South Heart River Walleye Project 2004

Leanne Osokin
Alberta Conservation Association
Box 730
Slave Lake, Alberta, Canada
T0G 2A0

John Tchir
Alberta Conservation Association
Bag 900-26
Peace River, Alberta, Canada
T8S 1T4

Alberta Conservation Association

Report Series Co-editors

GARRY J. SCRIMGEOUR DAVID FAIRLESS

Alberta Conservation Association
P.O. Box 40027
Baker Centre Postal Outlet
Edmonton, AB, T5J 4M9

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EXECUTIVE SUMMARY

This data report describes the results of radio telemetry studies on Lesser Slave Lake walleye (*Sander vitreus*) captured in the South Heart River drainage. The objectives of the study were to document spawning and post-spawning movement patterns of walleye in the South Heart-Buffalo Bay area and that in the west bay of Lesser Slave Lake. The Alberta Conservation Association conducted this study to provide Alberta Sustainable Resource Development with information that they could consider when evaluating the need to revise angling regulations to exclude harvest of walleye in a seasonal closure zone (west bay, Grouard channel and tributaries) from March 1 to June 15. This report describes results compiled over the two-year study period that was initiated in April 2003. Over the course of this study, 89 adult walleye were implanted with radio transmitters (68 in 2003, 21 in 2004). In 2003, fish were tracked over a 14-week period (12 May to 18 August 2003) with 19 fixed wing aerial telemetry surveys. Similarly in 2004, walleye were tracked over a 16-week period (29 April to 18 August 2004), comprising surveys completed using fixed wing (14 surveys), helicopter (two surveys), canoe (four surveys), and power boat (six surveys).

In 2003, we recorded a total of 307 locations of the 68 walleye implanted with transmitters. During 2004, 236 locations were recorded from 49 implanted walleye. Of the 68 walleye implanted in 2003, 28 were relocated during the 2004 survey period. In 2003, we were only partially successful in quantifying spawning movements of walleye due to later season implant dates; one walleye was recorded upstream of Buffalo Bay. In 2004, we documented 23 individual walleye upstream of Buffalo Bay from 10 - 31 May. Movement out of Buffalo Bay and upstream tributaries were comparable for both years, as walleye were not detected in this area after 9 June in 2003 and 7 June in 2004. On 16 June 2003, (one day after the seasonal closure) 14 implanted walleye were found within the seasonal closure zone of Lesser Slave Lake in comparison to four walleye relocated in this zone on 17 June 2004. As the season progressed, data from both years showed that walleye use of the seasonal closure zone was minimal; three implanted walleye relocated on 18 August 2003 and two recorded on 27 August 2004. Over the course of the study, anglers removed five implanted walleye

while two were reported as caught by anglers but were subsequently released. Although, it is highly likely that more implanted walleye were harvested, we cannot quantify actual levels of angler-induced mortality. In 2004, we tested the following telemetry assumptions: effectiveness in relocating transmitters from various modes of travel and the accuracy of the relocations. The results indicated that we relocated between 50 – 68% of walleye that had implanted transmitters when all survey modes were combined. Analyzing modes of travel for telemetry surveys separately, showed that telemetry reconnaissance conducted using a canoe was the most effective (i.e., 75% success) and accurate (i.e., within 49 m on average) in relocating transmitters. Surveys completed during the spring of 2004 indicated that walleye occurred in Horse Lakes, a shallow wetland area that drains into Buffalo Bay. It is believed that this area, while unsuitable for spawning, may be an essential feeding, staging area during the spring spawning and post-spawning phase movements.

ACKNOWLEDGEMENTS

We thank Dave Jackson, Greg Fortier, and Paul Hvenegaard of Alberta Conservation Assocation (ACA) and Martin Brilling and David DeRosa of Sustainable Resource Development (ASRD) for assistance with data collection and review of earlier drafts of this manuscript. Also, thanks to all those who assisted on telemetry flights, boat and / or canoe events. Appreciation is also extended to Kevin Gardiner (ACA) for providing several transmitters to use in our relocation efficiency tests.

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1.0 INTRODUCTION

Lesser Slave Lake is the most popular destination in Alberta for walleye (*Sander vitreus*) anglers (Lucko 1999). As a result of its popularity, walleye populations in this system face increasing harvest pressure from recreational anglers, and domestic and commercial fishing. Continued degradation of spawning and rearing habitat, as well as fluctuating water levels and increasing shoreline development, likely impact the walleye's recruitment success. In response to perceived increased stresses on walleye populations in Lesser Slave Lake, Alberta Sustainable Resource Development (ASRD) implemented progressively restrictive angling regulations and commercial fishing quotas aimed at reducing walleye mortality. In 1987, new zoning restrictions closed recreational fishing from 1 April to 15 May in known walleye spawning areas in the Lesser Slave Lake drainage of Buffalo Bay and Grouard Channel. In 1990, this closure was extended to include the entire bay west of Shaw's Point and Little Grassy Point. In 1997, the period in which angling is prohibited (i.e., closure period) was extended from 1 March to 1 June to further protect spawning walleye and extended further again in 2001 to 15 June. In reference to the seasonal closure, which applies to the "portion west of a line drawn from Shaw Point to the point of land in 26-74-14-W5 known as Little Grassy Point, including Buffalo Bay and the Grouard Channel and their tributaries" (ASRD 2004), it will be referred to as the seasonal closure zone. Although, these zoning regulations have not been formally evaluated to determine their effectiveness in reducing mortality of adult walleye, it is highly likely that excluding anglers from this area during the spawning phase, including the post-spawn period, will reduce angler – mediated mortality (Dave DeRosa, Alberta Sustainable Resource Development, Fish and Wildlife Division, Slave Lake, Alberta, pers. comm.). In addition to harvest regulations, spawning and rearing habitats used by these adfluvial walleye in the South Heart River have also been evaluated.

The South Heart River is an extremely important drainage to sustaining the walleye population in the Lesser Slave Lake. Several studies have been conducted to quantify walleye spawning demographics in this drainage (Dietz 1979, Dietz and Tulman 1981, Dietz 1982, O'Neil 1983, O'Neil and Nelson 1984, Lewis 1985, Buchwald and Kaleta 1987, Brilling 1991, Walty 1992, Collett and Rhodes 1995, Lucko 1997). The fisheries potential of the Horse Lakes complex, located upstream of Buffalo Bay, was also surveyed by Fish and Wildlife Division in 1983 and 1987 and recorded high numbers of forage fish

indicating that this area may be an important staging / rearing area for spawning walleye. Collett and Rhodes (1995) reported that the Buffalo Bay area, including the Grouard Channel and the South Heart River, was considered the main river spawning area for the Lesser Slave Lake walleye population. Recent periods of drought and increased intensity of agricultural activity (e.g., hay cropping, cattle grazing and watering) in the South Heart River and Buffalo Bay complex have raised concerns over the viability of these walleye spawning areas. Previous studies on the drainage reported that the distribution of spawning walleye in the system shifts in relation to water levels and habitat suitability (Dietz 1979, Brilling 1991, Walty 1992, Collett and Rhodes 1995). Current distributions of habitats used by spawning walleye within the watershed are largely unknown.

The main objectives of this two-year project were two-fold. First, we assessed the effectiveness of the fishing closure to protect spawning walleye. Second, we documented spawning movements of walleye within the South Heart River drainage. Insights into areas used by walleye during spawning phase movements will support habitat securement initiatives in the South Heart River drainage.

2.0 STUDY AREA

Fieldwork was completed in the South Heart River located downstream of the West Prairie River and in the west portion of Lesser Slave Lake in central Alberta (Figure 1). The South Heart River, which empties into the west basin of Lesser Slave Lake, is the largest tributary with an overall drainage area of approximately 5,900 km^2 (Berry 1978). This drainage has been altered through water control structures, channelization and water diversion. The South Heart River flows through the central and dry mixedwood natural regions (Strong and Leggat 1998).

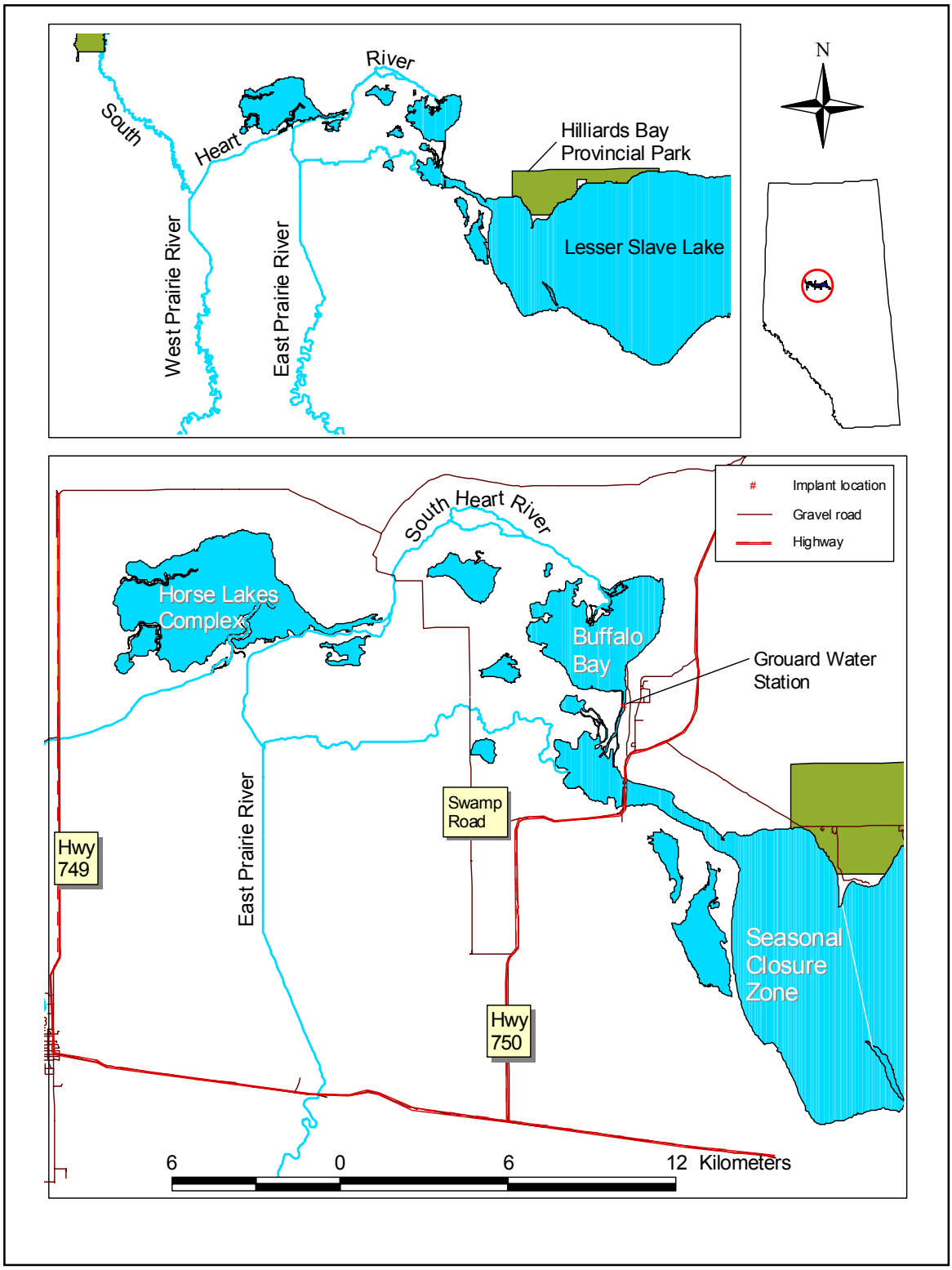

Figure 1. Location of the South Heart River - Horse Lakes complex in central Alberta, Canada.

3.0 MATERIALS AND METHODS

3.1 Electrofishing

In 2003, we collected walleye between 1 – 28 May. Larger reaches of the South Heart River were electrofished in 2003 to capture walleye that were adequate for transmitter implants. We used a fork length (FL) of 430 mm as the minimum length required for implants; a walleye considered legal for angling harvest is 430 mm total length (TL). In 2004, weather and stream conditions allowed for electrofishing earlier in the spring (i.e., 29 April). Electrofishing was conducted in two sections of the Grouard Channel, from the outlet of Buffalo Bay to the pump house approximately 200 m in length, and from the same outlet to approximately 800 m downstream. The Grouard water station enclosure was used for the main staging and operating area (Figure 1).

Walleye were collected using a Smith-Root™ 16-H electrofishing jet boat. A 5.0 kWh generator powered the 5.0 GPP Electrofisher unit, which was operated at 60 pulses per second (PPS) direct current (DC). In this design, cathode arrays were located along the front and sides of the boat, while two anode boom arrays were mounted off the bow to complete the electrical circuit. An output power of 4.0 - 5.0 amperes was used and adjusted according to the responses of walleye to the electric field. Electroshocking settings were adjusted to provide a balance between maximizing capture efficiency while not injuring fish.

3.2 Radio Telemetry

After capture, walleye were held in an aerated live well prior to implantation of radio transmitters. All fish were anaesthetized with clove oil prior to implantation. Based on existing studies, solutions of 5:1 to 10:1 ethanol to clove oil in various concentrations of water were recommended depending on application (Anderson et al. 1997, Peake 1998, Prince and Powell 2000, Woody et al. 2002). Our observations in 2003 showed that walleye responded to these concentrations by displaying vigorous mouth 'popping' and gill flaring when removed from the anesthetic solution, regardless of the concentration of clove oil. The intensity and occurrence of this behavioural response decreased when the ratio was adjusted to a 1:1 ethanol / clove oil solution. The concentration used in 2004 was adjusted again from a 1:1 to a 1:4 ratio as the active constituent in clove oil appeared

to have degraded from the previous year. Four mL of the solution were added to 20 L of river water to produce a 100 mg/L solution of anesthetic. Fish were anesthetized, measured (FL), weighed (g), expressed to determine for sex (i.e., the presence of milt or eggs), and tagged with a T-bar anchor, external Floy™ tag prior to being placed on the operating bed to facilitate implantation of radio transmitters.

Walleye greater than 430 mm FL were considered mature and generally of adequate size for implantation of a intraperitoneal transmitter. Implantation of radio tags were conducted according to methods documented in Bidgood (1980) and McKinley (1992). We used a transmitter weight ratio range of 5% of body weight (Moser et al. 1990, Jakober et al. 1997) to 12% (Brown et al. 1999) of body weight to ensure fish did not experience adverse effects on swimming performance. In 2003, 50 Lotek™ coded microprocessor series (MCFT-3L™ dimensions: 16x73 mm and 26 g) and 18 Global Tracking System™ FH-3 series (GTS™ dimensions: 73 mm in length and 28 g) transmitters were implanted into adult walleye. The coded transmitters are designed to accommodate multiple individual transmitters on a single frequency. In 2004, a combination of Lotek™ 3V microprocessor beeper (n = 18) and coded (n = 1) series (MBFT-3A™ dimensions: 46x16 mm and 16 g) and two Global Tracking System™ FH-3 series (GTS™ dimensions: 58 mm in length and 10 g) were deployed. Radio transmitters implanted in 2003 had a minimum battery life of 3.1 years, while those implanted in 2004 had a battery life of 314 days. According to the manufacturer, the transmitters were effective up to a depth range of 14 ft (4.3 m). The total number of frequencies were split and scanned for on two Lotek™ SRX_400 4 MHz bandwidth receiver / data loggers.

Telemetry relocation events in 2003 started on 12 May and concluded on 19 August. Telemetry events in 2004 were initiated earlier in the season starting on 16 April and concluding on 27 August. In 2003, aerial surveys were completed on three occasions per week in the spring and once weekly for the majority of the summer period (i.e., 1 June to 19 August). Fish movements in 2004 were tracked twice for the months of April and August, 3 times a week for May, and weekly for June and July. Fish were located by fixed wing aircraft (Cessna Cardinal 177) using a four element "Yagi" directional antennae mounted on the wings. Survey flights were conducted 100 -150 m above the water at approximately 110 to 115 km/h and orientated to the horizon. Relocation

methods in 2004 were augmented with surveys using other modes of transportation (i.e., helicopter, powerboat, and canoeing events).

Flight surveys began immediately upstream of the confluence of West Prairie River and South Heart River and proceeded in downstream direction to the Horse Lakes complex, Buffalo Bay and the closed zone of Lesser Slave Lake. Two survey passes were made in the Horse Lakes, Buffalo Bay and the seasonal closure zone study area; a counter-clockwise pattern starting at the inlet of each basin and running southwest was used on the first pass, and a clockwise pattern running northeast on the second pass. Flights were limited to within the seasonal closure zone on Lesser Slave Lake.

Telemetry reconnaissance using a canoe (assisted by a 4 hp motor) were limited to the area that extended between bridges on highways 749 and 750 (Figure 1). For efficiency, this section was further split into 2 survey sections: one from Hwy 749 bridge to the Swamp Road bridge, the second from the Swamp Road bridge to the Hwy 750 bridge.

Telemetry surveys via powerboat were limited to the seasonal closure zone of Lesser Slave Lake, downstream of the Hwy 750 bridge. A 22 ft (6.7 m) Eaglecraft with a 225 hp motor and an 18 ft (5.5 m) Marathon with a 115 hp motor were used for the powerboat surveys. Both boats were operated at a maximum speed of 40 km/hr during survey events. Spatial data were recorded with a GARMIN™ 12 CX field global position system (GPS) receiver.

3.3 Data Management

All field data were recorded on standardized field forms and entered into Microsoft EXCEL spreadsheets. Locations of walleye implanted with radio transmitters were corrected to hydrographic data using Microsoft MapInfo™. Biological and spatial information on implanted fish were loaded into the Provincial Government's Fisheries Management Information System (FMIS) under Inventory Project number 4561. All data analyses were performed using Microsoft EXCEL™ 2000, FAST© 2.0 software whereas spatial data were analyzed and presented using Arcview™ 3.2.

3.4 Relocation Efficiency And Accuracy

We attempted to test the assumption that all implanted fish within the survey area would be located by approximating the probability of locating an implanted fish using different modes of travel. Specifically, we approximated the effectiveness of survey staff and equipment in relocating transmitters from various modes of travel within the study area and assessed the accuracy of relocations. During May 2004, 12 radio transmitters comparable to those used in the study were deployed randomly throughout the study area. Transmitters were secured to anchors and placed at varying water depths and locations. Seven of the 12 test transmitters were deployed with surface floats to facilitate recovery of the units at the end of the project. During each telemetry survey, five different test frequencies were randomly selected and scanned for independently on each receiver (e.g., three frequencies on one receiver and two on the other). Results from various survey modes were analysed using maximum likelihood estimation from the binomial distribution.

In August 2004, five test transmitters were deployed throughout the boat study section at random locations from Arcview™ Create Random Pointsscript. Two search patterns were used (i.e., serpentine and circular), to determine which pattern was more effective in picking up the frequency signal. Additional tests were conducted to assess the range of detection at various depths. The data collected during these surveys were analysed using JMP® 5 software.

3.5 Temperature Monitoring

Water temperatures were monitored during the study to correlate the timing of spawning movements. Two MicroDaq™ T-100-WP temperature loggers were deployed on 11 April 2003 and 16 April 2004. The devices were secured by nylon coated aircraft cable to separate pilings on the Highway 750 bridge. The units were protected within concrete cinderblocks that were lowered into the water. The units were retrieved on 22 July 2003 and 19 Aug 2004.

4.0 RESULTS

4.1 Electrofishing

In 2003, walleye were implanted with radio transmitters and tracked as close to the onset of the spawning run as possible. However, the presence of substantial ice cover and hazardous weather conditions, delayed capture of walleye until 1 May. Collection and transmitter implants of walleye continued throughout the month of May, concluding on 28 May. Ice conditions were more favorable in 2004 and as a result walleye were collected and implanted with radio transmitters on 29 April 2004.

4.2 Radio Transmitter Implants In Walleye

In 2003, 68 walleye that were implanted with transmitters of which 72% were females and 28% were males. The largest fish implanted was a spent female (FL = 727 mm, body weight = 3290 g) and the smallest fish implanted was a ripe female (FL = 440 mm, body weight = 985 g). A means table displaying the fork length and weight averages of fish implanted for both 2003 and 2004 is provided in Table 1. Fork length frequency distributions of all fish implanted within this project are presented in Figures 2 and 3.

In 2004, 21 walleye that were implanted with transmitters of which 52% were females and 48% were males. The largest fish implanted was female with a fork length of 749 mm weighing 4900 g. The smallest fish implanted was male with a fork length of 442 mm and weighed 1387 g. Three male fish implanted were underweight compared to their measured fork length; maturity could not be determined for one of the males while the other two were categorized as 'ripe' (i.e., peak sexual maturity).

We were successful in maintaining the recommended 5% weight ratio between the transmitter weight and body weight of implanted walleye (Winter 1983) for both years surveyed. The relative weight of radio transmitters ranged from 0.8% to 3.0% of body weight of implanted walleye. Previous research on body weight to transmitter weights ratios (Moser et al. 1990, Jakober et al. 1997, Brown et al. 1999) suggest that the movement patterns and swimming performance of the implanted walleye were not greatly affected by the size of transmitters deployed in our study. By contrast, it is

possible that fish movements during the first two weeks following surgery may be influenced by the implantation of transmitters (Knights and Lasse 1996, Paukert et al. 2001). However, relocation data in 2004 on the returning fish from the 2003 implants is expected to be minimally influenced by the presence of transmitters.

Table 1. Mean (± 1SE) fork length and weights of walleye implanted with transmitters in 2003/2004 in South Heart River, Alberta. SE = standard error of the estimate. * = means and standard error estimates based on 18 individuals, ** = means and standard error estimates based on 66 individuals.

Year	Sex	Number of fish	Mean fork length (mm)	Fork length SE (mm)	Mean weight (g)	Mean weight SE (g)
2003	M	19	506.2	7.5	1307.6*	53.9
	F	49	531.3	10.1	1678.9*	100.8
	Total	68	524.3	7.7	1577.7**	77.3
2004	M	10	521.4	13.6	1409.4	88.6
	F	11	562.5	32.6	2177.2	400.6
	Total	21	543.0	18.4	1811.6	226.0

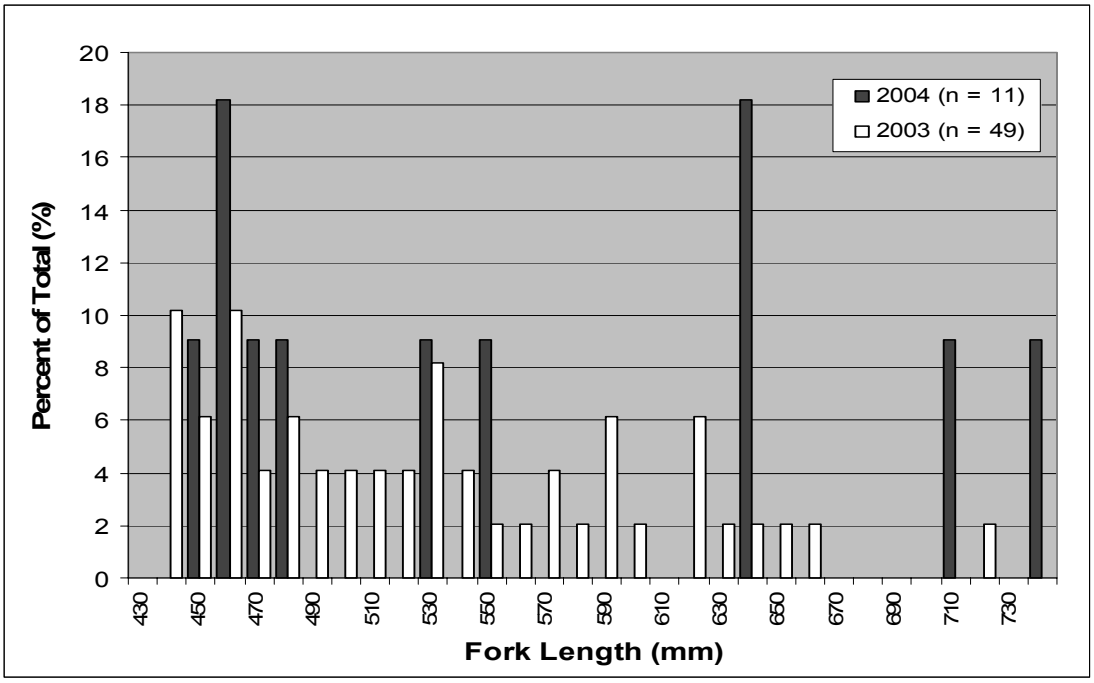

Figure 2. Fork length distribution of female walleye implanted with transmitters in the South Heart River, Alberta in 2003-2004.

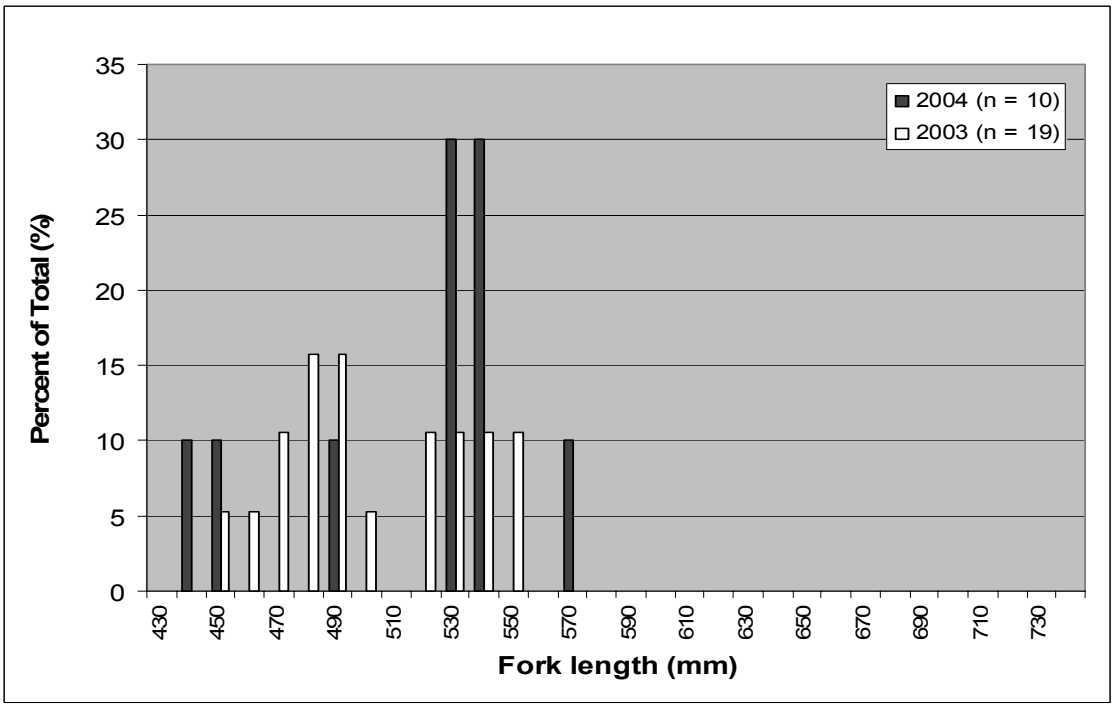

Figure 3. Fork length distribution of male walleye implanted with transmitters in the South Heart River, Alberta in 2003-2004.

4.3 Radio Telemetry

Aerial telemetry surveys in 2003 commenced on 12 May with a total of 14 relocation flights conducted from 12 May to 19 August 2003. Over this 14-week period, 307 relocation points were collected on 68 walleye. We successfully relocated almost half of all individual walleye (i.e., 44%) on more than 5 occasions (i.e., relocation events). Four (5.9%) of the walleye implanted with transmitters were not relocated after the implant procedure. Relocation points for 2003 and 2004 data are shown in Figure 4. Interference was experienced in both surveyed years with the MBFT-3A™ coded series transmitters causing them to not code out. Identification of individual fish implanted with these coded tags could not be discerned during all telemetry surveys.

In 2004, aerial surveys commenced on 16 April and throughout the season comprised 15 flights (including two helicopter events), four canoe and six powerboat surveys over the study area from 16 April to 27 August. During this 19-week period, 236 relocation points were collected on 49 individual walleye. Of the total number of fish relocated, 28 were individuals implanted in 2003. We successfully relocated 41% of all implanted walleye on more than five distinct relocation events. One fish, implanted in 2003, was successfully re-located 18 times. Of the fish implanted in 2004, only one fish (Frequency 148.800 Code 60) was not relocated after being released. All relocation points are shown in Figure 4. Numbers of relocations of implanted walleye are provided in Table 1.

The sample size of fish tracked during the spawning phase and post-spawning phase was reduced slightly from the original number of fish implanted in both years. The reductions were likely due to angler harvest of walleye. Since 2003, we confirmed that five implanted walleye had been removed during the study due to angler harvest. There were reports of two other implanted fish that were captured and released; tag information was only provided for one walleye (Frequency 150.300, Code 040). Although, it is highly likely that more implanted walleye were harvested we cannot quantify levels of angler-induced mortality.

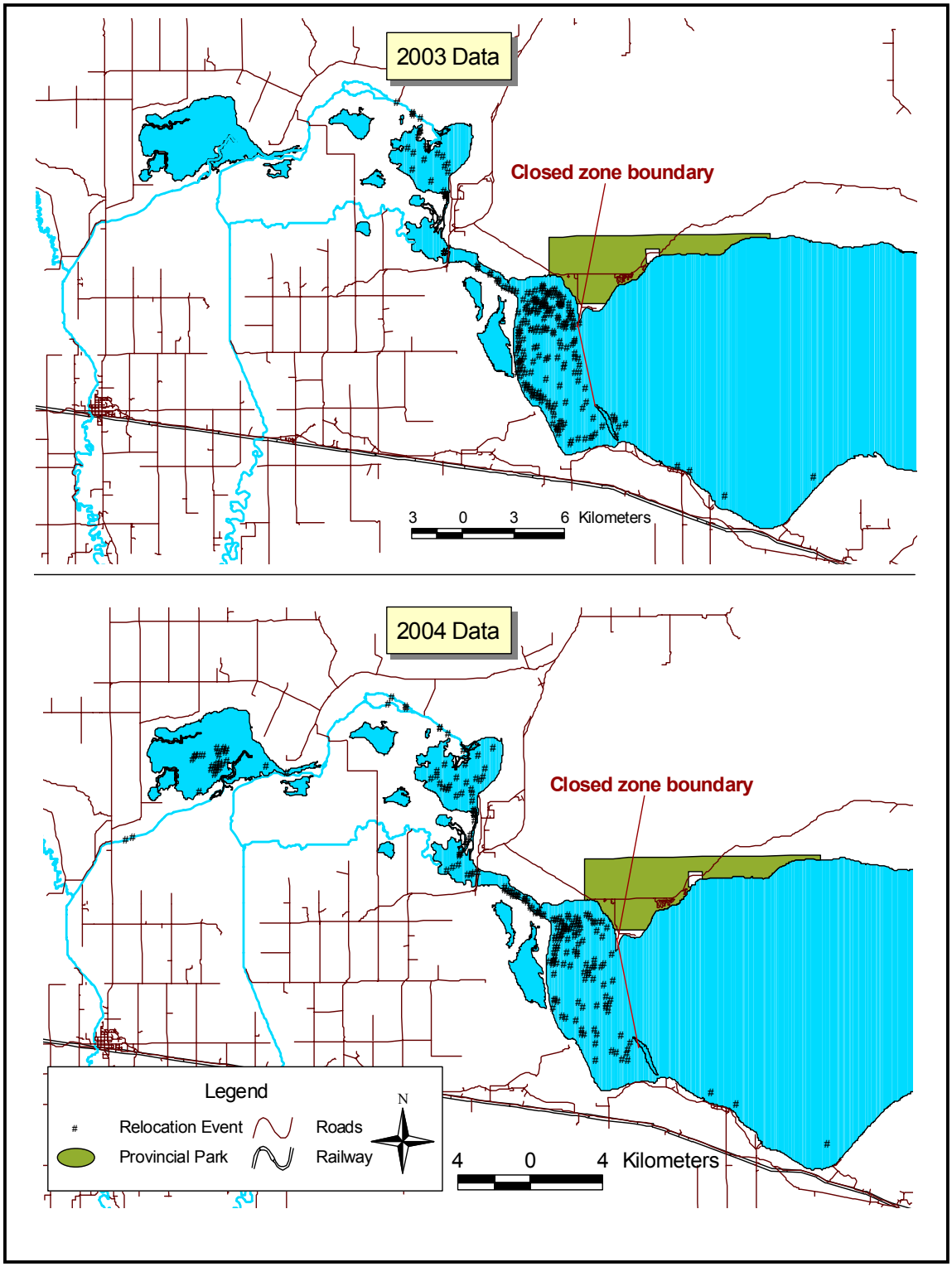

Figure 4. Location of individual walleye implanted with radio transmitters in the South Heart River and Lesser Slave Lake, Alberta in 2003-2004.

Table 2. Total number of walleye relocated in 2004 implanted with radio transmitters in 2003-2004 in South Heart River, Alberta.

Year implanted	Radio frequency	Radio code	Total relocation events
2003	148.780	14	3
	148.800	29	4
	150.280	35	1
	150.300	47	1
	150.300	50	4
	148.780	16	2
	150.280	30	2
	150.280	34	1
	150.300	59	3
	148.780	18	1
	150.280	44	2
	149.607		1
	149.622		7
	149.690		3
	149.706		2
	149.736		4
	150.280	41	3
	149.634		2
	149.304		2
	149.672		2
	149.722		2
	149.026		2
	149.085		2
	149.101		1
	149.131		3
	149.208		18
	149.232		11
	149.257		2
2004	148.100		4
	148.200		11
	148.300		6
	148.320		8
	148.360		7
	148.380		6
	148.400		12
	148.420		11
	148.440		10

	148.460		10
	148.500		7
	148.540		5
	148.600		3
	148.680		7
	148.700		8
	148.760		6
	148.800	60	1
	149.360		3
	149.420		8
	150.340		6
	150.500		6
Grand Total	**49**		**236**

4.3.1 Re-location Events before Opening Date (June 15)

Telemetry flights commenced on 16 April 2004 and resulted in the relocation of eight walleye implanted in 2003 downstream of the South Heart River mouth. The next fixed wing aircraft survey on 29 April, prior to implanting new transmitters, resulted in the relocation of seven fish, two of which had moved into Buffalo Bay. The first helicopter survey on 1 May resulted in the relocation of nine fish implanted in 2003 in addition to 17 fish implanted in 2004; none of these fish were found upstream of Buffalo Bay. Walleye were not relocated upstream of Buffalo Bay until 10 May when one female was relocated in the southern most braided channel of the South Heart River.

Data collected in 2004 showed that fish moved into new areas of the South Heart River (Figures 5 – 8). By contrast, we generated little evidence that walleye used these areas in 2003. For example, 23 individuals were relocated upstream of Buffalo Bay between 10 – 31 May 2004. Walleye (n=20; female to male ratio 7:13) were relocated within Horse Lakes during the spawning phase movements. The furthest migrations recorded were two displayed by males that moved approximately seven kilometers upstream of Horse Lakes into the South Heart - West Prairie River. Previous studies have also reported walleye dispersing as far as the lower reaches of the East and West Prairie rivers (Dietz and Tulman 1981).

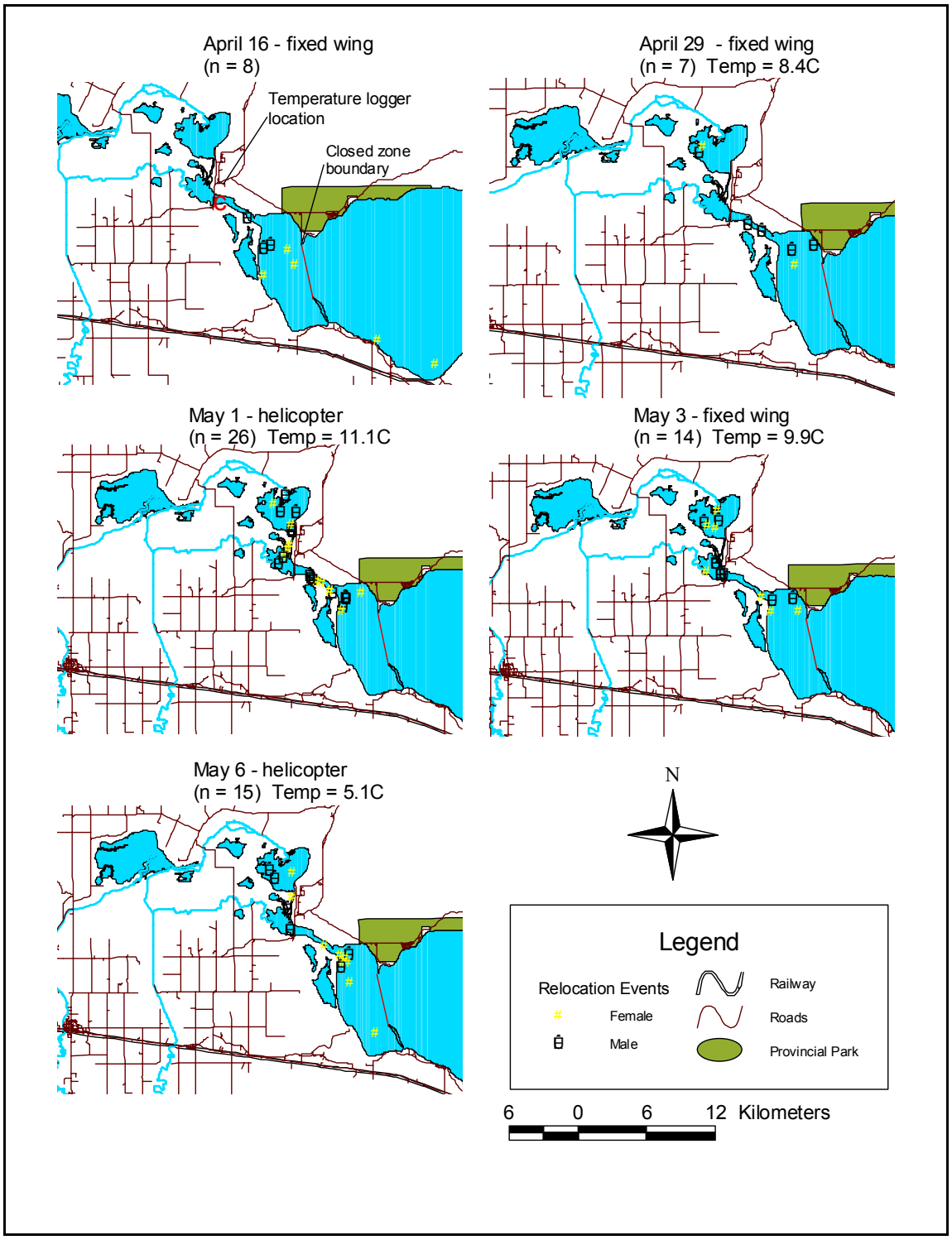

Figure 5. Locations of walleye implanted with radio transmitters in the South Heart River - Lesser Slave Lake, Alberta from 16 April to 6 May, 2004.

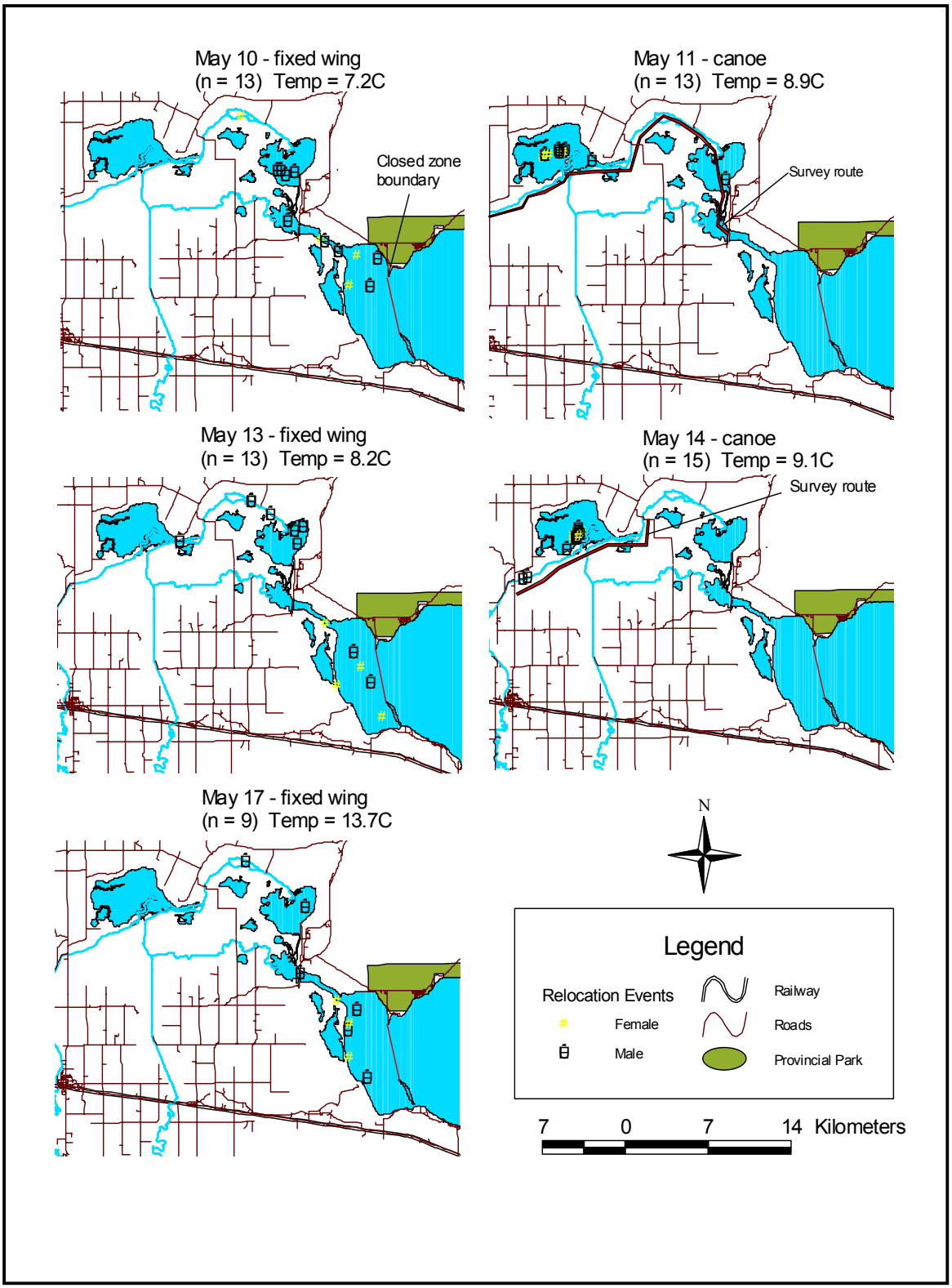

Figure 6. Locations of walleye implanted with radio transmitters in the South Heart River - Lesser Slave Lake, Alberta from 10 - 17 May, 2004.

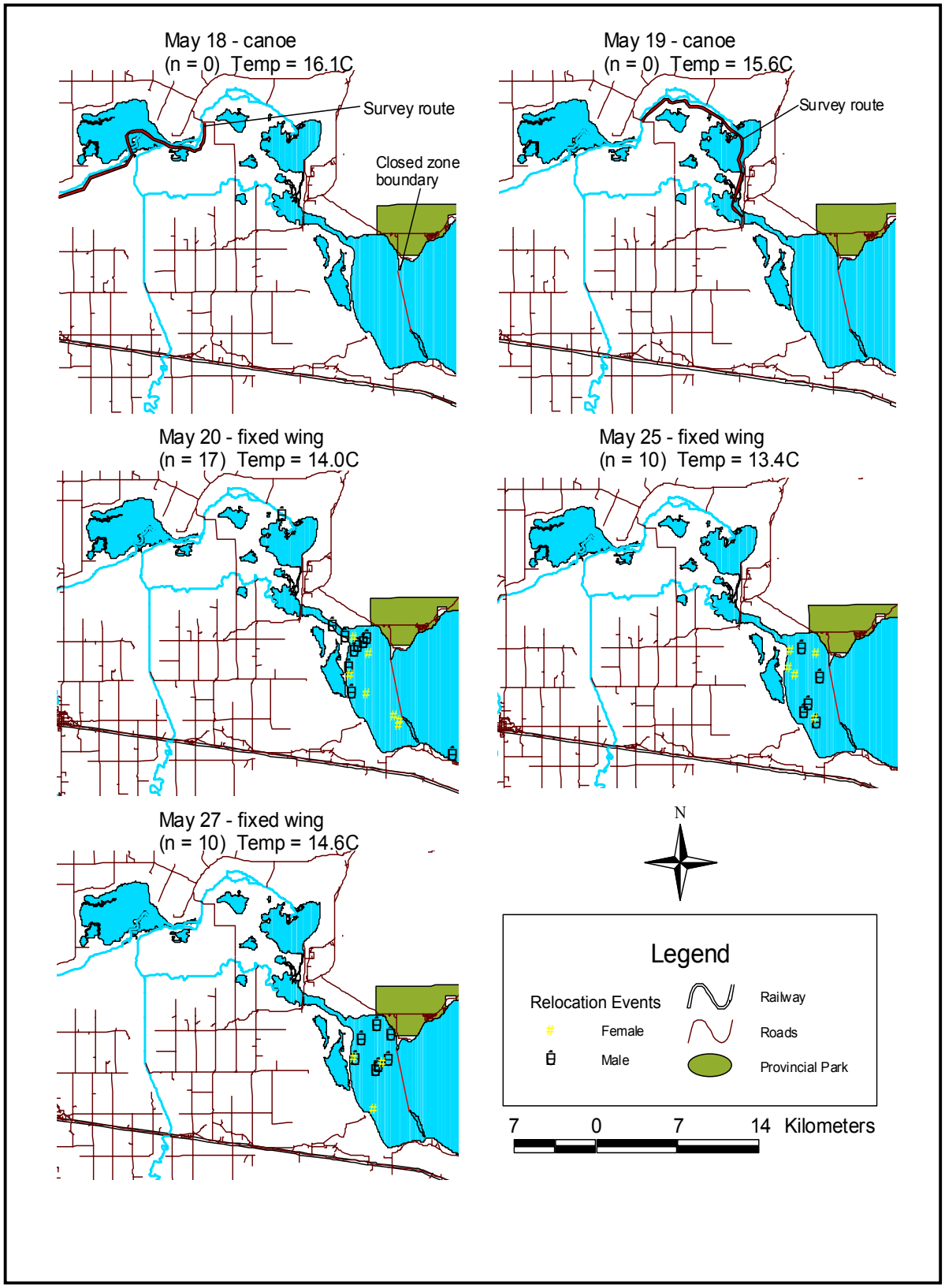

Figure 7. Locations of walleye implanted with radio transmitters in the South Heart River - Lesser Slave Lake, Alberta from 18 – 27 May, 2004.

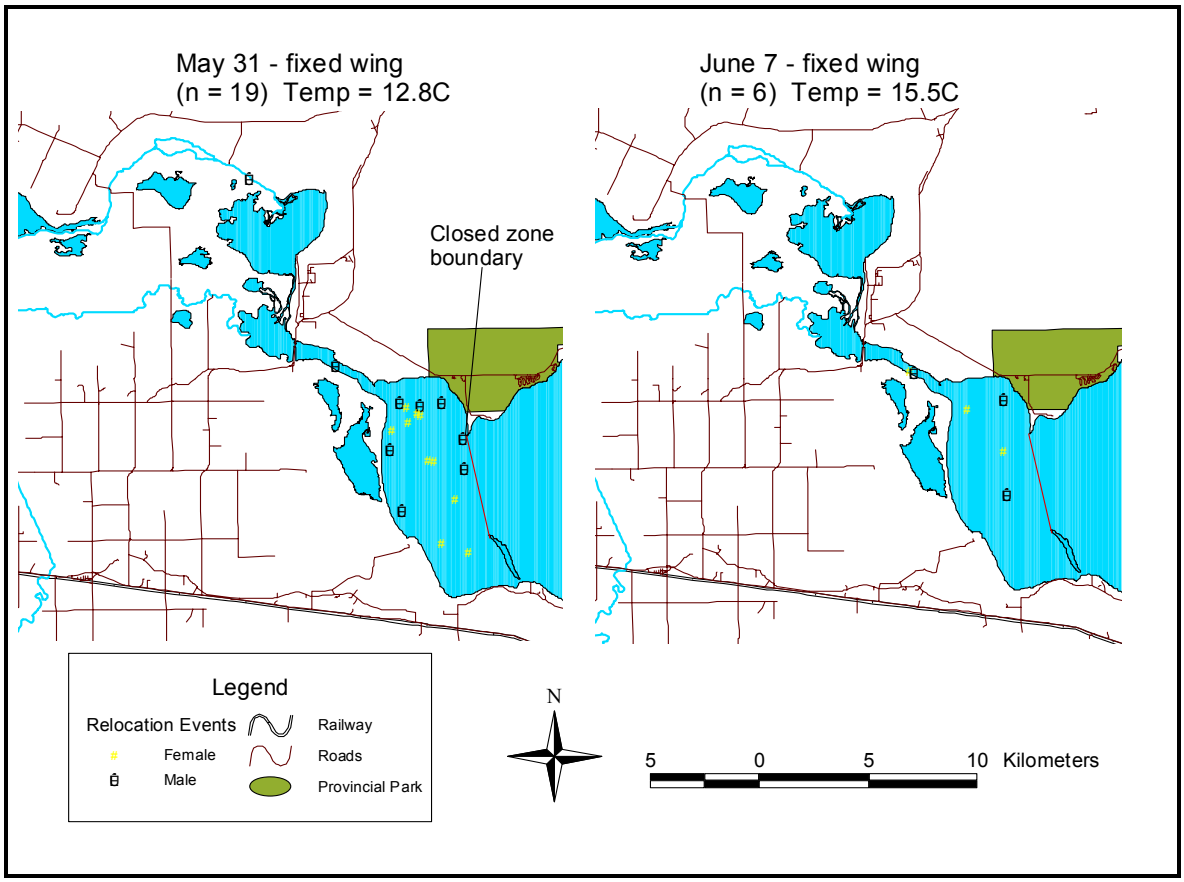

Figure 8. Locations of walleye implanted with radio transmitters in the South Heart River - Lesser Slave Lake, Alberta for 31 May and 7 June, 2004.

In 2004, female walleye were not observed upstream of Buffalo Bay after 17 May whereas males continued to be present in this area until 20 May. Analyses of data collected in 2003 showed limited movement of walleye above Buffalo Bay; one female was relocated above the Bay on 2 June. In 2004, all walleye had left Buffalo Bay by 7 June with six fish relocated in the seasonal closure zone of the lake. Relocation data collected in 2003 showed walleye had left the Buffalo Bay system by 9 June with a large percentage of the fish (49%) present in the seasonal closure zone. Results from telemetry surveys completed from 16 April to 7 June 2004 are provided in Figures 5 – 8.

4.3.2 Re-location Events after Opening Date (June 15)

In 2004, surveys were conducted in the seasonal closure zone after 15 June by powerboat and fixed wing flights once a week in June and July. The study area was surveyed on 17 June and resulted in the relocation of four walleye within the seasonal closure zone (Figure 9). Three additional surveys completed from a powerboat in August identified two walleye, a male and female, in the closure zone on 27 August 2004 (Figure 10).

Data collected in 2004 showed a decrease in the number of walleye located in the seasonal closure zone of the lake as compared to 2003. On 16 June 2003, 14 walleye were relocated downstream of the South Heart River mouth compared to 4 walleye relocated on 17 June 2004. Overall, implanted walleye were found to stage in the seasonal closure zone of the lake after 15 June for both surveyed years. Although, it appears the numbers of walleye remaining in this area are variable.

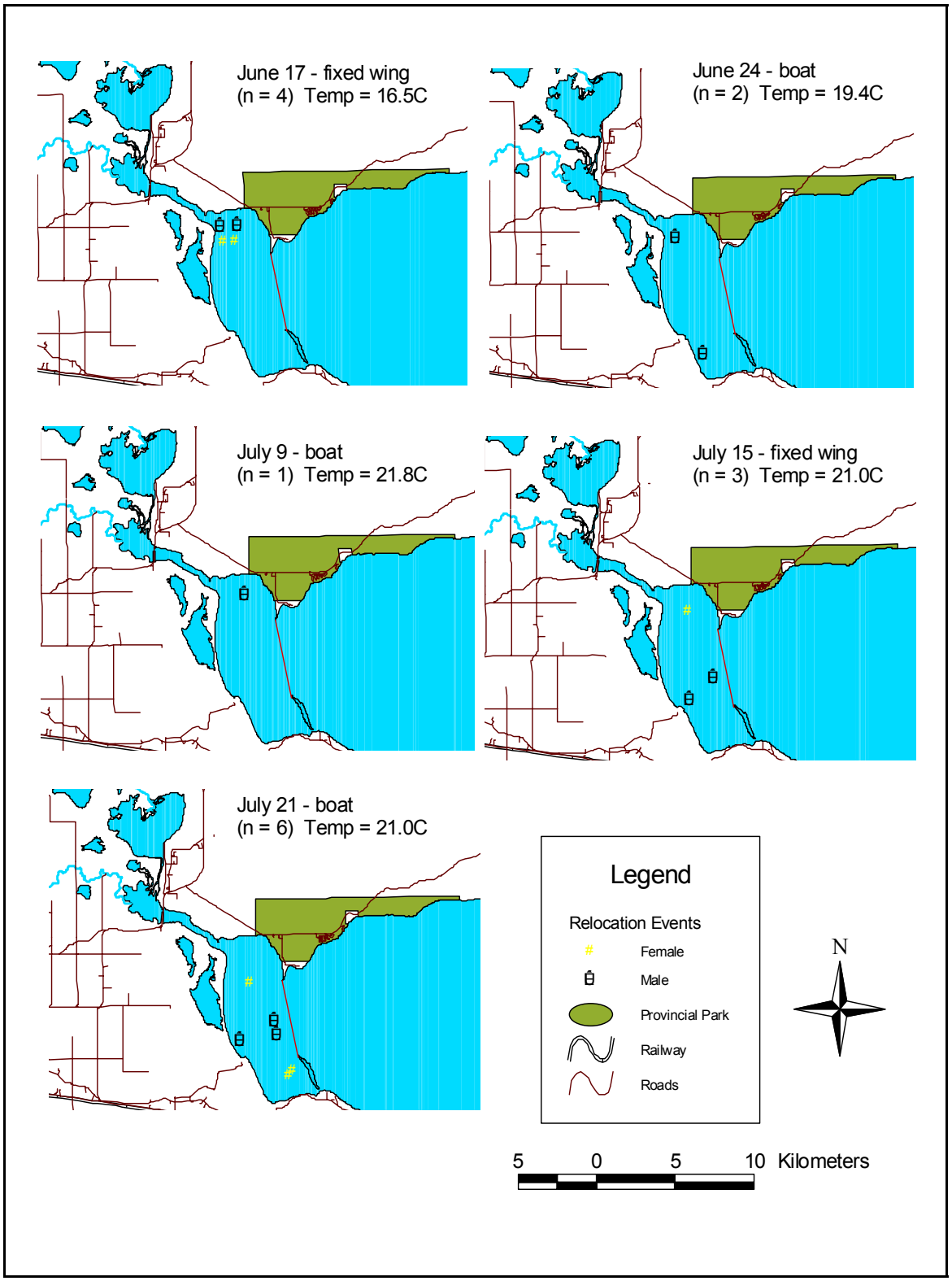

Figure 9. Locations of walleye implanted with radio transmitters South Heart River - Lesser Slave Lake seasonal closure zone from 17 June – 21 July 2004.

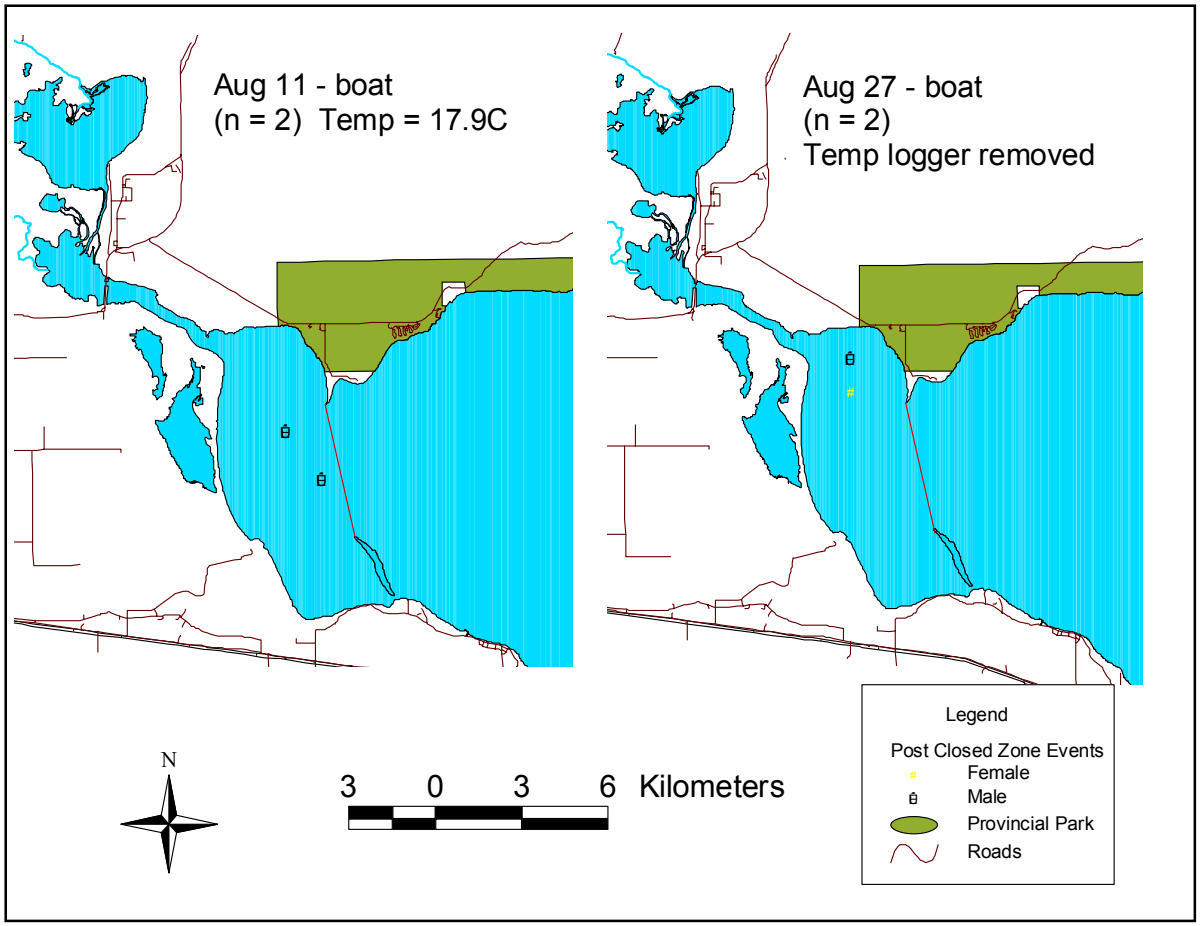

Figure 10. Locations of walleye implanted with radio transmitters in the South Heart - Lesser Slave Lake seasonal closure zone for 11 and 27August, 2004.

4.3.3 Individual Walleye Movements within the Study Area

Radio transmitter implant operations in 2004 were completed early in the spawning migration and thus provided increased spring phase (i.e., the period between 30 April and 30 May) movement data compared to 2003. As observed movement of fish is a function of how often the fish is located (Baras 1998), those fish with multiple relocation events (e.g., greater than five events) often showed distinct movement patterns through the study area in 2004. The presence of walleye in Horse Lakes has only been reported through unpublished trapping data that captured male walleye at the lake outlet (Martin Brilling, Alberta Sustainable Resource Development, Fish and Wildlife Division, Slave Lake, Alberta, pers. comm.). Relocation surveys also recorded movements of two female walleye that illustrate this migration into Horse Lakes (Figure 11). Of the twenty-five

females relocated in 2004, 36% were observed on more than five occasions. Interestingly, all of these fish were implanted in 2004. Of the 15 female walleye implanted in 2003 that were relocated in 2004, none were relocated on greater than five occasions.

Walleye locations recorded in 2003 likely did not provide an adequate assessment of spring phase movements as a result of transmitter implants occurring late in the spawning migration. Of the fish implanted in 2003, three were relocated on more than five occasions in 2004 and all of these walleye were male. One of the males (Frequency 149.208) was relocated 18 times in 2004; all but one of the relocations was in the seasonal closure zone of the lake. Relocations of the remaining two males (Frequency 149.622 and 149.232) implanted in 2003 are provided in Figure 12.

The telemetry surveys for this project all occurred during daylight hours and as such, nocturnal movements of walleye during that time period were not assessed. Previous activities involving trapping of walleye on the South Heart River (Martin Brilling, Alberta Sustainable Resource Development, Fish and Wildlife Division, Slave Lake, Alberta, pers. comm.) reported that the greatest movement of fish occurred during the evening when water temperatures peaked. Scott and Crossman (1973) report that walleye spawning takes place at night. This telemetry survey project documented areas that are important to walleye during their spring phase movements.

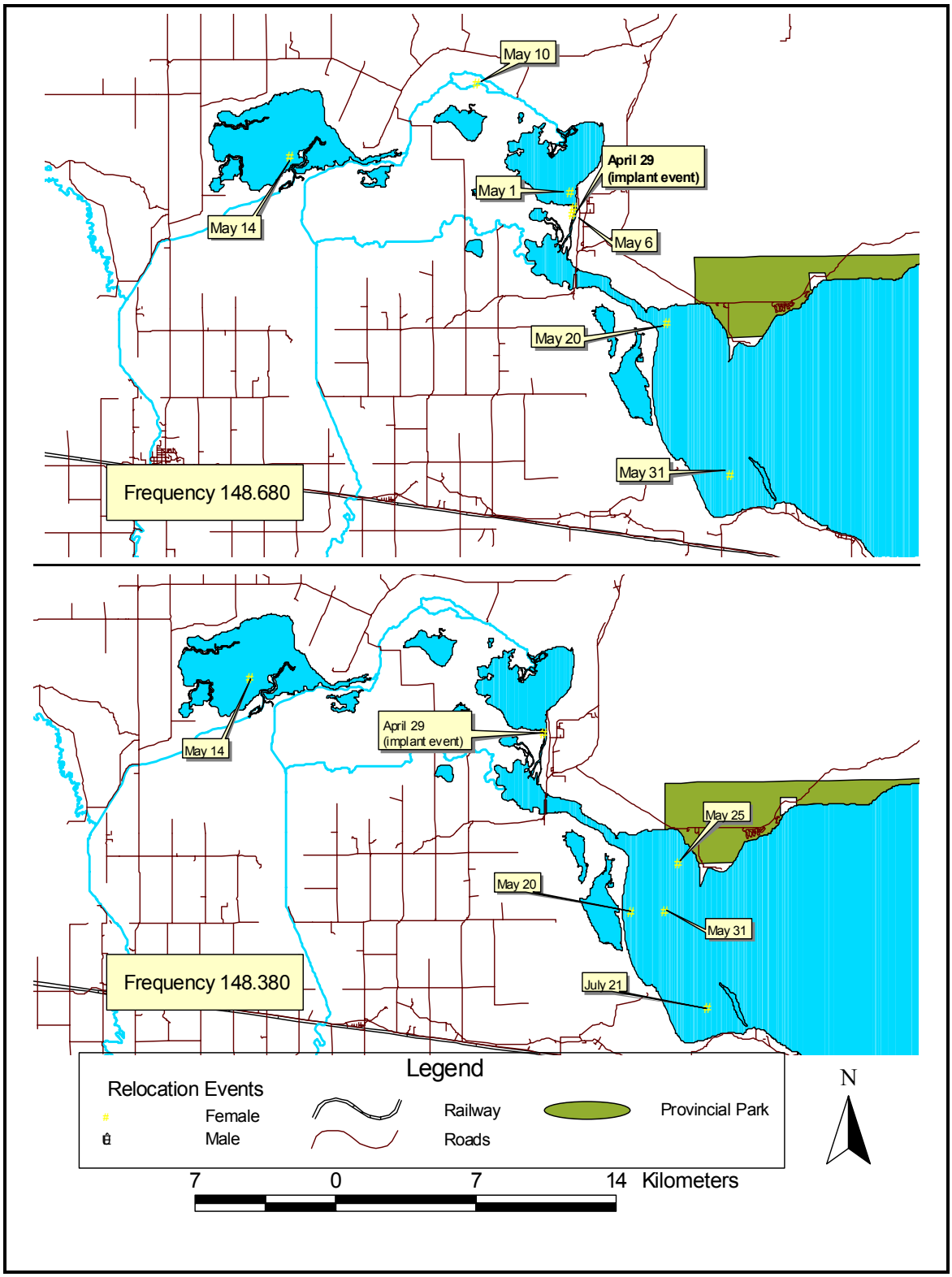

Figure 11. Example of movement patterns of two female tagged walleye that were relocated upstream of Buffalo Bay within the South Heart River - Lesser Slave Lake, Alberta.

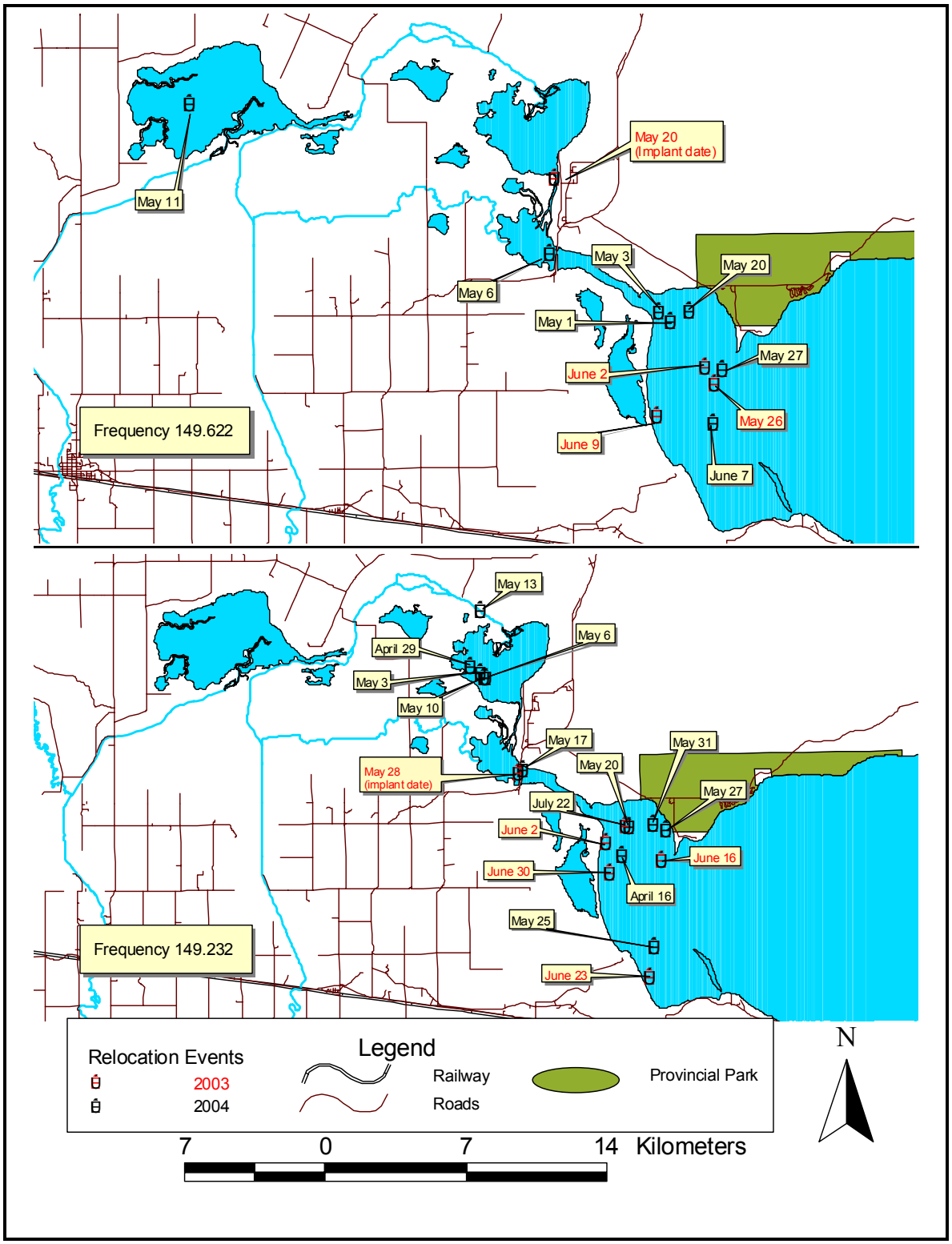

Figure 12. Example of movement patterns of two male walleye in 2003 and 2004, South Heart River - Lesser Slave Lake, Alberta

4.4 Relocation Efficiency and Accuracy

When results of survey modes (i.e., type of travel: fixed wing, helicopter, powerboat or canoe) were combined, a success rate (i.e., proportion of test tags in the study area that were relocated) of 50-68% resulted (Figure 13). Using this success rate as an overall proxy for detecting an implanted walleye within the study area, there was between 32 and 50% chance of not relocating an implanted fish.

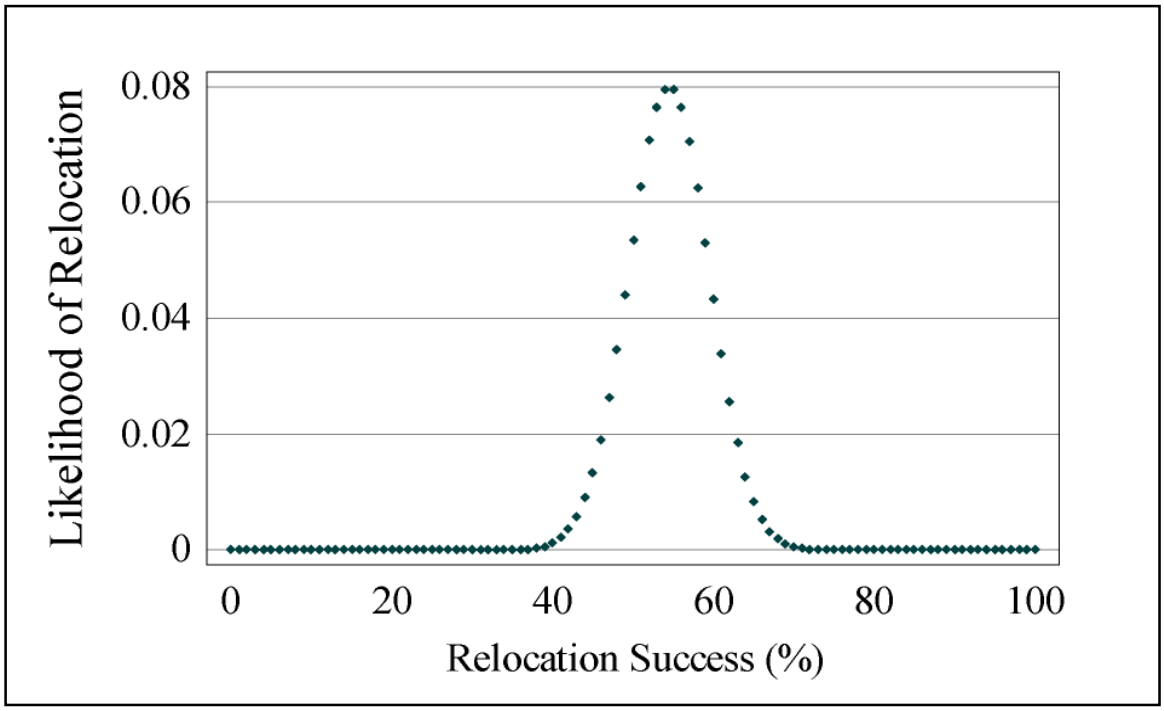

Figure 13. Binomial distribution of test transmitter relocation success within the South Heart River study area, Alberta (mode = 0.5444 ± 0.1888).

When results from survey modes were separated, the canoe mode of telemetry surveying was the most effective (75% success; range = 47 – 91%) based on 12 surveys. The fixed wing survey mode on average produced 37% (range = 23 – 53%) success based on 38 separate surveys. Separate analyses were not completed for powerboat and helicopter survey modes due to inadequate sample size.

The canoe survey mode provided the greatest accuracy (distance to actual location: 49 ± 38.7 m) in determining the spatial location of the test tags. Where as fixed wing survey modes provided the least accuracy (distance to actual location: 260 ± 251.2 m). A map of the test transmitter physical locations and survey locations are shown in Figure 14. Helicopter and powerboat events were not analyzed because of the lack of relocation events for test transmitters. Although not tested, we believe that the variable level of accuracy using the global positioning system (GPS) can account for some measure of error in determining the spatial location of transmitters. For the purposes of this study, the level of accuracy was deemed to be adequate.

The number of frequencies that are scanned on a receiver can affect relocation success. Although the coded transmitters were used to address the high number of frequencies and corresponding total scan time, interference experienced with the coded frequencies meant that on several occasions individual fish could not be relocated. The interval between scanning for individual frequencies increases as the number of frequencies scanned for increases. For example, the telemetry receiver dedicated to beeper tag relocation scanned for 31 frequencies (including 2 test frequencies) on each telemetry survey. At a scan time of 3 seconds per frequency, it required 93 seconds (1 min 33 sec) to scan all of the frequencies (i.e., an individual frequency was scanned for a duration of 3 seconds at an interval time of 93 seconds between scans). The second telemetry receiver, which scanned at 4 seconds for both coded and beeper frequencies (n=16), required 64 seconds (1 min 4 sec) to scan all frequencies. This could explain why slower survey modes like canoeing, were more effective than aircraft surveys; slow travel speed allowed all frequencies to be scanned before potentially traveling beyond the range of detection.

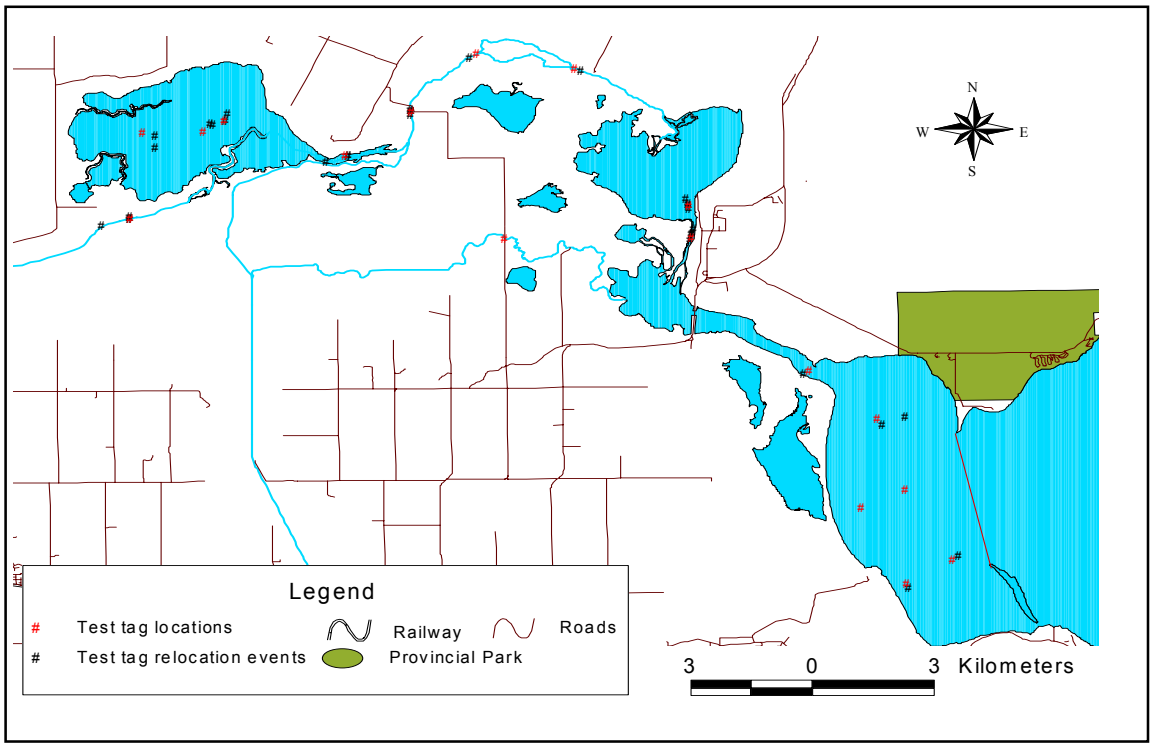

Figure 14. Map of test tag locations and corresponding relocations in the South Heart River and Lesser Slave Lake, Alberta.

Frequencies were deleted from the receiver once fish were relocated. If the time interval between scanning has a direct effect on the probability of detecting an individual fish, then the likelihood of relocating fish would increase as frequencies were removed from the receiver. Other factors influencing signal attenuation included water temperature, frequency interference, water conductivity and the fishes' relative position in the water (under cover) (Winters 1996).

4.5 Temperature Monitoring

Daily maximum and minimum temperatures are presented in Figure 15. Scott and Crossman (1973) suggest optimum spawning temperature range for walleye to be between 5.6°C - 11.1°C; this range is provided in Figure 15. Dietz and Tulman (1981)

documented that walleye spawning in South Heart River coincided with water temperatures between 7.7 to 11.1°C. Average daily temperatures recorded in 2004 ranged from 0.5°C (17 April) to 24.9°C (18 July) during the study period. Field collections in 2004 coincided with an average daily temperature of 8.4°C compared to 9.6°C recorded for the start of 2003 implants. This may have influenced the spawning stage (e.g., pre or post-spawn) at which walleye were intercepted in 2003 and explain the lack of recorded upstream movement. Cold spring ambient temperatures were experienced between 5 – 7 May 2004, causing the water temperature to drop slightly. Movement of fish upstream of Buffalo Bay coincided with a temperature of 7.2°C. In 2004, no fish were relocated upstream of the bridge crossing after 7 June; an average temperature of 16.5°C was recorded for that day. In 2003, no fish were relocated upstream of the bridge crossing after 2 June when the average daily water temperature was 17.1°C.

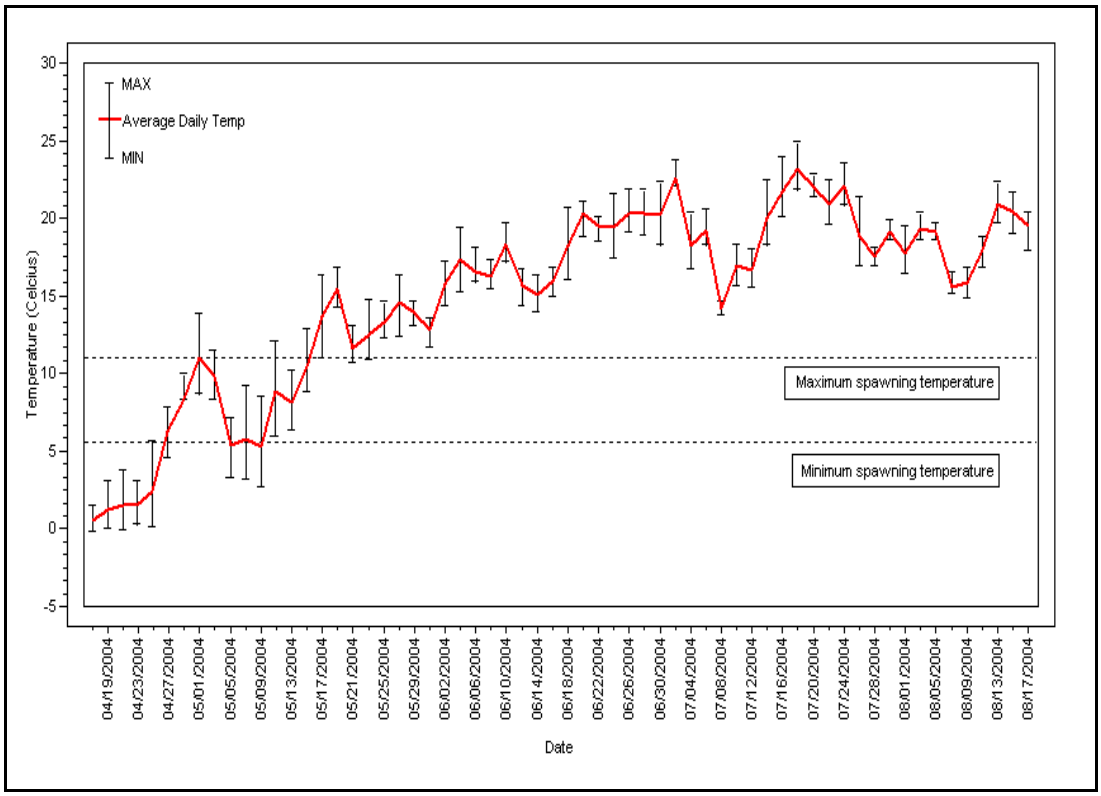

Figure 15. Average daily temperatures for 2004 recorded at the Highway 750 bridge crossing on the South Heart River, Alberta. Optimum spawning temperature range (max / min) as suggested by Scott and Crossman (1973).

4.6 Summary

Movement data of walleye collected in 2004 were believed to be more representative of spring phase movements of walleye compared to 2003. The earlier timing of flights to relocate walleye and implant operations resulted in the interception of pre-spawning phase walleye in the South Heart River. It also allowed for improved tracking of individual fish movement upstream of Buffalo Bay (i.e., observed movement being the function of how often the fish was located (Baras 1998). To obtain better estimates of true movement patterns and timing information we recommend more continuous tracking over 24-hour periods.

In 2004, locations recorded from 28 fish implanted in 2003 provided spring phase data representative of fish not influenced by handling or interruption of their annual migration. Although several reports document that fish undergoing invasive surgery may exhibit abnormal activity patterns at least two weeks following surgery (Smith 1974, Manns and Whiteside 1979, Knights and Lasse 1996, Paukert et al. 2001) we did not observe abnormal behavior from walleye implanted during the spring of 2004. Of the 49 fish relocated in 2004, 47% were relocated upstream of Buffalo Bay with the majority (61%) being fish implanted in 2003.

Recent distributions of spawning walleye within the South Heart River may indicate a shift from historically known spawning areas. Past walleye demographic studies identified areas such as the outlet channel of Horse Lakes and the locally known site of Mullen's farm as critical walleye spawning areas (Walty 1992, Collett and Rhodes 1995, Lewis 1985, O'Neil and Nelson 1984, O'Neil 1983). The absence of fish, especially males staging within these areas during non-spawning periods (i.e., during the day) could indicate a shift away from traditionally known sites. Additional surveys, such as egg sampling, would need to be conducted to confirm new or previously undocumented spawning areas.

That said, the overall health of the entire South Heart River system must be protected to ensure walleye populations can continue to spawn in the drainage. This includes protecting all habitats needed during their spring migration such as feeding and staging areas. The Horse Lakes complex was identified during this telemetry survey as an important area to spawning walleye as they may be using this area for feeding either before and / or after depositing their eggs downstream. This would align with previous studies conducted by Buchwald and Kaleta (1987) that found this complex supported high numbers of forage fish. Based on historical and current evidence we recommend Horse Lakes be recognized as important fish habitat and designated as such.

Habitats needed by walleye during their spring phase movements, as identified by this telemetry project, will guide habitat remediation initiatives conducted by ACA in the South Heart River drainage. The South Heart River and Lesser Slave Lake Riparian Conservation Project was initiated in 2004 to conserve riparian habitat within the South Heart River and Lesser Slave Lake shorelines. For example, a partnership with the Horse

Lakes Grazing Association enabled the construction of an exclusion fence to protect a portion of the Horse Lakes complex from cattle grazing. It is anticipated that with increased awareness and successful partnership initiatives, additional riparian habitat in the South Heart River and Lesser Slave Lake will be protected.

Migration timing of walleye out of the seasonal closure zone of Lesser Slave Lake varied between 2003 and 2004. Data collected in 2003 showed a larger percentage (21%) of fish remained within the seasonal closure zone after it opened to angling, as compared to the four walleye (8%) relocated on 17 June 2004. This variability in walleye numbers may be attributed to environmental factors (i.e., temperature, light intensity, food availability) within the river and lake dictating the walleye's duration within this protected zone (Scott and Crossman 1973). The seasonal closure timing, based on these data, appears to offer some protection to walleye during the post-spawning phase. However, for extended protection it would be beneficial to extend the seasonal timing to account for variable residency time of post-spawn walleye in the seasonal closure zone.

The results obtained by testing telemetry assumptions illustrate factors that can affect telemetry relocation success (e.g., total scan time). We found that more accurate relocations were obtained with slower mode(s) of transportation to accommodate for large total scan times. Although the surveys conducted from a canoe were the most effective (e.g, 75% relocation success) and accurate (e.g., 49 m), it may not be the most practical for all circumstances.

5.0 REFERENCES

Alberta Sustainable Resource Development, Fish and Wildlife. 2004 Alberta guide to sportfishing regulations. Queen's Printer Bookstore, Edmonton, Alberta, Canada. 92 pp.

Anderson, W.G., R.S. McKinley, and M. Colavecchia. 1997. The use of clove oil as an anesthetic for rainbow trout and its effect on swimming performance. North American Journal of Fisheries Management 17: 301-307

Baras, E. 1998. Selection of optimal positioning intervals in fish tracking: an experimental study in *Barbus barbus*. Hydrobiologia 371/372:19-28.

Berry. D.K. 1978. Preliminary biophysical survey of the tributary streams entering the south and west shores of Lesser Slave Lake. Alberta Recreation, Parks and Wildlife Division, Slave Lake, Alberta, Canada. 71 pp.

Brilling, M. 1991. A trap netting study of the Horse Lakes outlet channel, South Heart/West Prairie River, April 1991. Slave Lake, Alberta, Canada. Field data sheets collected by Fish and Wildlife Division, Alberta Sustainable Resource Development, Fish and Wildlife Division, Slave Lake, Alberta, Canada.

Brown, R.S., S.J. Cooke, W.G. Anderson, and R.S. McKinley. 1999. Evidence to challenge the "2% rule" for biotelemetry. North American Journal of Fisheries Management 19: 867-871

Buchwald, V. and T. Kaleta. 1987. Small fish survey of Horse Lakes, Buffalo Bay and Lesser Slave Lake. Draft report completed by Fish and Wildlife Division, Slave Lake, Alberta, Canada. 18 pp + App.

Collett, T. and T. Rhodes. 1995. Walleye egg and substrate sampling program for the Buffalo Bay, West Prairie/South Heart River, Grouard Channel and Lesser Slave Lake spawning areas, 1992 – 1993. Slave Lake, Alberta, Canada. 47 pp + App.

Dietz, K. 1979. Some aspects of the life history of walleye (*Stizostedion vitreum vitreum*) in Lesser Slave Lake, Alberta. Report prepared for Alberta Fish and Wildlife Division. Slave Lake, Alberta, Canada. 38 pp.

Dietz, K. 1982. Spawning movements of Lesser Slave Lake walleye (*Stizostedion vitreum vitreum*) into Buffalo Bay and the South Heart River. K.G.D. Environmental Consultants Ltd. Report prepared for Alberta Energy and Natural Resources. Slave Lake, Alberta, Canada. 26 pp.

Dietz, K., and C. Tulman. 1981. The life history of walleye (*Stizostedion vitreum vitreum*) in Lesser Slave Lake, Alberta. Fish and Wildlife Division, Edmonton, Alberta, Canada. 14 pp.

Jakober, M.J. 1995. Autumn and winter movement and habitat use of resident bull trout and westslope cutthroat trout in Montana. Master's Thesis. Montana State University, Bozeman, USA.

Knights, B. C., and B. A. Lasse. 1996. Effects of implanted transmitters on adult bluegills at two temperatures. Transactions of the Amercian Fisheries Society 125: 440-449.

Lewis, J. 1985. Walleye spawning run evaluation Lesser Slave Lake – Buffalo Bay System, 1985. F&W Biophysical Research Ltd. Report prepared for Alberta Fish and Wildlife Division, Slave Lake, Alberta, Canada. 55 pp.

Lucko, B. 1997. Walleye fry emergence and migration in the Buffalo Bay / South Heart River system. Environmental Protection, Natural Resources Service, Slave Lake, Alberta, Canada. 22 pp + App.

Lucko, B. 2000. Lesser Slave Lake creel survey summer 1999. Technical report produced by Alberta Conservation Association, Peace River, Alberta, Canada. 34 pp.

Manns, R.E., and B.G. Whiteside. 1979. Behavioral variations associated with ultrasonic tagging of Guadalupe bass in Lake Travis, Texas. Underwater Telemetry Newsletter 9: 4-9

Moser, M.L., A.F. Olson, and T.P. Quinn. 1990. Effects of dummy ultrasonic transmitters on juvenile coho salmon. Pages 353-356. *In* N.C. Parker and five coeditors. Fish marking techniques. American Fisheries Society, Symposium 7, Bethesda, Maryland, USA.

O'Neil, J. 1983. Walleye spawning movements into Buffalo Bay and the South Heart River (1983). RL & L Environmental Services Ltd. Report prepared for Alberta Fish and Wildlife Division, Slave Lake, Alberta, Canada. 49 pp.

O'Neil, J. and R. Nelson. 1984. Walleye movements and spawning in the Lesser Slave Lake (west basin) – Buffalo Bay System (1984). RL & L Environmental Services Ltd. Report prepared for Alberta Fish and Wildlife Division, Slave Lake, Alberta, Canada. 53 pp.

Osokin, L. and J. Tchir. 2003. Progress Report: South Heart River walleye project. Technical report produced by Alberta Conservation Association, Slave Lake, Alberta, Canada. 19 pp + App.

Paukert, C. P., P. J. Chvala, B. L. Heikes, and M. L. Brown. 2001. Effects of implanted transmitter size and surgery on survival, growth, and wound healing of bluegill. Transactions of the American Fisheries Society 130: 975-980.

Peake, S. 1998. Sodium bicarbonate and clove oil as potential anesthetic for nonsalmonid fishes. North American Journal of Fisheries Management 18: 919-924.

Prince, A., and C. Powell. 2000. Clove oil as an anesthetic for invasive field procedures on adult rainbow trout. North American Journal of Fisheries Management 20: 1029-1032.

Scott, W.B. and E.J. Crossman. 1973. Freshwater fishes of Canada. Fisheries Research Board of Canada, Ottawa, Canada. 966 pp.

Smith, D.C. 1974. Movement and home range of largemouth bass (*Micropterus salmoides*) tagged with ultrasonic transmitters. Master's thesis. Clemson University, Clemson, South Carolina, USA.

Strong, W.L., Leggat, K.R. 1992. Ecoregions of Alberta. Land Information Services Division, Alberta Forestry, Lands and Wildlife, Edmonton, Alberta, Canada.

Walty, D.T. 1992. A comparison of walleye egg densities and substrate preference for two walleye spawning areas in the South Heart/West Prairie Rivers, 1991. Unpublished report produced by Alberta Fish and Wildlife Division, Slave Lake, Alberta, Canada.

Winter, J.D. 1996. Advances in underwater biotelemetry. *In* B.R. Murphy and D.W. Willis, editors. Fisheries Techniques, second edition. American Fisheries Society, Bethesda, Maryland, USA. 555 - 590 pp.

Woody, C.A., J. Nelson, and K. Ramstad. 2002. Clove oil as an anesthetic for migrating sockeye salmon: field trials. Journal of Fish Biology 60: 340-347.

Walleye implanted with a transmitter ready to be released back into the South Heart River, Alberta.
Photo credit: Al Wildeman