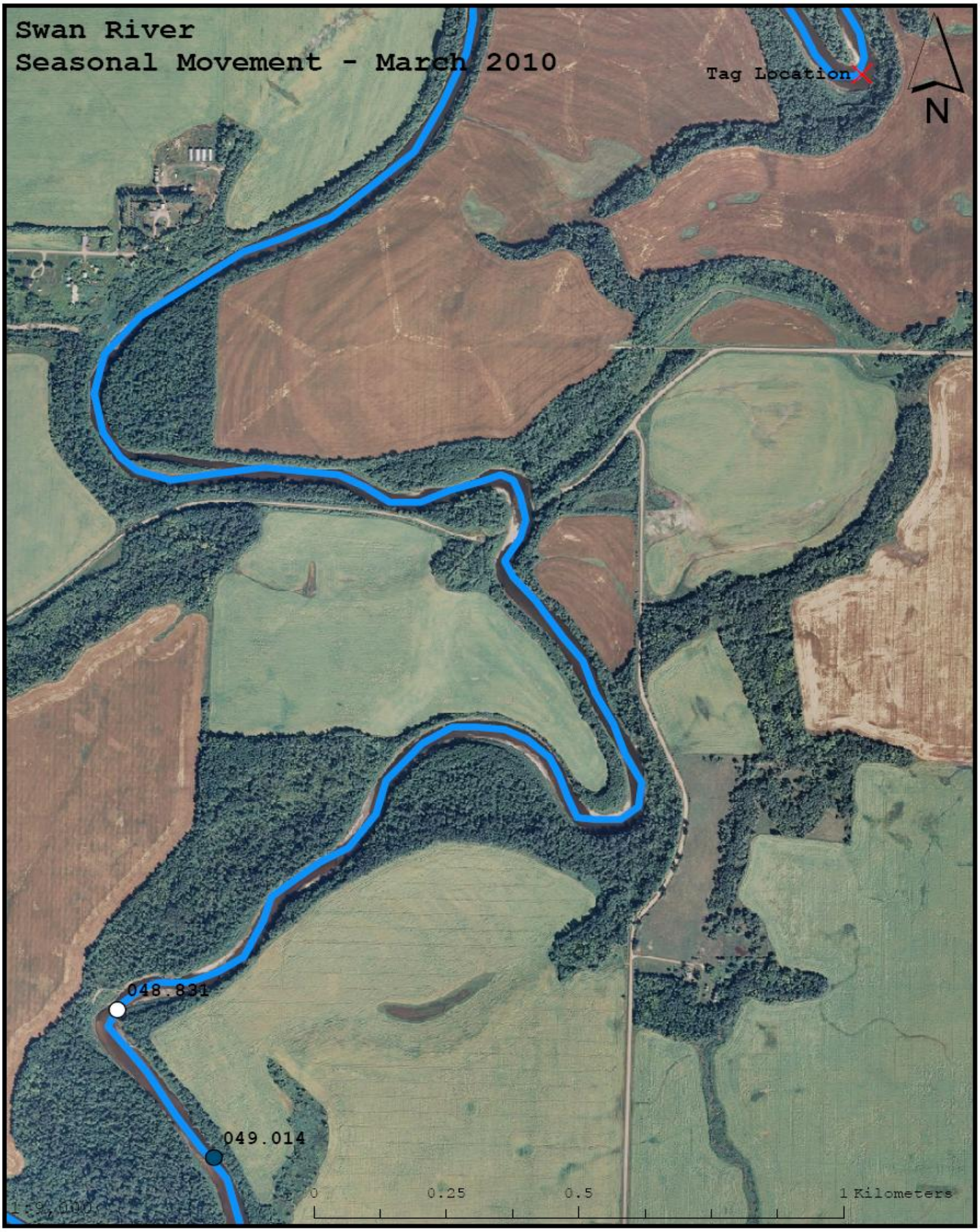


Figure 20: Swan River Seasonal Movements - March

Walleye movement during the month of April (Figure 21) displayed interesting behaviour out of the three flights. The first flight on April 11th found only one walleye, fish 049.071. This walleye was not located since January (downstream tagging site), and still remained near the tagging location.

The second flight on April 18th tracked eight walleye. Of these walleye six moved significantly downstream from their last known location or were found in Swan Lake. One walleye, fish 048.211, was ascending upstream from the lake and fish 049.050 was still upstream of tagging location. Ice within the river broke up and flushed out between the first and second flight of April. The one walleye found between the first two April flights, fish 049.071, was found to travel approximately 42 km downstream during the flush in a seven day period. During a study in Michigan, river walleye were found to travel downstream with distances of 10 to 60 km within a couple days (Hanson, 2006).

A third flight on April 27th located six fish in total. Two fish which were not found since February moved downstream. The remaining four tracked walleye were all on the upstream journey from the April 18th location with three of the four fish travelling from Swan Lake back to the original tagging location.

No further flights were flown until July 28th. Aerial flights are quite costly and funding limited additional flights in May. In July, local SVSFE member and pilot offered to assist the project and track the river walleye in his personal aircraft. Unfortunately no fish were located during this flight. Additional attempts were made to track by zodiac during the spring and summer months, but extreme high water levels impeded technicians from completing this task. See Appendix A for individual fish movement.

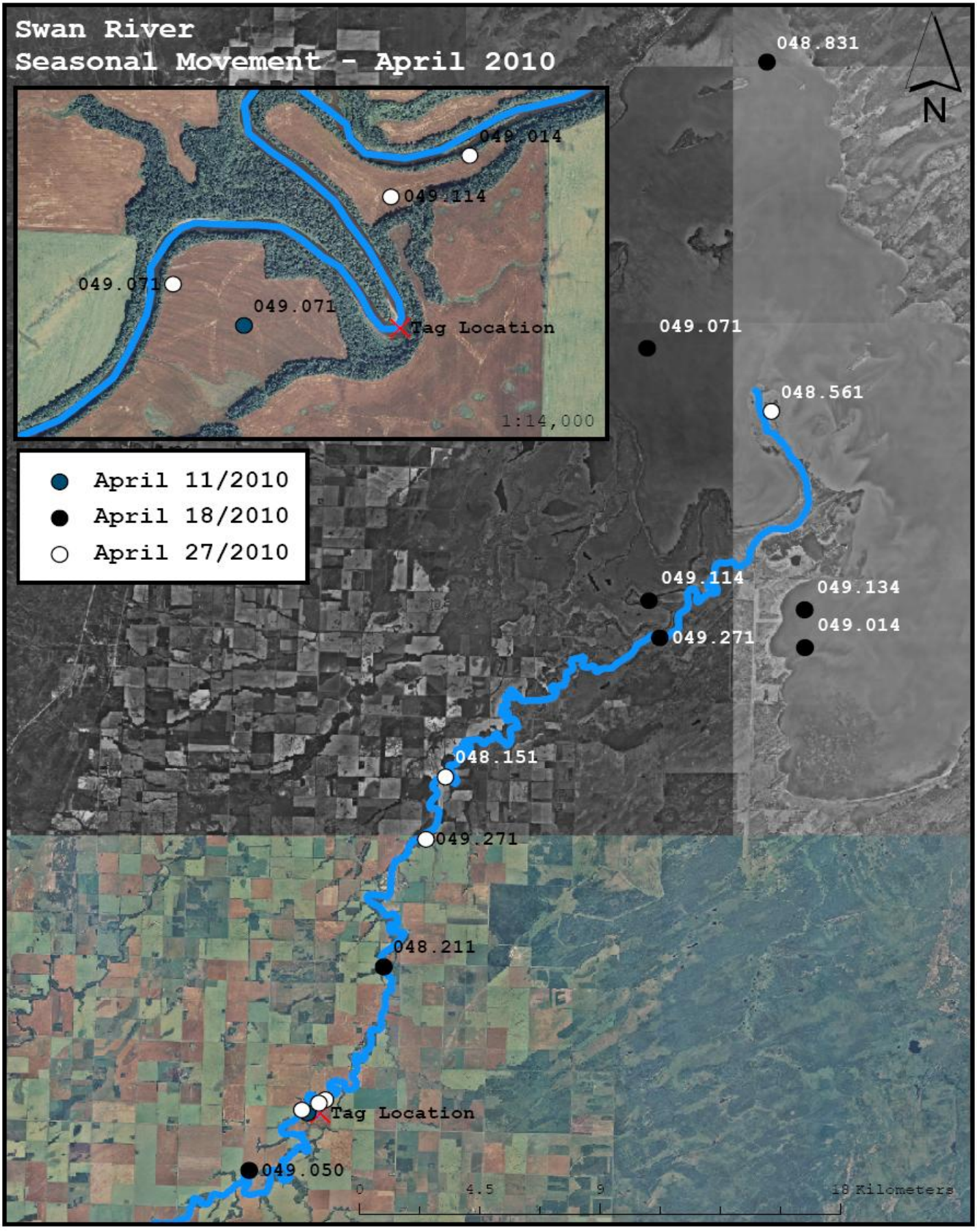
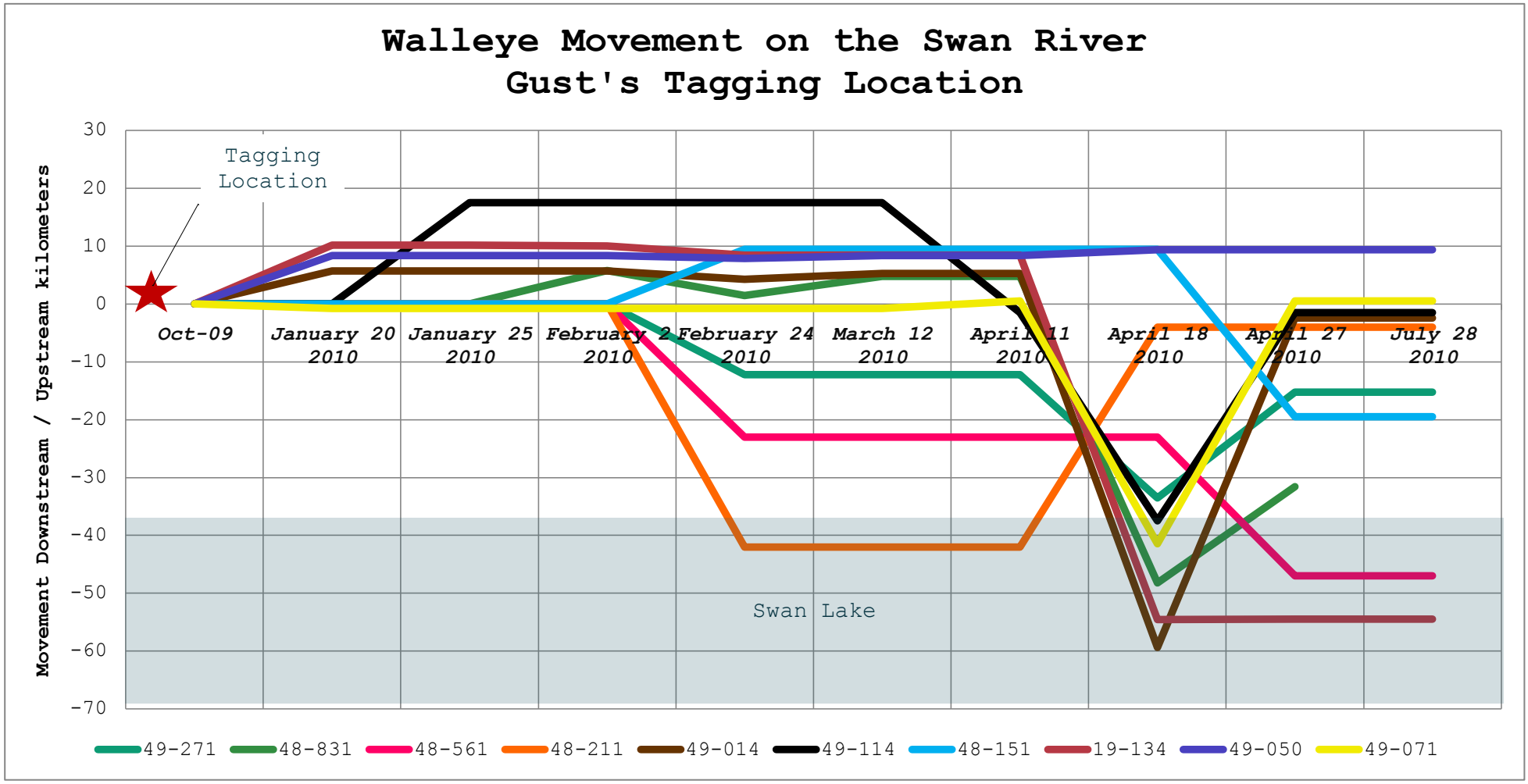
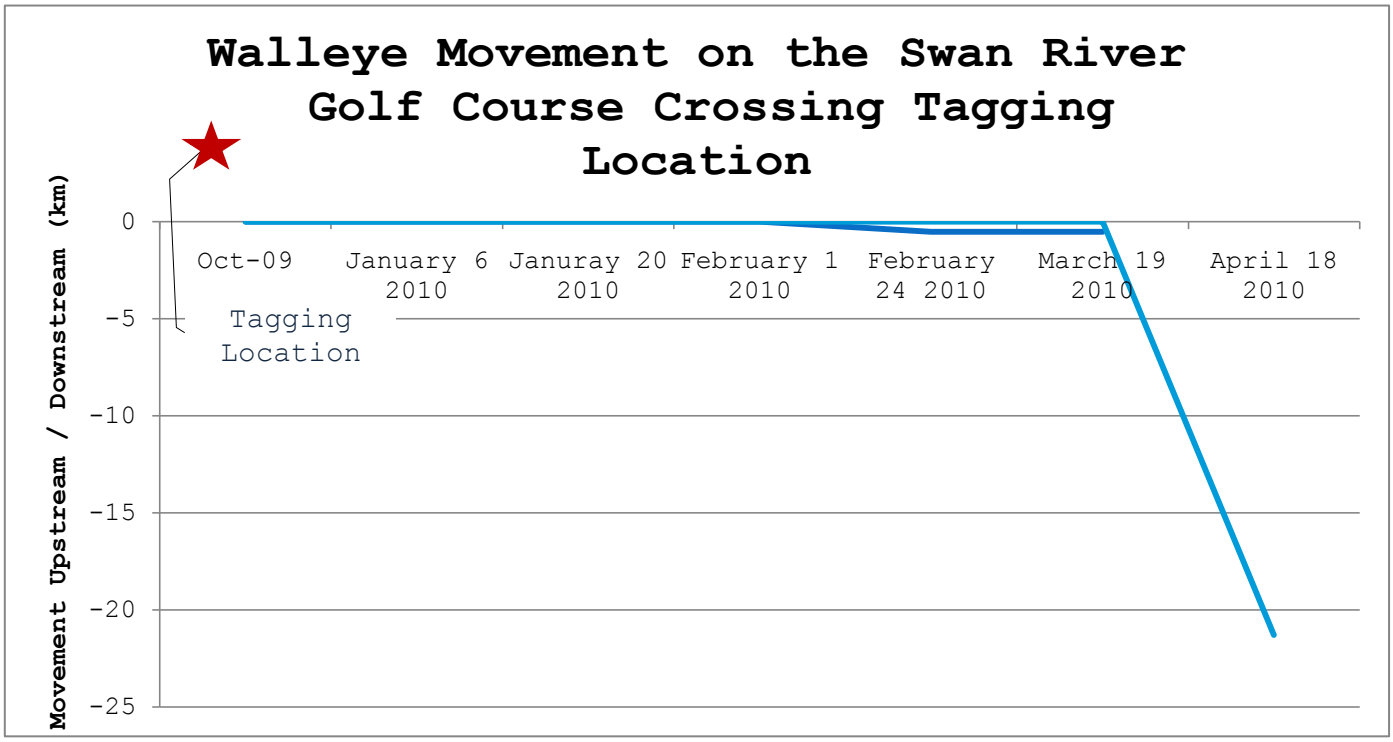


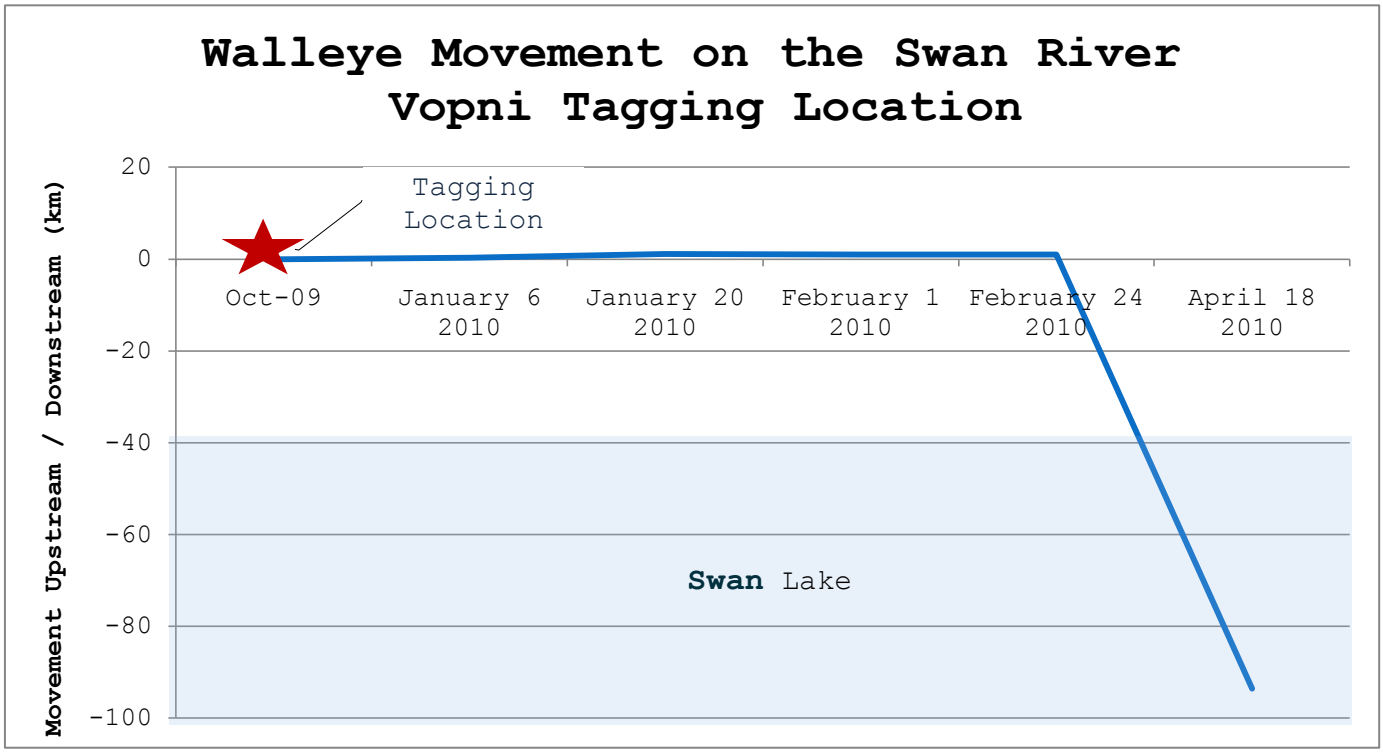
Figure 21: Swan River Seasonal Movements - April



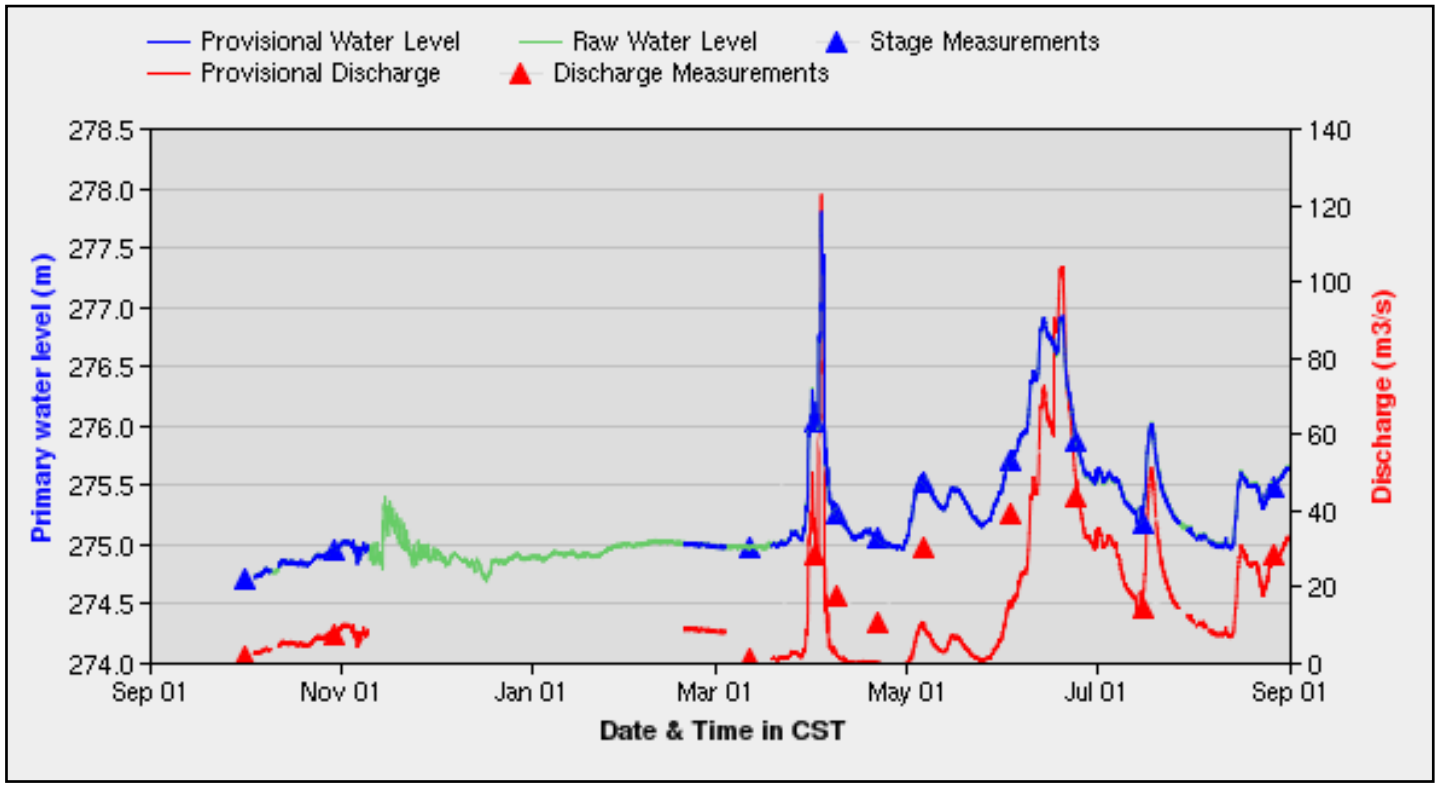
To display the trend of movement of walleye within the Swan River, distances were calculated to show upstream and downstream movement throughout study period. 60% of walleye from Gust`s tagging location displayed a trend of downstream movement followed by upstream movement during the spawning period.

The three walleye from the Vopni and Golf Course tagging locations were found to be flushed once ice went out (see below). Although they did show minimum movement during the winter, these fish were not located after the flush. One walleye from the Golf Course tagging site showed no movement through the winter and was not located after ice break up. It is presummed that this walleye did not survive.





The following graph indicates the variable river conditions from April to September 2010. This information is provided by Environment Canada – Water Office from the #05LE006 station located near Minitonas on the Swan River.



Behaviour / Habitat Utilization

It is unsure why the walleye who reside in the river during the winter travel to the lake before returning back to the river during the spawn / pre-spawn. It is stated during the winter walleye do not change their habitat, except to avoid strong currents (Unknown). No obstructions were apparent for downstream fish movement. Fish moving upstream during the spawn did not encounter any barriers as all movement was downstream of any ford crossings. When compared to the 1995 telemetry work, there is no evident pattern between the two studies. In 1994-95 study only three out of nine fish were located. This year showed considerable discharge at six times the amount compared to 2010 (Appendix B). Other fish may have relocated to more favourable habitat (ie: Swan Lake).

Findings show that the Swan River is suitable habitat to sustain walleye populations, even in the upper reaches. Fish stocks throughout the river are

evidently diverse between downstream and upstream of the Town of Swan River.

The instability was apparent with 2009 - 2010 water levels, creating unstable habitat and could explain why the walleye moved into or close to the lake. In addition, feed may have been more available in slower moving water or the lake.

Discussion

The main objective of the telemetry study on the Swan River is to better understand requirements, behaviour and movements of walleye in our area. Recommendations can be developed from the current and past telemetry findings, and be specific to the waterbody.

It was hypothesized that the walleye within the Swan River were resident fish and would move within the reaches of the river. It is apparent this is not always the case. Walleye display complex seasonal movements that can be attributed to spawning, over wintering, and foraging (Hanson, 2006). The river is unique as levels, discharge and available habitat and forage are constantly changing. For this reason, walleye movement is dependent on these factors. With the comparison of the past data from 1994 – 1995 and the results from the tagging in 2009, it is clear that the Swan River can sustain resident walleye and stocking efforts within all reaches should continue.

5. Whitefish Lake

Past Research

In October 2005 a walleye telemetry study was initiated by Fisheries Branch and partially funded by SVSFE ($1600 for re-furbished telemetry tags). A total of eight walleye were angled and tagged with radio telemetry tags. Three tagging locations were used, with the North Island being the most successful. Walleye targeted were slot size and tagged fish ranged from 472 – 730 mm (18.6”-28.7”) in fork length.

Tracking effort consisted of twelve days from October 4, 2005 to September 4, 2006. Methods of tracking walleye included; snowmobile in the winter, boat during spawn and once by helicopter in the summer. On April 30th all fish were located and on average five walleye were located per effort throughout the study period.

It was found that the walleye do utilize the two tributaries, North Creek and Lagoon Creek (Figure 22 & 23) during the spawn. It is uncertain of the condition of the creeks at that time and the success of spawning within them. It was indicated in the 2010 Trap Netting Program, the 2006 spawn (4 year age class) produced 5% of all walleye sampled.

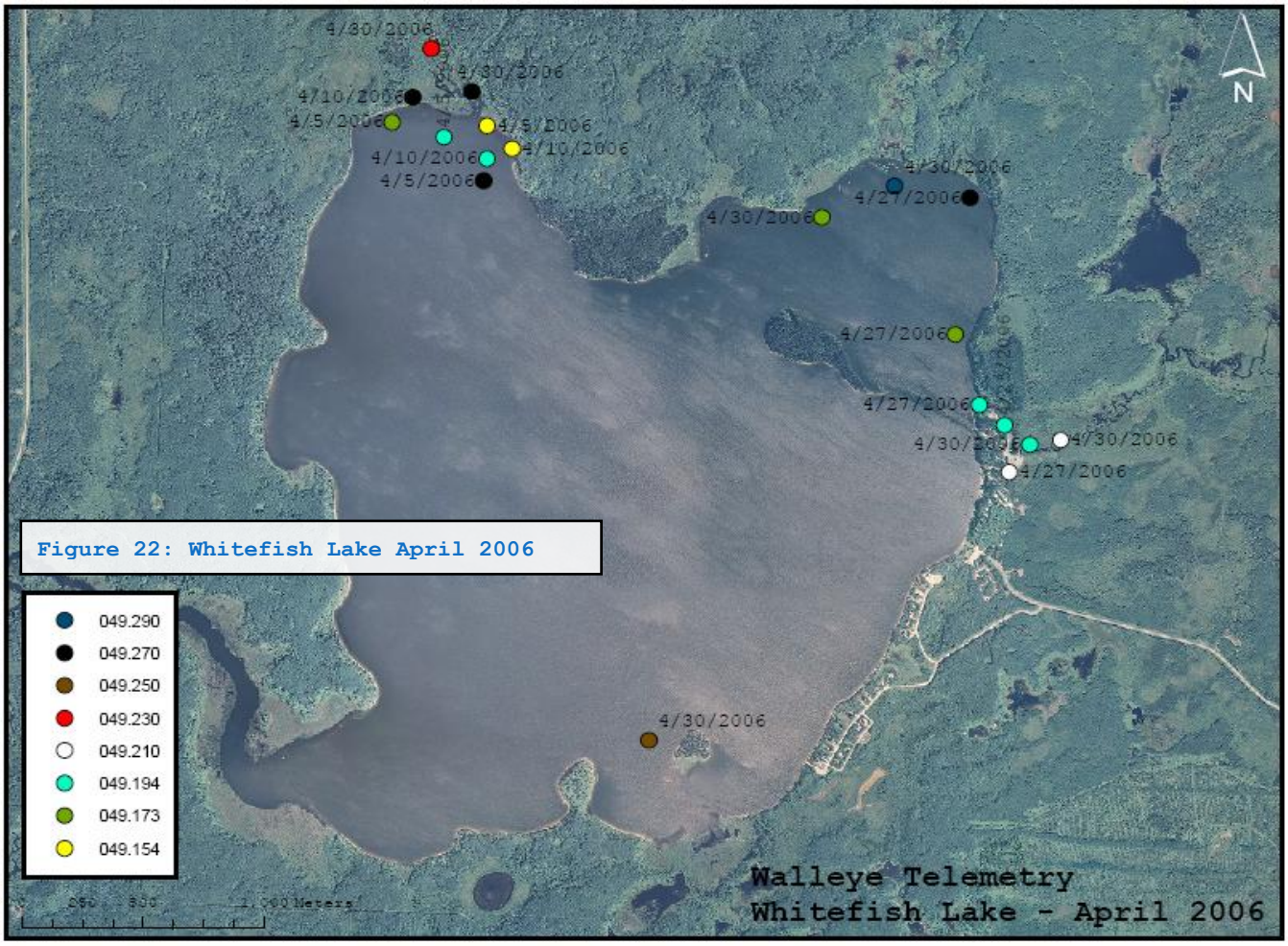


Figure 22: Whitefish Lake April 2006

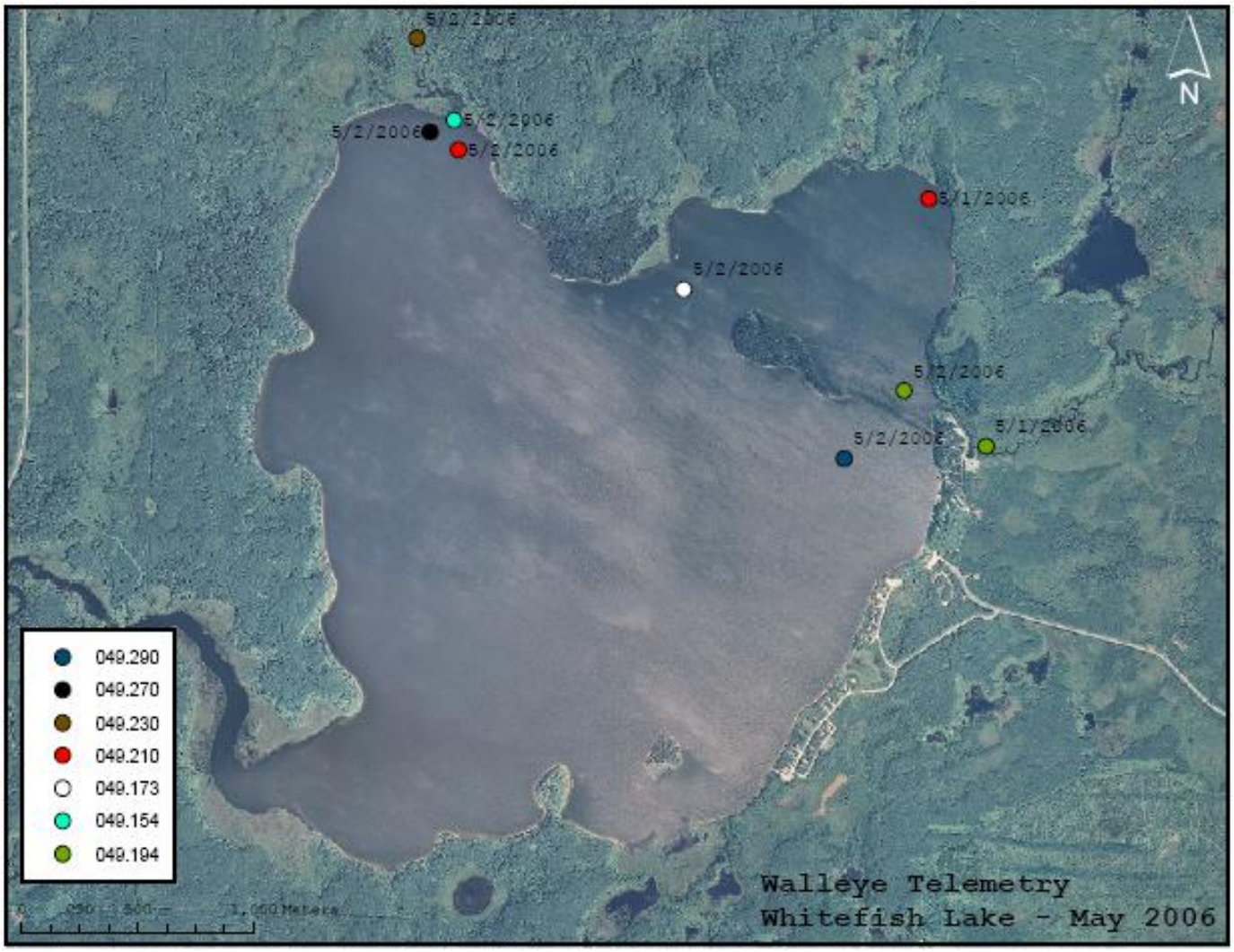


Figure 23: Whitefish Lake May 2006

Individual fish movement throughout entire study was mapped and can be found in Appendix C

Figure 24: North Creek Beaver Dam

Over the years the concern for the condition of the two tributaries; North and Lagoon Creek grew. AAE Services was contracted to conduct the Whitefish Lake Tributaries Fish & Habitat Assessment in 2009-2010 on behalf of SVSFE with funding by FEF. The project was initiated to start the rehabilitation process.

Figure 25: North Creek suitable walleye spawning habitat

Tributary Survey by AAE Services
Main Objectives

1) Conduct habitat assessments on each tributary to understand and document the potential and available spawning habitat

2) Conduct fish community surveys to understand species utilization, species composition, and relative abundance of fish species

3) Identify barriers impeding fish movement

4) Achieve recommendations to improve and restore the habitat within the two tributaries

Both tributaries exhibited several barriers throughout their reaches, although throughout the creeks potential spawning habitat was identified. North Creek possessed a diverse range of potential habitat (Figure 25). Numerous gravel and rock outcroppings were found throughout the entire creek. Lagoon creek had less potential within the first 5 km, but farther upstream rock outcrops were documented. Both creeks have been extremely altered by beaver activity (Figure 24 - 27).

Figure 26: Lagoon Creek Beaver Dam

Fish communities consisted of 15 species totalling a catch of 659 fish. Walleye were not found within either creek, although other game species including northern pike, yellow perch and white sucker were.

The following recommendations were concluded:

- Remove all barriers on both creeks to provide additional spawning habitat for the Whitefish Lake fish community.
- Conduct studies to identify whether fish are utilizing the tributaries once the restoration efforts are completed.
- Conduct telemetry or adult fish surveys during the spawning run to verify fish are utilizing the tributaries.

Figure 27: North Creek Beaver Dam

- Conduct aerial surveys either on an annual basis or every other year to document the changes taking place to the habitat once restored. Habitat diversity will likely increase and provide additional habitat to the fish communities utilizing the tributaries.
- Conduct regular index-netting surveys to examine catch per unit effort and monitor the recreational fishery on Whitefish Lake.
- Conduct creel surveys for numerous years to get a better understanding of fishing pressure on Whitefish Lake. Fishing pressure will differ from year to year and therefore it is important to conduct the survey over multiple years to get meaningful data.

SVSFE has either completed or initiated each individual recommendation proposed by AAE Tech Services. Beaver dam removal was the number one and key component in restoring the habitat within the tributaries. Dam removal was contracted out to a licensed blaster, Marty Thomas and was assisted by SVSFE directors and volunteers. Blasting took place in late March and a total of 25 dams were removed between the two creeks. SVSFE decided to conduct blasting late in the season to ensure the accessibility of the creeks for the local registered trap line (RTL) during his trapping season. Coordinates and maps were utilized from the AAE Tech Services to locate barriers and ensure all obstructions were removed in a continuous pattern (Figure 28 & 29).

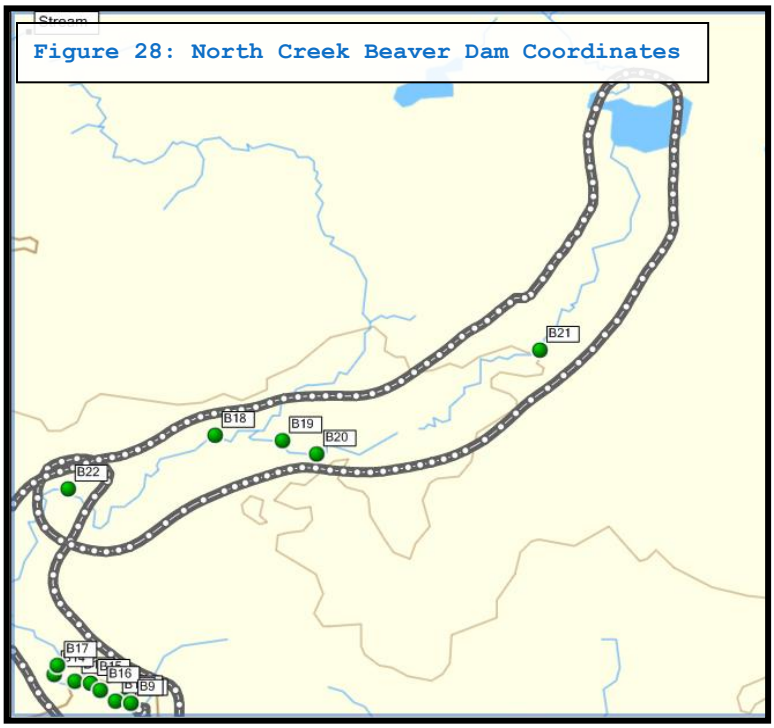


Figure 28: North Creek Beaver Dam Coordinates

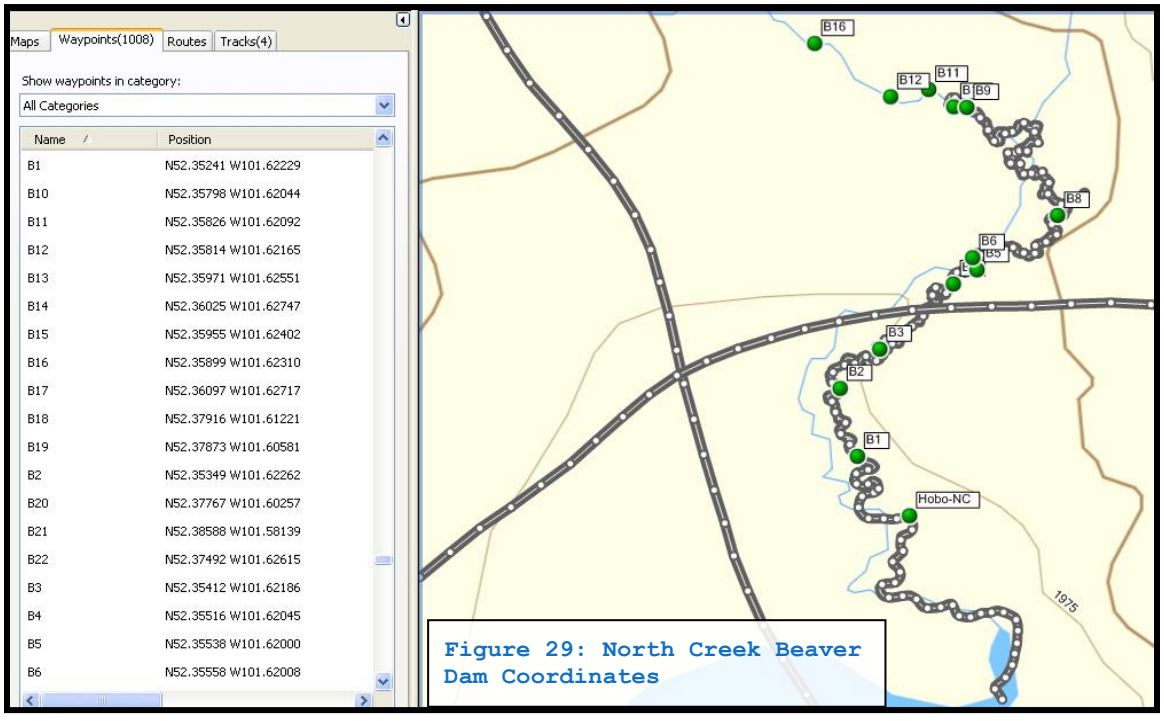


Figure 29: North Creek Beaver Dam Coordinates

Spring thaw demonstrated the success of the removal with high flows on both creeks and observations of numerous walleye spawning within upper reaches of one creek (Figure 30 & 31). Elevated discharge continued through to the fall on both tributaries.

Figure 31: SVSFE director tracking walleye up North Creek

Figure 30: Creek post beaver dam removal

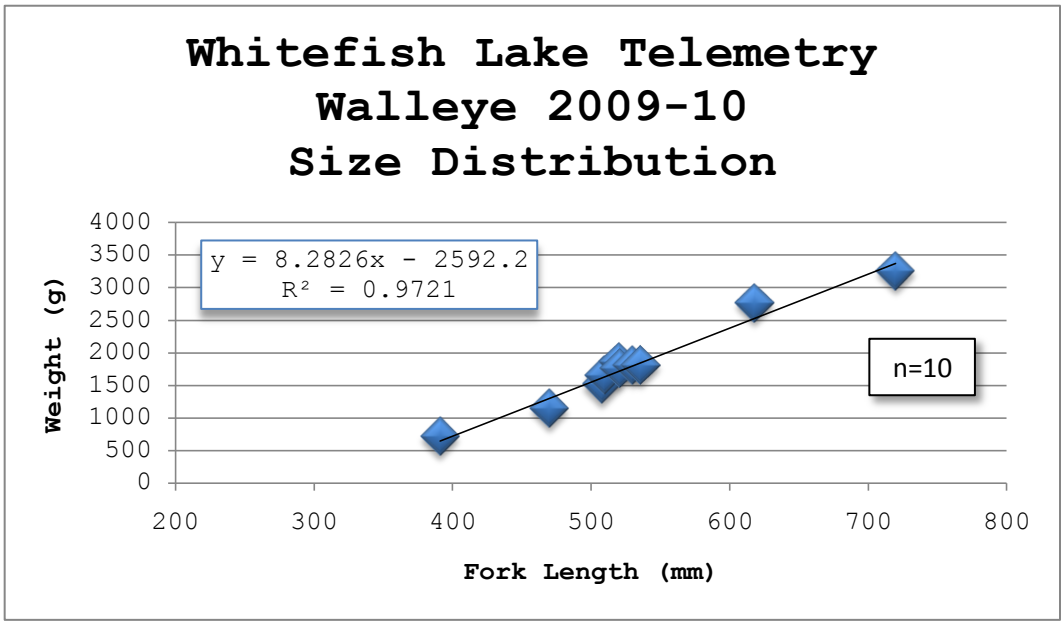
2009/2010 Telemetry Research

Walleye Biology

During the late summer/fall sampling at Whitefish Lake, ten walleye were tagged with telemetry tags. Walleye sizes were targeted to be within or relative to the slot limit size. Size of mature walleye vary with water temperature and food availability (lake fertility), within a given lake (Colby, 1981). Walleye ranged from 391 – 720 mm (15.4 – 28.3")fork length and 700 – 3250 g (1.5 – 7.2 lbs) in weight (Table 2). The North American mean size of when male and female walleye matures, are 375 - 464 mm and 421 - 518 mm, respectively (Morton, 2006).

Table 2: Walleye Biology

Fish #	Fork Length (mm)	Weight (g)
049.141	391	700
049.034	470	1125
049.191	508	1500
049.095	510	1650
049.171	520	1850
049.194	521	1750
049.174	530	1800
049.181	536	1800
049.231	618	2750
049.121	720	3250



Fish Movement, Behaviour & Habitat Utilization

Throughout the winter season (January – February) eight of the ten walleye were located. Four walleye were found to inhabit the north east side of the lake. All walleye demonstrated minimal movement throughout the winter, with maximum distance between locates being < 1.5km. All but one of the remaining walleye were tracked on the south end of the lake. Two of these walleye, 049.121 & 049.181 were later presumed dead as there was no movement throughout entire study (Appendix D). These walleye are not mentioned when comparing following seasonal movement.

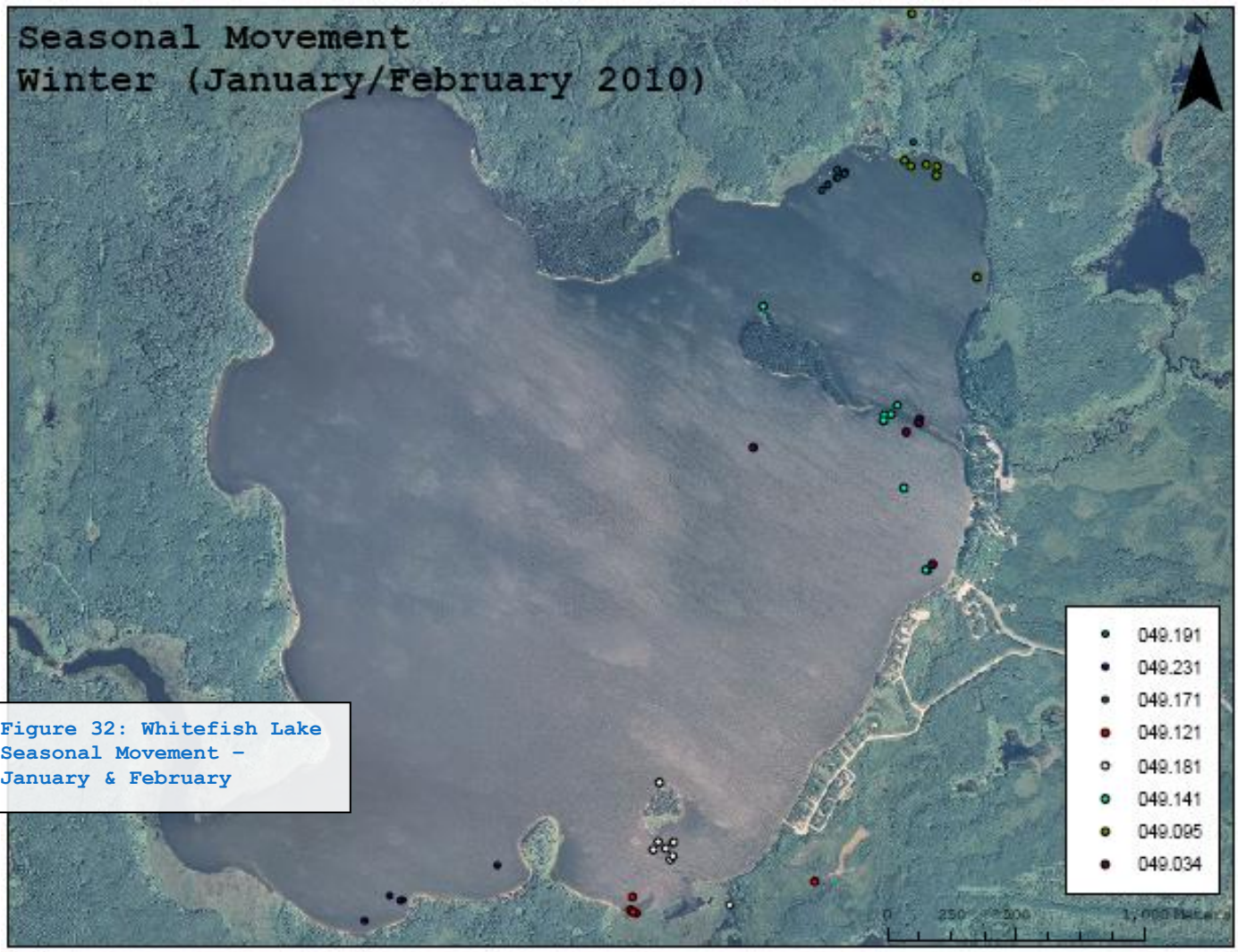


Figure 32: Whitefish Lake Seasonal Movement – January & February

The last fish, 049.191 was the only fish to be located once in the winter season. This location was approximately 3 km north of Whitefish Lake within the North Creek (Appendix E). It is uncertain if there was interference with the transmitter or if this was a true location of fish 049.191. The date the walleye was located was prior to the dam removal in March. All walleye inhabited shallow waters < 6.6 meters (20 feet) during the winter season.

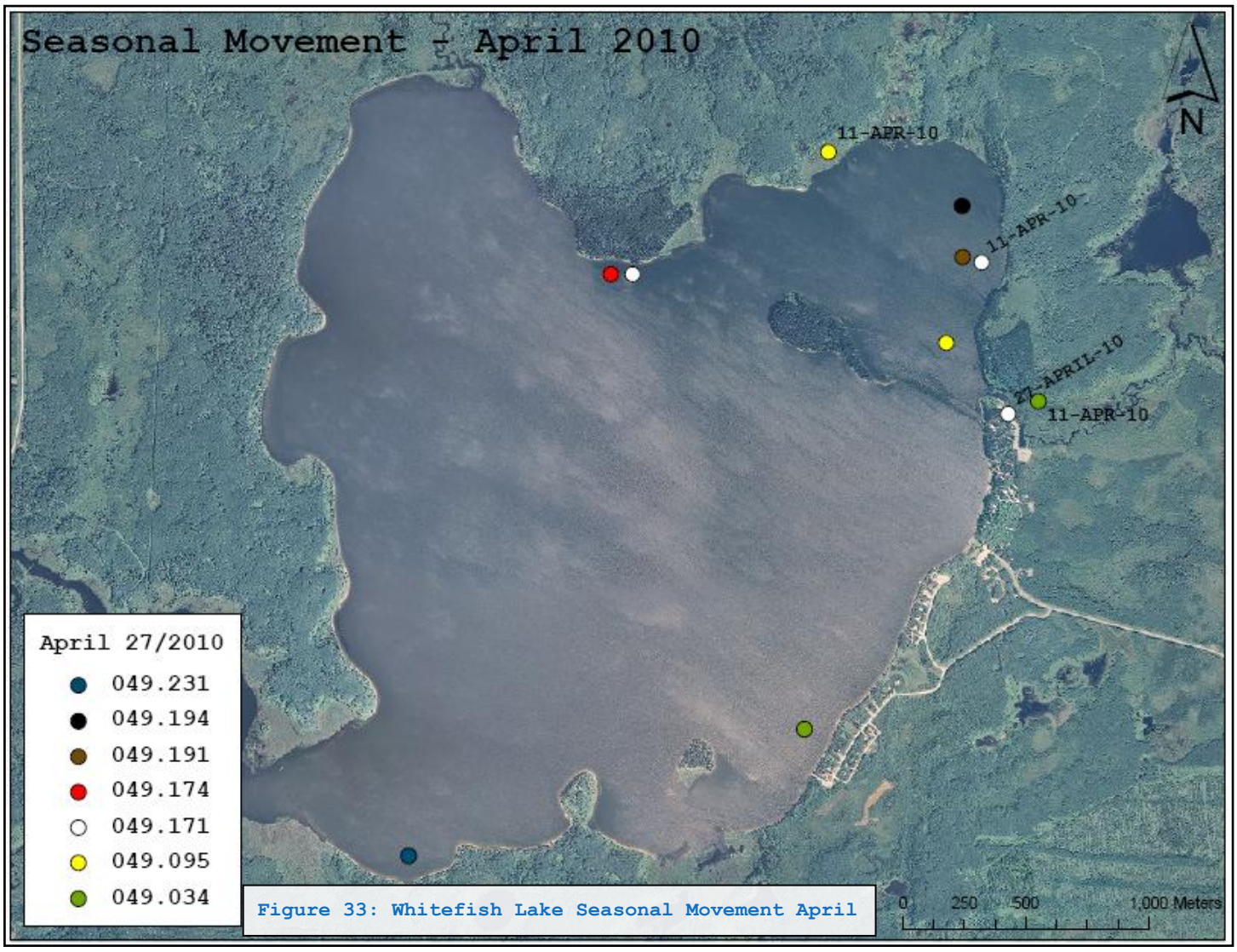
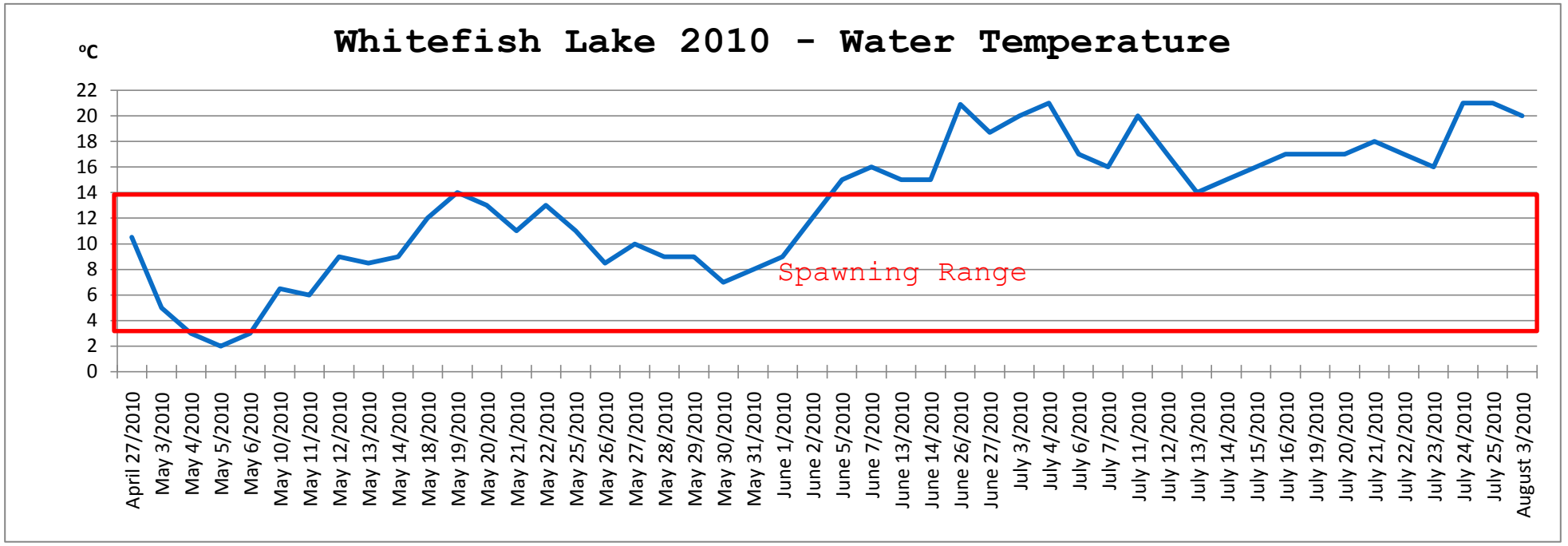
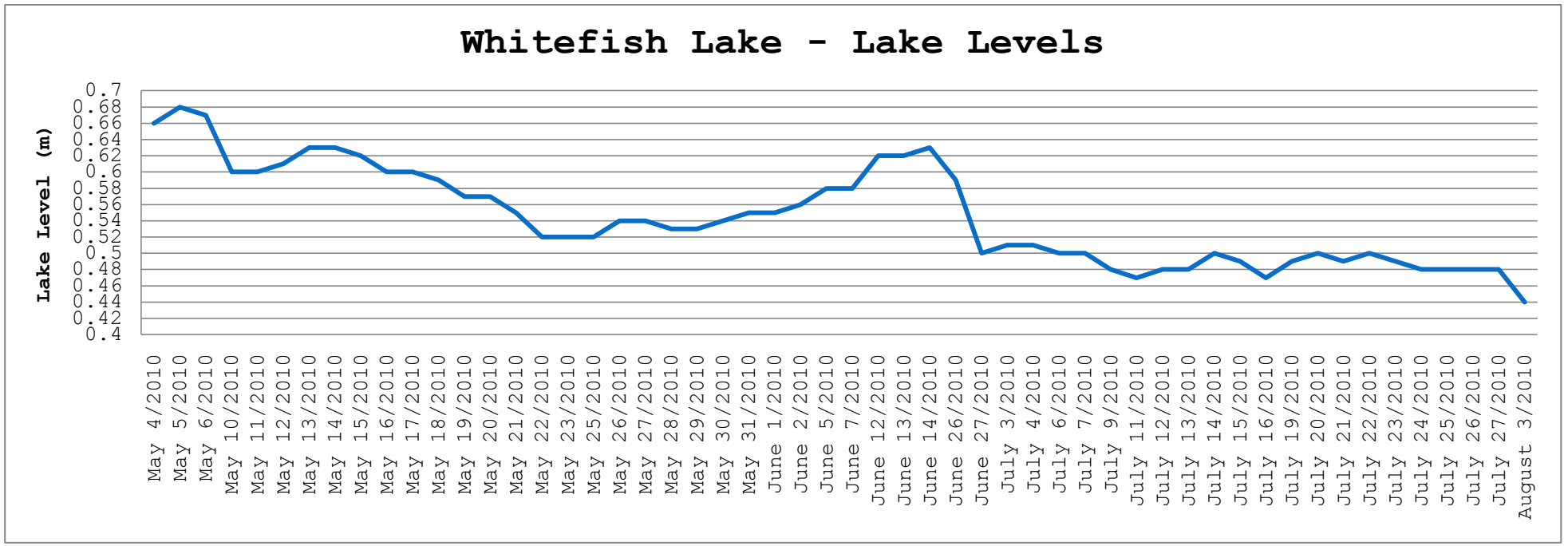


Figure 33: Whitefish Lake Seasonal Movement April

Tracking in late April was difficult due to ice break-up. The April 11th flight located three walleye, all within lagoon creek and Syl's Bay. The locations were found to be similar of the winter positions. The following telemetry tracking commenced on April 27th. Within the 16 day period between the 11th and the 27th, there was 9 evenings with temperatures above zero and a 7 day period with afternoon highs ranging from 15 – 23 °C. The above seasonal temperatures rapidly warmed the water and by April 27th lagoon creek reached 10.5°C (See Chart: Whitefish Lake 2010 – Water Temperature). Peak spawning activity usually occurs between 3.4 °C and 14 °C in Ontario and walleye spawning normally takes place shortly after ice breakup in the spring (Morton, 2006). This could explain why some walleye were within Lagoon Creek. On April 29th walleye movement had a slight increase and two additional walleye were located, 049.174 & 049.194.


Whitefish Lake 2010 - Water Temperature
°C
22
20
18
16
14
12
10
8
6
4
2
0
Spawning Range
April 27/2010
May 3/2010
May 4/2010
May 5/2010
May 6/2010
May 10/2010
May 11/2010
May 12/2010
May 13/2010
May 14/2010
May 18/2010
May 19/2010
May 20/2010
May 21/2010
May 22/2010
May 25/2010
May 26/2010
May 27/2010
May 28/2010
May 29/2010
May 30/2010
May 31/2010
June 1/2010
June 2/2010
June 5/2010
June 7/2010
June 13/2010
June 14/2010
June 26/2010
June 27/2010
July 3/2010
July 4/2010
July 6/2010
July 7/2010
July 11/2010
July 12/2010
July 13/2010
July 14/2010
July 15/2010
July 16/2010
July 19/2010
July 20/2010
July 21/2010
July 22/2010
July 23/2010
July 24/2010
July 25/2010
August 3/2010


Whitefish Lake - Lake Levels
Lake Level (m)
0.7
0.68
0.66
0.64
0.62
0.6
0.58
0.56
0.54
0.52
0.5
0.48
0.46
0.44
0.42
0.4
May 4/2010
May 5/2010
May 6/2010
May 10/2010
May 11/2010
May 12/2010
May 13/2010
May 14/2010
May 15/2010
May 16/2010
May 17/2010
May 18/2010
May 19/2010
May 20/2010
May 21/2010
May 22/2010
May 23/2010
May 25/2010
May 26/2010
May 27/2010
May 28/2010
May 29/2010
May 30/2010
May 31/2010
June 1/2010
June 2/2010
June 5/2010
June 7/2010
June 12/2010
June 13/2010
June 14/2010
June 26/2010
June 27/2010
July 3/2010
July 4/2010
July 6/2010
July 7/2010
July 9/2010
July 11/2010
July 12/2010
July 13/2010
July 14/2010
July 15/2010
July 16/2010
July 19/2010
July 20/2010
July 21/2010
July 22/2010
July 23/2010
July 24/2010
July 25/2010
July 26/2010
July 27/2010
August 3/2010

During the first few days in May water temperatures dropped significantly due to below zero temperatures. Walleye appeared to be staging within or near the two tributaries of Whitefish Lake at this time. Water temperatures began to increase on May 6th. Increased movement along with optimal spawning temperatures indicated

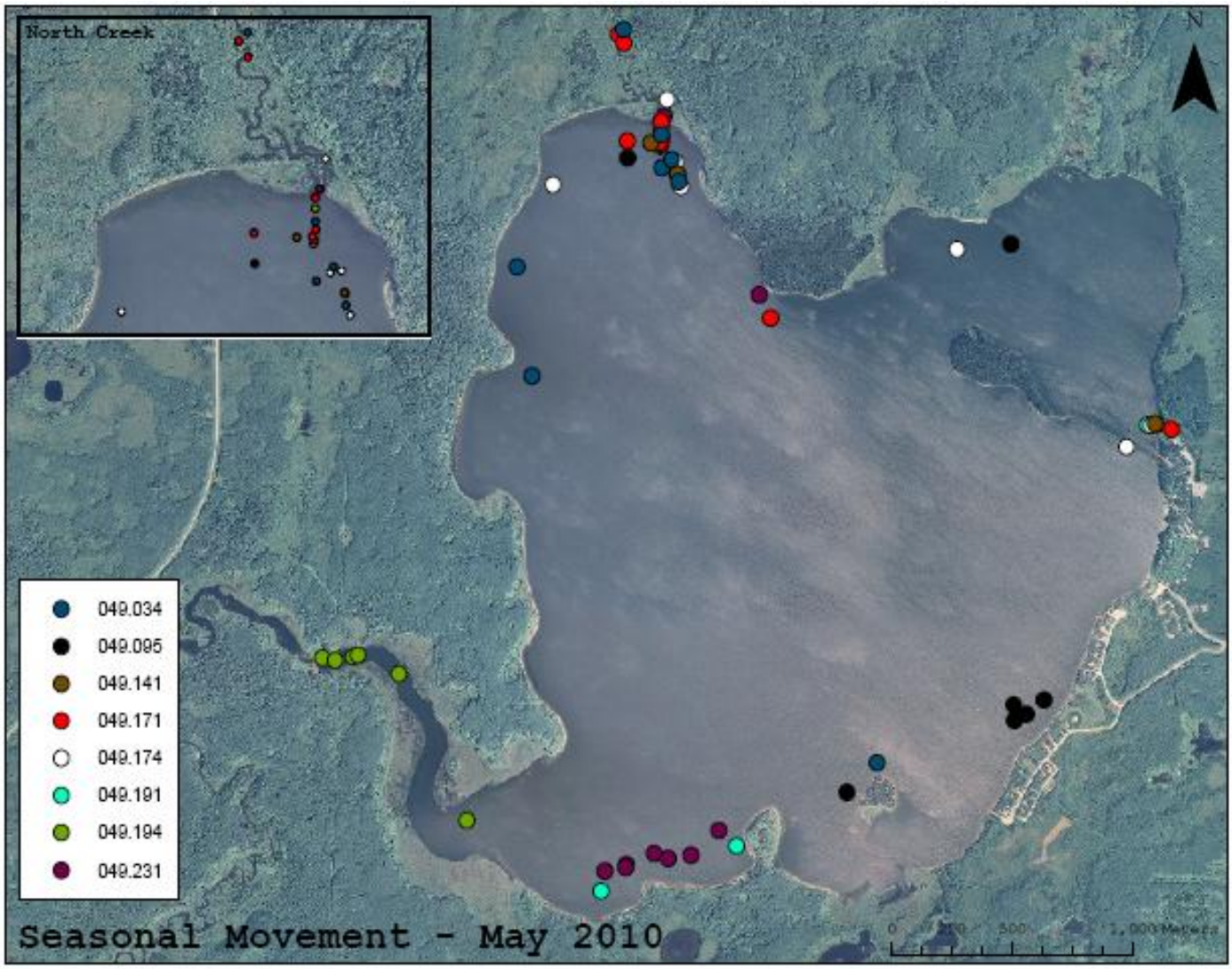
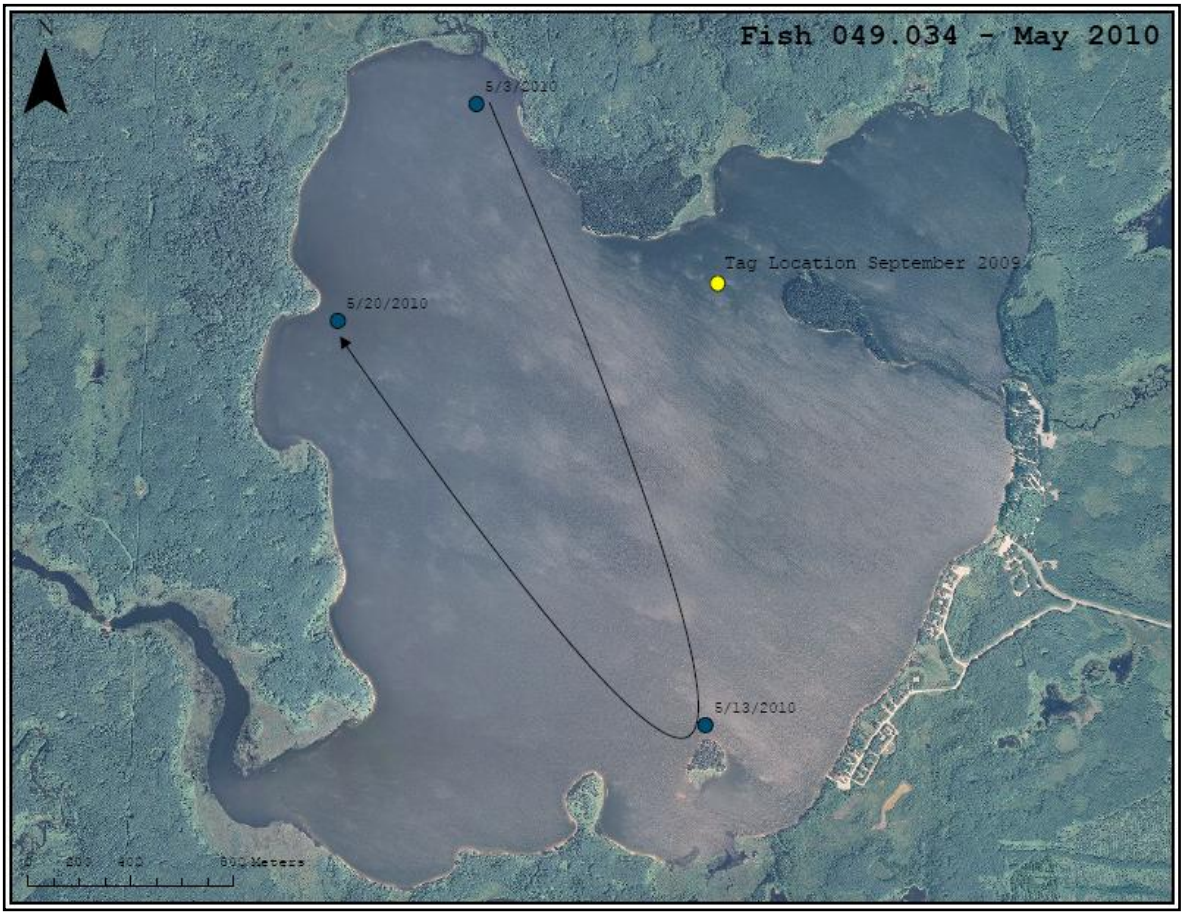
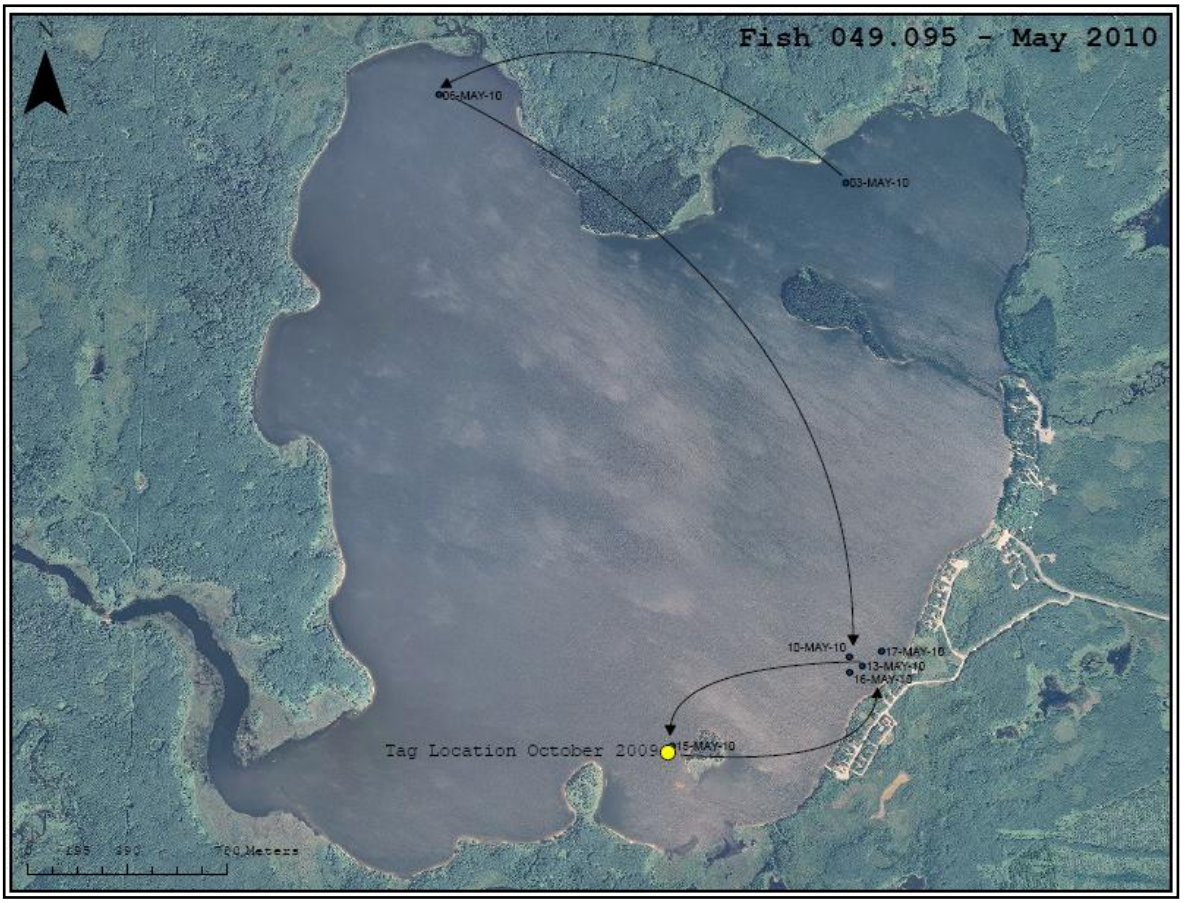


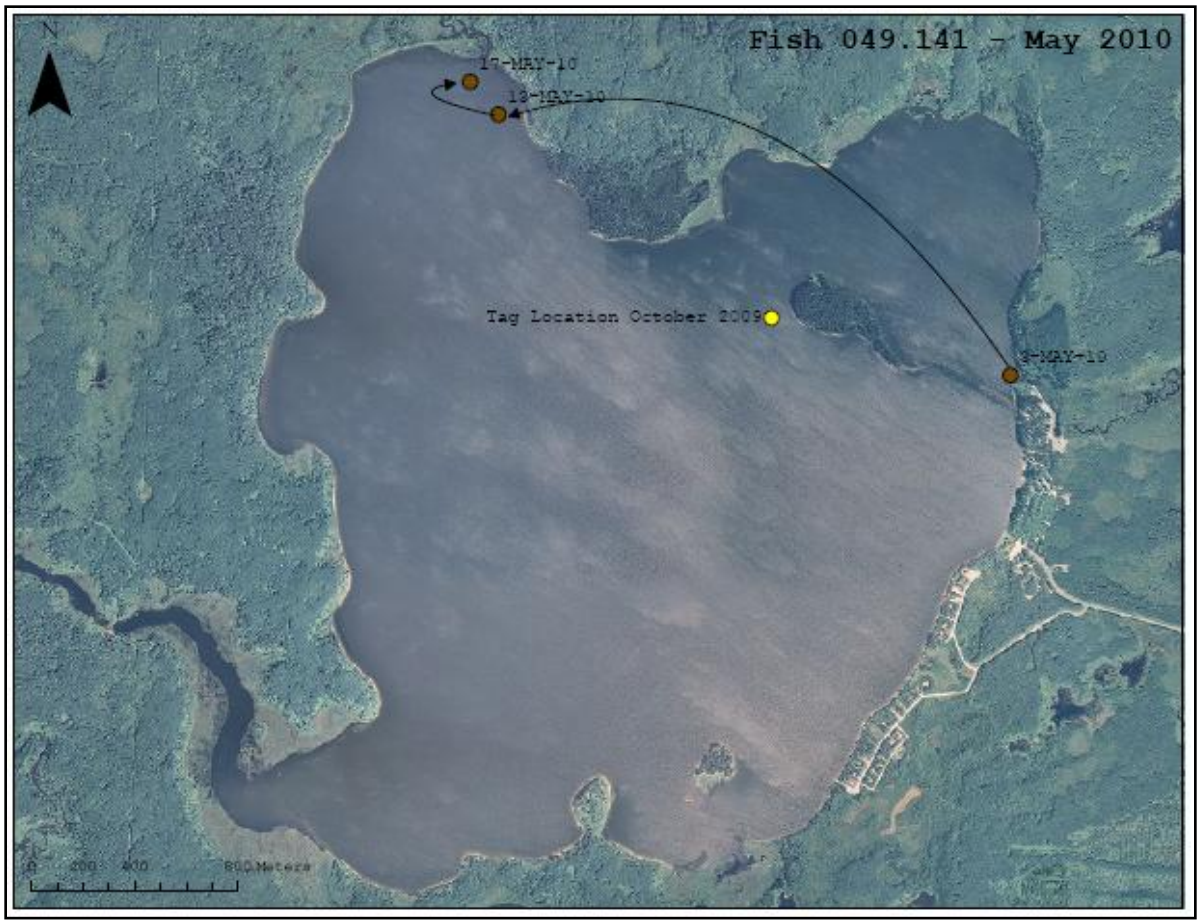
Figure 34: Whitefish Lake Seasonal Movement - May

the start of the spawn. Walleye move daily and seasonally in response to temperature or food availability (Unknown). On May 10th, water temperatures increased from 3 °C to 6.5 °C and technicians observed several walleye utilizing upper reaches of North Creek. All active walleye inhabited both creeks, or were in close proximity, during the month of May. Walleye are known to remain in loose but discrete schools with separate spawning grounds (Unknown). Three of these walleye specifically preferred North Creek only. The total time spent between each creek is uncertain because not every fish was located each day during tracking and on numerous occasions walleye would move between both locations within a short period of time.

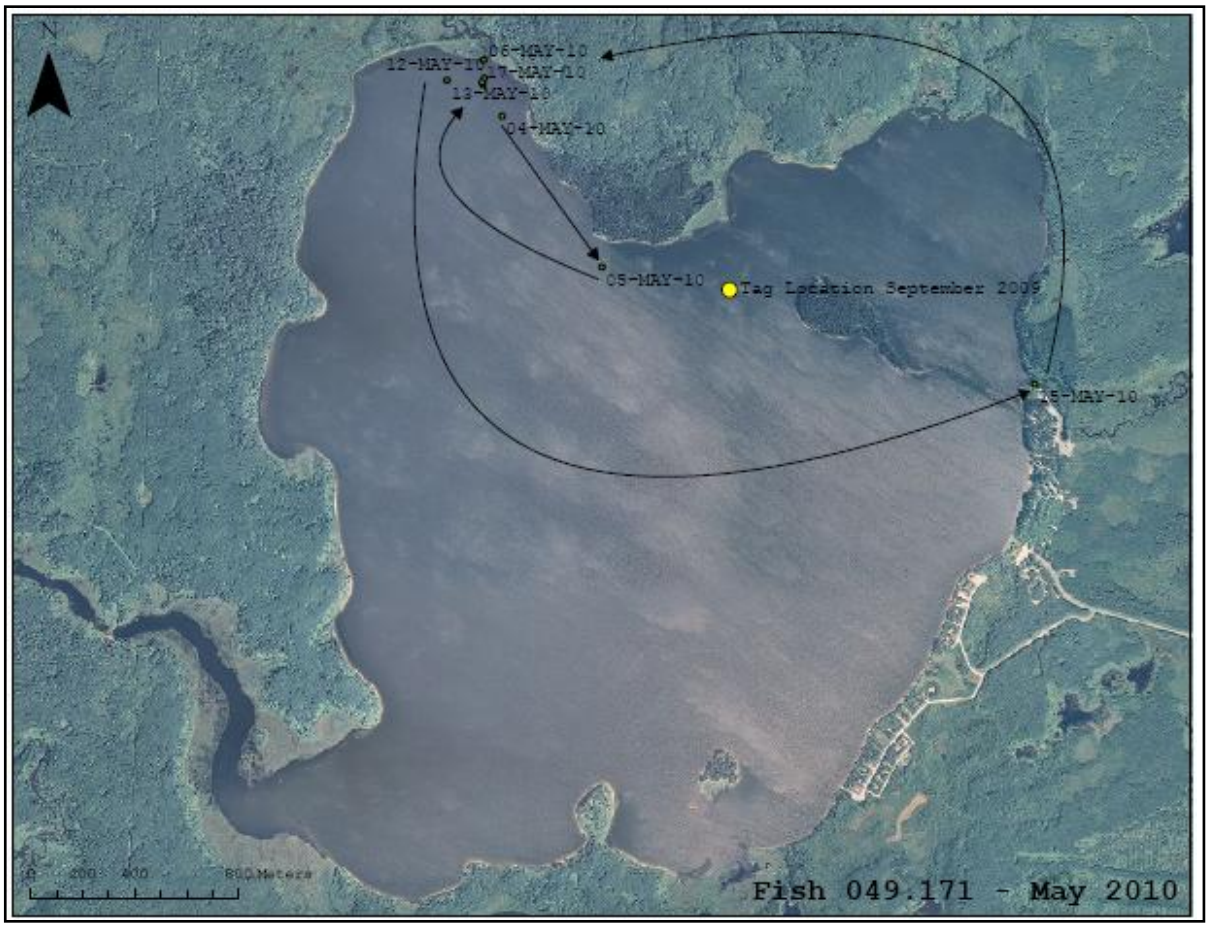
Individual fish locates and movements for May are as follows:

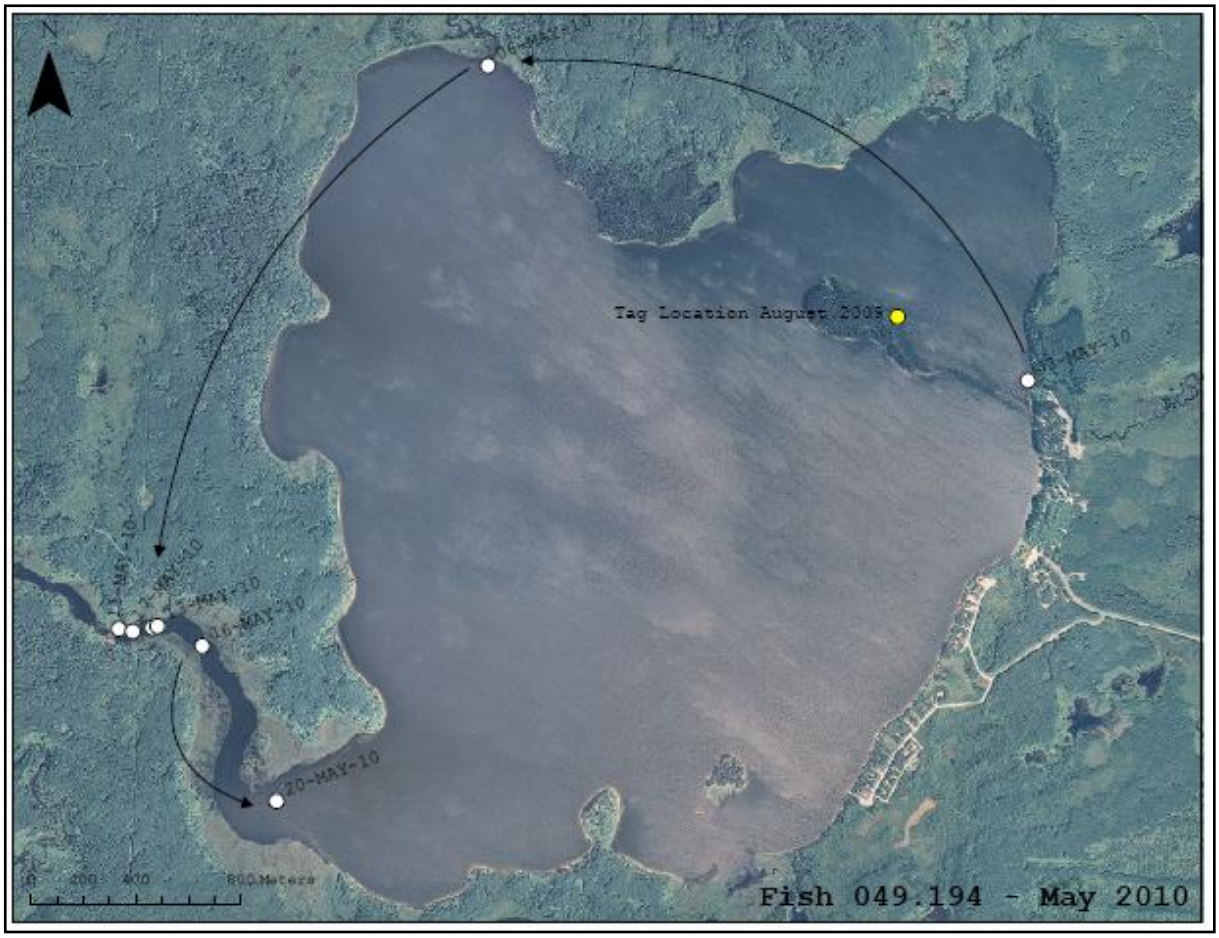




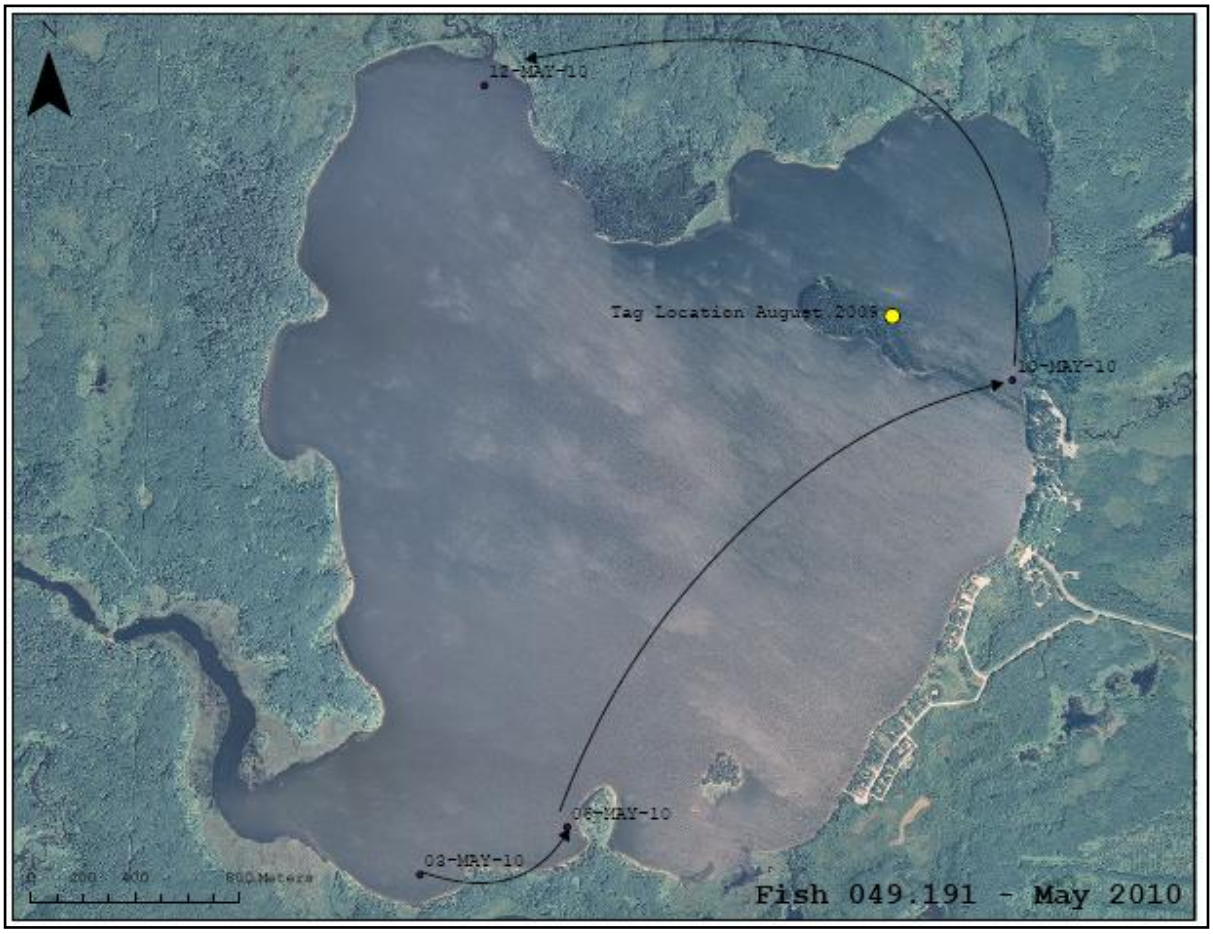

Fish 049.141 - May 2010
N
17-MAY-10
18-MAY-10
Tag Location October 2009
9-MAY-10
0 200 400 800 Meters


Fish 049.231 - May 2010
N
08-MAY-10
03-MAY-10
13-MAY-10
16-MAY-10
20-MAY-10
17-MAY-10
0 200 400 800 Meters


N
06-MAY-10
12-MAY-10
07-MAY-10
13-MAY-10
04-MAY-10
05-MAY-10
Tag Location September 2009
15-MAY-10
0 200 400 800 Meters
Fish 049.171 - May 2010


N
Tag Location August 2009
20-MAY-10
0 200 400 800 Meters
Fish 049.194 - May 2010


Fish 049.174 - May 2010
11-MAY-10
06-MAY-10
12-MAY-10
04-MAY-10
10-MAY-10
17-MAY-10
Tag Location September 2009
16-MAY-10
16-MAY-10
N
0 200 400 800 Meters


12-MAY-10
Tag Location August 2009
10-MAY-10
06-MAY-10
03-MAY-10
Fish 049.191 - May 2010
N
0 200 400 800 Meters

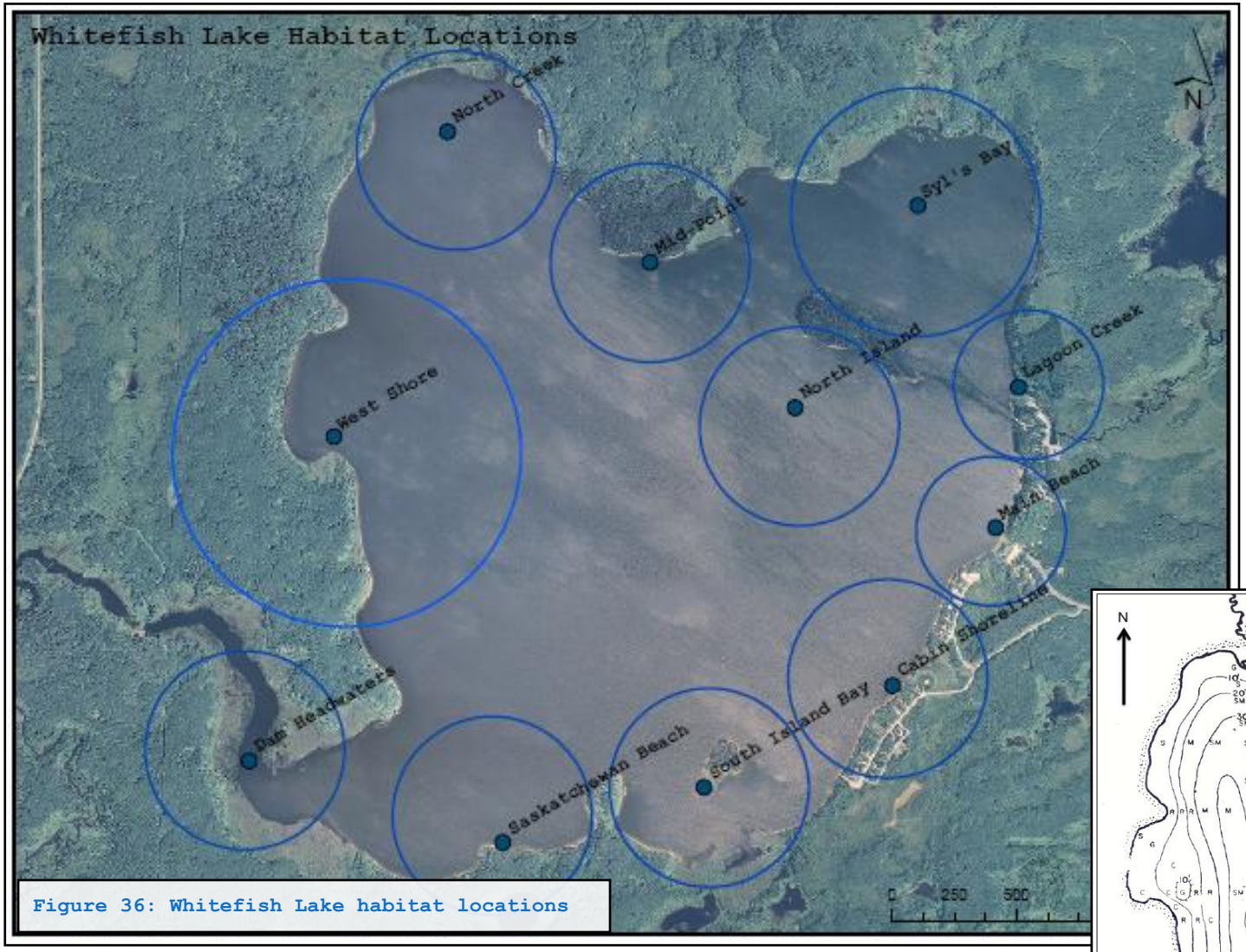


Figure 36: Whitefish Lake habitat locations

Telemetry has been used to determine the timing of fish movement among habitat types, and the routes taken (Hanson, 2006). During the spring, high concentrations of walleye illustrate the important spawning habitat in Whitefish Lake (Figure 34&35). Each of these areas utilized are considered excellent walleye habitat. This includes rock ledges, gravel beds and sands bars within tributaries and the lake. Walleye spawn over rock, rubble, gravel and similar substrate in rivers or windswept shallows in water 1 to 6 feet deep, where current clears away fine sediment and will cleanse and aerate eggs (Unknown, Walleye Biology and Identification, 2011).

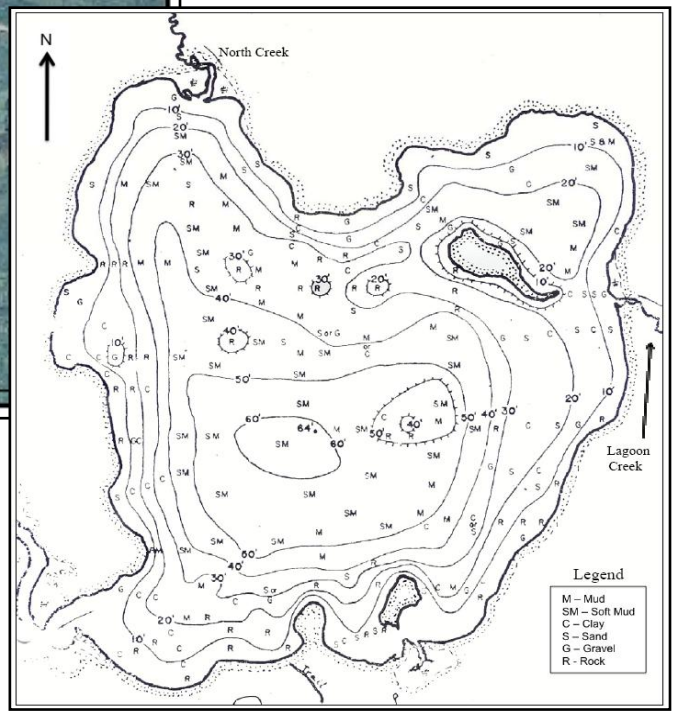
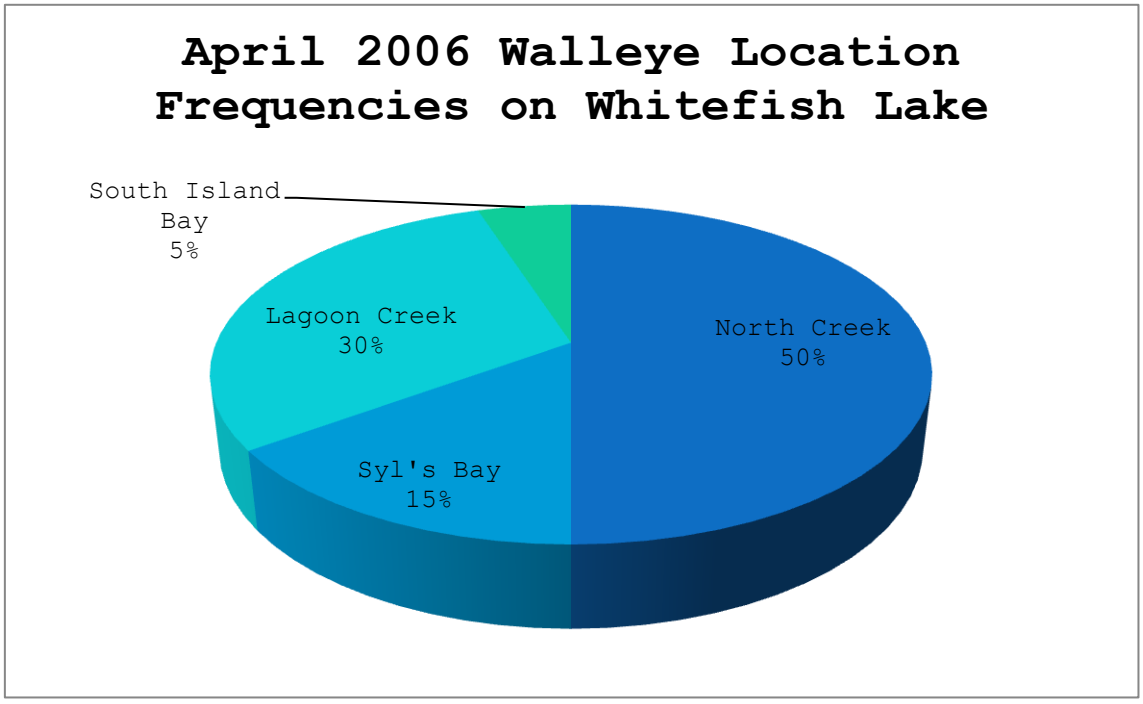
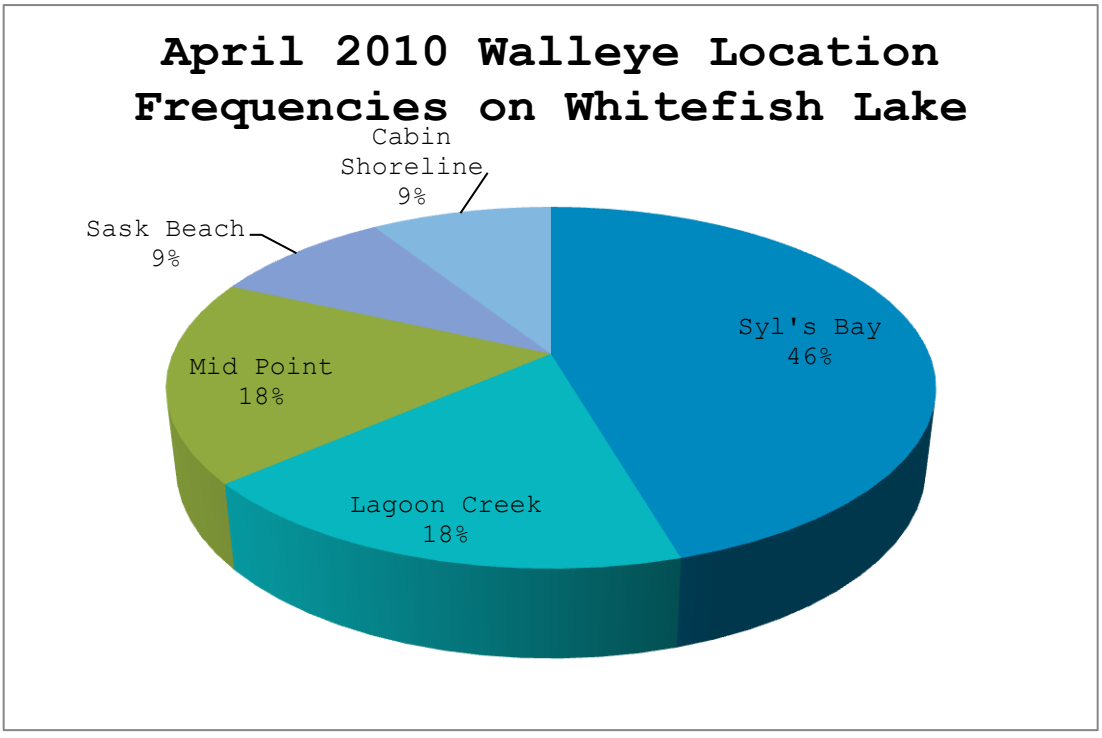


Figure 35: Whitefish Lake substrate

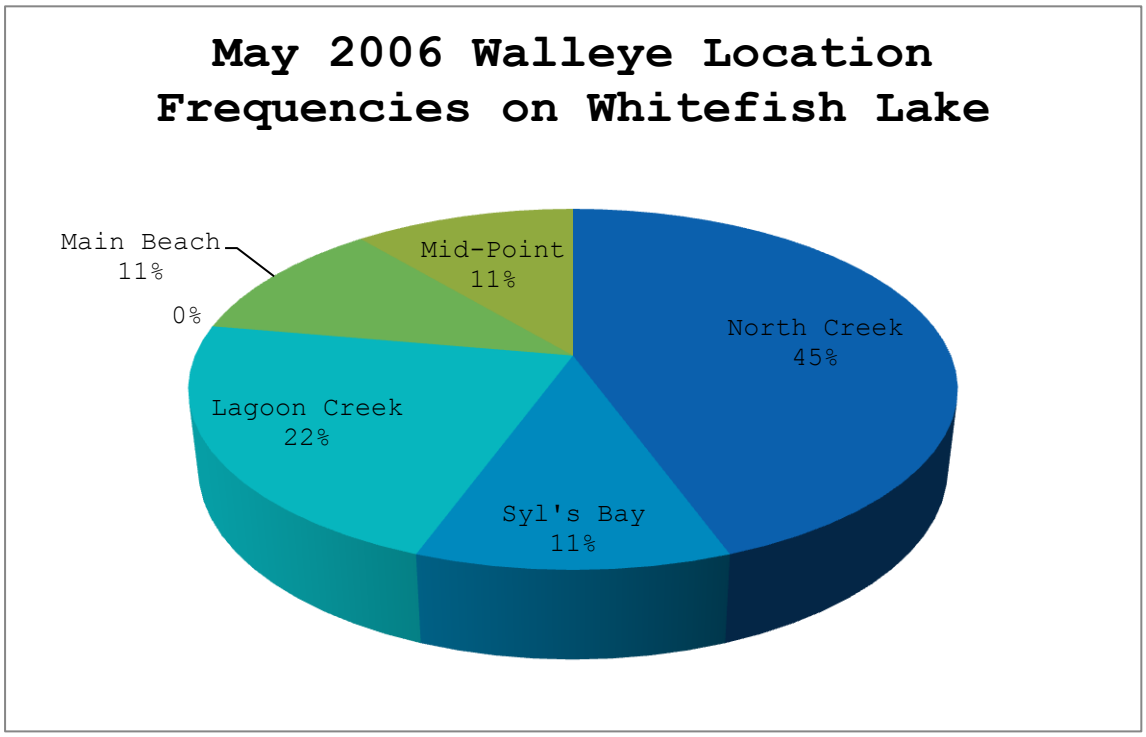
When comparing spawning behaviour between the 2006 and 2010 telemetry, habitat similarities are present. Both North and Lagoon Creek play a valuable role in the spawn. Both years display walleye utilizing not just one but both habitats.





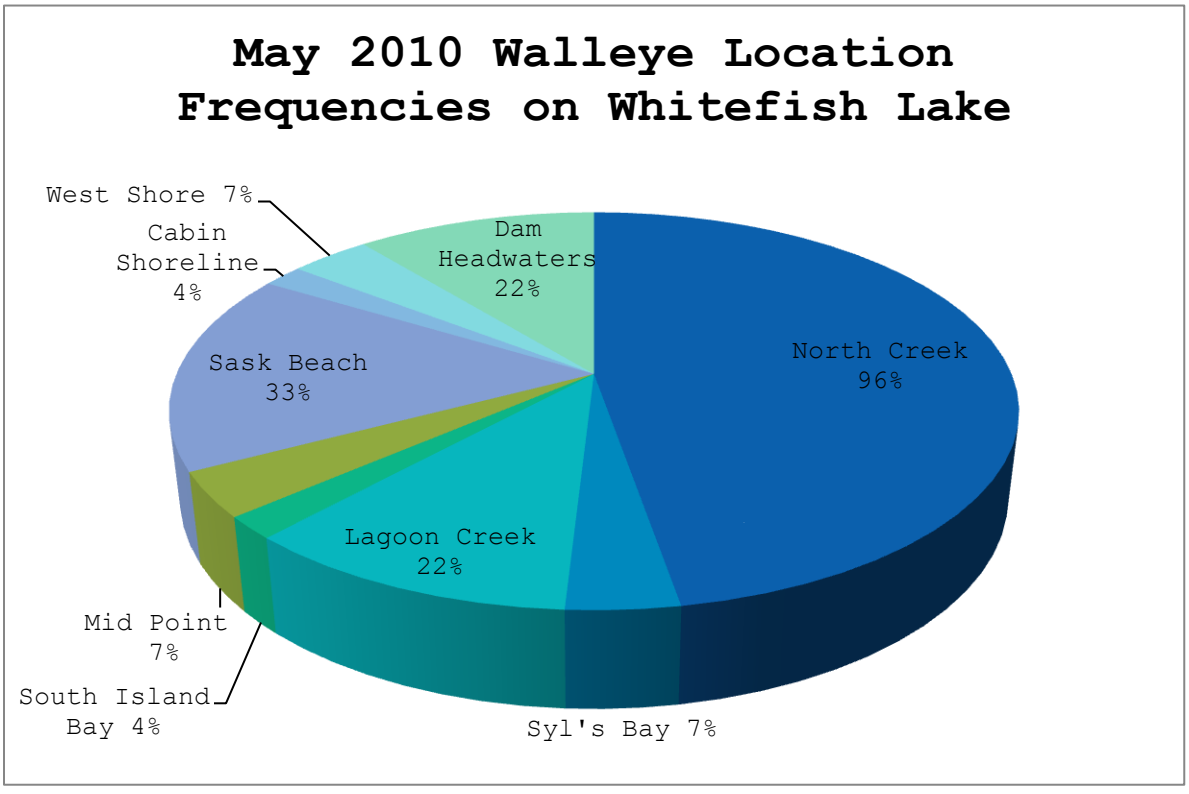
In April 2006, North Creek was the preferred habitat among 50% of tagged walleye compared to 0% in 2010. The first dates of spawning activity at a given location may vary up to four weeks on a year to year basis, depending on seasonal

variations in spring weather conditions (Morton, 2006). Weather during April 2006 & 2010 were very similar. In 2006, water temperatures were 9°C in Lagoon Creek and 6.5°C in the lake on April 27th and by May 2nd lake temperatures rose to 8.5°C. Whitefish Lake did not experience a significant drop in temperatures in 2006 as in 2010. This difference would indicate an earlier spawn and explain why North Creek was utilized earlier in 2006.



Walleye were tracked on May 1st and 2nd in 2006, while in 2010 walleye were followed from May 3rd to the 20th.

The diverse habitat frequencies in 2010 compared to 2006 demonstrates other spawning habitats within the lake itself and post spawn environments.



Walleye movement throughout the summer (June – September) demonstrated typical seasonal behaviour (Figure 37). Only one walleye out of the eight active walleye inhabited the southern portion of Whitefish Lake. Summer locations seemed to be centralized to the northern portion of the lake (See Appendix E for Individual Fish Movement).

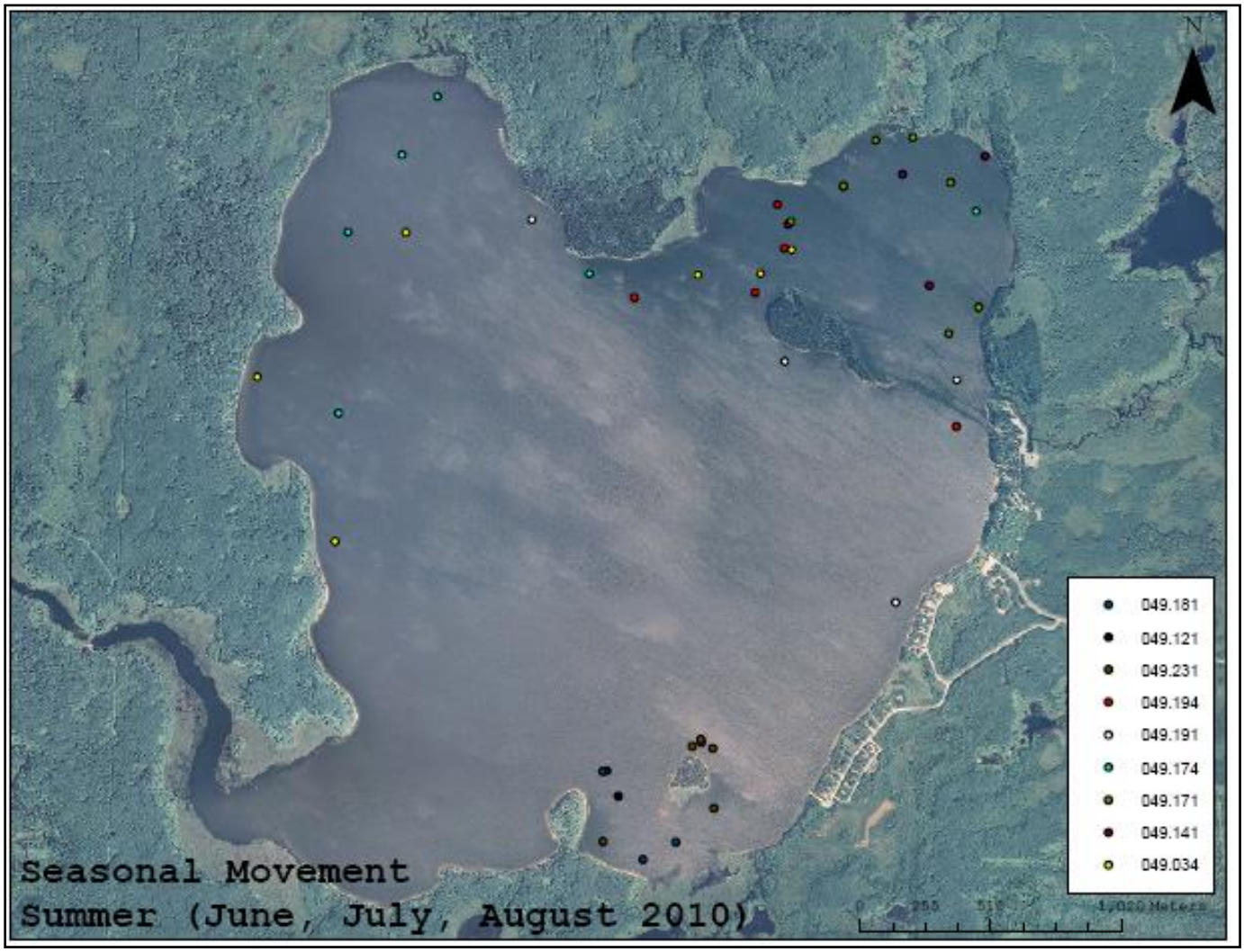


Figure 37: Whitefish Lake Seasonal Movement - Summer

These locations do not demonstrate all potential habitats which could be utilized during the summer. During the summer, walleye exhibit a variety of movement patterns from patrolling short sections parallel to the shoreline, moving inshore and then back offshore, and random roaming, during the sunset and night periods (Hanson, 2006). All tracking was carried out during day time hours; therefore peak activity was not documented. Day time walleye activity recorded does reveal walleye behaviour, as most walleye remained in deeper waters and locations were not concentrated but sporadic. This behaviour is a typical reaction to increasing water temperatures, foraging and weather conditions. 2006 walleye behaviour was similar with fish occupying diverse areas of the lake.

Discussion

The main objective of the telemetry study on Whitefish Lake is to better understand requirements, behaviour and movements of walleye in our area. Recommendations can be developed from the current and past telemetry findings, and be specific to the waterbody.

Whitefish Lake's fish community has evidently benefited from its two main tributaries. The lake has sustained an adequate fish population through natural reproduction for the past 31 years, only being stocked once with 300,000 walleye fry in 1980. Frequency of walleye utilizing these creeks for spawning habitat has been consistent or slightly increased over the years. SVSFE has taken a proactive approach in rehabilitating and restoring the creeks to their highest potential. This is necessary for the sustainability of Whitefish Lake. Whitefish Lake is a popular fishing destination with 91% of it's anglers residing locally. Fishing pressure has increased and the recent four month Creel Survey indicates the amount of walleye currently being harvested is near the lakes' maximum sustainable yield (Urban, 2010).

Due to the overlap of fishing seasons' opening weekend and the natural timing of the spawn, some actions should be implemented to ensure fish for future generations. Suggestions include:

- *Lagoon Creek rehabilitation* – Lagoon Creek is used by spawning walleye and enhancement of the lagoon would highly benefit the walleye as the lagoon has silted in over the years from beaver activity altering flows. Additional measures of enhancement (ie dredging & stabilization) is necessary to achieve the potential habitat within the creek.
- *Continue beaver control/management on both creeks as required*
- *Implement Catch & Release to Protect spawning walleye* –Lagoon Creek is frequently angled during the opening week of fishing because of its location (marina) and success. During the spawning period, both tributaries should be monitored for Catch & Release within designated areas. Similar practices in the past have been implemented at Whitefish Lake.

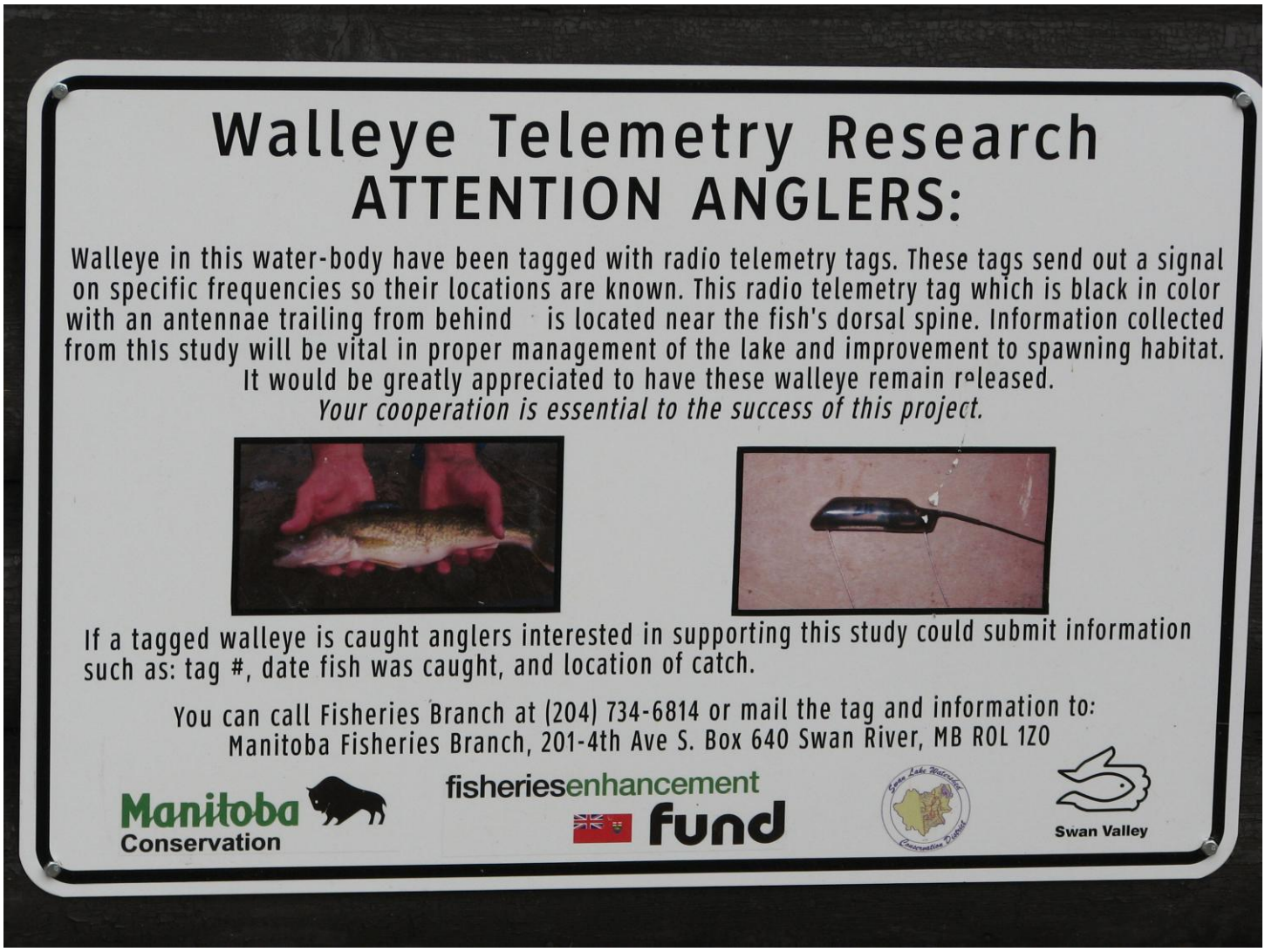
For the continued success of Whitefish Lake`s fishing opportunities, an active management approach is required. With the partnership and co-operative relationship between all individuals involved with Whitefish Lake, a sustainable fishery will be available for generations to come (Figure 38).

Figure 38: Steward of the Future at Whitefish Lake

6. Publications & Awareness

Signs

Two signs were posted at Whitefish Lake to inform anglers of the Telemetry Project, and how they could participate.



Look out for tagged fish

Submitted Story

Swan Valley Sport Fishing Enhancement (SVSFE) has initiated three main projects this season with the support of Fisheries Enhancement Fund (FEF). The group has become active in the past year with projects to assist with local fisheries management. The group is looking for co-operation from the anglers to help make these projects a success. The following are active projects which SVSFE would like everyone to be aware of:

Swan River and Whitefish Lake Walleye: The main objective for both water bodies is to monitor the seasonal movements of walleye using radio telemetry tags. The focus of the monitoring will be on spring spawning and habitat requirements. Data collected will be used for future fisheries management on both systems. Habitat improvements, migration and movement patterns and seasonal habitat requirements information will be a consideration in future management of the species with the data gathered.

Whitefish Lake Fisheries and Creel Survey: The first objective of this project will be to utilize a standard live release trap netting program designed to evaluate abundance and other attributes of fish species that inhabit the littoral zone of lakes. Fish will be tagged with a small external plastic tag with individual numbering to assist in assessing fish health in the future. The second objective is to conduct a Creel survey. Creel surveys are a common tool fishery managers use to obtain the total pressure or "effort" that anglers exert on a fishery, angler catch rates, and fish harvest rates.

Stocked Trout Waters Assessment: The main objective of this project is to provide an unbiased index of stocked trout abundance, as well as to provide biological information on the target species. The secondary objective of this assessment will be to assist fisheries managers with a better understanding of these water bodies to assist in future trout stocking rates. Lakes being assessed include Glad Lake, Gull Lake, Black Beaver Lake, Beaver Lake, Vini Lake, Shilliday Lake, Olsen Lake and Two Mile Lake.

Voluntary Angler Diaries: The objective of this project is to involve anglers in the collection of data on catch and harvest rates. In addition, biological data (length and weight) will be collected from anglers to help managers evaluate the fishery. This type of program also involves anglers in fisheries monitoring which encourages them to be better stewards of the resources. Angler diaries are available anywhere you buy angling licenses.

What we need from the public is cooperation. Please submit any information regarding tagged fish captures, respect equipment and net sets in the various locations, and partake in the creel and angler surveys. SVSFE and Water Stewardship-Fisheries Branch staff will be working closely together on projects and look forward to improving angling opportunities for the future. Please contact 734-6814 with any information you may have or if you have any questions. Thanks for your cooperation.

– Swan Valley Sportfishing Enhancement

Creel Survey & Tracking Presentations

SVSFE presented to children during Swimming Week at Whitefish Lake on how technicians sample and tag walleye, and how and why we track our telemetry tagged walleye. Presentation was followed by a fun fish relay.

7. Acknowledgements

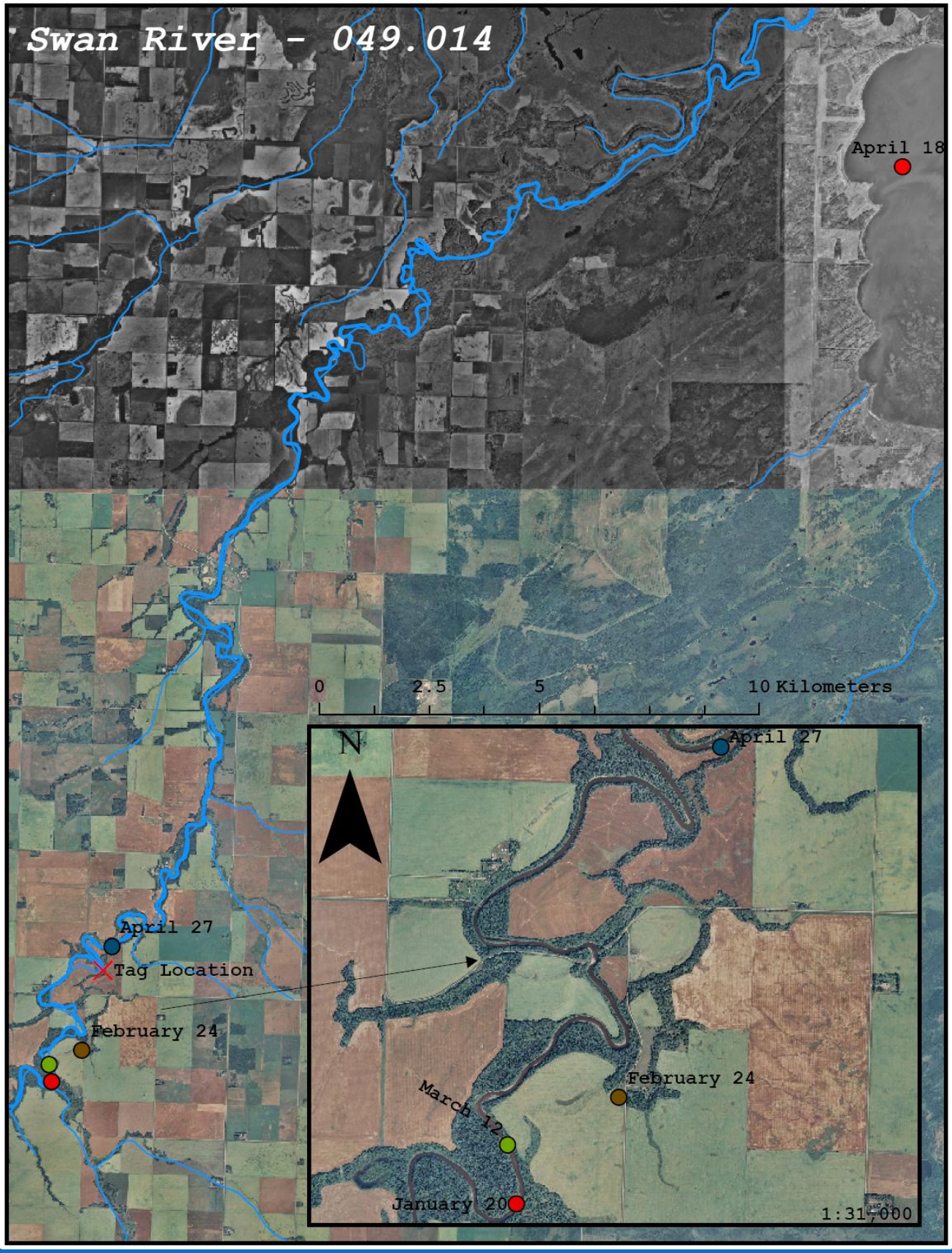
Swan Valley Sport Fishing Enhancement Inc. would like to thank everyone who participated in the Walleye Telemetry Project at Whitefish Lake and the Swan River. We appreciate the strong interest and cooperation from the public with our past and present studies. We also welcome the consistent reports of tagged fish from anglers for all information is valuable for our studies. Local Whitefish Lake anglers are always enthusiastic about participating in SVSFE projects, and we would like to thank them for offering support and advice as to where the hot spots were.

SVSFE would like to acknowledge Ian Kitch; Water Stewardship – Fisheries Branch for his professional advice, in-kind support and assistance in all our projects. We would also like to thank Conservation for their time to help tag and track walleye; Clint Church, Terry Kulhavy, Dave Chetyrbuk, and Gerald Shelemy. SVSFE would also like specially thank one of our sport fish members; Lawrence Taylor for angling four walleye that were tagged for the study. We would like to express our gratitude to Swan Lake Watershed Conservation District for the in-kind support of time and the use of the software ArcMap 9.3 used for mapping all walleye locates. Thank – you to Mark Lowden – AAE Tech Services for providing us with excellent data to continue the work on Whitefish Lake. SVSFE would like to recognize Andy Maxwell and Dauphin Air Services for providing safe and excellent aerial services to SVSFE for the tracking and locating of the tagged walleye.

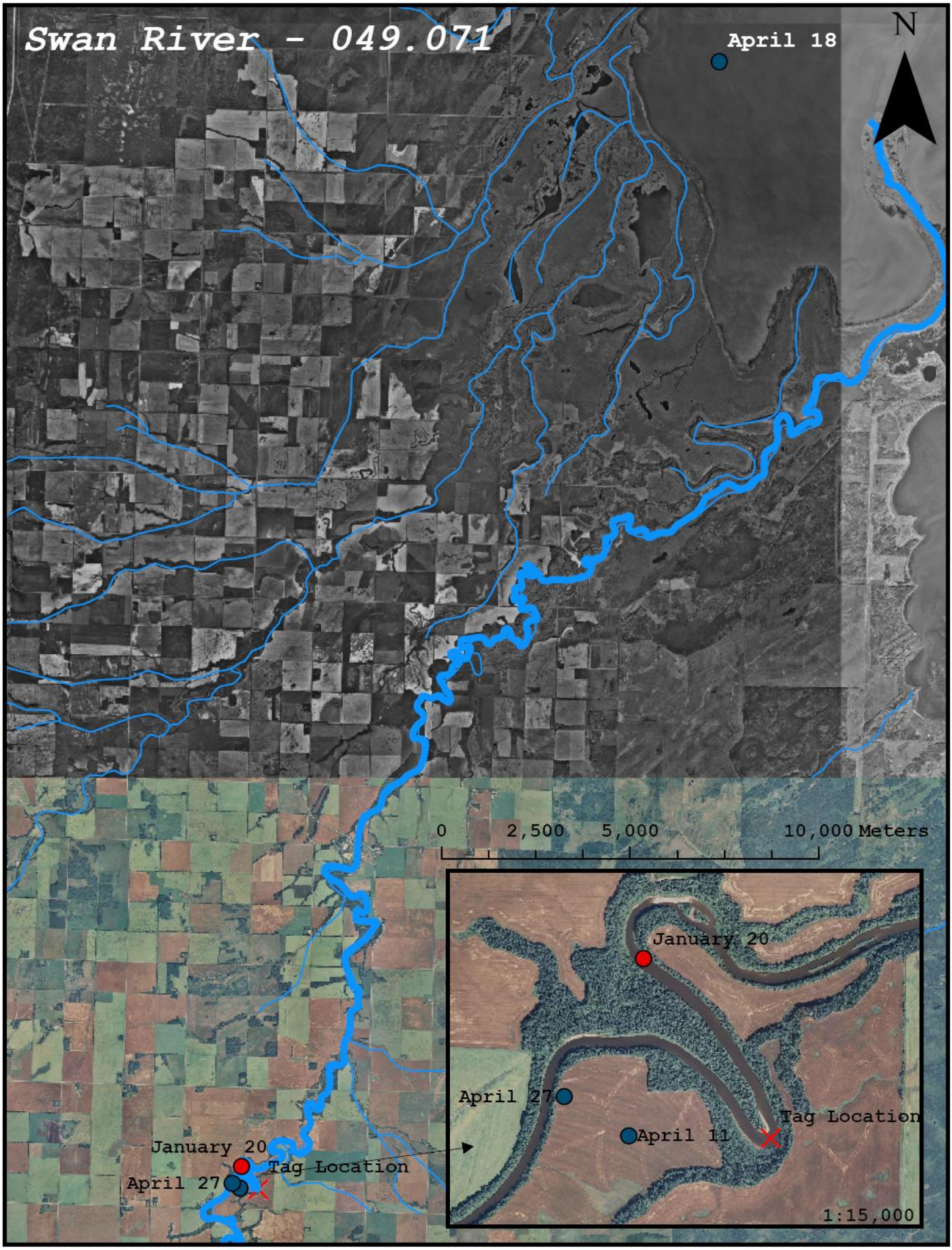
We would like to acknowledge the importance and benefits the Fisheries Enhancement Fund (FEF) brings to our recreational fishery. The stamp should be a reminder that a portion of the license fee helps fund projects, like the Whitefish Lake Fisheries & Creel Survey, that ensure adequate fish stock for future generations.

8. Appendices

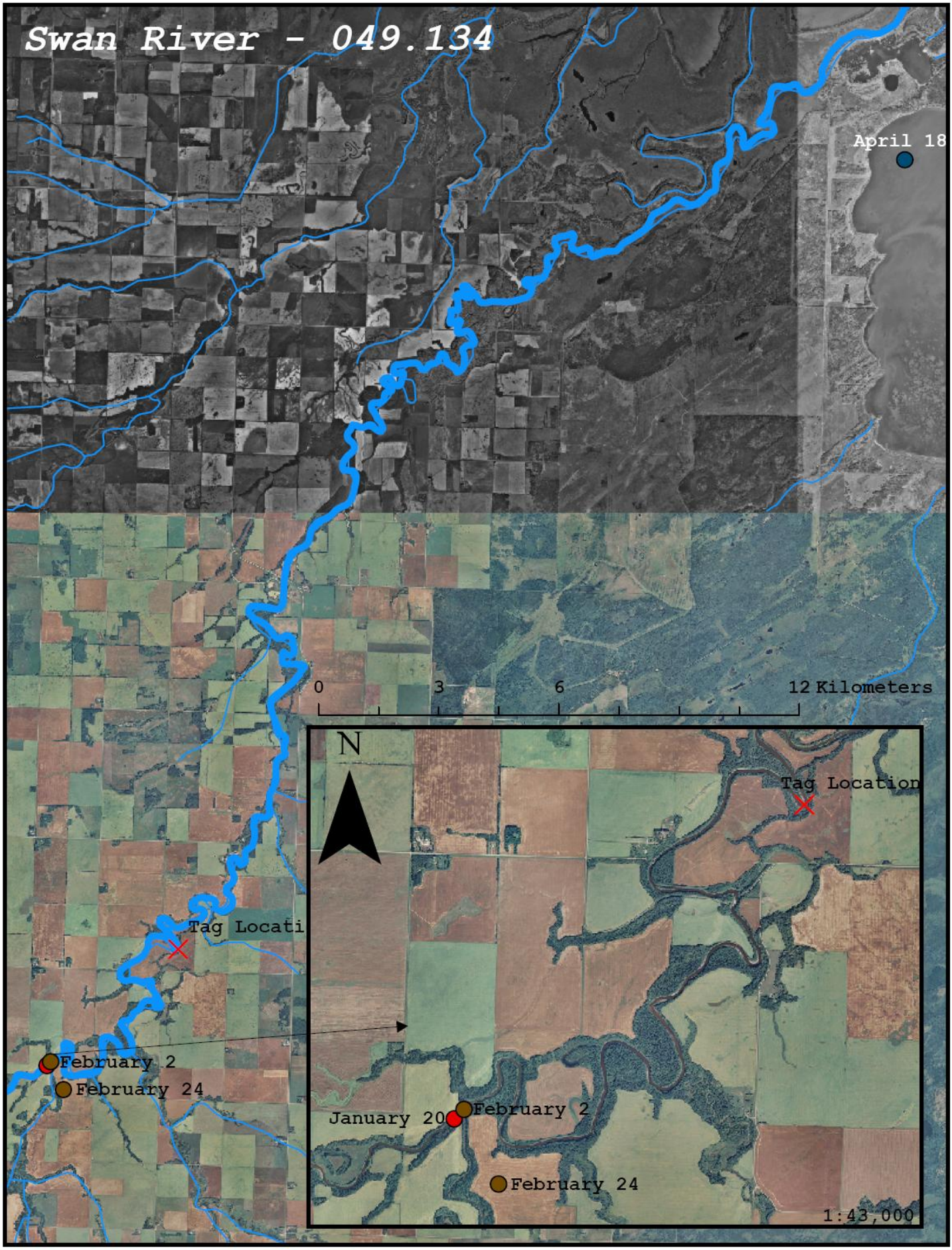
A - Individual Fish Movement of Swan River Walleye 2009 – 2010

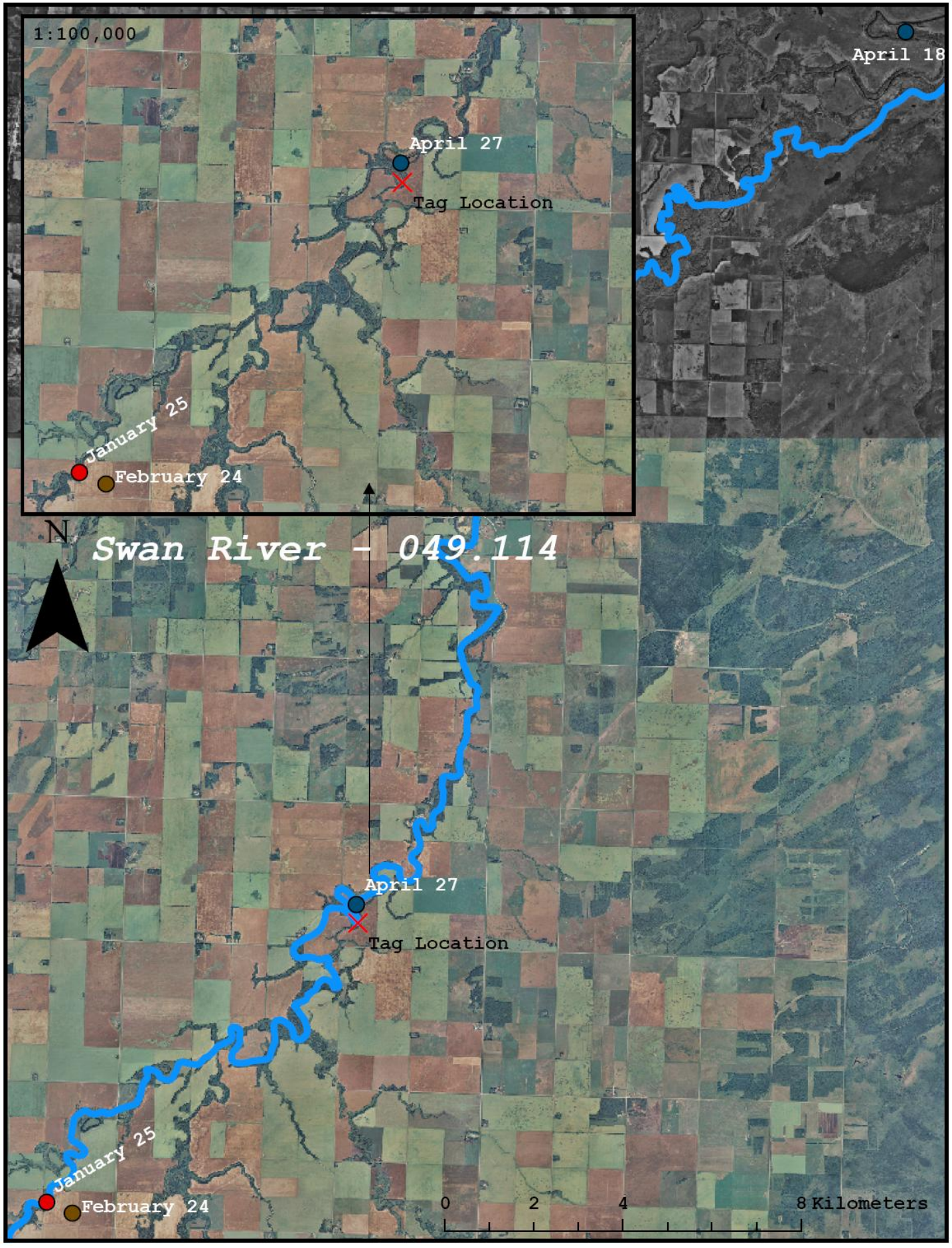


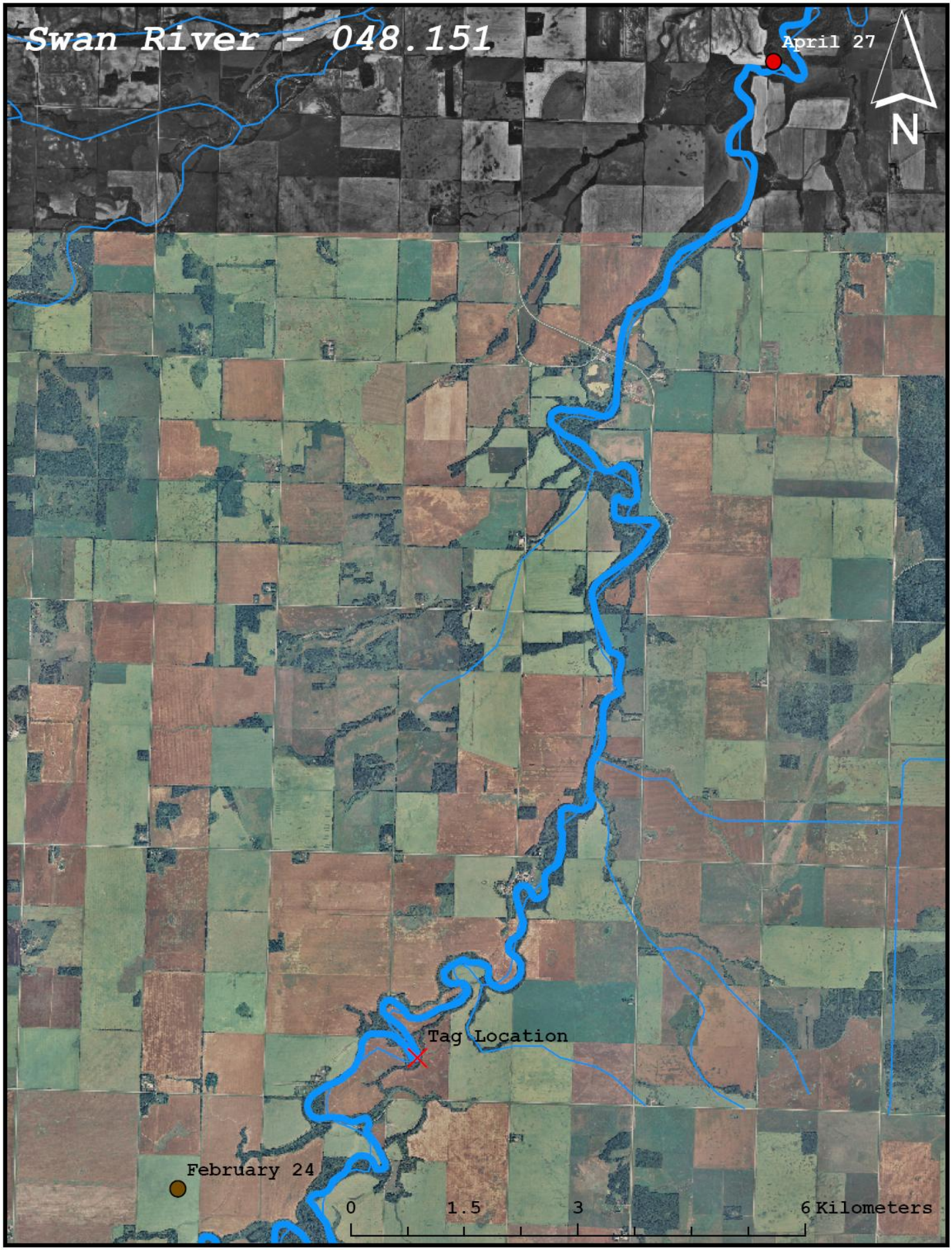

N
Swan River - 049.050
Tag Location
April 18
January 20
March 12
February 24
0
0.5
1
2 Kilometers


Swan River - 049.071
April 18
N
0
2,500
5,000
10,000 Meters
January 20
Tag Location
April 27
January 20
April 27
April 11
Tag Location
1:15,000

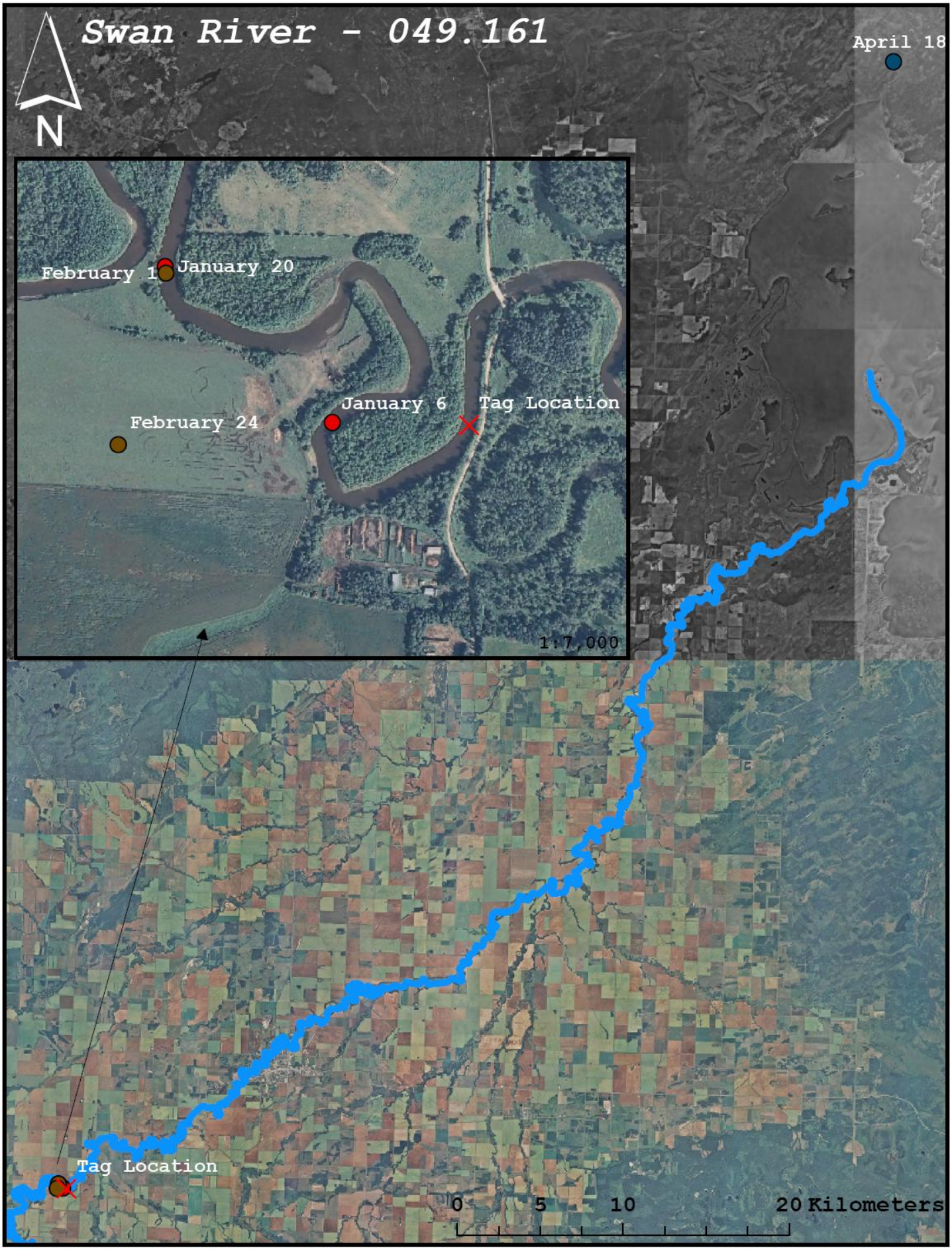

Swan River - 049.104
N
April 18
Tag Location
0
3
6
12 Kilometers
March 19
Tag Location
February 1
January 20
January 6
1:2,000

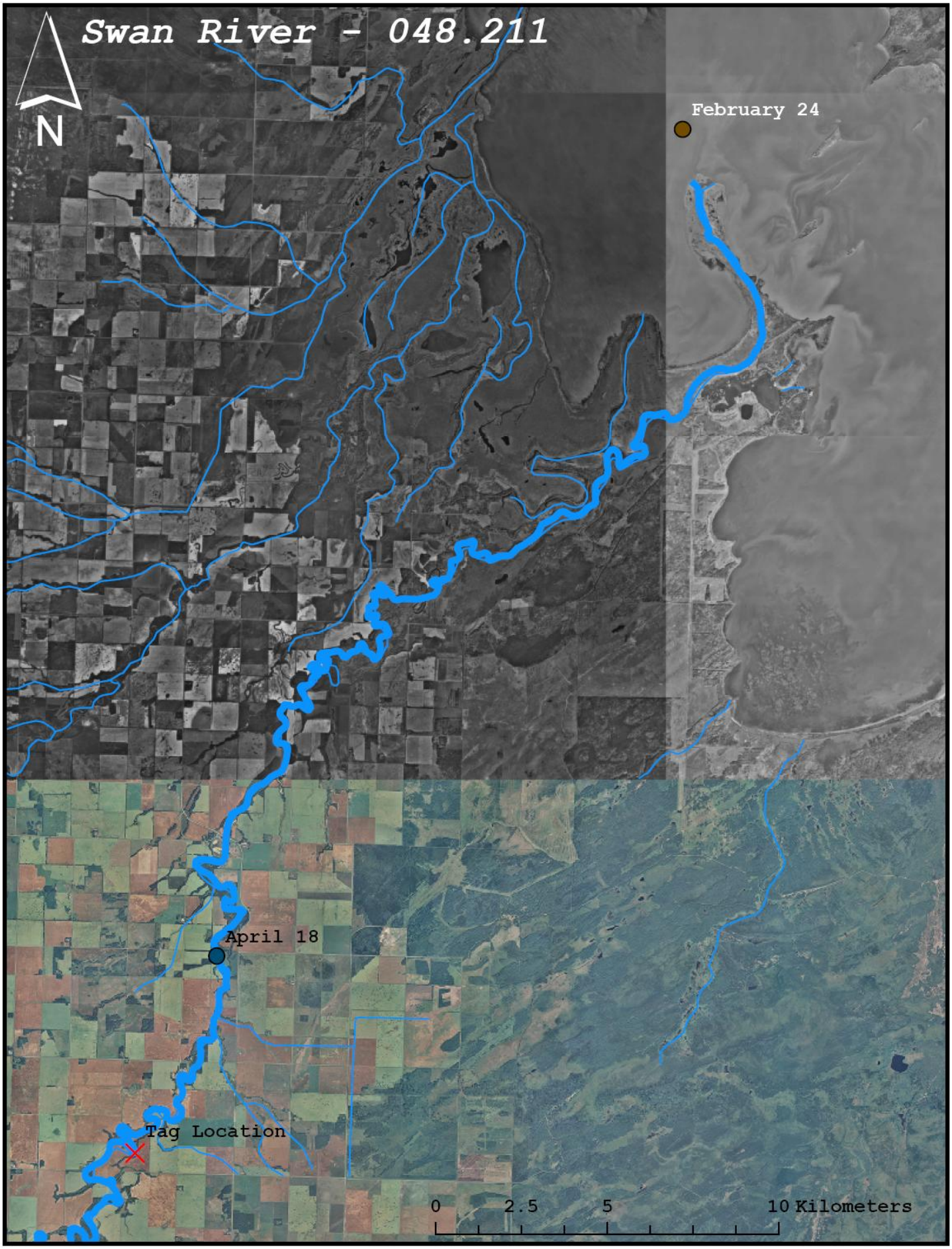

Swan River - 049.134
April 18
0
3
6
12 Kilometers
N
Tag Location
Tag Locati
February 2
February 24
January 20
February 2
February 24
1:43,000

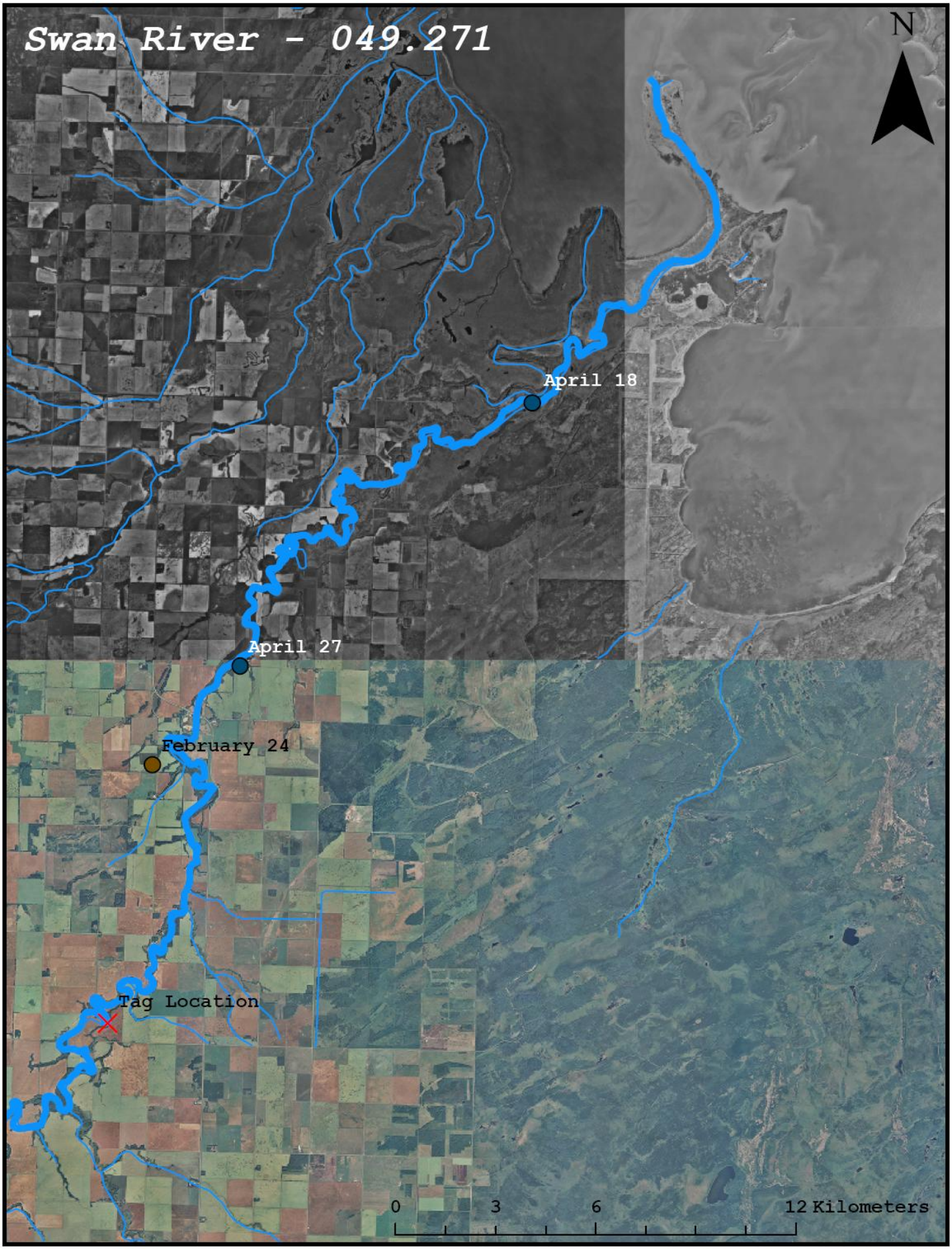

1:100,000
April 27
Tag Location
January 25
February 24
April 18
N
Swan River - 049.114
April 27
Tag Location
January 25
February 24
0
2
4
8 Kilometers

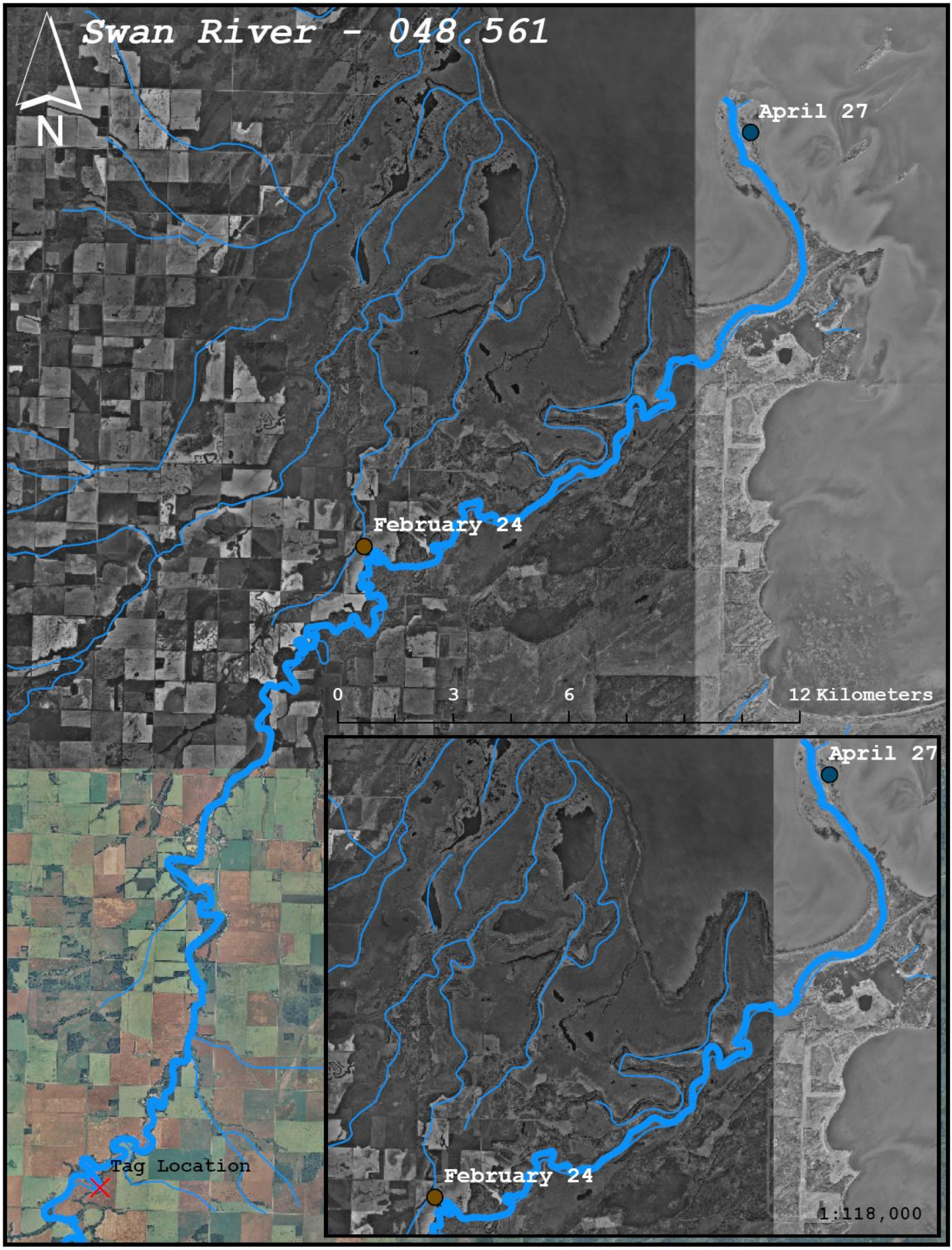

Swan River - 048.151
April 27
N
Tag Location
February 24
0
1.5
3
6 Kilometers

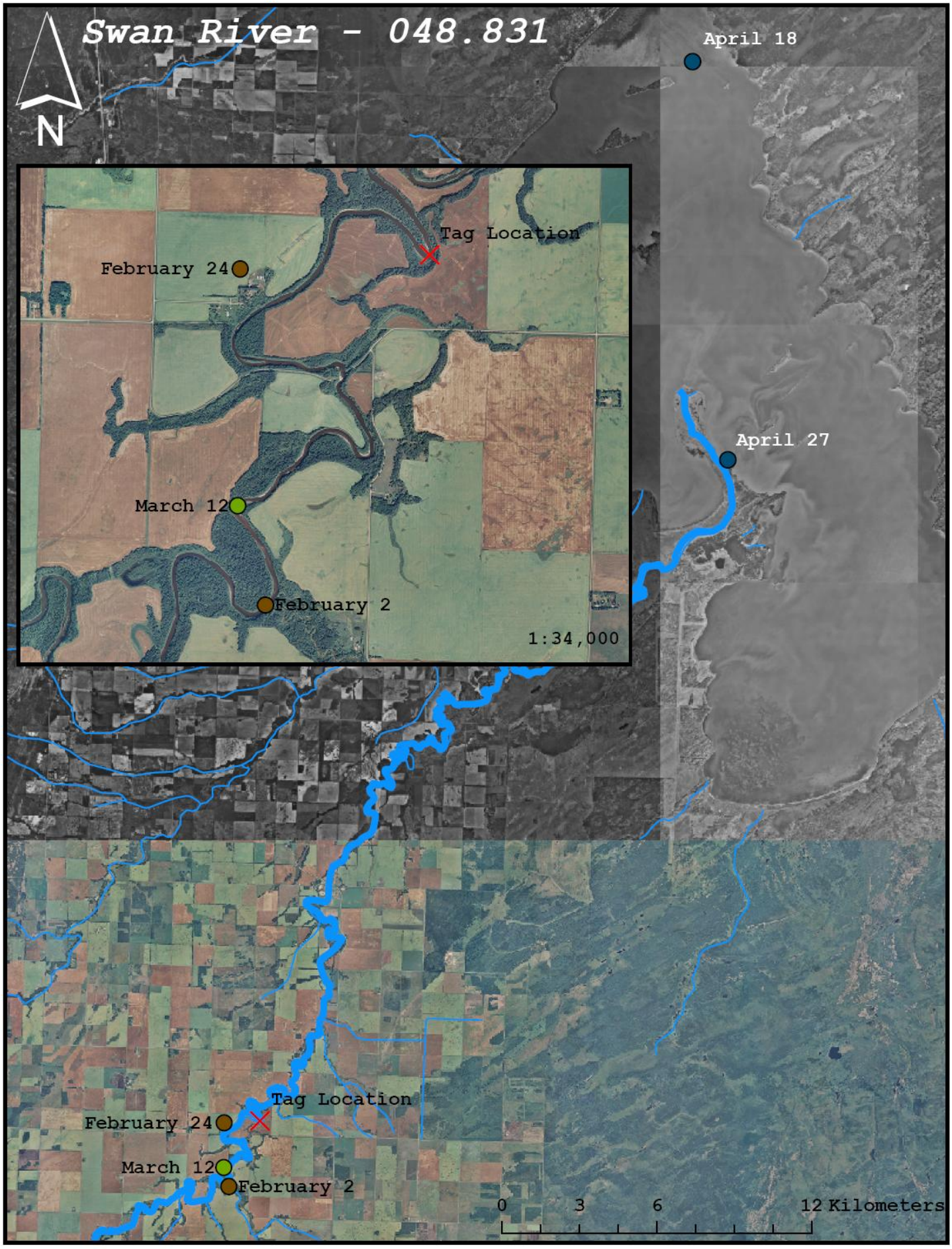

Swan River - 049.153
N
Tag Location
January 6
March 19
February 1
January 20
February 24
0
250
500
1,000 Meters


Swan River - 049.161
N
April 18
February 1
January 20
February 24
January 6
Tag Location
1:7,000
Tag Location
0
5
10
20 Kilometers


Swan River - 048.211
N
February 24
April 18
Tag Location
0
2.5
5
10 Kilometers


Swan River - 049.271
N
April 18
April 27
February 24
Tag Location
0
3
6
12 Kilometers


Swan River - 048.561
N
April 27
February 24
0
3
6
12 Kilometers
April 27
Tag Location
February 24
1:118,000


Swan River - 048.831
N
April 18
Tag Location
February 24
April 27
March 12
February 2
1:34,000
Tag Location
February 24
March 12
February 2
0
3
6
12 Kilometers

B - Swan River Discharges for 1995 and 2010

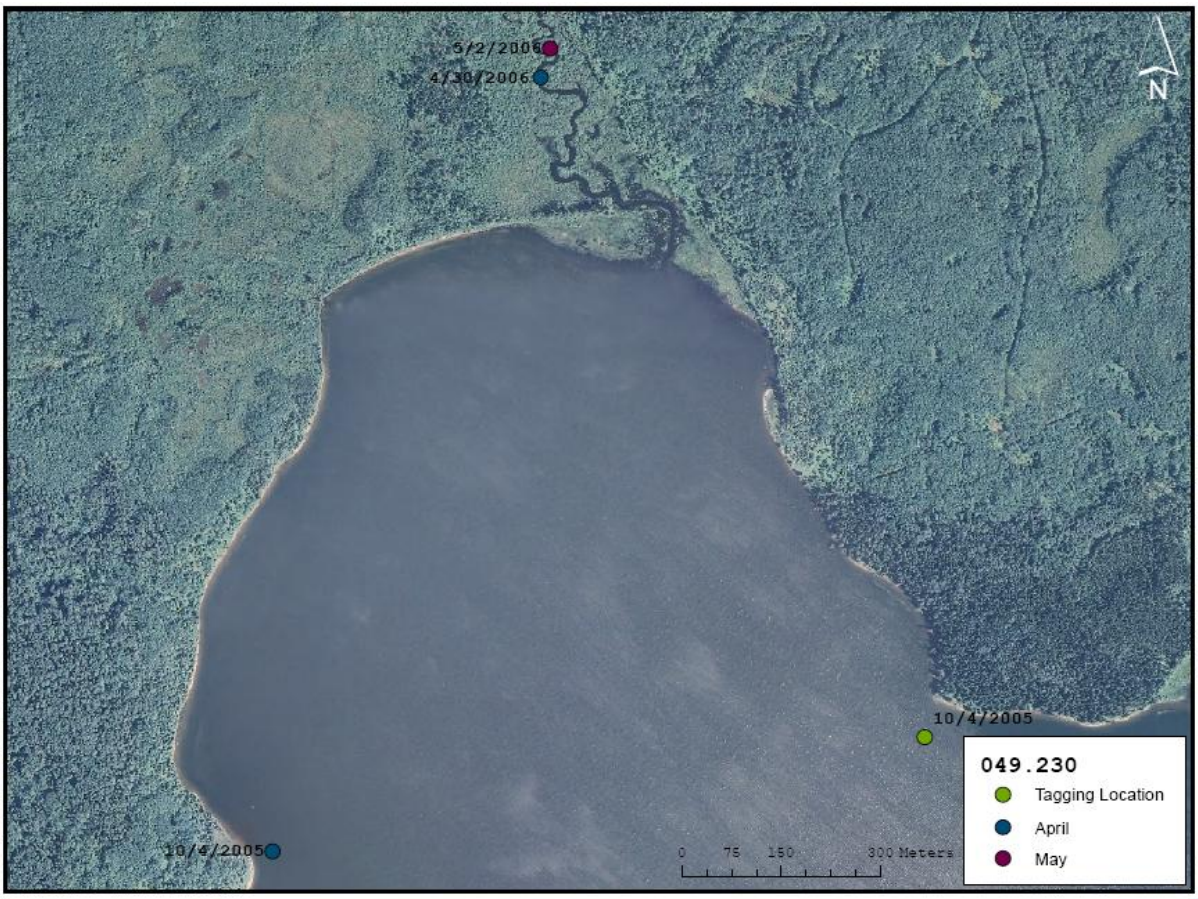
1995 Daily Discharge (m^3/s)

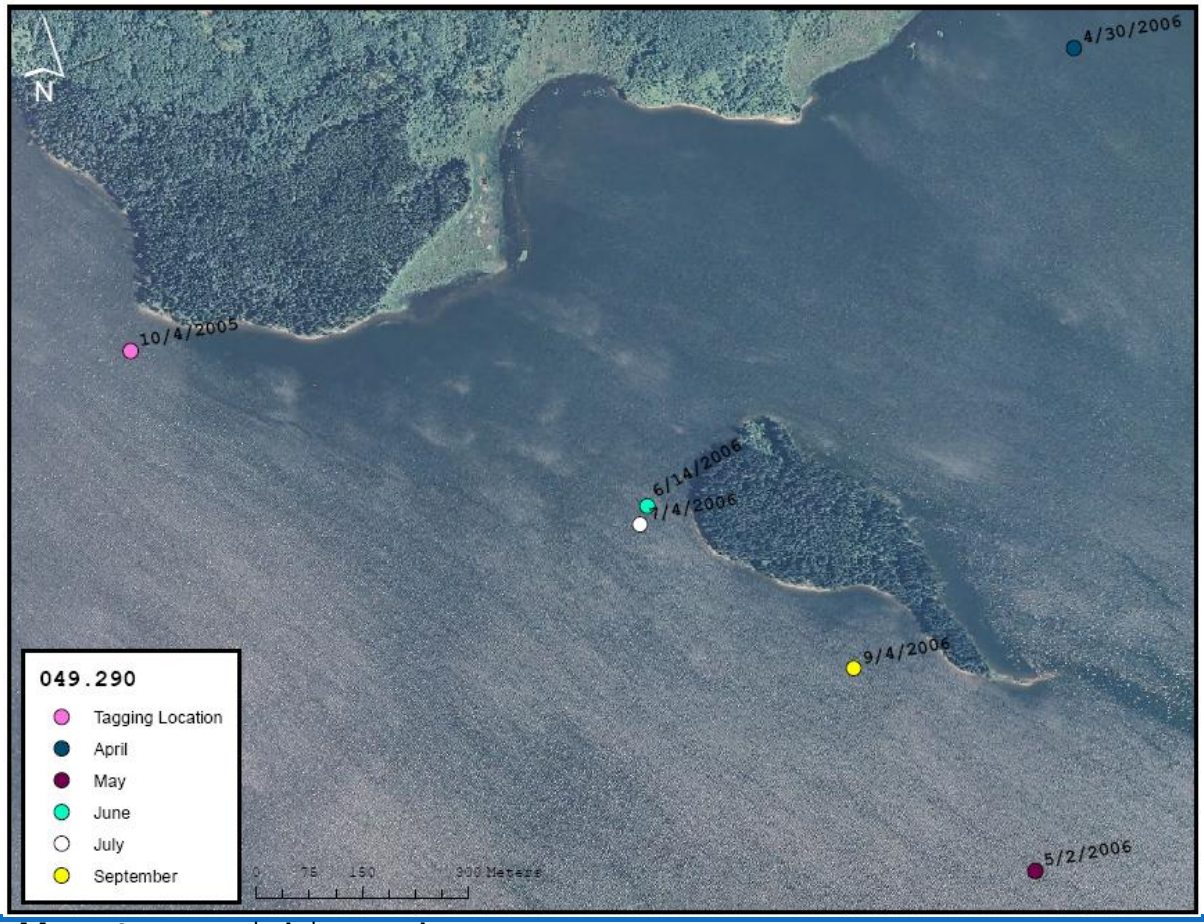
1995	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	1.30 B	0.790 B	0.705 B	1.50 B	132	15.0	18.5	3.96	23.2	2.85	6.10 B	1.88 B
2	1.28 B	0.780 B	0.707 B	1.60 B	134	14.2	22.5	3.35	23.2	2.84	5.20 B	1.82 B
3	1.25 B	0.770 B	0.709 B	1.70 B	133	13.2	22.2	2.96	22.5	3.79	4.60 B	1.80 B
4	1.23 B	0.760 B	0.710 B	1.80 B	125	12.0	21.4	2.92	21.0	3.63	4.20 B	1.75 B
5	1.21 B	0.760 B	0.711 B	1.90 B	116	11.0	19.5	2.72	18.9	3.08	3.85 B	1.70 B
6	1.20 B	0.750 B	0.712 B	2.10 B	108	10.2	17.5	2.34	16.8	2.92	3.65 B	1.68 B
7	1.18 B	0.730 B	0.715 B	2.22 B	102	9.38	15.6	1.92	15.3	2.79	3.40 B	1.65 B
8	1.17 B	0.720 B	0.730 B	2.42 B	99.6	9.36	14.2	2.31 A	14.2	2.74	3.25 B	1.62 B
9	1.15 B	0.710 B	0.740 B	2.92 B	99.9	9.26	13.0	2.22	13.0	2.69	3.10 B	1.60 B
10	1.14 B	0.705 B	0.750 B	4.60 B	98.6	10.7	11.8	1.97	11.8	2.67	3.05 B	1.58 B
11	1.12 B	0.705 B	0.760 B	6.20 B	94.7	11.9	11.5	1.79	10.9	2.63	2.95 B	1.52 B
12	1.11 B	0.705 B	0.780 B	9.00 B	90.7	11.4	10.6	1.70	9.90	3.14	2.85 B	1.48 B
13	1.08 B	0.700 B	0.800 B	14.0 B	85.9	10.0	9.43	1.78	9.06	3.62	2.80 B	1.46 B
14	1.06 B	0.700 B	0.805 B	20.0 B	81.8	8.96	8.08	3.57	8.28	3.64	2.72 B	1.44 B
15	1.02 B	0.700 B	0.807 B	26.0 B	76.6	8.88	7.15	4.09	7.46	4.28	2.65 B	1.42 B
16	1.00 B	0.700 B	0.810 B	37.5 B	71.9	7.50	6.36	5.16	6.68	4.89	2.60 B	1.40 B
17	0.999 B	0.700 B	0.840 B	45.0 B	65.9	8.38	5.50	15.6	5.97	5.35	2.53 B	1.39 B
18	0.970 B	0.700 B	0.860 B	64.0 B	58.9	12.2	4.59	33.0	5.35	5.52	2.45 B	1.37 B
19	0.960 B	0.700 B	0.870 B	93.0 B	49.6	26.8	4.29	51.0	4.90	5.86	2.42 B	1.35 B
20	0.950 B	0.700 B	0.900 B	136	41.8	33.9	4.43	60.2	4.54	5.67	2.37 B	1.35 B
21	0.920 B	0.700 B	0.915 B	158	37.3	34.5	4.66	62.3	4.12	5.64	2.32 B	1.34 B
22	0.910 B	0.700 B	0.939 B	174	33.9	31.5	4.22	63.9	3.75	5.67	2.28 B	1.31 B
23	0.900 B	0.700 B	1.00 B	219 E	30.7	27.5	3.50	65.5	3.49	6.16	2.22 B	1.30 B
24	0.880 B	0.700 B	1.05 B	241 E	28.0	23.4	3.56	65.6	3.37	6.42	2.18 B	1.29 B
25	0.850 B	0.700 B	1.07 B	237 E	26.0	19.0	3.45	62.7	3.31	6.52	2.15 B	1.28 B
26	0.830 B	0.702 B	1.10 B	224	23.9	15.8	3.65	56.0	3.26	6.53	2.10 B	1.27 B
27	0.820 B	0.703 B	1.20 B	196	23.3	12.9	5.74	45.0	3.21	6.48	2.07 B	1.26 B
28	0.810 B	0.704 B	1.25 B	167	21.4	11.1	5.23	34.1	3.11	6.55	2.03 B	1.25 B
29	0.805 B		1.30 B	147	19.0	10.2	4.32	28.2	2.96	6.59	2.00 B	1.24 B
30	0.800 B		1.35 B	134	17.5	10.6	5.81	25.5	2.86	6.52	1.90 B	1.23 B
31	0.800 B		1.40 B		16.3		4.69	24.3		6.54		1.22 B
Mean	1.02	0.718	0.903	79.0	69.1	15.0	9.58	23.8	9.55	4.65	2.93	1.46
Max	1.30	0.790	1.40	241	134	34.5	22.5	65.6	23.2	6.59	6.10	1.88
Min	0.800	0.700	0.705	1.50	16.3	7.50	3.45	1.70	2.86	2.63	1.90	1.22
Total	31.704	20.094	27.995	2370.46	2143.2	450.72	296.96	737.66	286.38	144.22	87.99	45.25

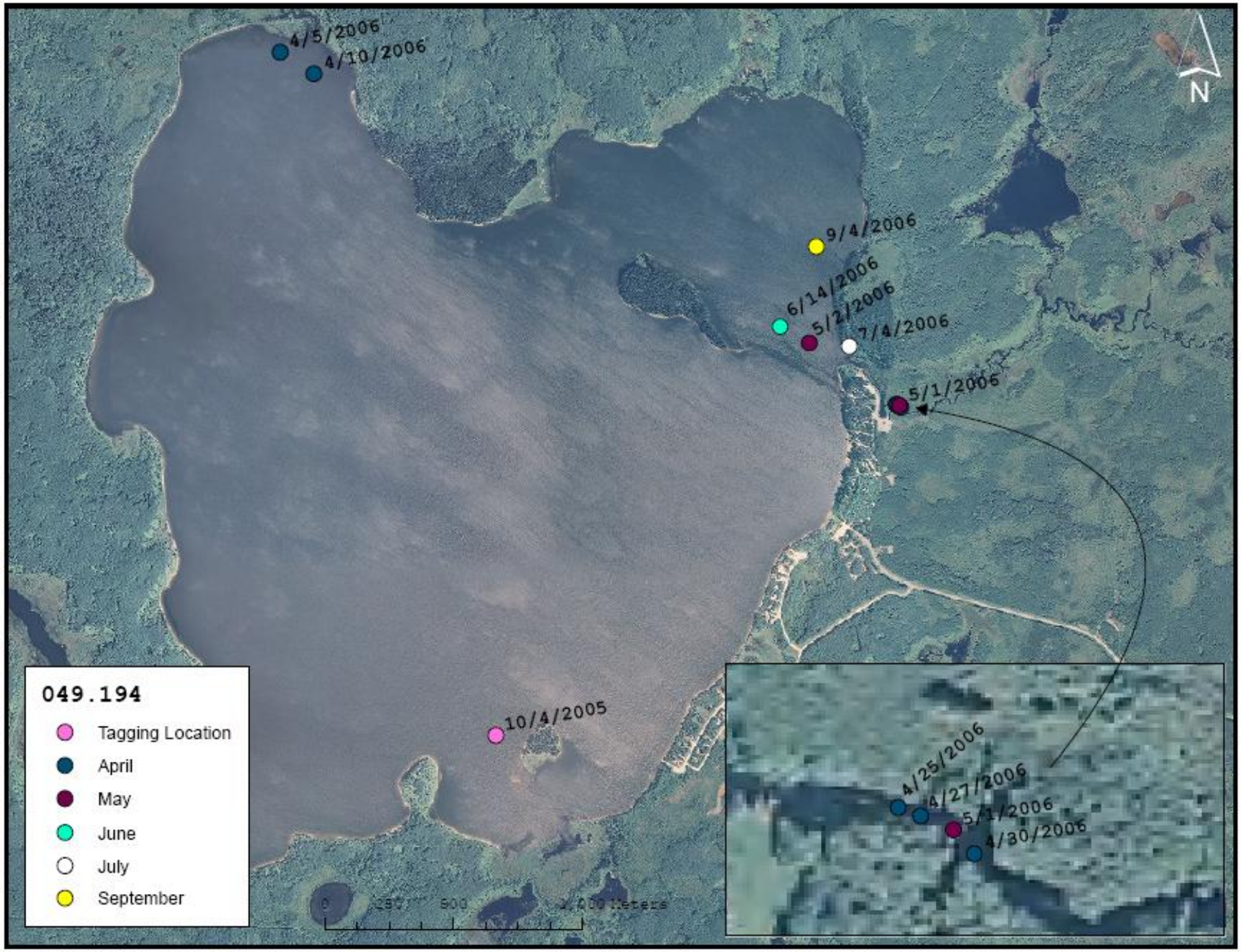
2010 Daily Discharge (m^3/s)

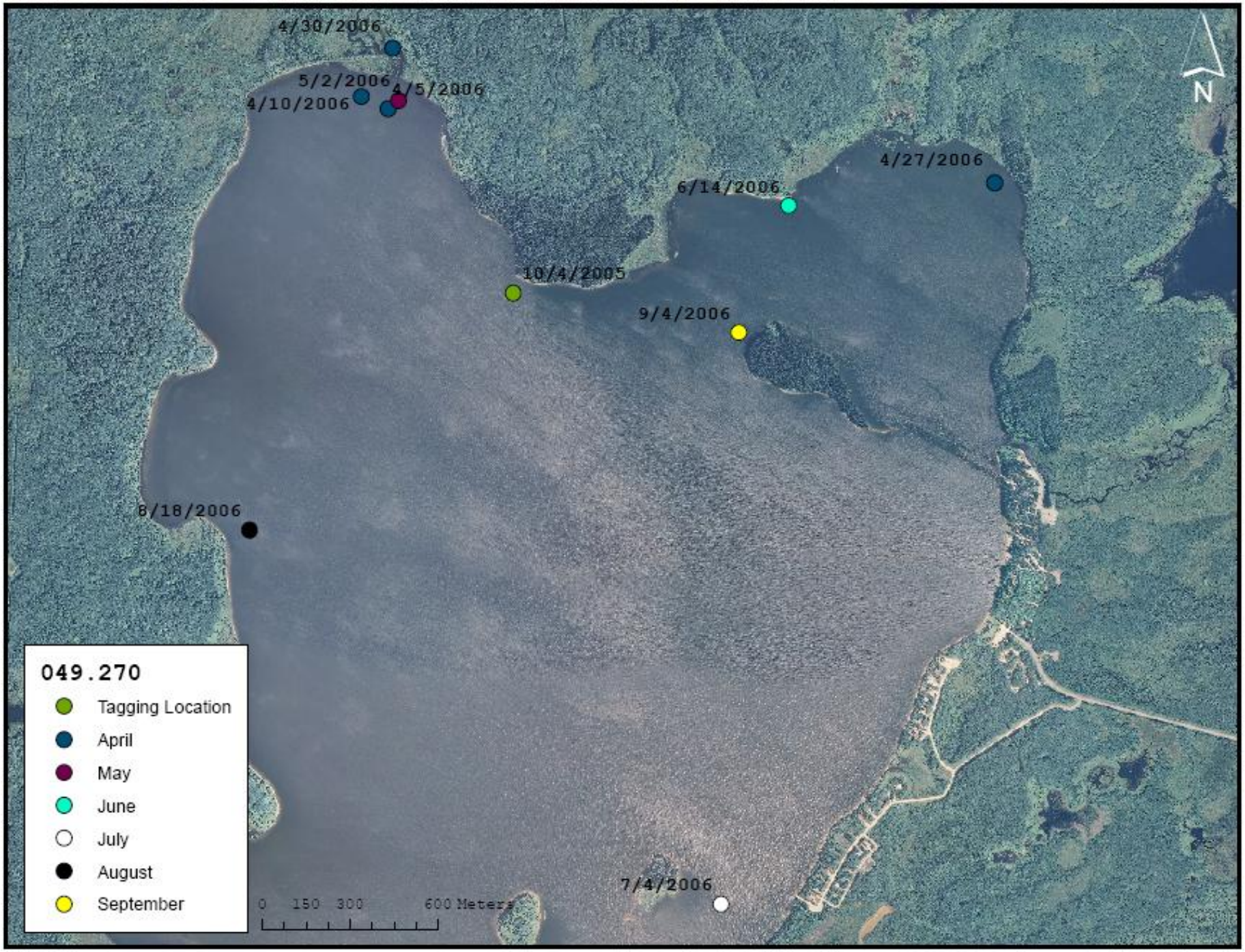
2010	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	-	-	1.13 B	24.8 B	11.4	31.4	29.8 A	9.74	41.1	21.1 A	-	-
2	-	-	1.10 B	28.0 B	15.8	37.0	27.7	9.57	38.1	19.4	-	-
3	-	-	1.07 B	30.3 B	22.0	39.7	26.2 A	9.66	36.8	18.3	-	-
4	-	-	1.08 B	28.7 B	27.0	42.4	28.0 A	9.78	34.5	17.0	-	-
5	-	-	1.09 B	24.6 B	29.8	44.7	27.4	8.70	33.2	15.9	-	-
6	-	-	1.10 B	21.4	30.5	49.1	26.0 A	8.15	34.8	15.0	-	-
7	-	-	1.08 B	19.3	28.5	50.7	26.4 A	7.68	40.9	14.3	-	-
8	-	-	1.08 B	17.4	27.0	52.9	23.9	7.40	42.2	13.6	-	-
9	-	-	1.04 B	14.9	24.7	67.3	20.1 A	7.37	41.3	13.1	-	-
10	-	-	1.08 B	14.6	22.8	76.0	18.0 A	7.43	41.8	12.7	-	-
11	-	-	1.04 B	13.6	21.1	73.9	16.8	7.89	46.9	12.2	-	-
12	-	-	1.09 B	12.3	20.0	86.3	15.5 A	7.06	52.0	11.7	-	-
13	-	-	1.08 B	10.9	20.5	98.3	13.8 A	8.03	55.0	11.4	-	-
14	-	-	1.11 B	10.4	24.1	98.4	12.8 A	16.9	57.3	10.7	-	-
15	-	-	1.12 B	10.9	26.8	93.1	15.0	28.3	57.8	10.8	-	-
16	-	-	1.08 B	11.2	26.9 A	91.2	26.5	31.5	59.2	9.72	-	-
17	-	-	1.30 B	12.3	26.7 A	87.3	43.2	30.0	59.6	9.47	-	-
18	-	-	1.52 B	12.2	24.8	89.4	49.3	27.8	57.6	9.18	-	-
19	-	-	1.48 B	11.8 A	22.7	101	41.6	27.4	52.5	9.02	-	-
20	-	-	1.44 B	11.5	20.9	90.1	32.3	28.0	47.1	8.77	-	-
21	-	-	1.62 B	11.1	18.5	70.9	26.2	26.4	41.6	8.52	-	-
22	-	-	1.65 B	10.2	16.9	62.6	22.5	22.1	36.5	8.35	-	-
23	-	-	1.78 B	9.46	15.9	52.9	19.8	20.4	34.2	8.18	-	-
24	-	-	2.25 B	9.09	14.7	44.2 A	17.5	23.5	33.5	7.98	-	-
25	-	-	3.18 B	8.77	14.2	37.4 A	15.6	27.4	32.5	8.16	-	-
26	-	-	3.14 B	8.34 A	15.3	32.5	14.4	28.4 A	30.5	9.95	-	-
27	-	-	2.66 B	8.04	15.9	29.2 A	13.3	29.6	28.5	14.0	-	-
28	-	-	2.33 B	8.21	18.3	28.6 A	12.5	30.6	26.4	20.3	-	-
29	-		3.75 B	7.74	21.2	27.2	11.8	32.2	24.4	23.9	-	-
30	-		10.1 B	8.90	23.9	26.7 A	11.5	34.0	22.6	21.9	-	-
31	-		19.6 B		26.3		10.8	37.2		21.4		-
Mean			2.42	14.4	21.8	60.4	22.5	19.7	41.3	13.4		
Max			19.6	30.3	30.5	101	49.3	37.2	59.6	23.9		
Min			1.04	7.74	11.4	26.7	10.8	7.06	22.6	7.98		
Total			75.17	430.95	675.1	1812.4	696.2	610.16	1240.4	416		
Total Dam^3			6490	37200	58300	157000	60200	52700	107000	35900		

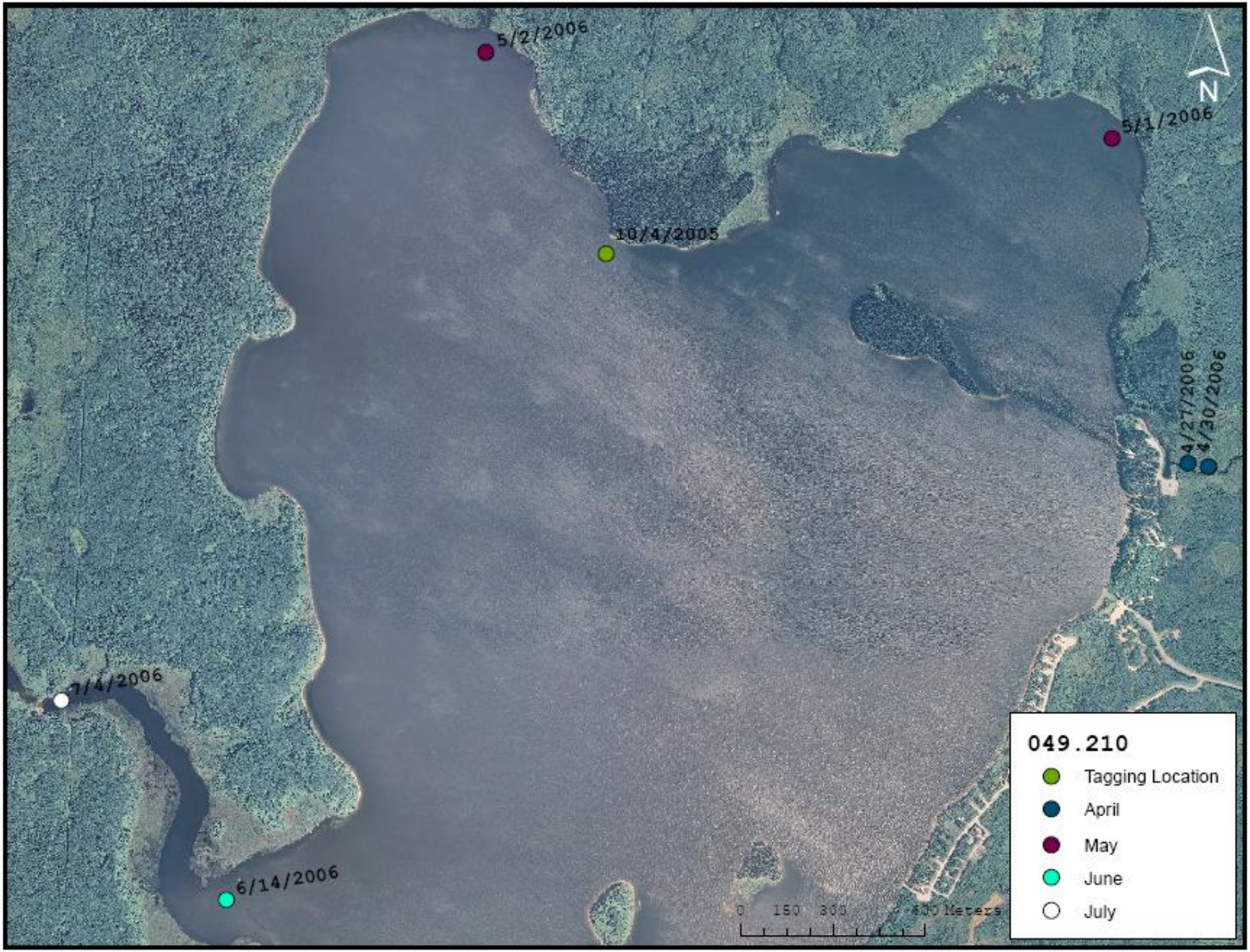
C – Individual Fish Movement of Whitefish Lake Walleye 2005 – 2006

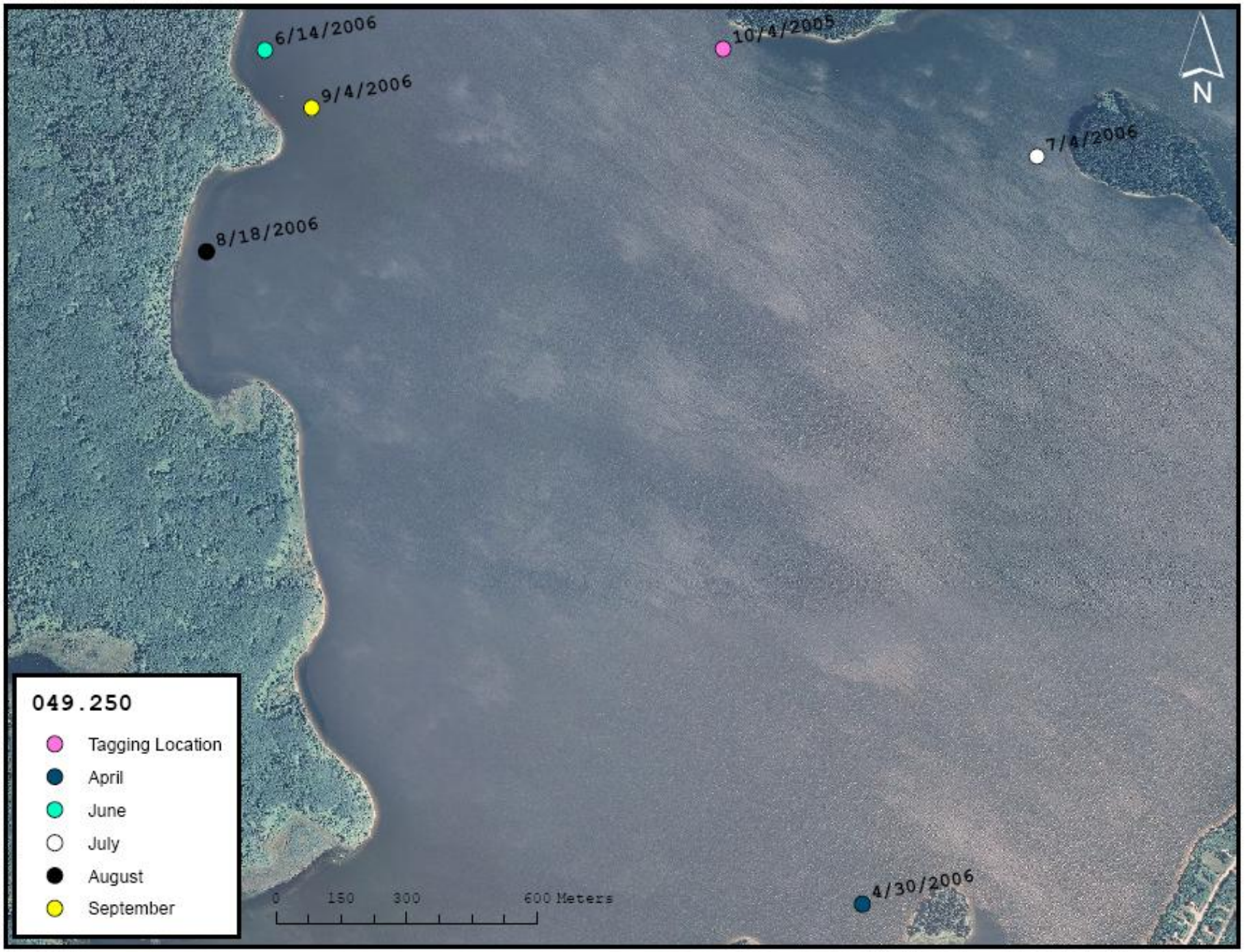


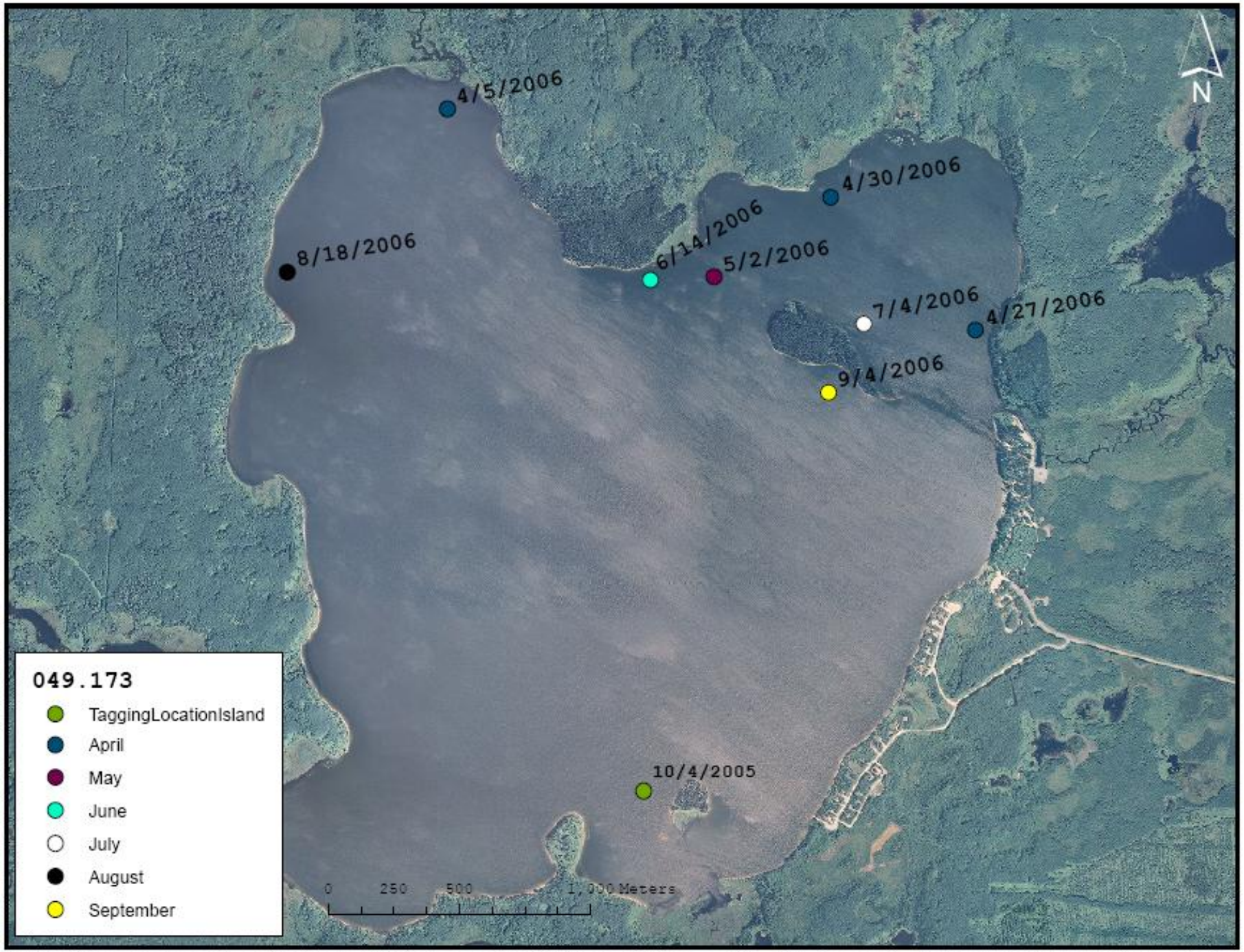


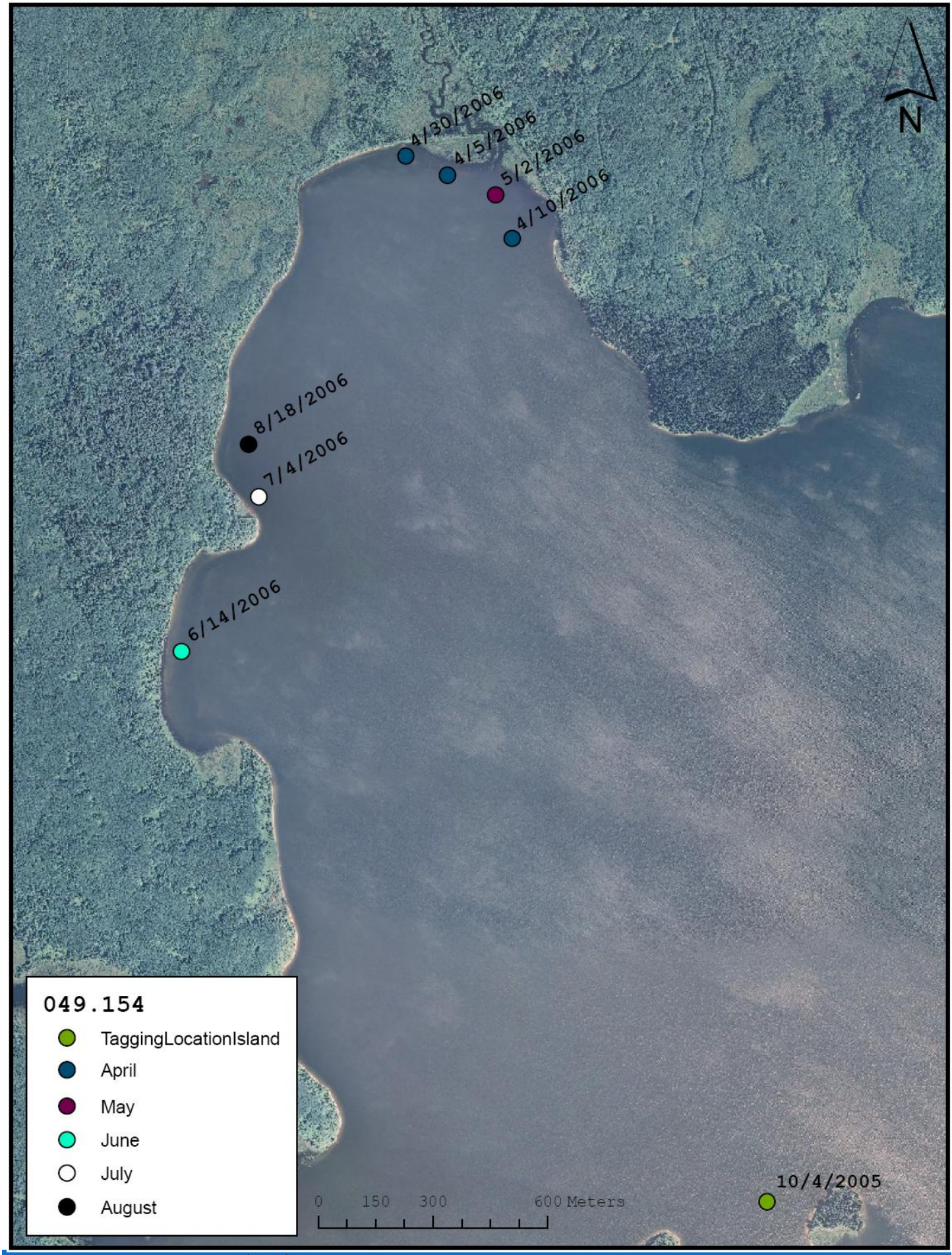

4/5/2006
4/10/2006
9/4/2006
6/14/2006
5/2/2006
7/4/2006
5/1/2006
10/4/2005
4/25/2006
4/27/2006
5/1/2006
4/30/2006
N
049.194
Tagging Location
April
May
June
July
September
0
300
600
1,200 Meters


4/30/2006
5/2/2006
4/5/2006
4/10/2006
4/27/2006
6/14/2006
10/4/2005
9/4/2006
8/18/2006
7/4/2006
N
049.270
Tagging Location
April
May
June
July
August
September
0 150 300 600 Meters

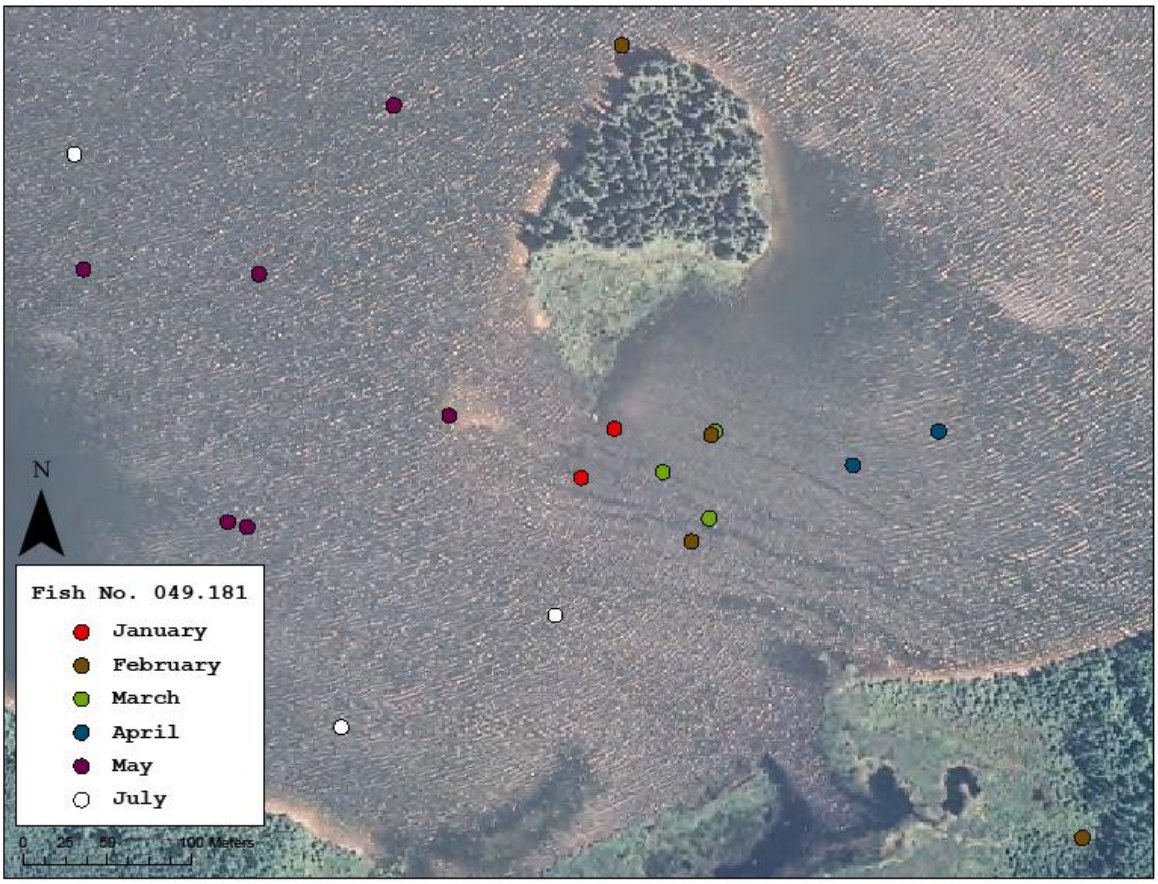

5/2/2006
5/1/2006
10/4/2005
4/27/2006
4/30/2006
7/4/2006
6/14/2006
N
049.210
Tagging Location
April
May
June
July
0 150 300 600 Meters

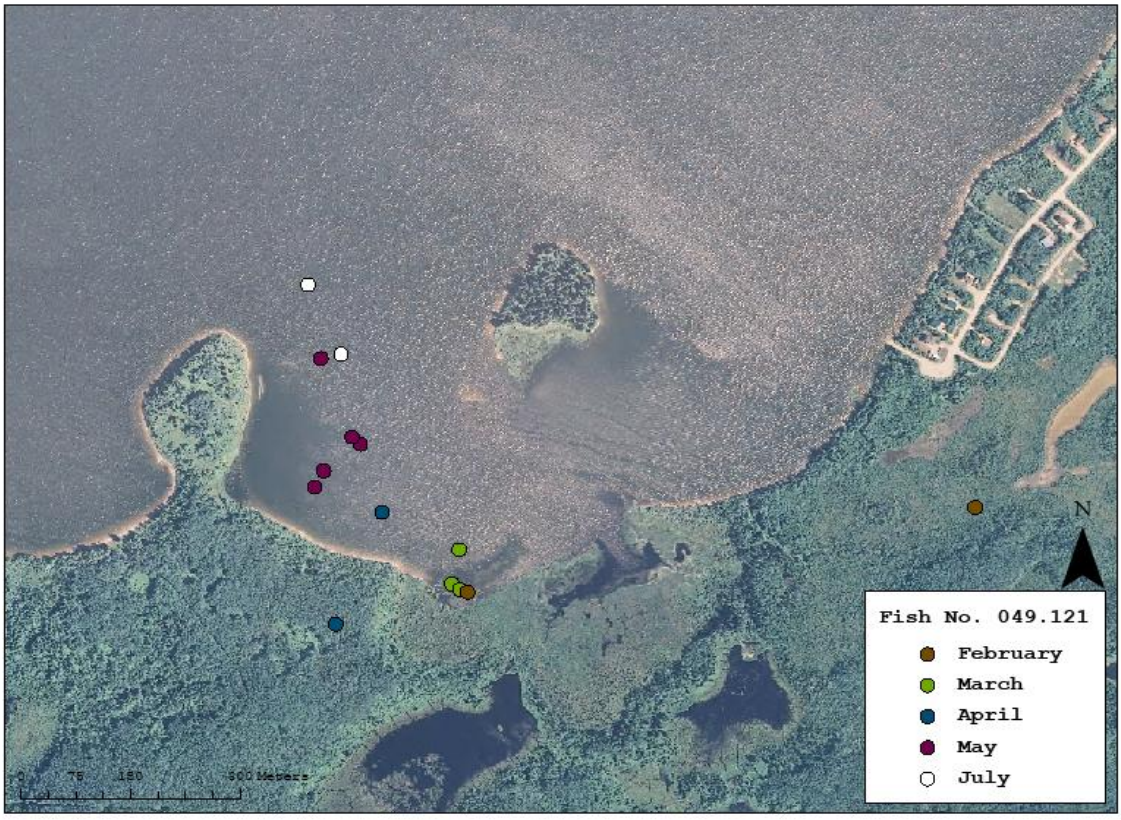

6/14/2006
10/4/2005
9/4/2006
N
7/4/2006
8/18/2006
049.250
Tagging Location
April
June
July
August
September
0
150
300
600 Meters
4/30/2006


4/5/2006
4/30/2006
8/18/2006
6/14/2006
5/2/2006
7/4/2006
4/27/2006
9/4/2006
10/4/2005
N
049.173
TaggingLocationIsland
April
May
June
July
August
September
0
250
500
1,000 Meters

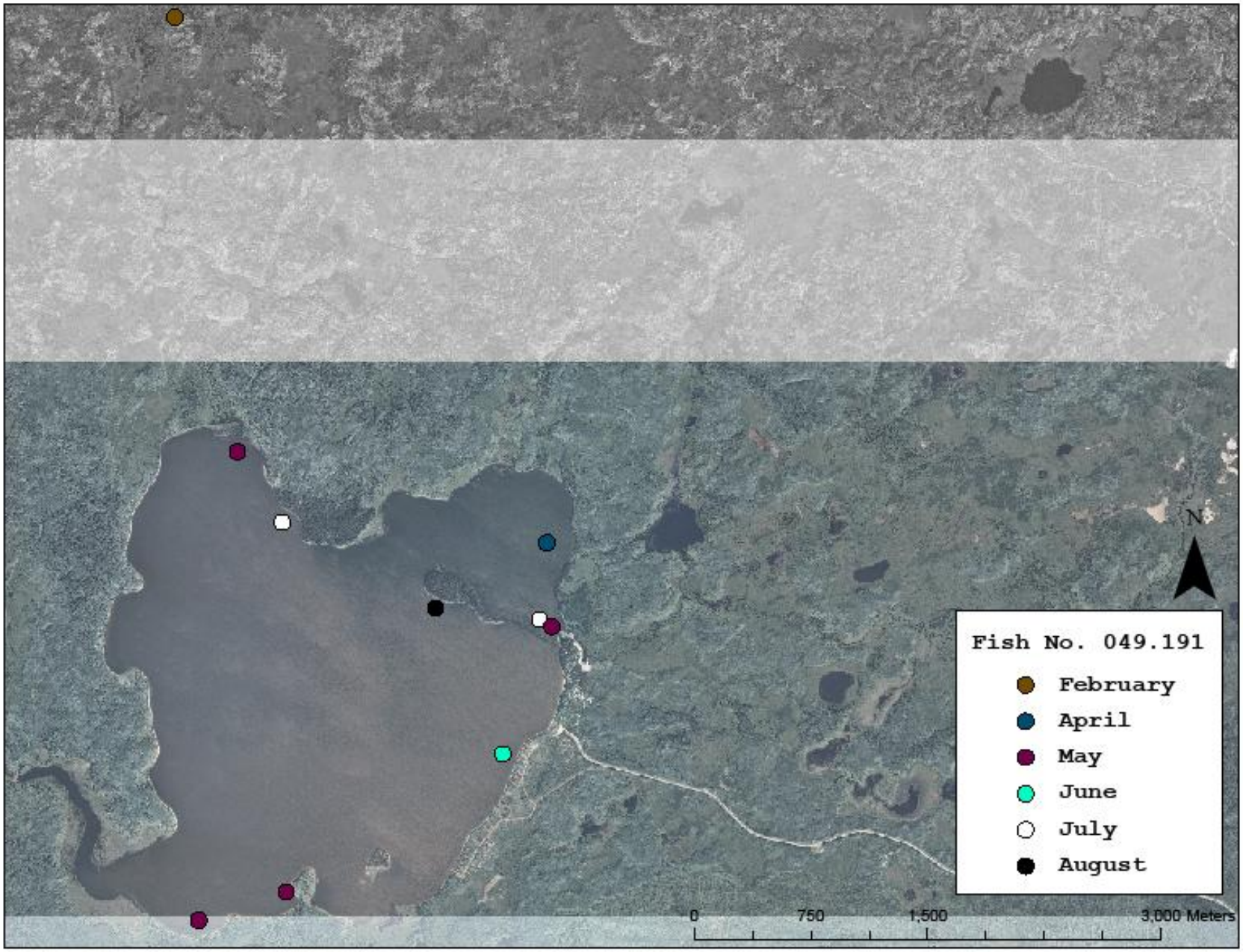

N
4/30/2006
4/5/2006
5/2/2006
4/10/2006
8/18/2006
7/4/2006
6/14/2006
10/4/2005
049.154
TaggingLocationIsland
April
May
June
July
August
0 150 300 600 Meters

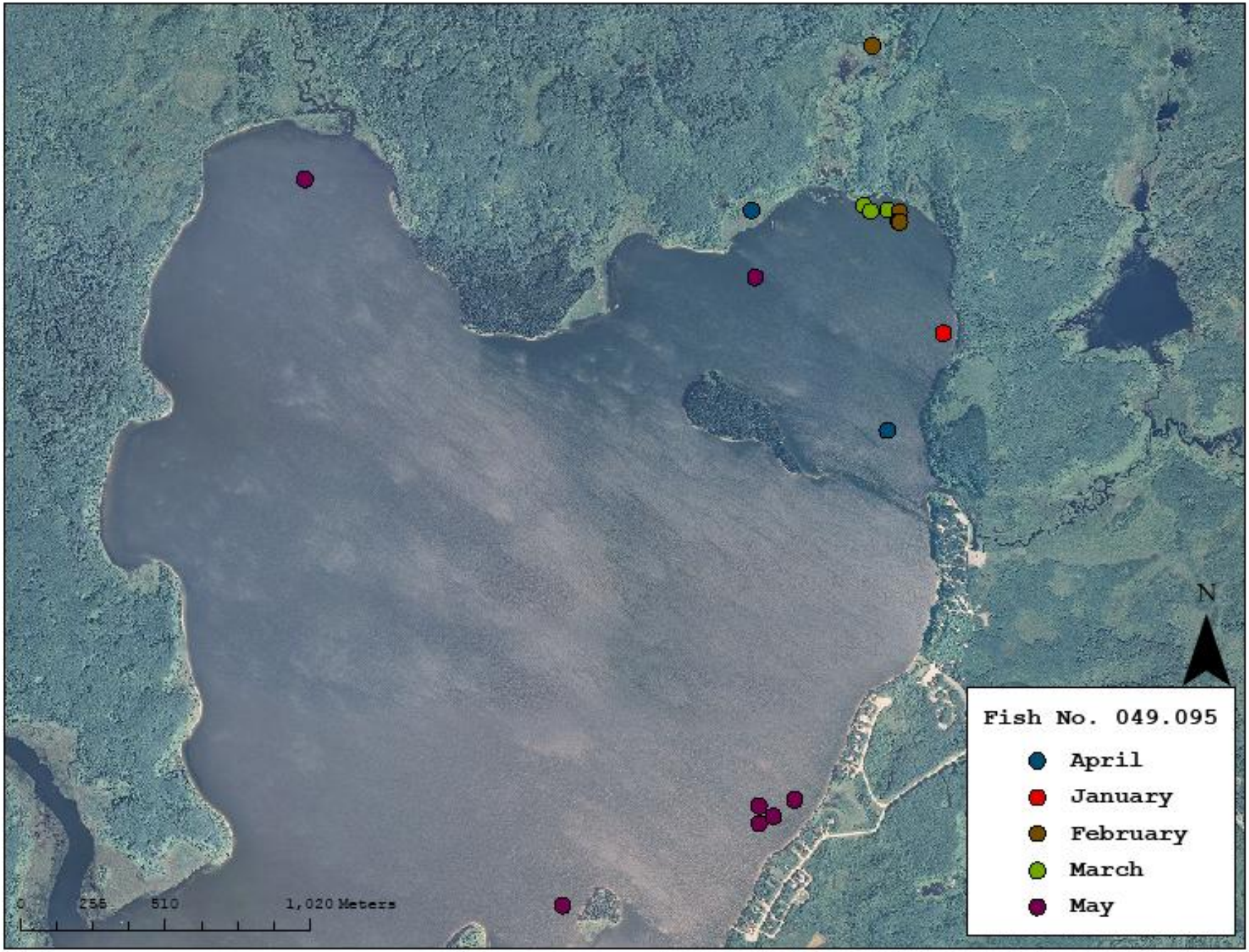
D - Fish 00.121 & 049.181 – Walleye from Whitefish Lake presumed Dead

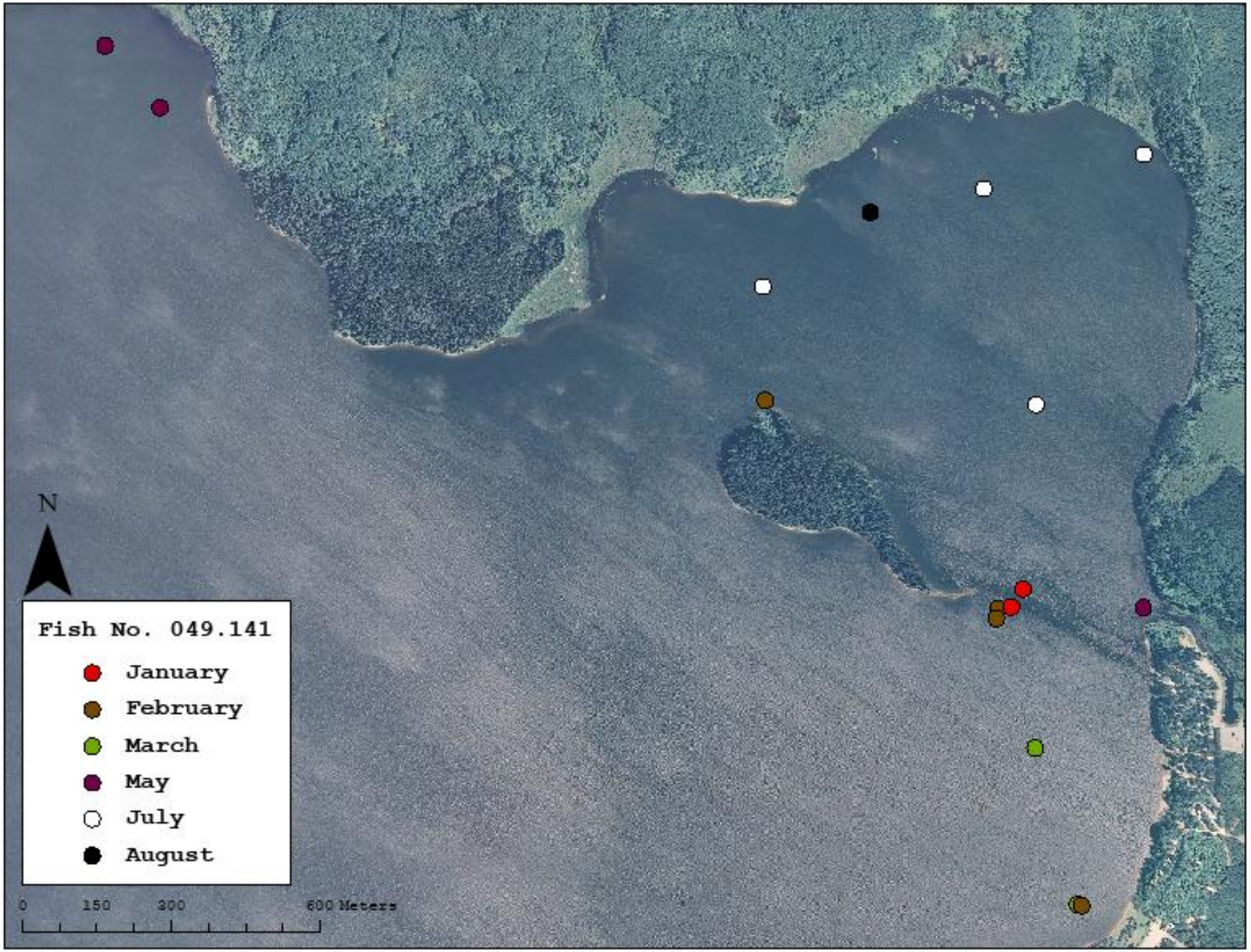


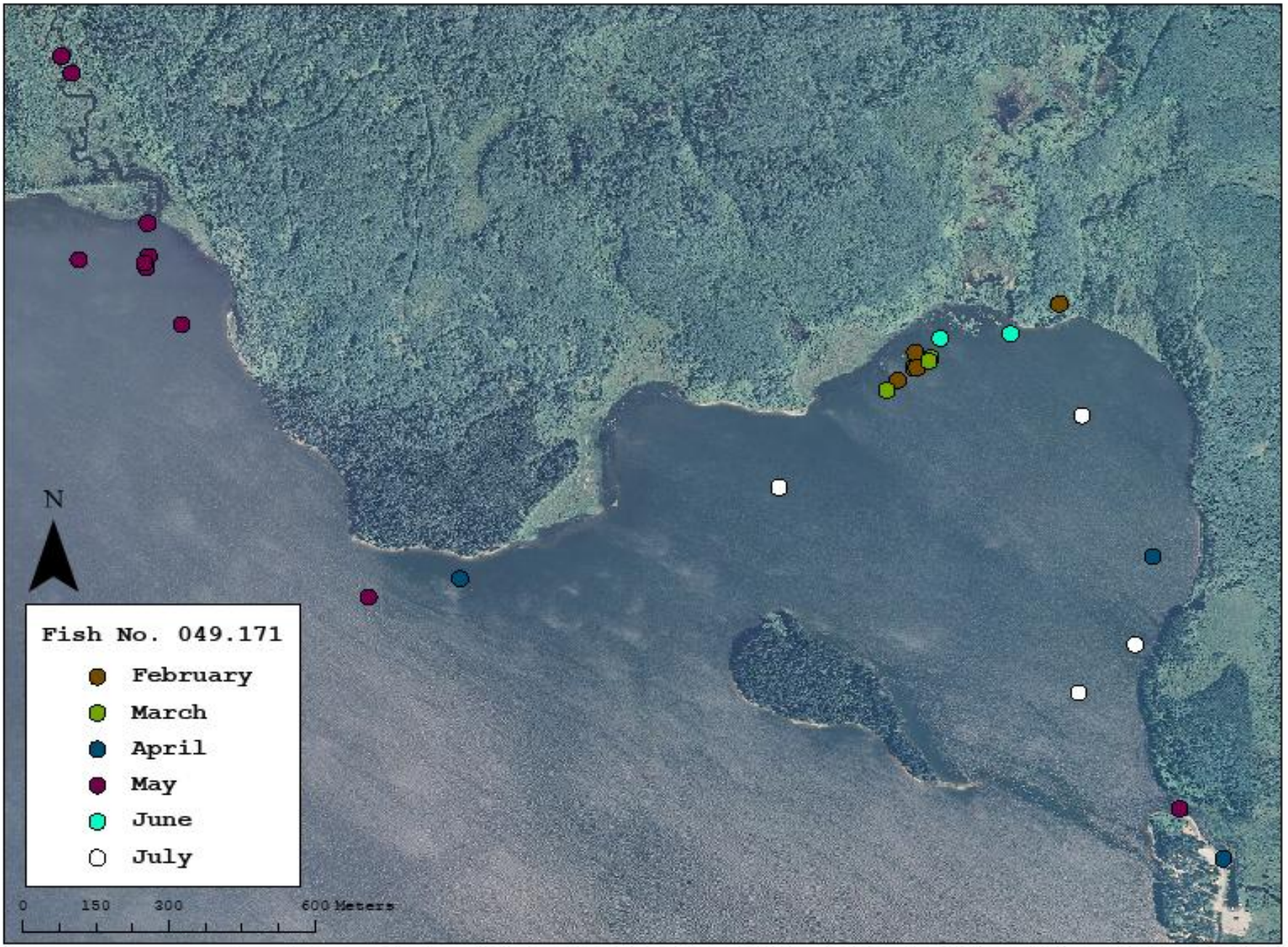


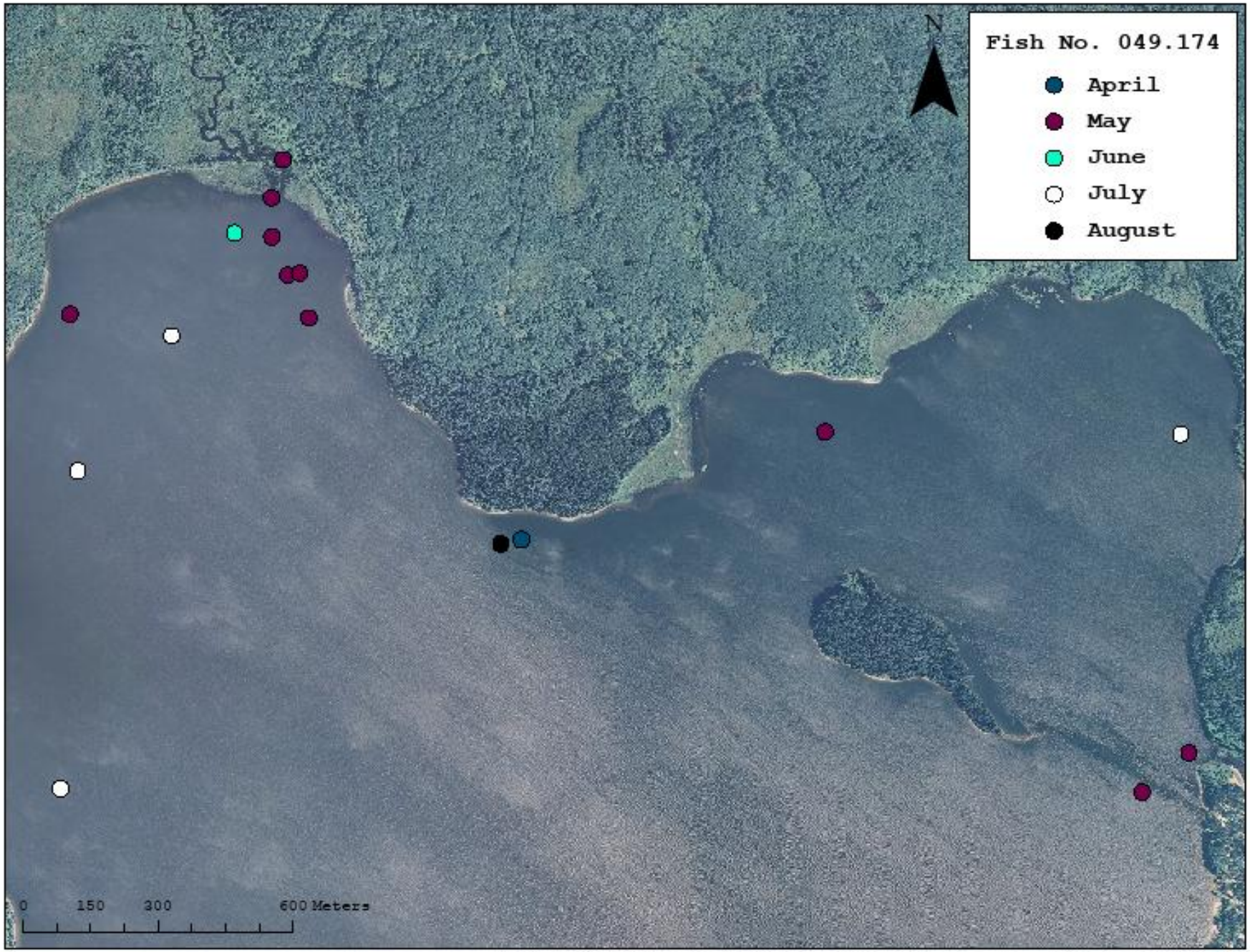
E – Individual Fish Movement of Whitefish Lake Walleye 2009 - 2010

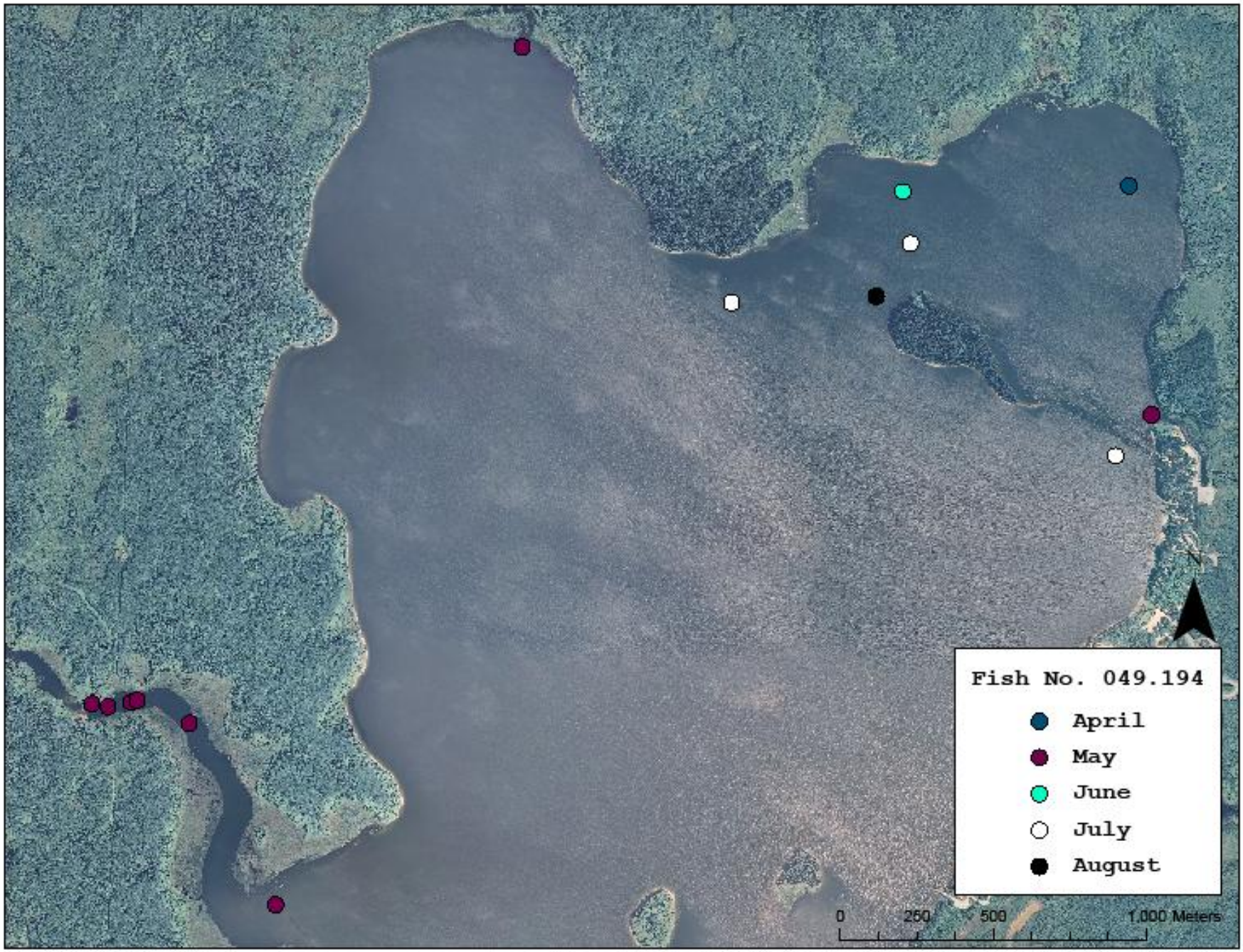


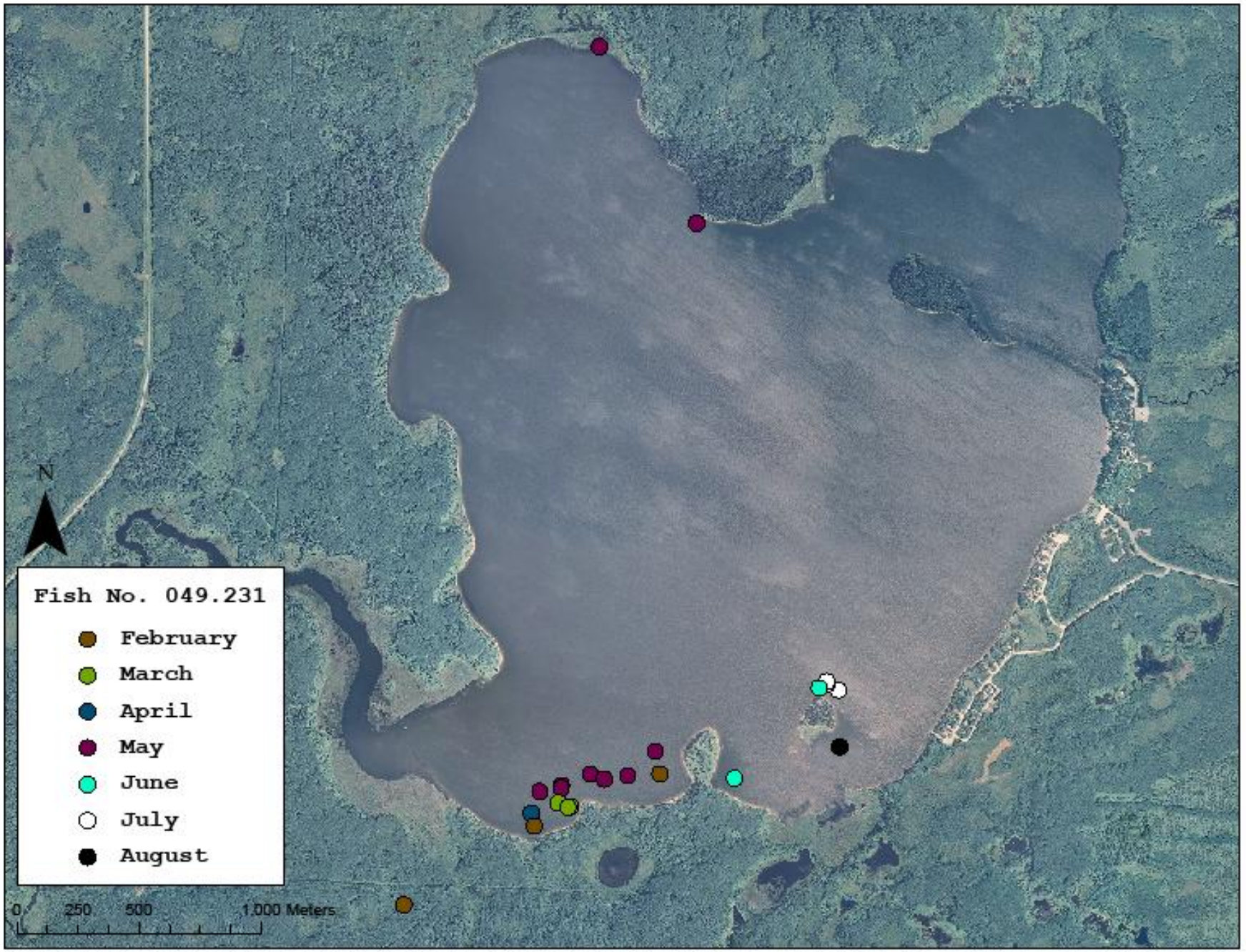

N
Fish No. 049.095
April
January
February
March
May
0
255
510
1,020 Meters


N
Fish No. 049.141
January
February
March
May
July
August
0
150
300
600 Meters


N
Fish No. 049.171
February
March
April
May
June
July
0
150
300
600 Meters

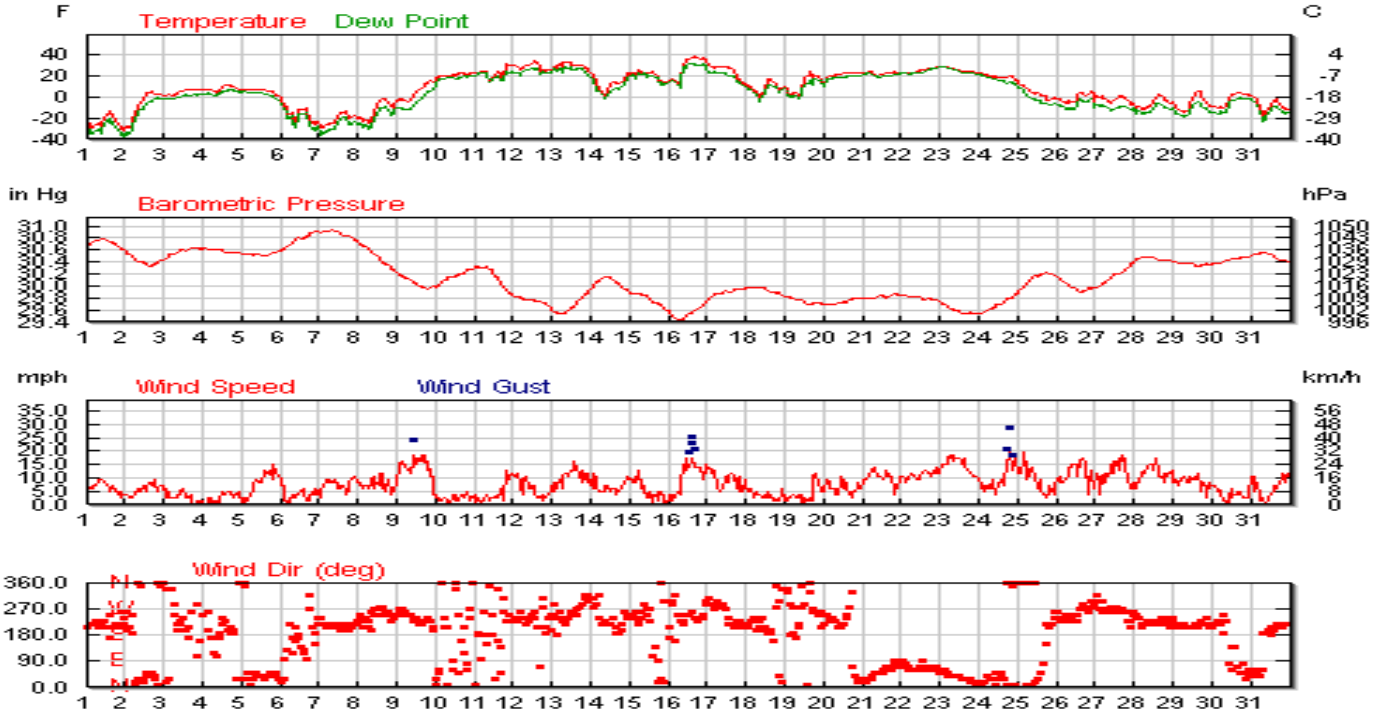

N
Fish No. 049.174
April
May
June
July
August
0
150
300
600 Meters


Fish No. 049.194
April
May
June
July
August
0
250
500
1,000 Meters

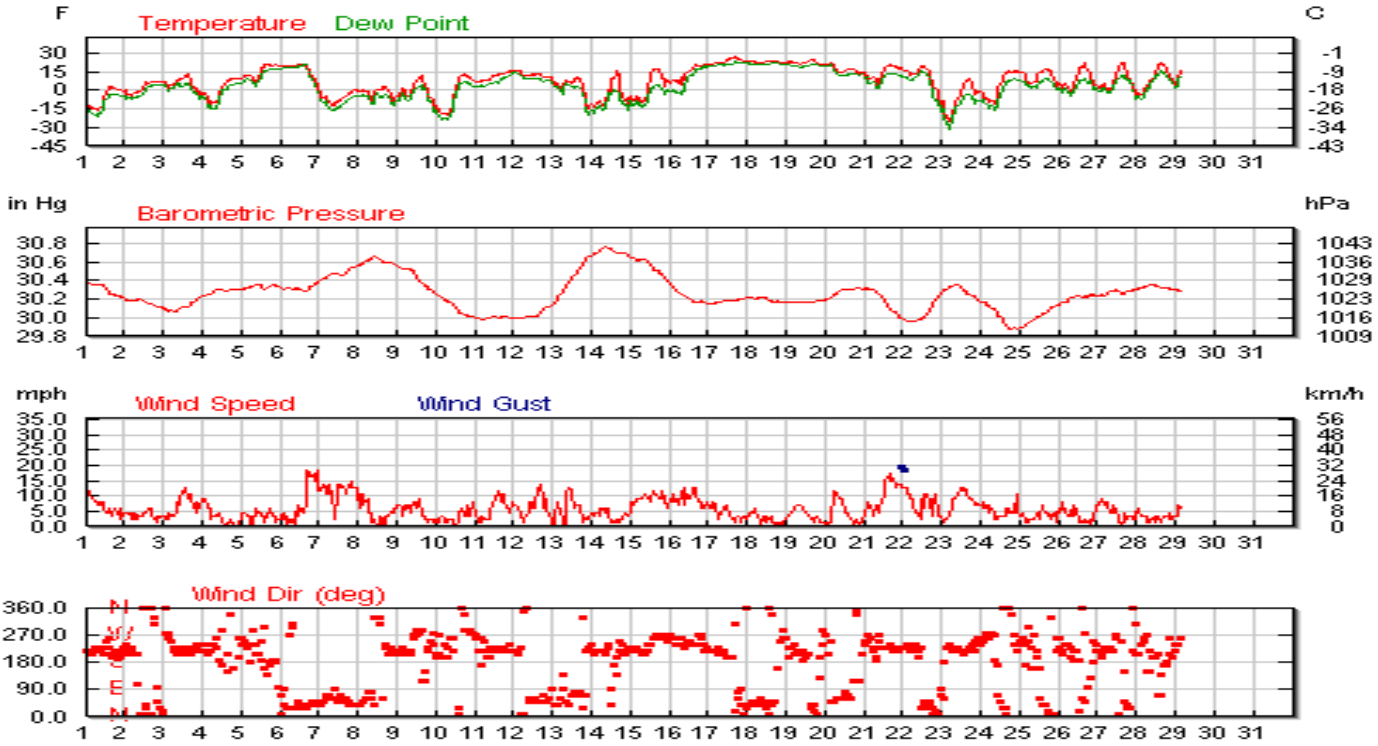

N
Fish No. 049.231
February
March
April
May
June
July
August
0
250
500
1,000 Meters

G – Weather for Whitefish Lake 2010

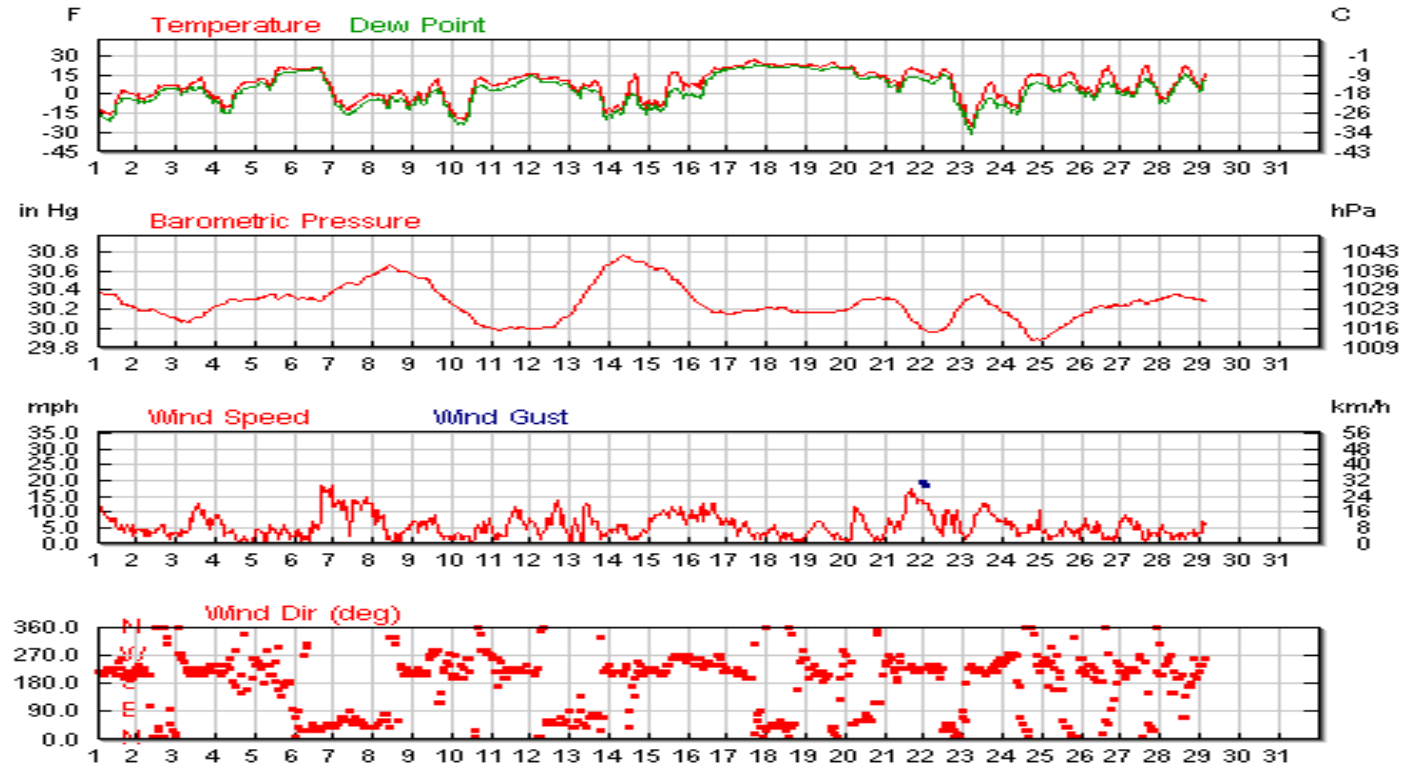
JANUARY



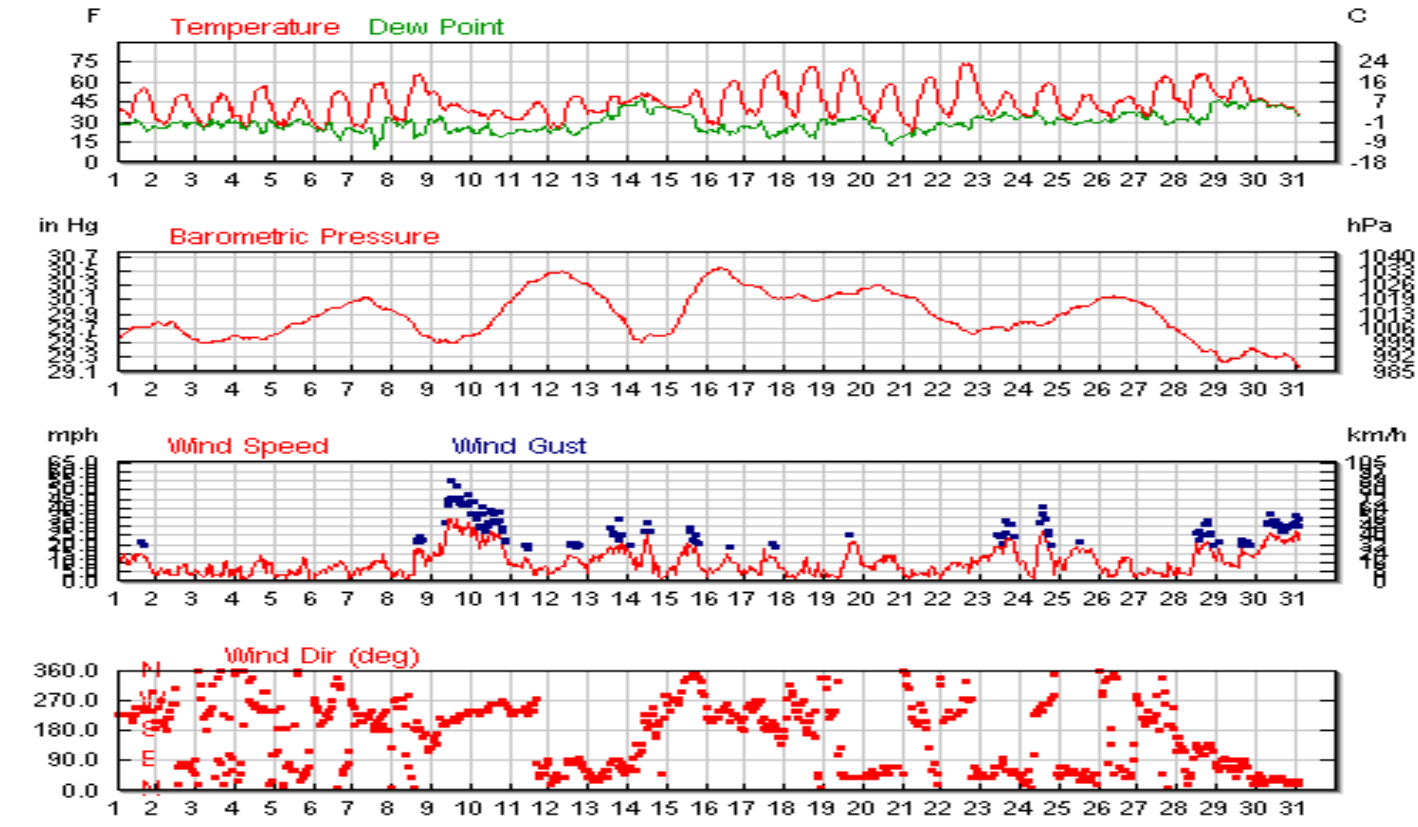
FEBRUARY



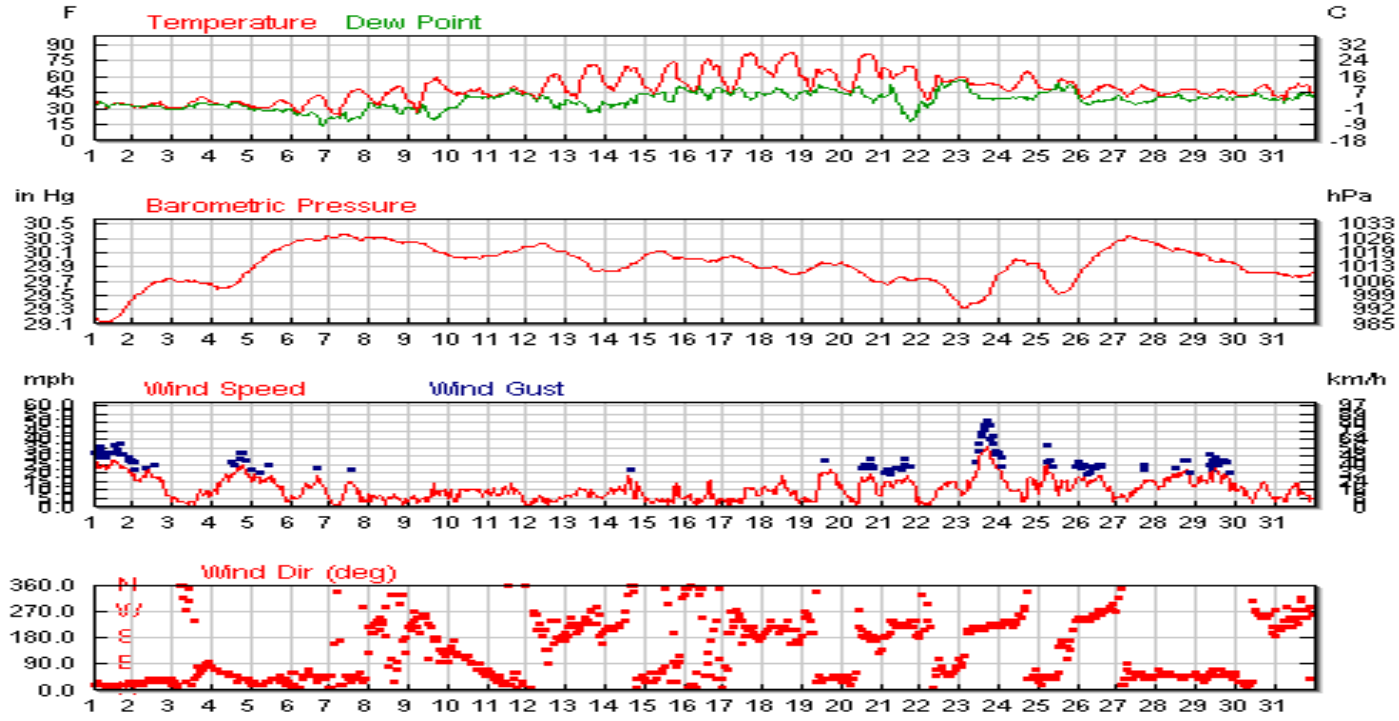
MARCH


F
Temperature
Dew Point
C
30
15
0
-15
-30
-45
-1
-9
-18
-26
-34
-43
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
in Hg
Barometric Pressure
hPa
30.8
30.6
30.4
30.2
30.0
29.8
1043
1036
1029
1023
1016
1009
mph
Wind Speed
Wind Gust
km/h
35.0
30.0
25.0
20.0
15.0
10.0
5.0
0.0
56
48
40
32
24
16
8
0
Wind Dir (deg)
360.0
270.0
180.0
90.0
0.0
N
W
S
E
N

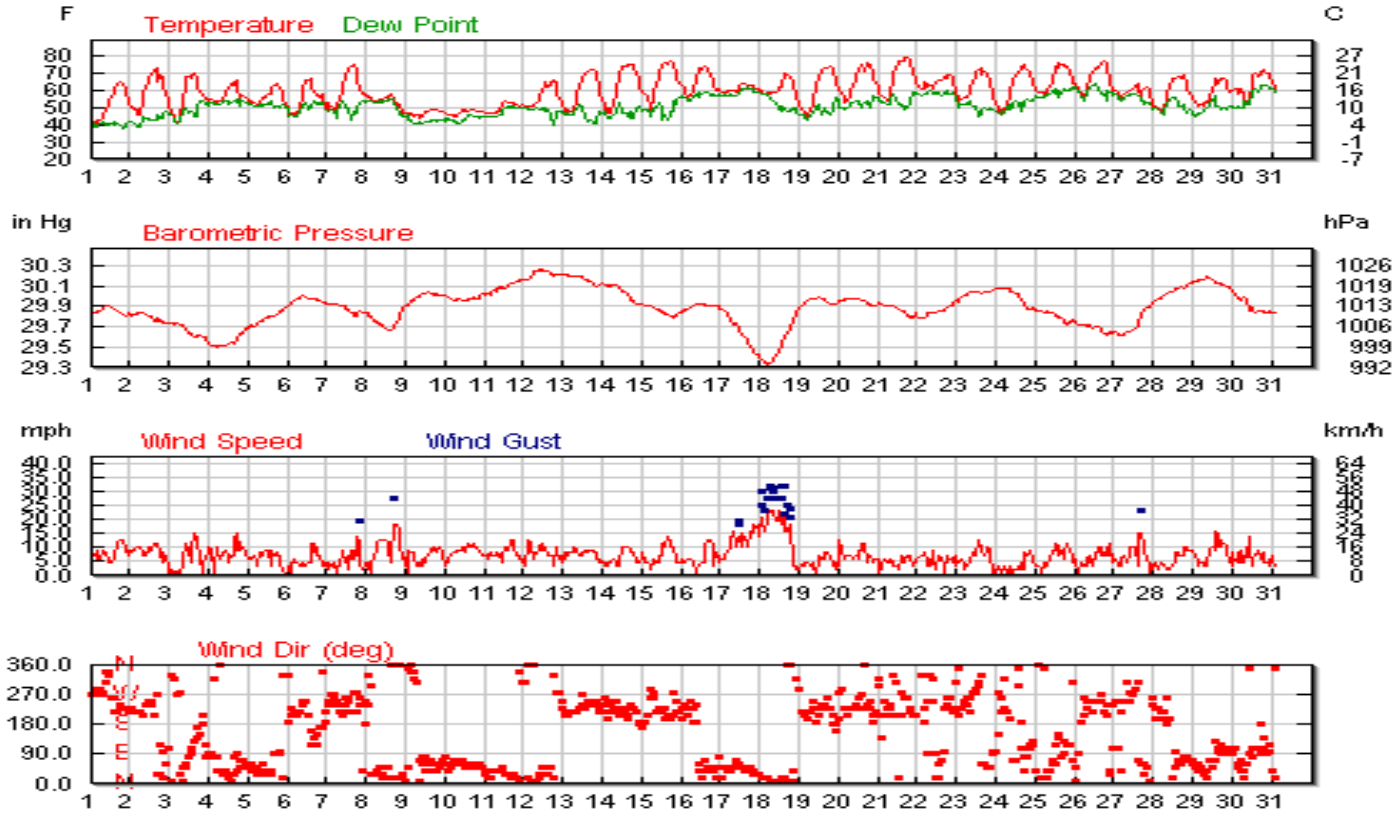
APRIL


F
Temperature
Dew Point
C
75
60
45
30
15
0
24
16
7
-1
-9
-18
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
in Hg
Barometric Pressure
hPa
30.7
30.5
30.3
30.1
29.9
29.7
29.5
29.3
29.1
1040
1033
1026
1019
1013
1006
999
992
985
mph
Wind Speed
Wind Gust
km/h
Wind Dir (deg)
360.0
270.0
180.0
90.0
0.0
N
W
S
E
N

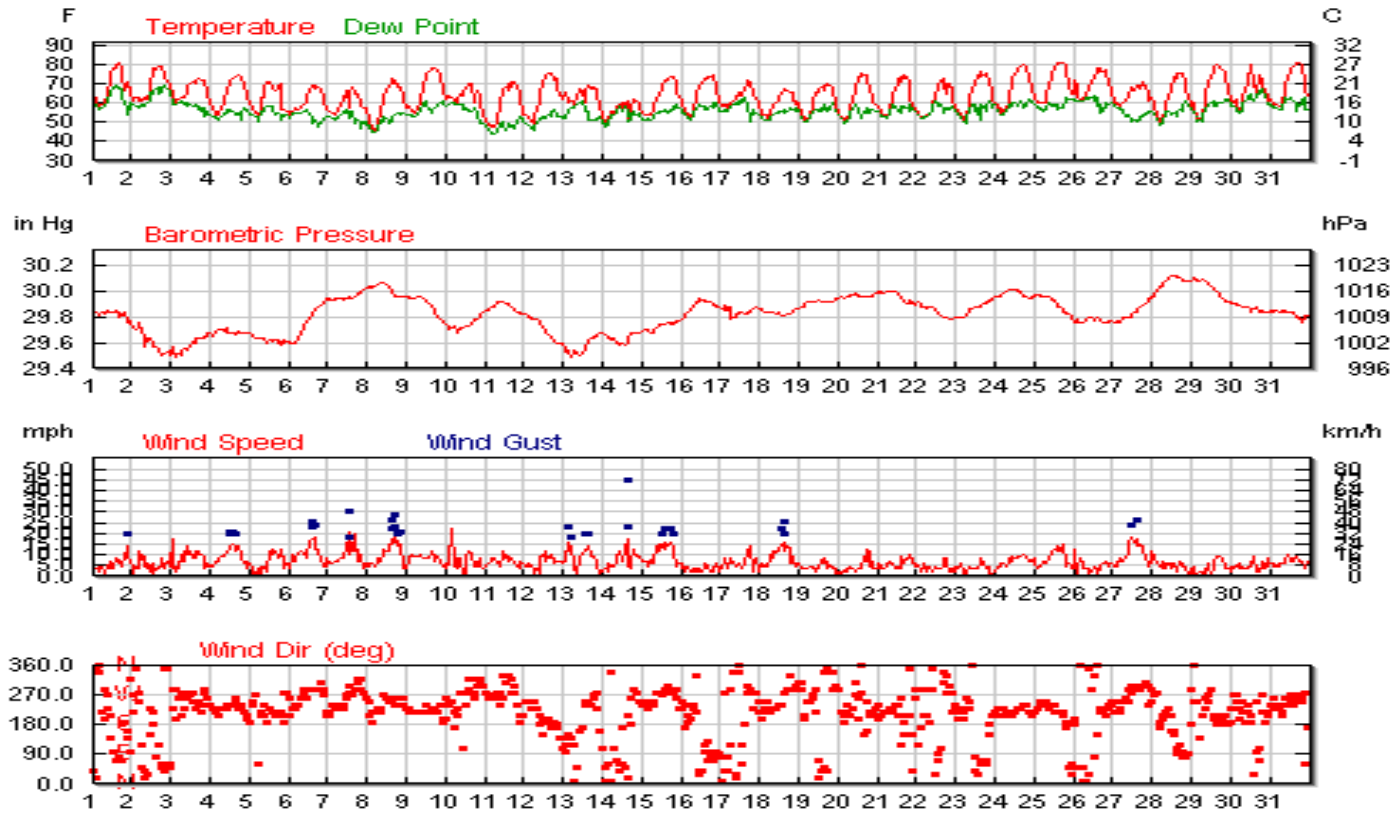
MAY


F
Temperature
Dew Point
C
in Hg
Barometric Pressure
hPa
mph
Wind Speed
Wind Gust
km/h
Wind Dir (deg)

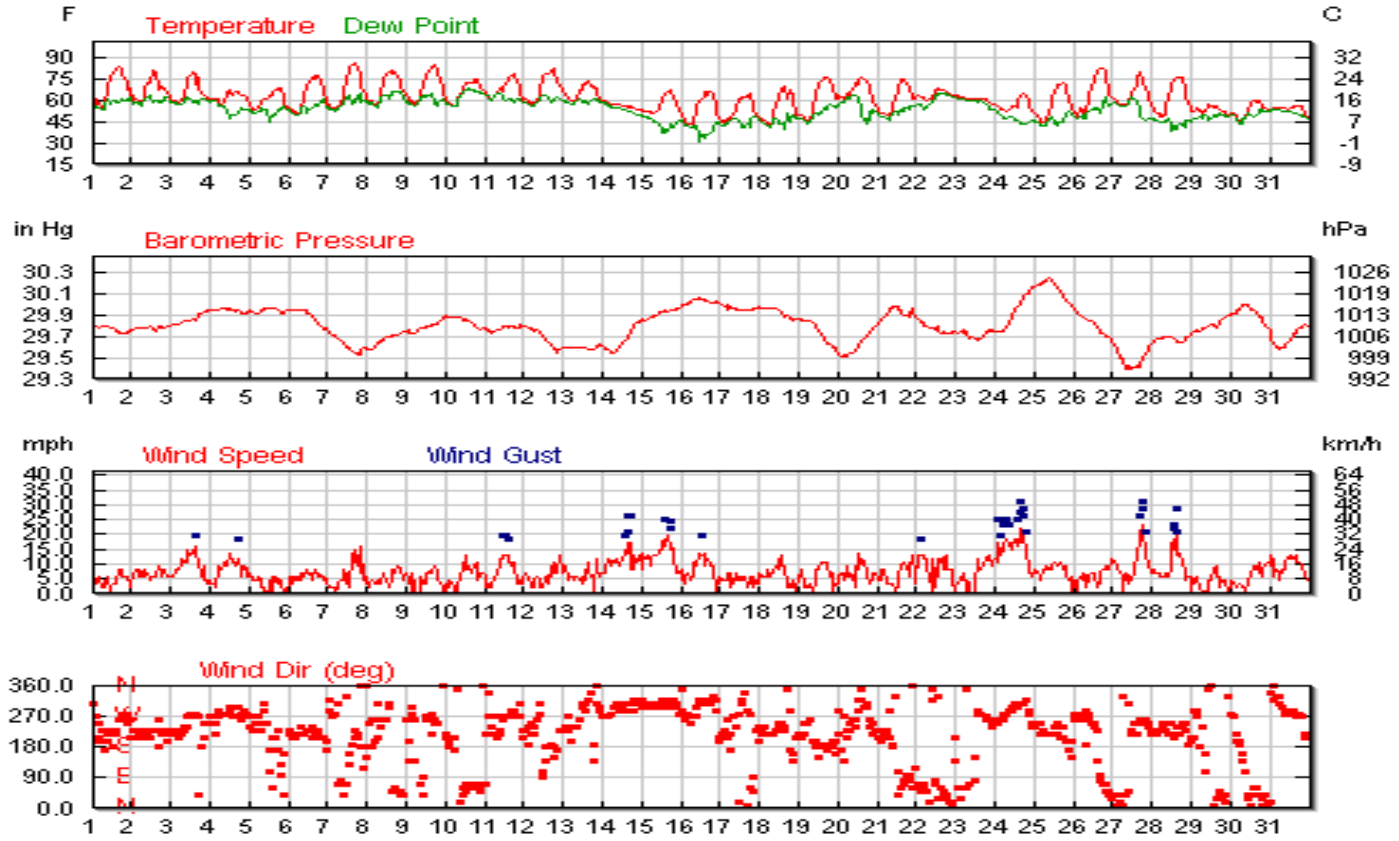
JUNE


F
Temperature
Dew Point
C
in Hg
Barometric Pressure
hPa
mph
Wind Speed
Wind Gust
km/h
Wind Dir (deg)

JULY


F
Temperature
Dew Point
C
90
80
70
60
50
40
30
32
27
21
16
10
4
-1
in Hg
Barometric Pressure
hPa
30.2
30.0
29.8
29.6
29.4
1023
1016
1009
1002
996
mph
Wind Speed
Wind Gust
km/h
Wind Dir (deg)
360.0
270.0
180.0
90.0
0.0
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31

AUGUST


F
Temperature
Dew Point
C
90
75
60
45
30
15
32
24
16
7
-1
-9
in Hg
Barometric Pressure
hPa
30.3
30.1
29.9
29.7
29.5
29.3
1026
1019
1013
1006
999
992
mph
Wind Speed
Wind Gust
km/h
40.0
35.0
30.0
25.0
20.0
15.0
10.0
5.0
0.0
64
56
48
40
32
24
16
8
0
Wind Dir (deg)
360.0
270.0
180.0
90.0
0.0
N
W
E
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31