

**Lake Sturgeon Population Characteristics, Movements,  
and Habitat Use in  
the Namakan Reservoir**

**2009 Progress Report**

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## Objectives

This multiagency project has two primary objectives:

1. Determine population characteristics of lake sturgeon in the Namakan Reservoir
2. Document seasonal habitat use and reproductive patterns of lake sturgeon in the Namakan Reservoir

## Preliminary results

### *Population characteristics*

A total of 101 adult lake sturgeon (*Acipenser fulvescens*) were captured in the Namakan Reservoir in May 2009 (Figure 1). Lake sturgeon were collected using gillnets by a multi-agency team that included biologists from the National Park Service, Ontario Ministry of Natural Resources, the U.S. Forest Service, Minnesota Department of Natural Resources, and South Dakota State University. All lake sturgeon were measured for total length, fork length, girth, and weight. Pectoral fin ray sections were collected from each fish for aging purposes. A blood sample was taken and used to determine gender and stage of maturity. Lake sturgeon (n=159) collected in 2008 and 2009 were added to a combined lake sturgeon database (J. Eibler, MN Department of Natural Resources) that includes all fish captured in Minnesota and Ontario portions of the Namakan system (including the Namakan River downstream of Snake Falls) from 2004 to 2009.

Population analyses were conducted on all fish contained in the database (n=663).

Sampling efforts from 2004 to 2009 resulted in a total catch of 663 lake sturgeon (Figure 2). Total length (TL) of lake sturgeon ranged from 774 to 1746 mm (n=622;  $\bar{x}$  TL 1245 mm) and was related to weight (WT, in kg) using the equation,

$$\log_{10}WT = -9.593 + 3.448(\log_{10}TL)$$

(log-log linear regression;  $r^2 = 0.92$ ,  $P < 0.001$ ).



Figure 1. The Namakan Reservoir is comprised of five connected lakes (Kabetogama, Namakan, Sand Point, Crane, and L. Vermillion), with 77% of the total area in Minnesota.

Blood samples were taken from 87 sturgeon in 2009. A total of 136 blood [plasma] samples from fish collected in 2008 and 2009 were sent to the U.S. Fish and Wildlife Service Bozeman Fish Technology Center for analysis of estradiol and testosterone concentration. To date, 125 plasma samples have been analyzed and resultant data revealed 91 females and 34 males. Namakan Reservoir fish exhibit sexual dimorphism typical of sturgeon species with females being generally older and larger than males (Table 1).

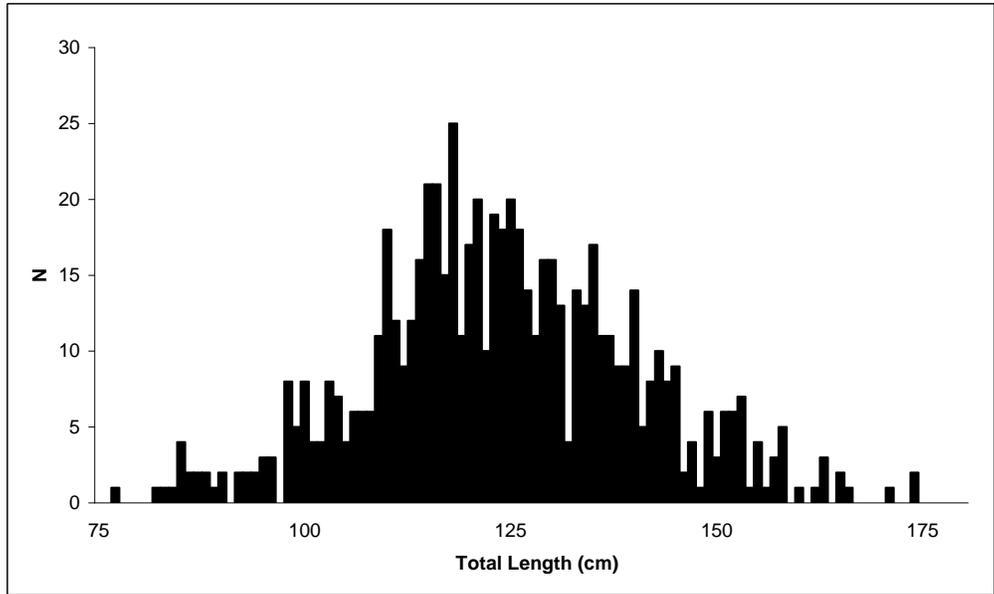


Figure 2. Length frequency distribution of lake sturgeon collected from Namakan Reservoir from 2004 to 2009.

Table 1. Age, length and weight of female and male lake sturgeon collected in Namakan Reservoir 2008 and 2009.

Parameter	Females (n = 91)	Males (n = 34)
Mean age (years)	47 (9 - 86)	40 (19 - 66)
Mean total length (mm)	1327 (832 - 1715)	1238 (1005 - 1442)
Mean weight (kg)	15.93 (5.4 - 35.0)	12.94 (6.0 - 22.0)

Growth increments on pectoral fin ray cross-sections were found to underestimate the true age of lake sturgeon on Lake Winnebago, Wisconsin greater than 14 years, and error increased with increasing age (Bruch et al., 2009). Therefore, an aging correction (true age = [estimated age]<sup>1.054796</sup>) was applied to all lake sturgeon 15 years of age and above (Bruch et al., 2009). The mean age of fish collected in Namakan Reservoir was 36 years (n=533, range 9 to 86 years; Figure 3). A total of 61 year classes were represented

from 1923 to 1999. A weighted, catch-curve analysis was conducted for lake sturgeon from the 1953 to 1981 year classes. The 1981 year class was the first year class considered fully recruited to the gear and the 1953 year class was the oldest age group with at least five individuals. Catch curve analysis showed that total annual mortality (A) was 4.8%, total annual survival (S) 95.2%, and instantaneous mortality (Z) was -0.0491. Lake sturgeon recruitment was consistent in Namakan Reservoir, with no missing year classes (Figure 4), although year class strength was variable. The strongest year classes occurred between 1963 and 1972 (ages 46-37).

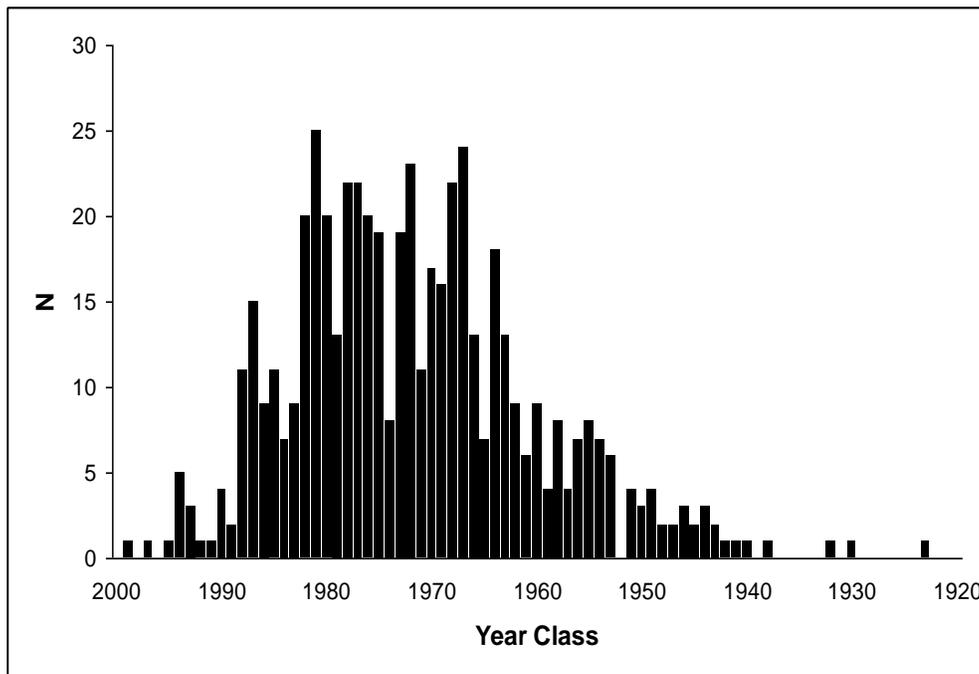


Figure 3. Age structure of lake sturgeon (n=533, sexes combined) from Namakan Reservoir collected from Minnesota and Ontario waters 2006-2009.

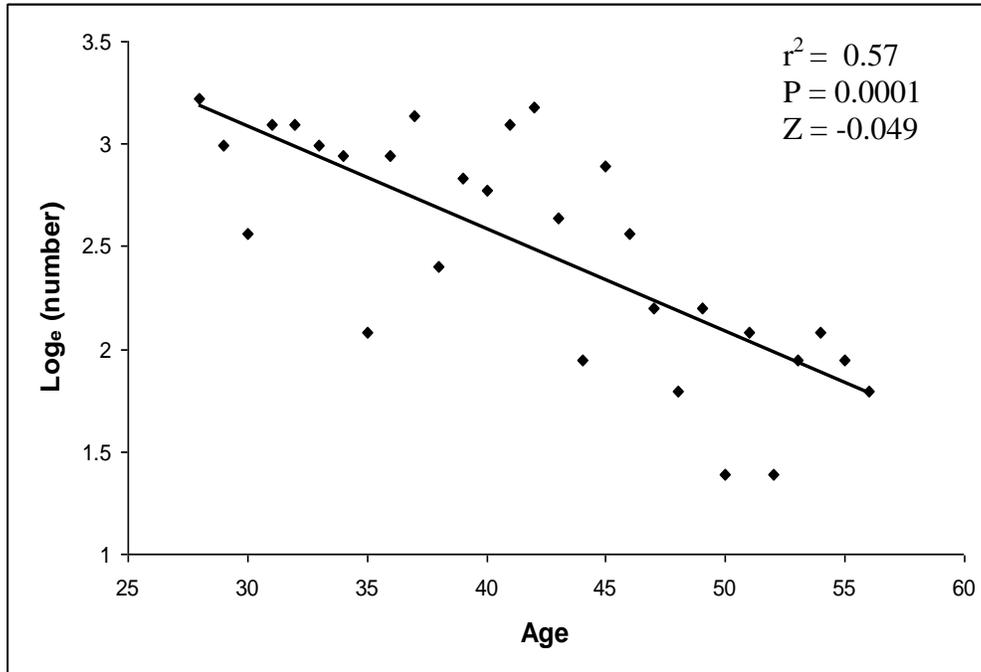


Figure 4. Catch curve analysis of Namakan Reservoir lake sturgeon. Data represent the 1981 to 1953 year classes.

*Seasonal movement patterns and habitat characteristics*

To determine seasonal movement patterns, 26 lake sturgeon were implanted with Vemco V16 acoustic transmitters (Figure 5a) in 2008 throughout the Namakan Reservoir (Figure 6a). Fish implanted with transmitters ranged in total length from 863 to 1662 mm ( $\bar{x} = 1256$  mm), girth from 329 to 659 mm ( $\bar{x} = 455$  mm) and weight from 4.25 to 31.1 kg ( $\bar{x} = 13.5$  kg). Fifteen VEMCO VR2W submersible receivers (Figure 5b) were stationed throughout Namakan Reservoir to track sturgeon movements (Figure 6b). HOBO temperature loggers were attached to stationary receivers to monitor lake water temperatures throughout the year.



Figure 5. a) VEMCO V16 acoustic transmitter. b) VEMCO VR2W acoustic receiver.

The acoustic technology used in this study is identical to that used in a separate study conducted by the Ontario Ministry of Natural Resources (OMNR) of lake sturgeon in the Namakan River. Thirty-four (34) lake sturgeon were implanted with acoustic transmitters by the OMNR (30 in 2007 and 4 in 2008) and thirteen (13) receivers were deployed throughout the Namakan River. Results from the Namakan River work are reported separately in McLeod and Debruyne (2009).

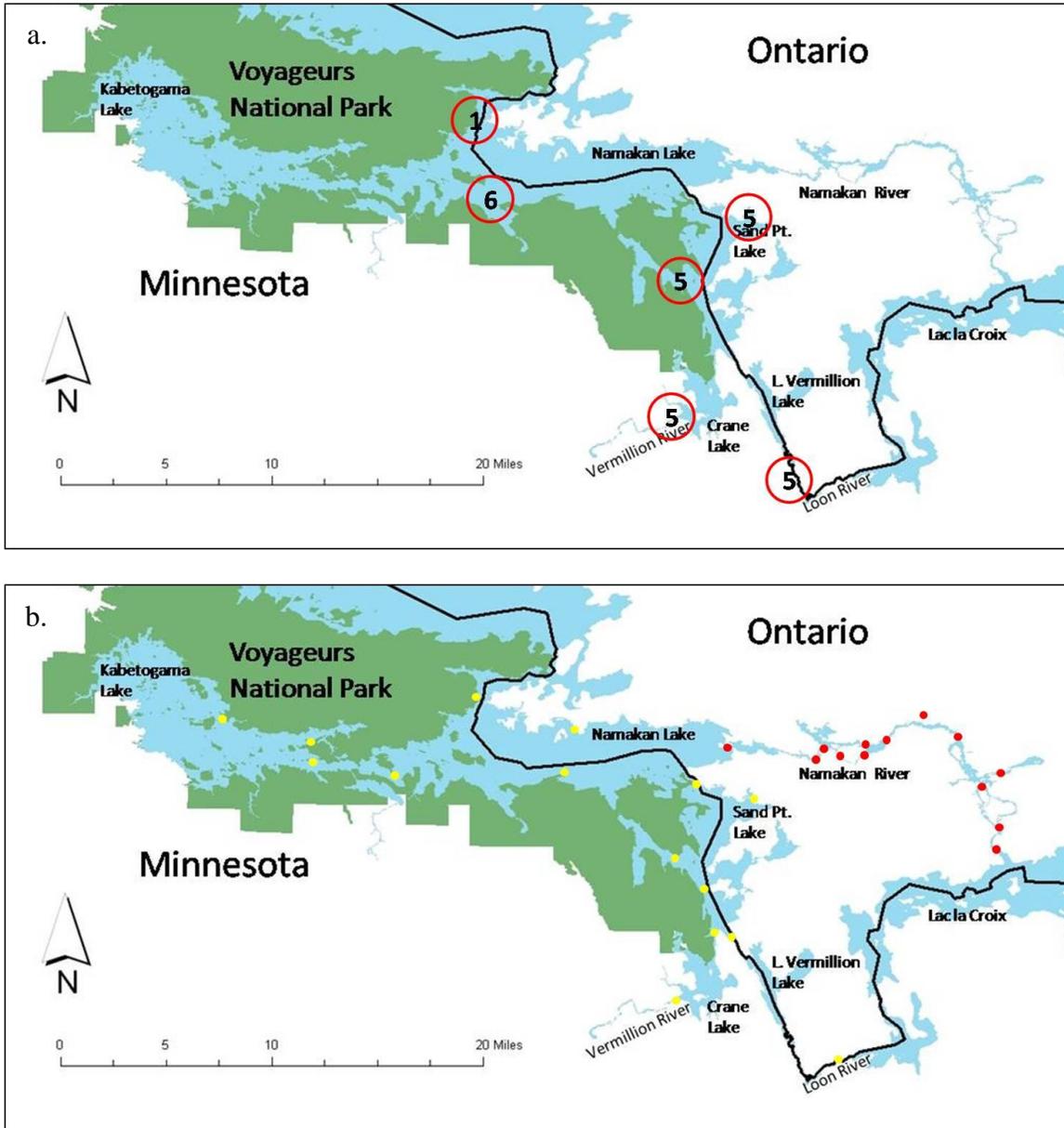


Figure 5. a). Release sites of 26 sturgeon implanted with acoustic transmitters in May 2008 in the Namakan Reservoir (large red circles with # of sturgeon). b). Locations of fifteen VEMCO VR2W receivers stationed within Namakan Reservoir to track movements of acoustically tagged lake sturgeon (yellow dots). Thirteen additional receivers were deployed in the Namakan River by the Ontario Ministry of Natural Resources in 2007/2008 (red dots).

Data from receivers were downloaded in May and October 2009. Twenty-five (25) of the 26 fish implanted with transmitters in this study have been detected at least once in the Namakan Reservoir or River. Sturgeon have been documented in all parts of the Namakan Reservoir (Kabetogama, Namakan, Sand Point, Crane, and Little Vermillion Lakes) and on both sides of the international boundary. To date, 18 of the 26 lake sturgeon (~70%) collected in the Namakan Reservoir and implanted with transmitters by this study were detected by OMNR receivers in the Namakan River, with 15 of these detected upstream of Lady Rapids (Darryl McLeod, personal communication) (Figure 7, Table 2). Most of these sturgeon were females (75%) and eight of these fish likely over-wintered in Little Eva Lake. Three more likely over-wintered in Three Mile Lake. In the spring of 2009, lake sturgeon implanted with transmitters in this study were documented in the upper reaches of the Namakan River from High Falls to as far upstream as Snake Falls. Additionally, 18 of the 34 fish implanted with transmitters by the OMNR in the Namakan River have been detected in the Namakan Reservoir. Individual movements of all lake sturgeon detected at least once in the Namakan Reservoir from May 2008 to July 2009 are shown in the Appendix.

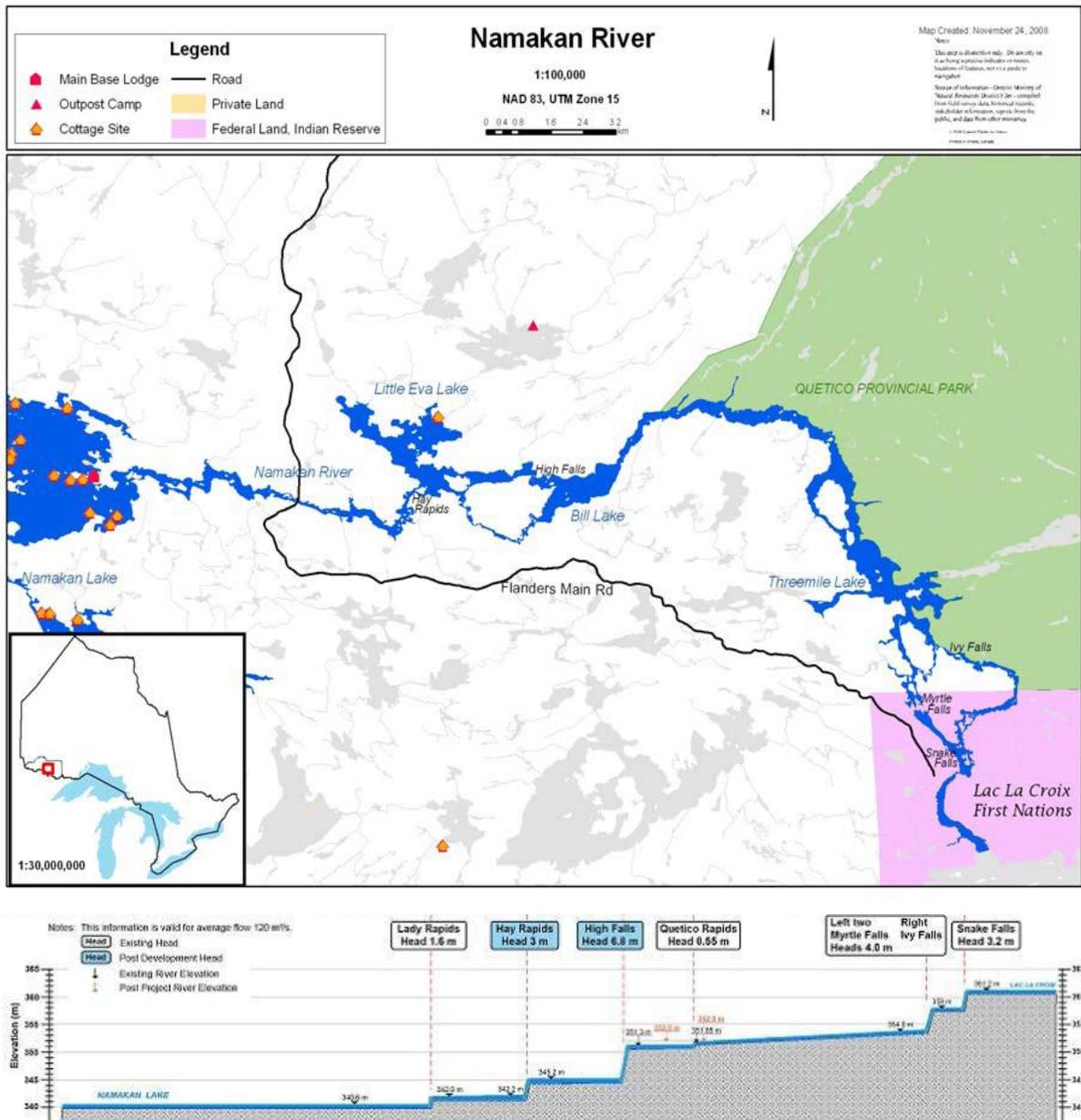


Figure 7. Location of the sites of interest in the Namakan River, Ontario. A proposed hydro development site is located at High Falls. Elevations are based on a mean flow of 120 m<sup>3</sup>/s. Reprinted from McLeod and Debruyne (2008) with permission.

Table 2. Lake sturgeon implanted with NPS transmitters detected in the Namakan River May 2008 through October 2009.

Transmitter Code	Sex	Age	Total Length (mm)	Date first detected in the river	Date last detected in the river	Farthest Upstream Detection
8495	F	-----	1277	8/26/08	7/17/09	Below High Falls
49630	F	55	1534	6/9/08	5/29/09	Below Myrtle Falls
49631	-----	29	1055	8/22/09	10/21/09	Below High Falls
49632	F	41	1245	6/23/08	5/29/09	Three Mile Lake
49633	F	43	1354	6/20/08	8/27/09	Three Mile Lake
49634	-----	17	1125	6/4/08	7/8/09	Below Myrtle Falls
49635	F	48	1430	7/14/08	8/31/09	Below Myrtle Falls
49637	F	46	1177	7/10/08	6/20/09	Below Myrtle Falls
49638	F	59	1415	6/27/08	9/18/09	Mouth of Namakan River
49640	M	41	1275	7/7/08	6/19/09	Below Snake Falls
49641	F	-----	1250	7/2/09	10/21/09	Below High Falls
49642	-----	52	1162	8/31/08	10/21/09	Below High Falls
49643	-----	45	1330	8/14/08	6/2/09	Quetico river
49644	F	67	1490	6/1/08	6/1/09	Three Mile Lake
49647	F	37	1180	7/2/09	10/21/09	Below High Falls
49650	F	40	1250	8/22/09	8/27/09	Mouth of Namakan River
49652	F	54	1369	10/8/09	10/23/09	Mouth of Namakan River
49653	M	45	1250	9/27/08	8/17/09	Below Myrtle Falls

During the spring of 2009, SDSU biologists recorded depth and velocity profiles in the Namakan Reservoir system using a Sontek Acoustic Doppler Profiler (ADP; Figure 8a). Transects were completed in the main tributaries (Vermillion Gorge, the Loon, Namakan, Redhorse, Moose, and Ash Rivers) as well as Little Vermillion Lake, Grassy Bay, Harrison Narrows, King William's Narrows and Namakan Narrows. Depth/velocity profiles will be used to develop spatially explicit depth and bottom velocity maps of the reservoir in ArcGIS. Velocity data from summer 2008 (base flows) and spring 2009

(high flows) will be compared and combined with depth and substrate data collected in 2008 to identify potential spawning habitat.



Figure 8. a) Acoustic Doppler Profiler (ADP) equipment used to map velocity profiles in areas of interest. b) SDSU graduate student Stephanie Shaw taking a substrate grab.

**Project duration:**

2008-2011

**Ongoing Work:**

Work planned for 2010 includes:

- Analysis of 2008-2009 seasonal movement data for individual lake sturgeon. Information on lake sturgeon movements will be summarized by week for both sexes.
- Characterize the reproductive structure of lake sturgeon in VOYA and relate to seasonal movement patterns and spring collection locations.
- Develop and characterize spatially-explicit habitat maps of potential spawning locations.

### **2008 Project Outreach:**

- Shaw, S.L., S.R. Chipps, D.W. Willis, S.K. Windels, and D. McLeod. 2008. Seasonal distribution of adult lake sturgeon in Namakan Reservoir, Voyageurs National Park, MN. Midwest Fisheries and Wildlife Conference, Columbus, OH, December 2008 (poster presentation).

### **2009 Project Outreach:**

- Shaw, S.L. 2009. Lake sturgeon population dynamics and movements in Namakan Reservoir. Voyageurs National Park, July 2009 (presentation).
- Shaw, S.L., S.R. Chipps, D.W. Willis, S.K. Windels, and D. McLeod. 2009. Seasonal distribution of adult lake sturgeon in Namakan Reservoir, Voyageurs National Park, MN. Annual meeting of the American Fisheries Society, Nashville, TN, (poster).
- Shaw, S.L., S.R. Chipps, D.W. Willis, S.K. Windels, and D. McLeod. 2009. Lake sturgeon population attributes in Namakan Reservoir, Voyageurs National Park, MN. Midwest Fisheries and Wildlife Conference, Springfield, IL, (presentation).
- Windels, S.K. and D. McLeod. 2009. Lake Sturgeon research in the Namakan system. Presentation to the Heart of the Continent Partnership. International Falls, MN January 2009 (presentation).

### **Acknowledgements**

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Darren Lilja, Brian McLaren, Hilary Meyer, Melissa Mosley, Wayne Nixon, Alyson Bisson, Luke Schultz, Chris Sundmark, Megan Thul and Cam Trembath.

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Bruch, R. M., Compana, S. E., Davis-Foust, S. L., Hansen, M. J., and Janssen, J.. 2009. Lake sturgeon age validation using bomb radiocarbon and known age fish. *Transactions of the American Fisheries Society* 138, 361-372.

McLeod, D., and C. Debruyne. 2009. Movement and seasonal distribution of lake sturgeon in the Namakan River, Ontario. Preliminary Report 2007-2008. Ontario Ministry of Natural Resources, Fort Frances District Report Series No. 82.

### Project Partners

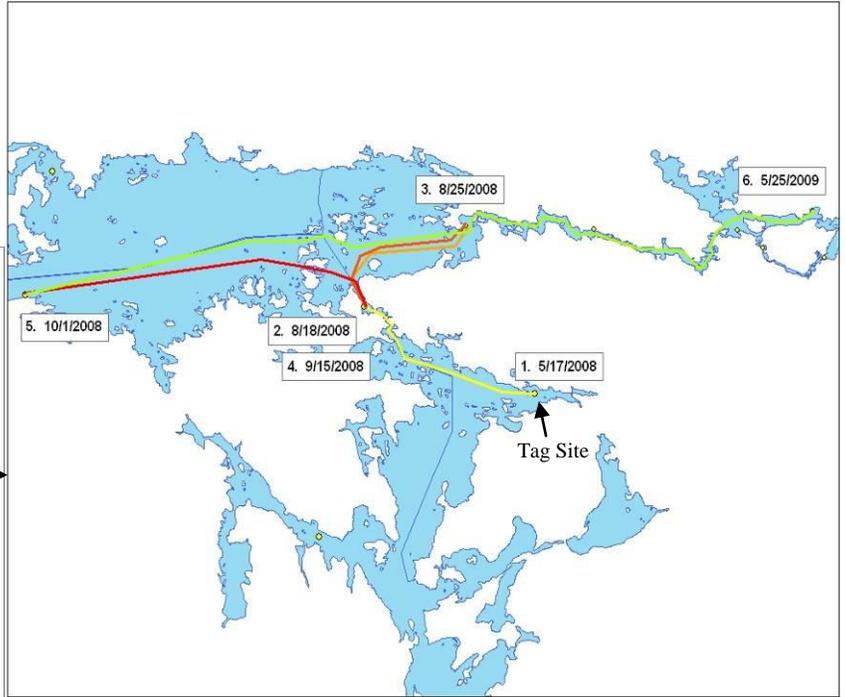
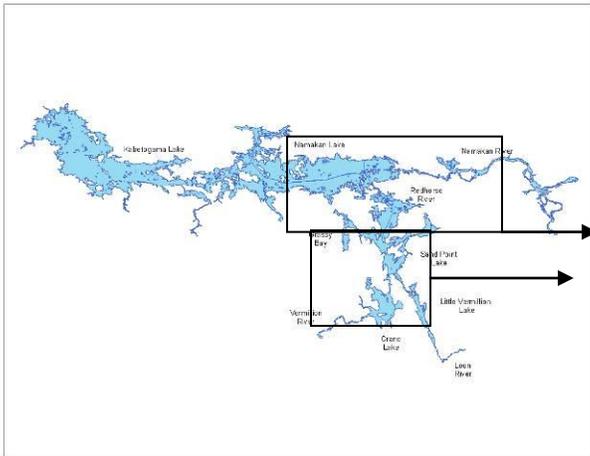


**Appendix. Movements of individual lake sturgeon in the Namakan Reservoir May 2008-July 2009 implanted with acoustic telemetry transmitters.**

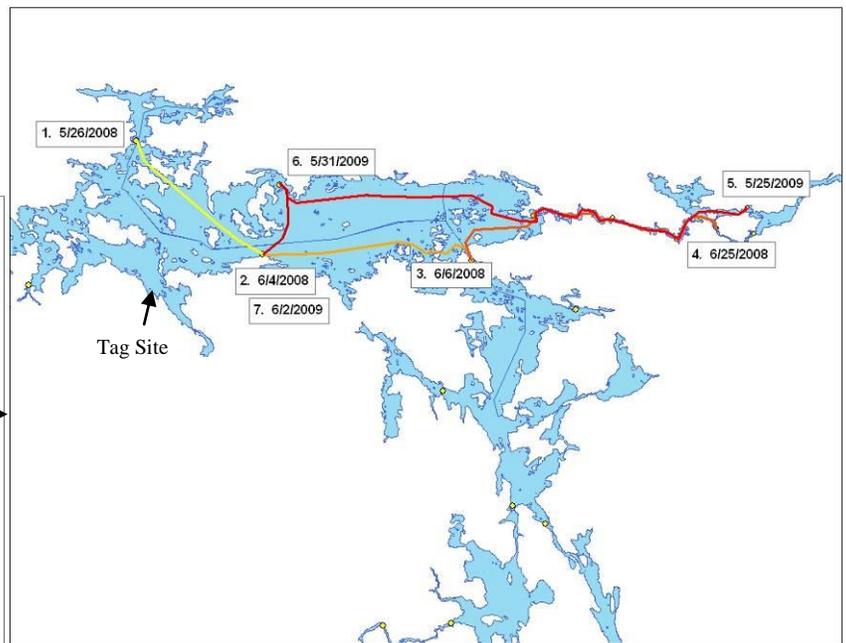
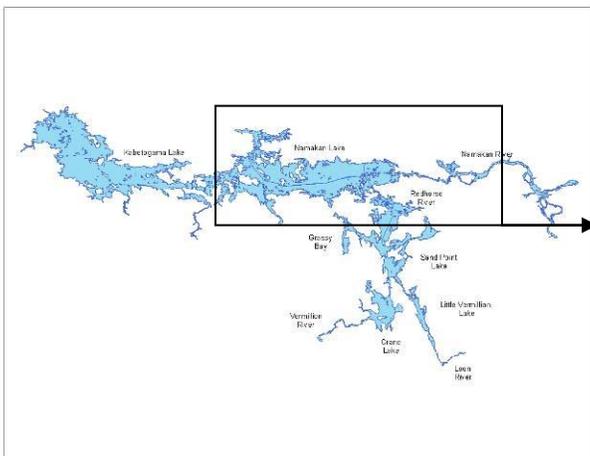
**\*\* NOTES \*\***

- Fish with ID #'s between 8495-49654 were originally captured in the Namakan Reservoir (downstream of the mouth of the Namakan River) between May 7, 2008 and May 21, 2008. See McLeod and Debruyne (2009) for additional details.
  - Tag sites (i.e., sites where fish were implanted with transmitters and released) for fish tagged in the Namakan Reservoir are noted. Maps indicate minimum movement of sturgeon interpreted from receiver detections. The shortest possible distance between receivers was used to draw the track.
  - Individual tracks (one detection to the next detection) are represented by a single color. All colored tracks combined represent minimum distance traveled.
  - Once a sturgeon moved into the Namakan River the first receiver detection is noted (Darryl McLeod personal communication). Specific information on sturgeon movements within the river can be viewed in McLeod and Debruyne (2009).
  - Lake Sturgeon that were not detected by reservoir receivers were not represented by a map. Fish that remained exclusively in the Namakan River are represented in McLeod and Debruyne (2009).
  
- Fish with ID #'s between 4739-8494 were originally captured in the Namakan River (upstream of Lady Rapids) between May 15, 2007 and May 2, 2008. See McLeod and Debruyne (2009) for additional details on these fish.
  - Tag sites for these fish are not shown.
  - Tag sites (i.e., sites where fish were implanted with transmitters and released) for fish tagged in the Namakan Reservoir are noted. Maps indicate minimum movement of sturgeon interpreted from receiver detections. The shortest possible distance between receivers was used to draw the track.
  - Individual tracks (one detection to the next detection) are represented by a single color. All colored tracks combined represent minimum distance traveled.

Fish - 8495  
 Final Assigned Age - Unknown  
 Sex - Female  
 Tag Site – Redhorse River, Ont.  
 Tag Date – 5/14/08  
 Agency - VNP

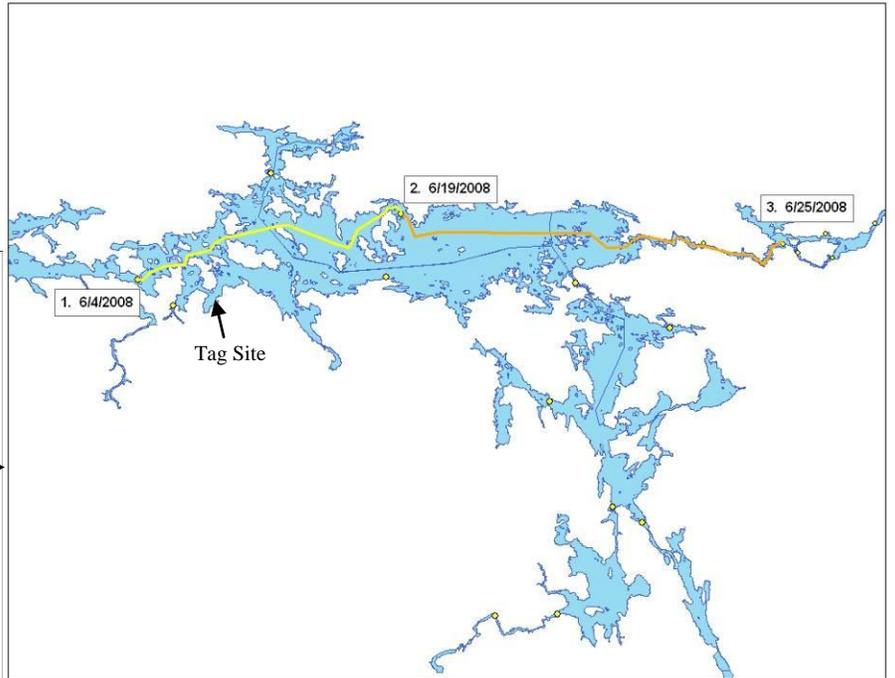
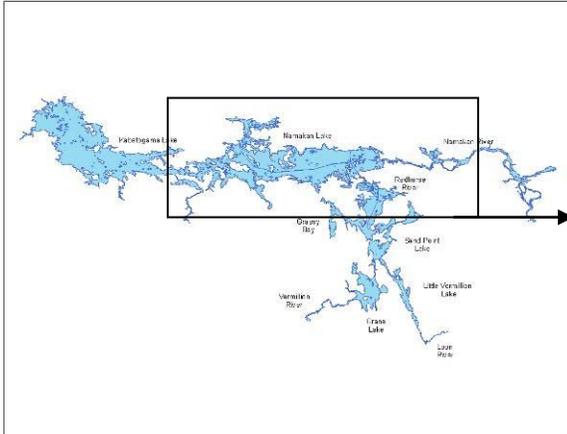


Fish - 49630  
 Final Assigned Age - 55  
 Sex - Female  
 Tag Site – Junction Bay  
 Tag Date – 5/20/08  
 Agency - VNP

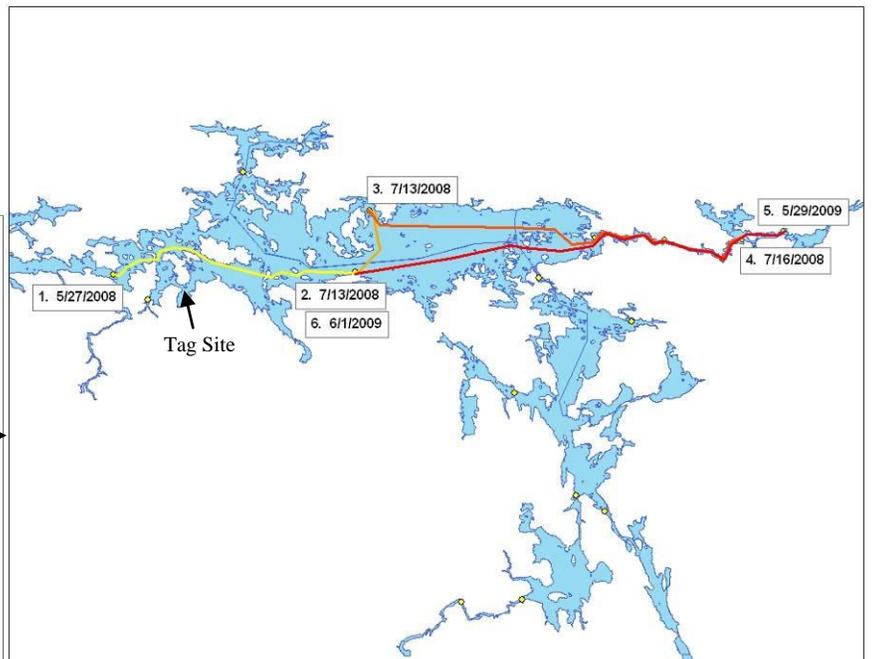
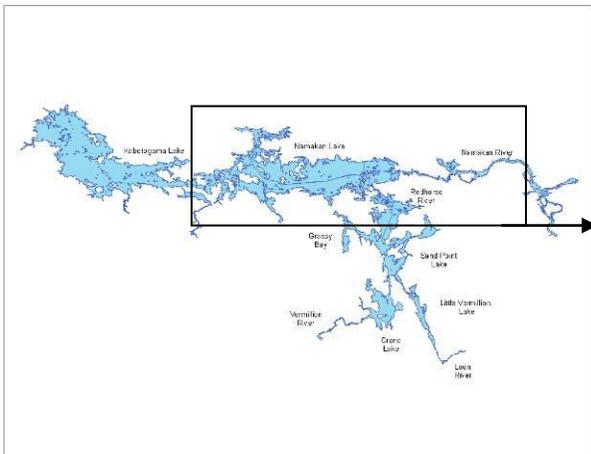




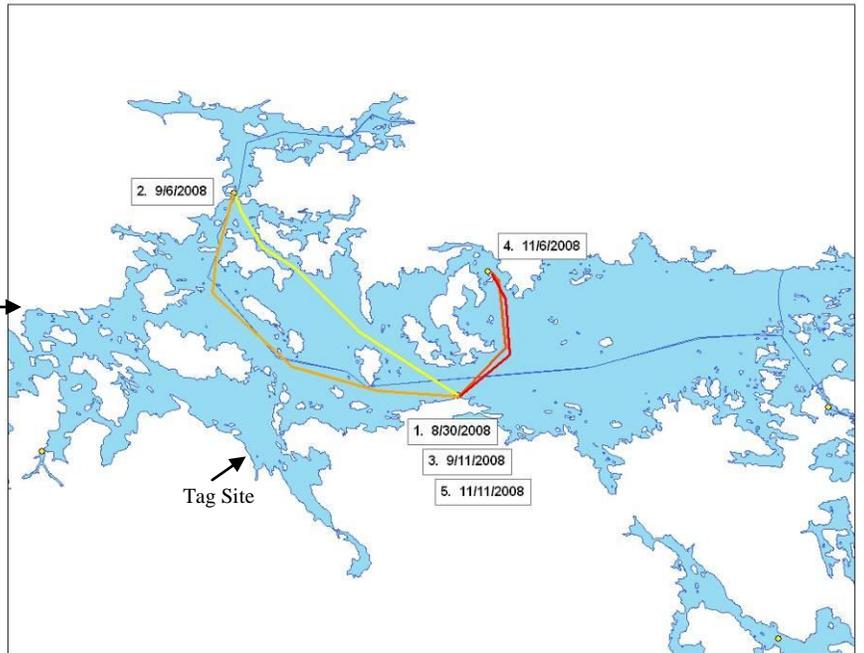
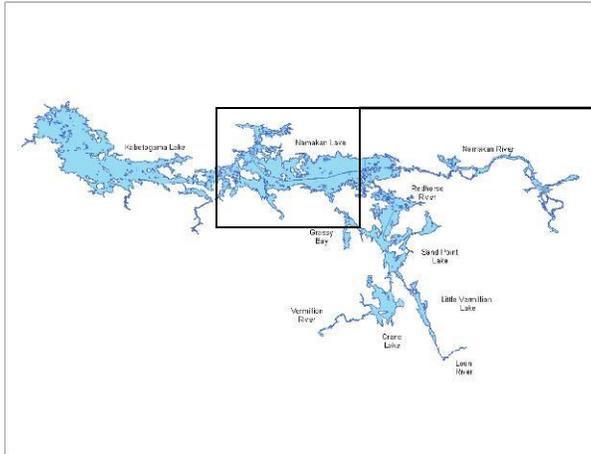
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Final Assigned Age - 43  
Sex - Female  
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Tag Date – 5/21/08  
Agency - VNP



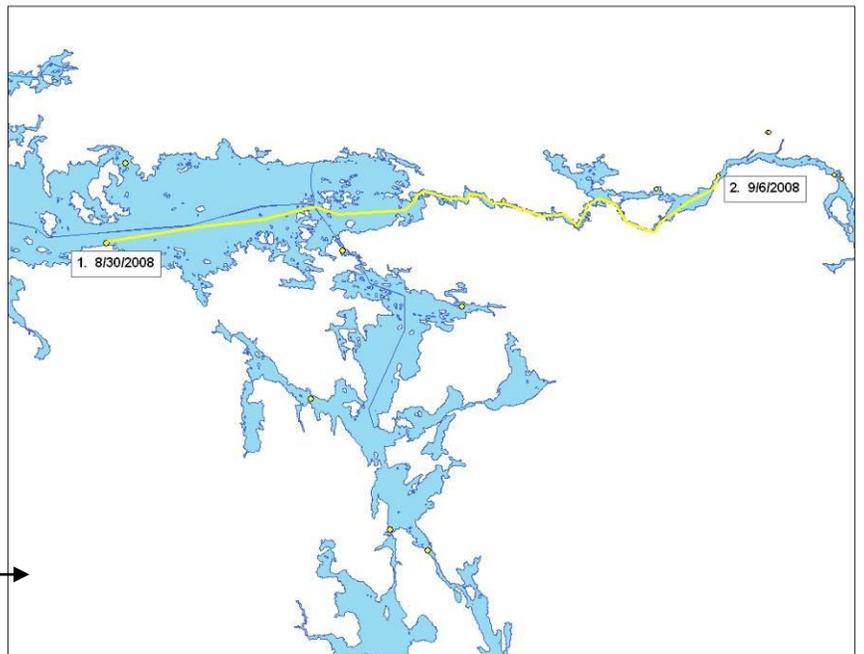
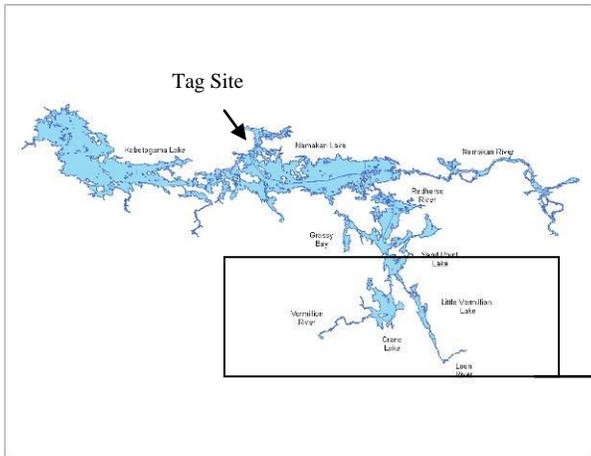
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Final Assigned Age - 48  
Sex - Female  
Tag Site – Hoist Bay  
Tag Date – 5/21/08  
Agency - VNP



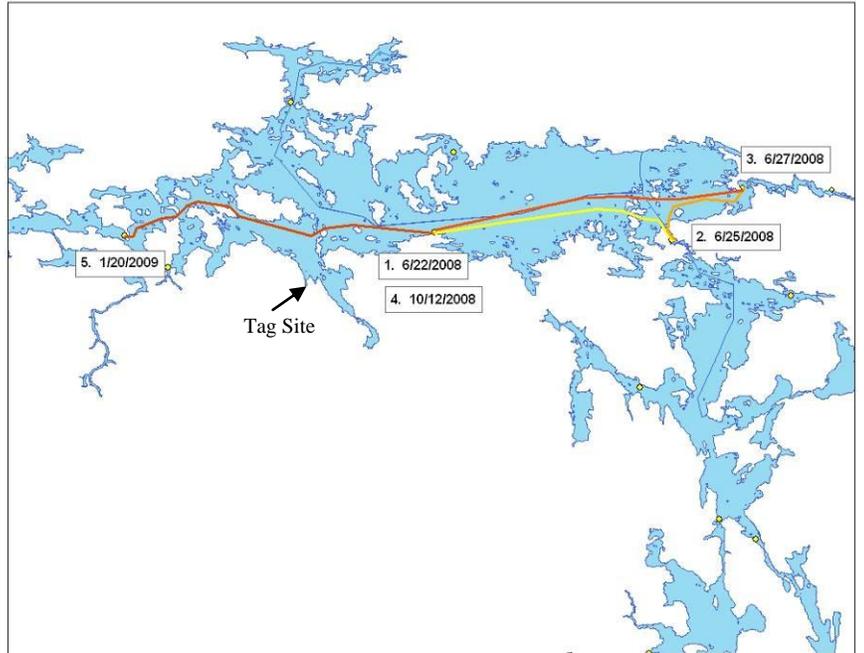
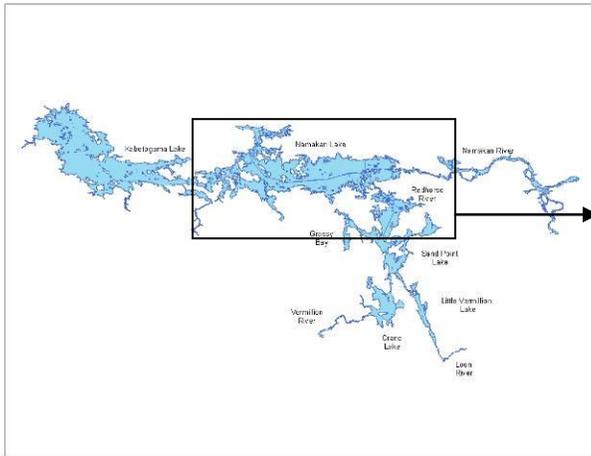
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Sex - Female  
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Tag Date - 5/21/08  
Agency - VNP



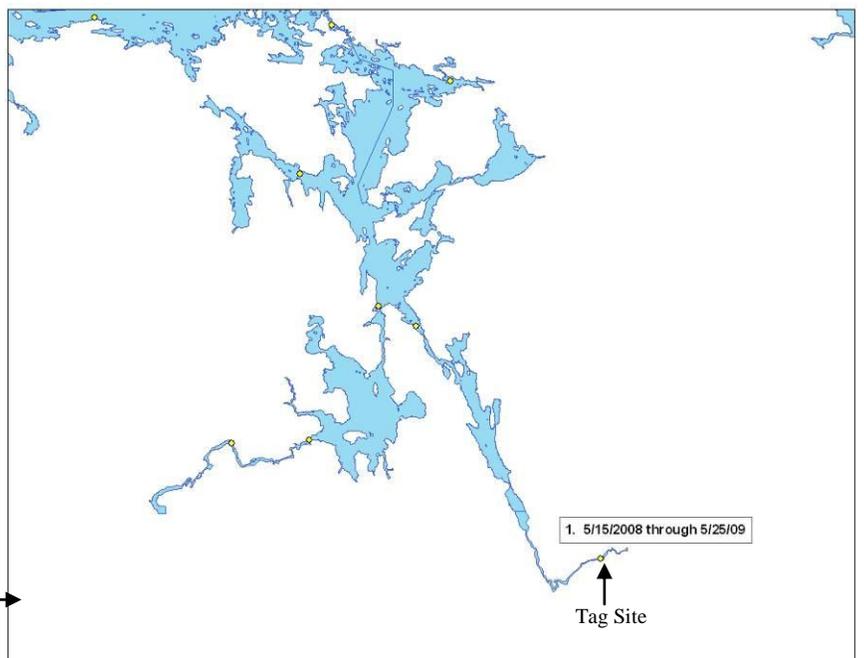
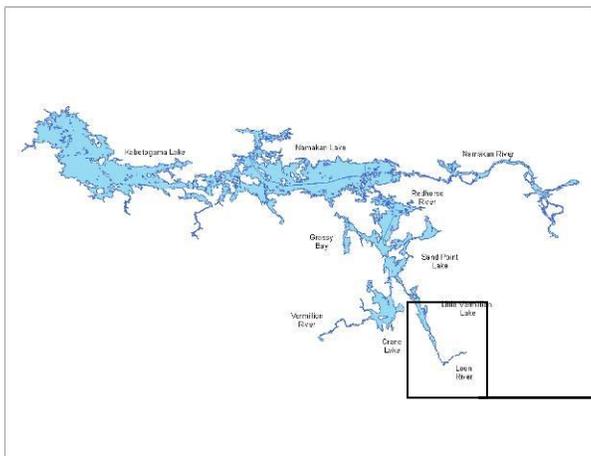
Fish - 49637  
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Sex - Female  
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Tag Date - 5/21/08  
Agency - VNP



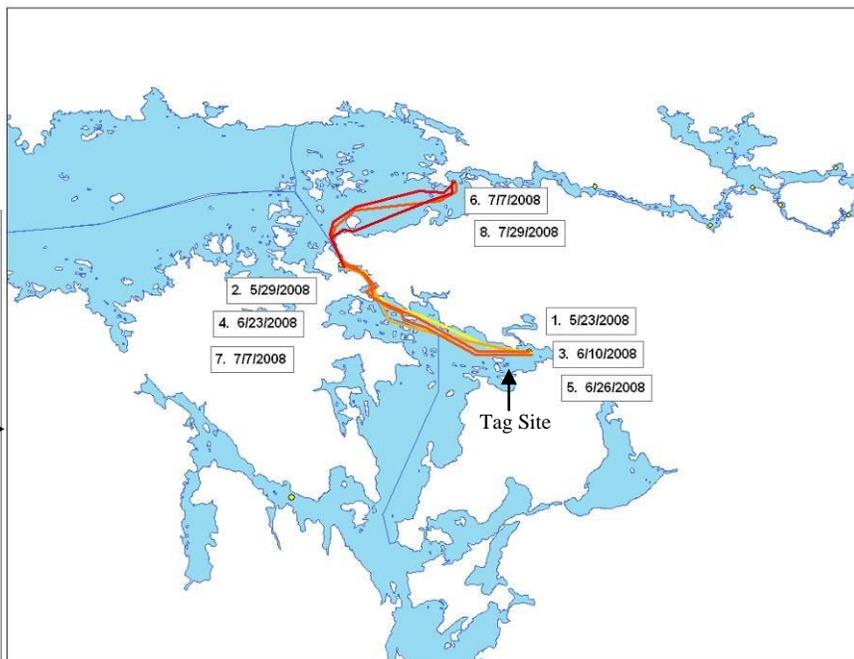
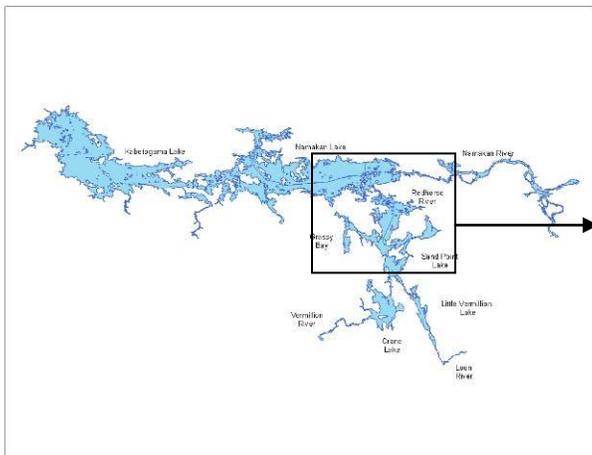
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 Sex - Female  
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 Tag Date - 5/20/08  
 Agency - VNP



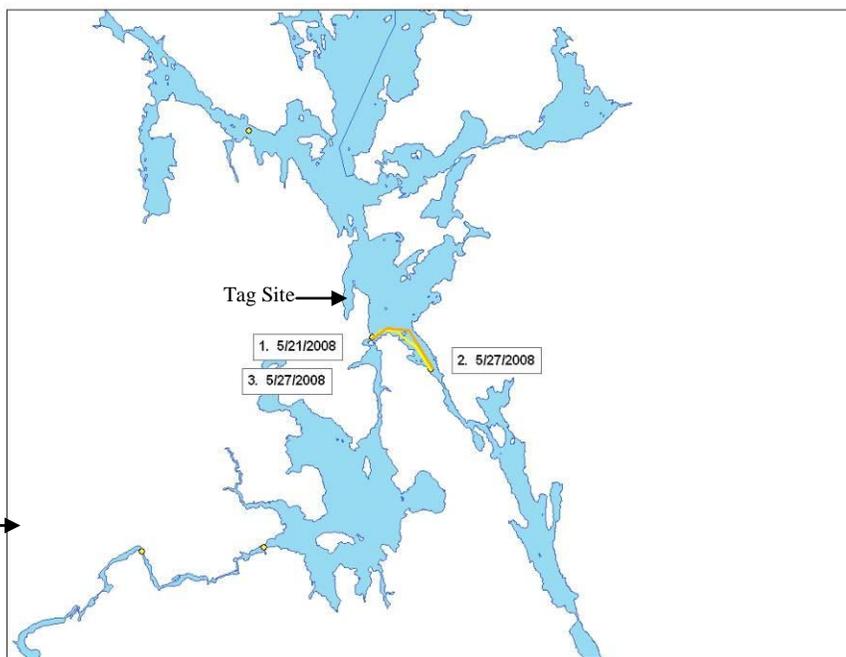
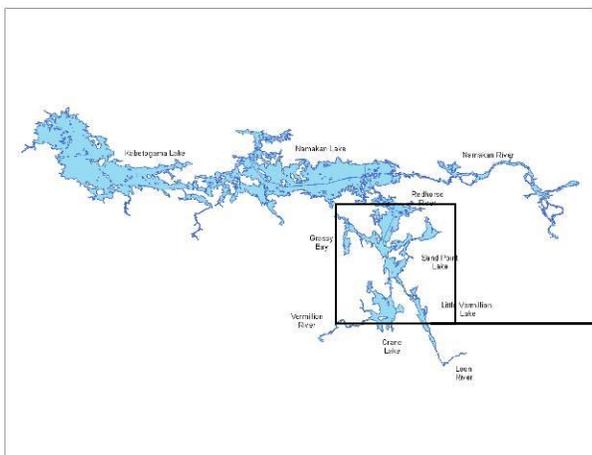
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 Agency - VNP



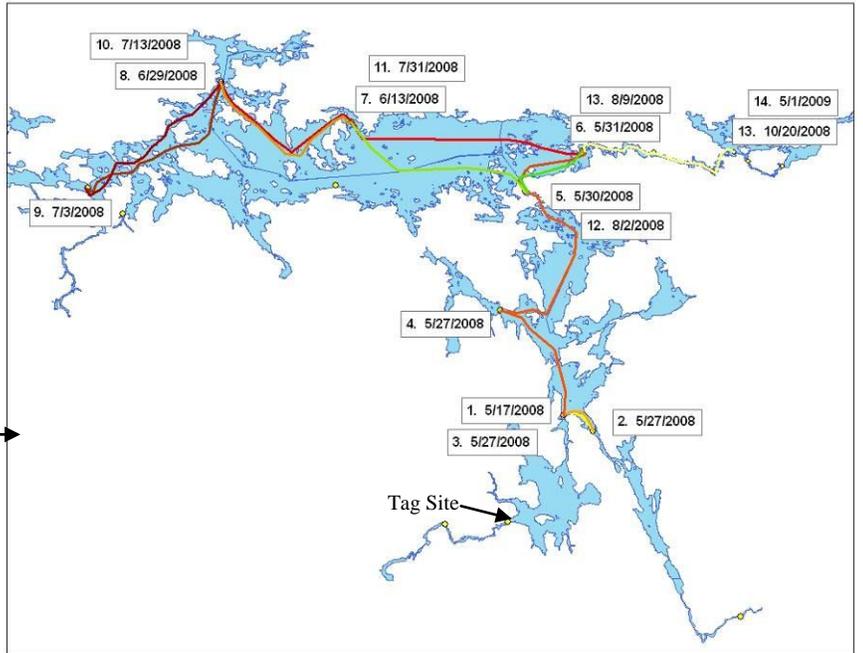
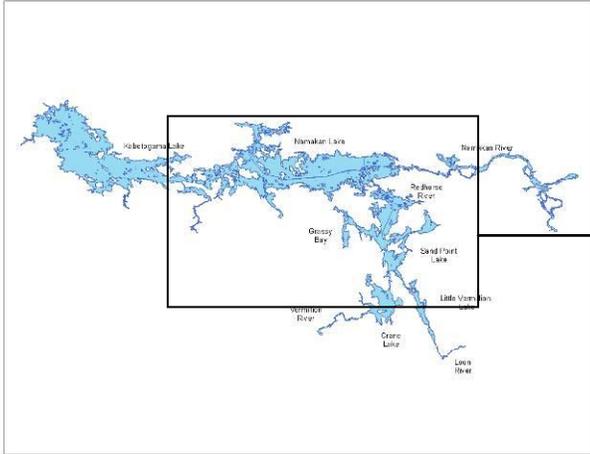
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Sex - Non-reproductive  
Tag Site - Redhorse River, Ont.  
Tag Site - 5/14/08  
Agency - VNP



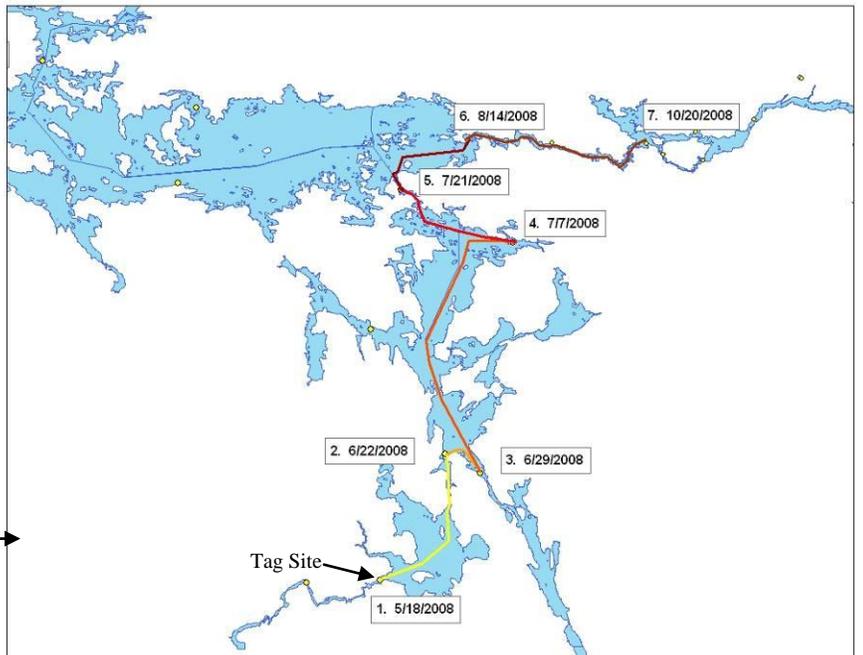
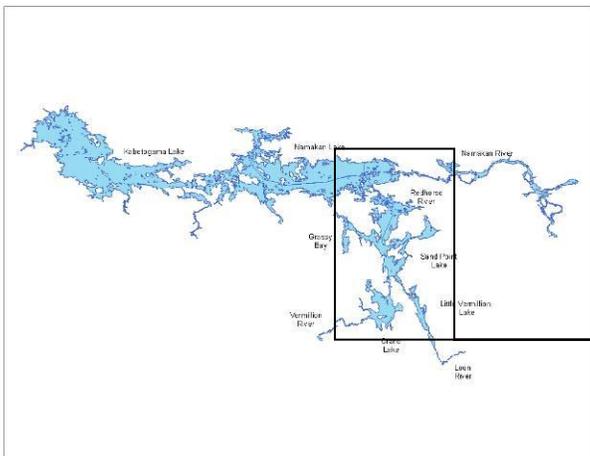
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Agency - VNP



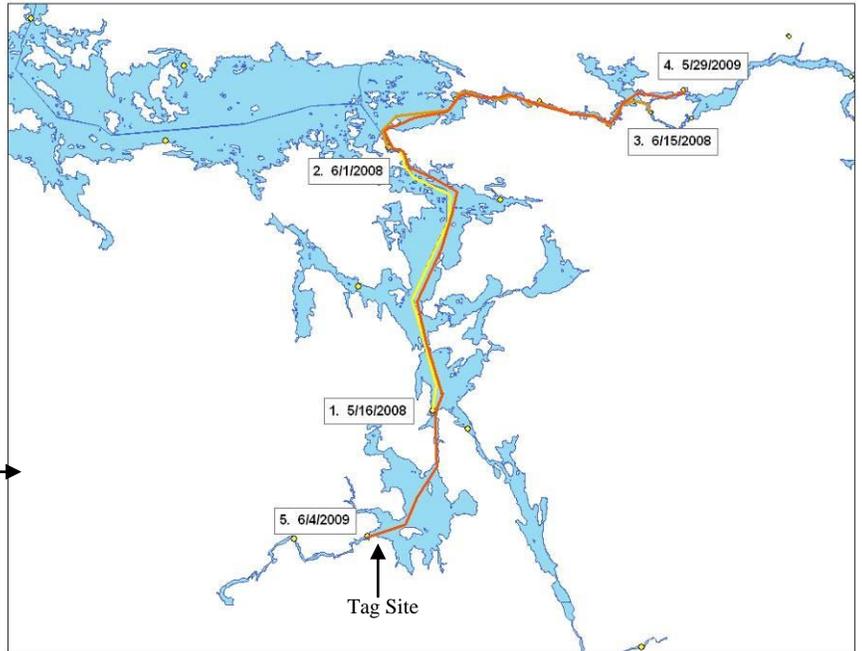
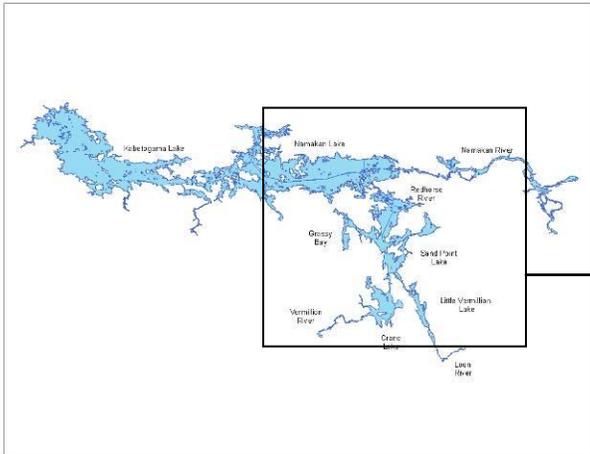
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 Tag Date - 5/7/08  
 Agency - VNP



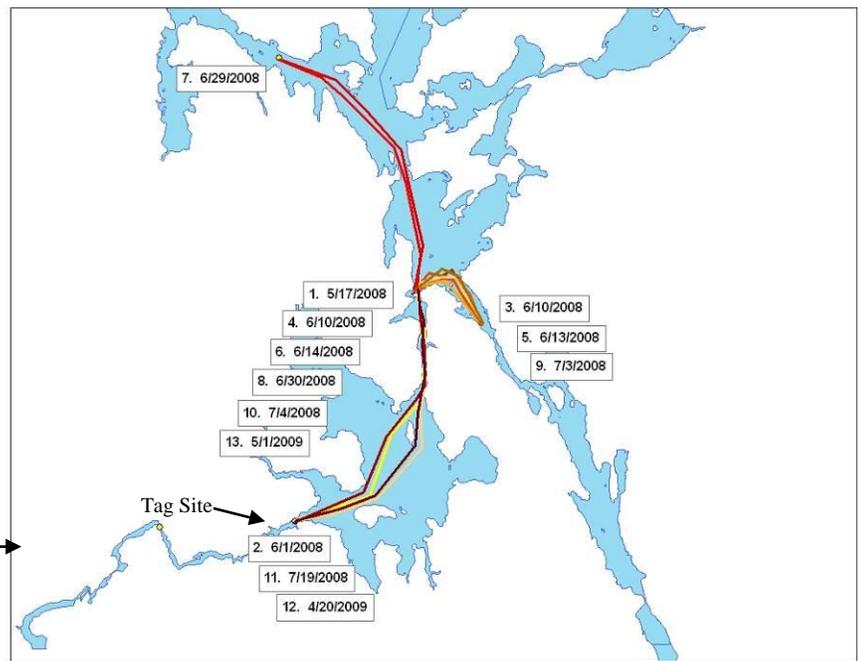
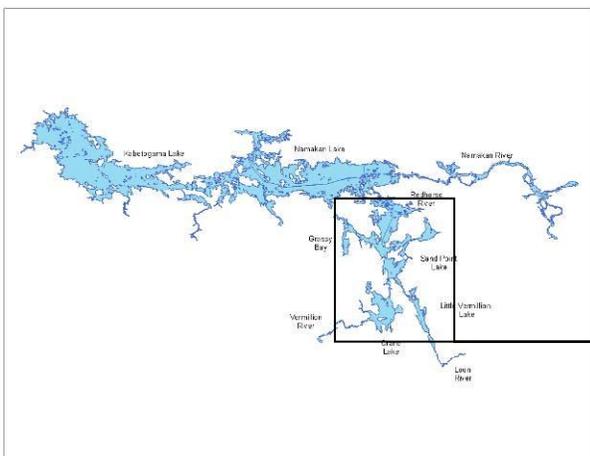
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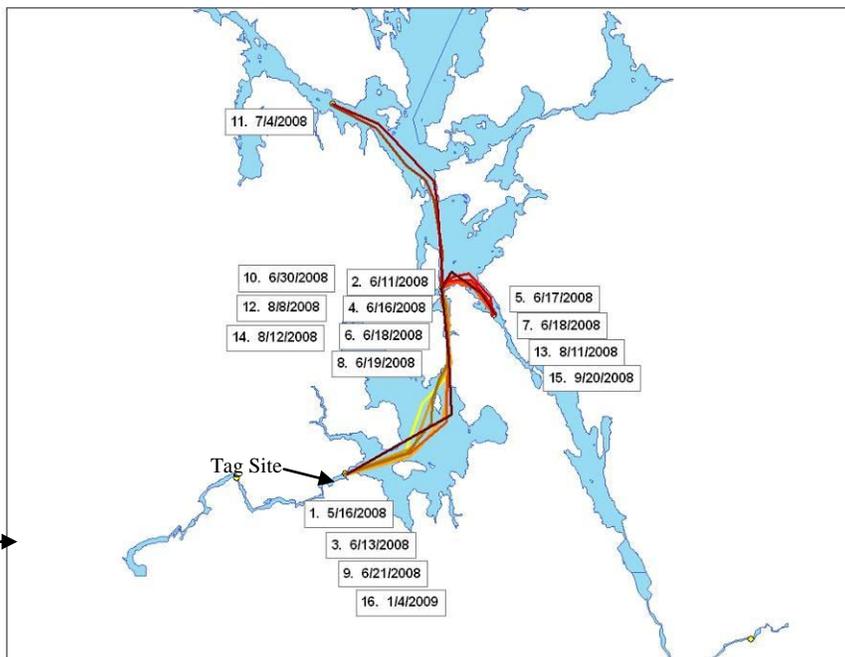
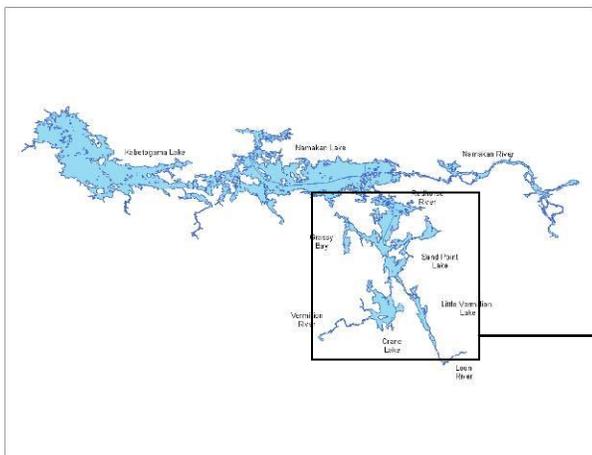
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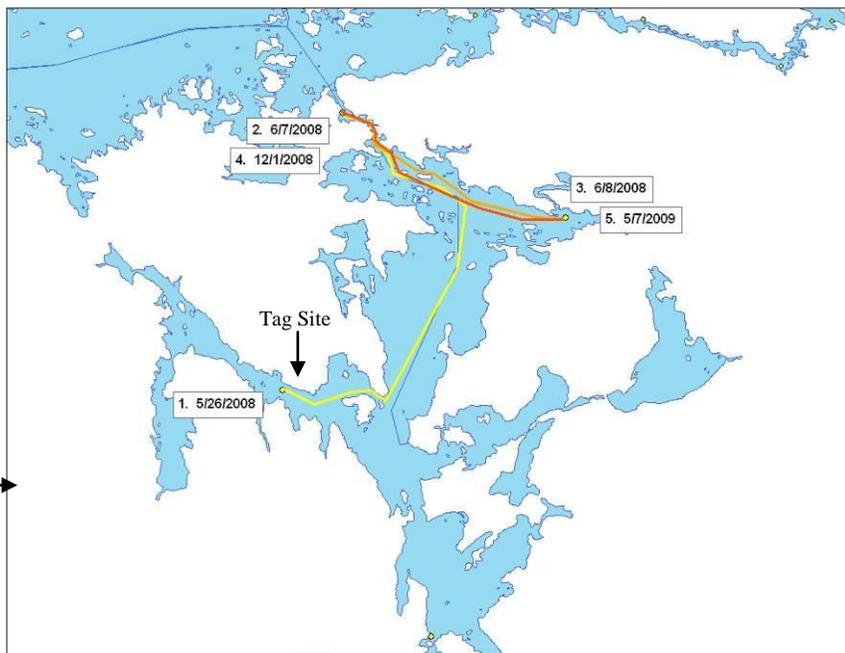
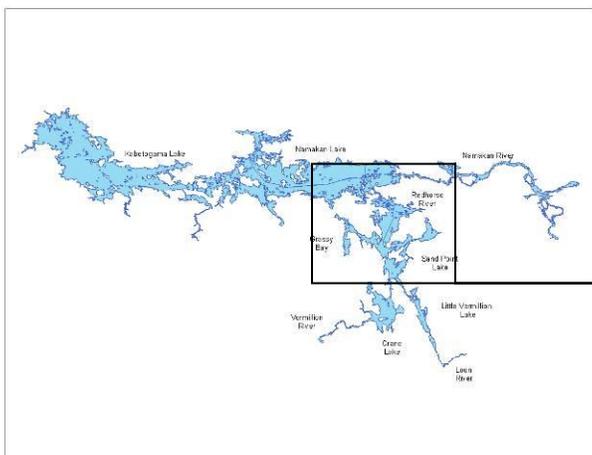
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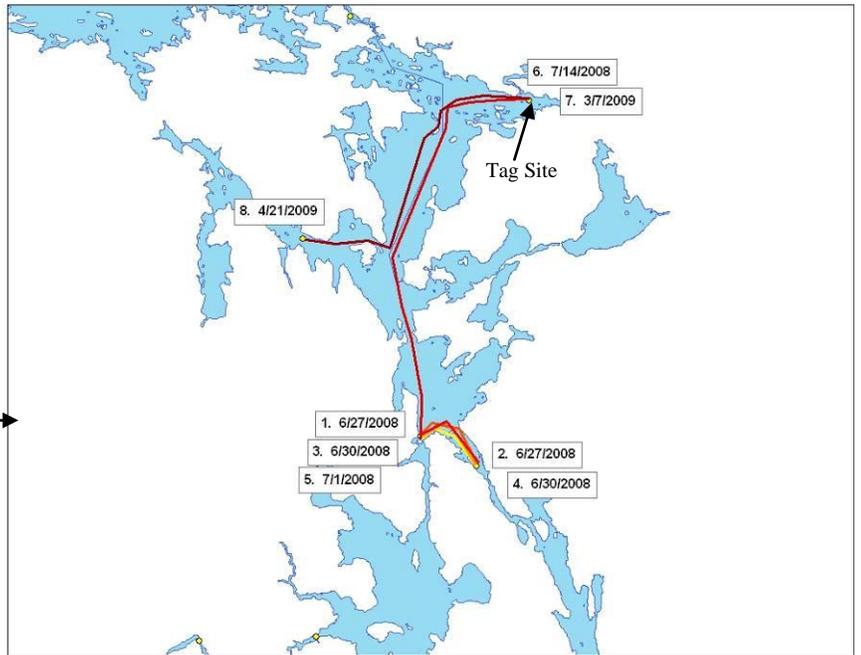
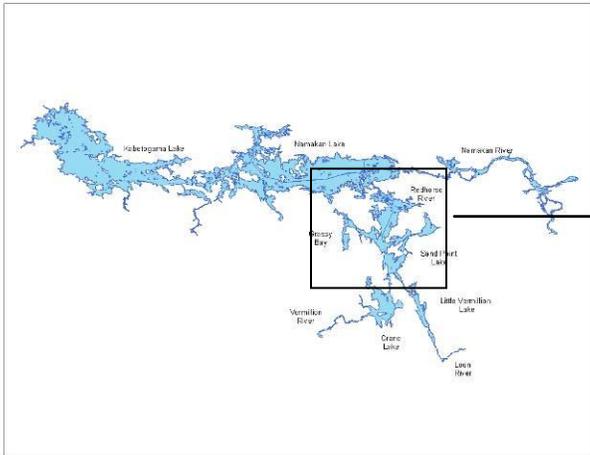
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 Tag Date - 5/7/08  
 Agency - VNP



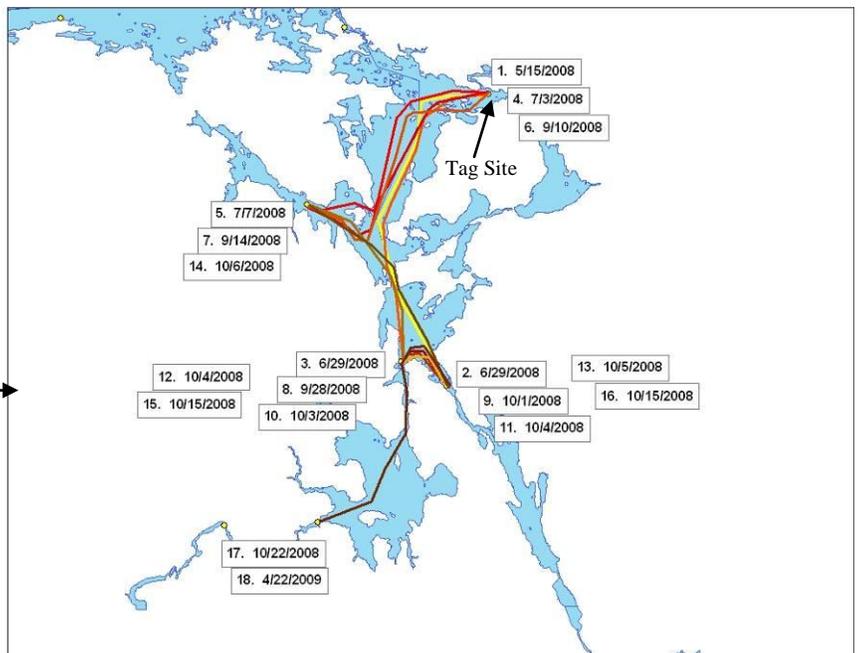
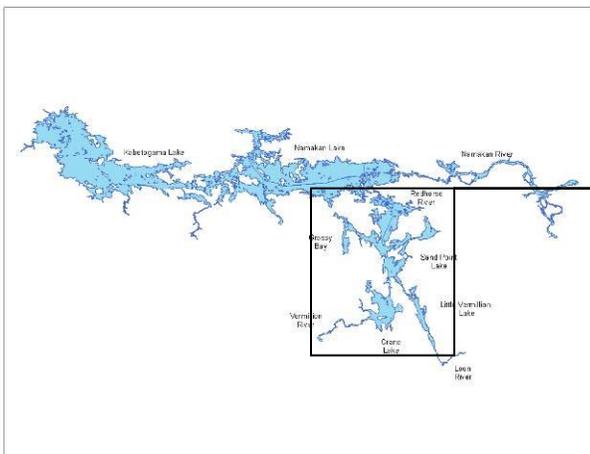
Fish - 49647  
 Final Assigned Age - 37  
 Sex - Female  
 Tag Site - Grassy Bay, Monroe Pt.  
 Tag Date - 5/13/08  
 Agency - VNP



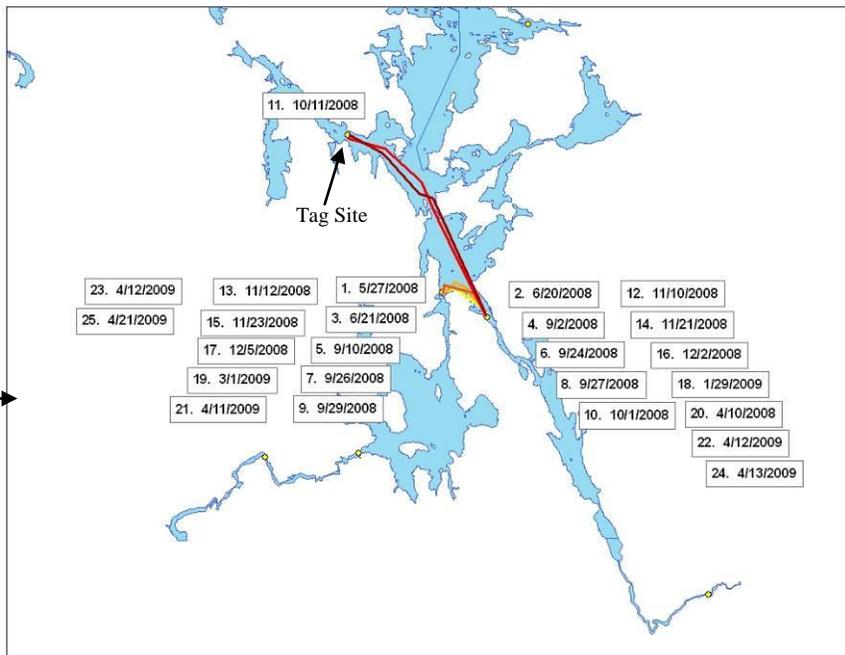
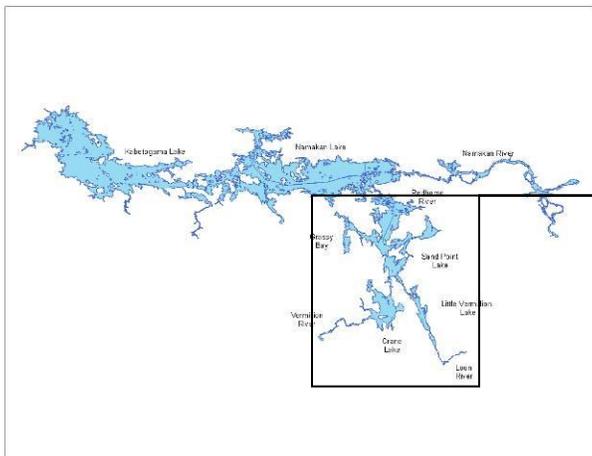
Fish - 49648  
 Final Assigned Age - Unknown  
 Sex - Unknown  
 Tag Site - Redhorse River, Ont.  
 Tag Date - 5/14/08  
 Agency - VNP



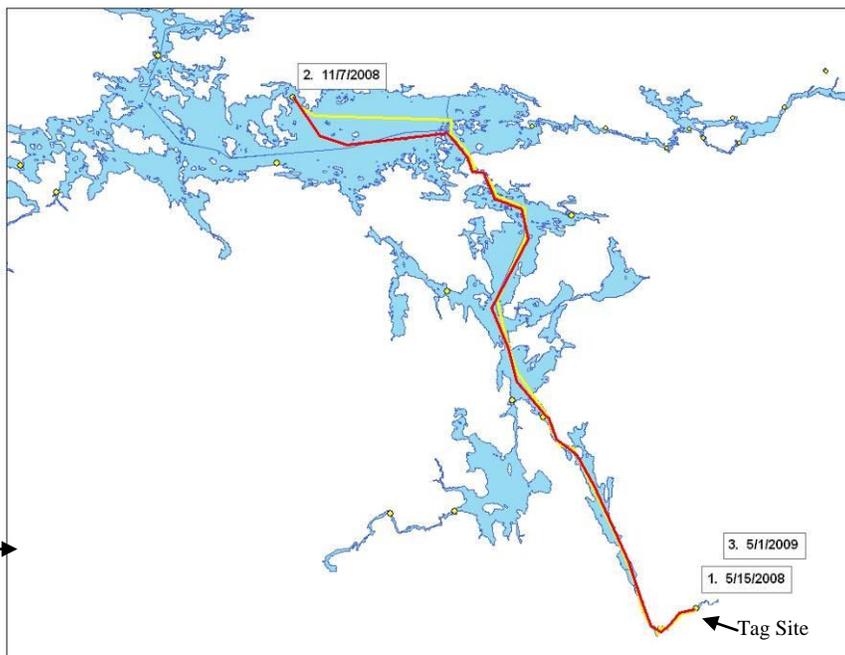
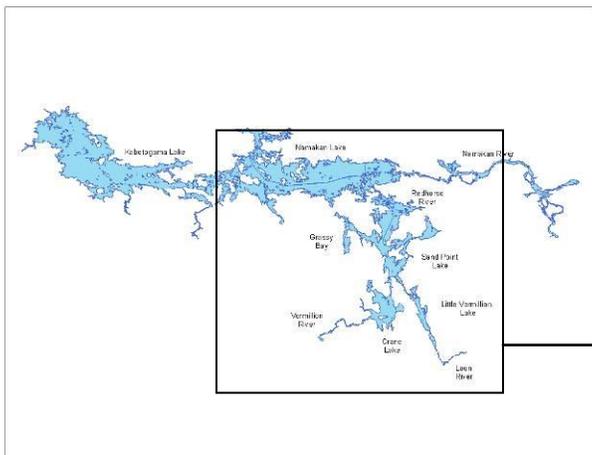
Fish - 49649  
 Final Assigned Age - 41  
 Sex - Female  
 Tag Site - Redhorse River, Ont.  
 Tag Date - 5/14/08  
 Agency - VNP



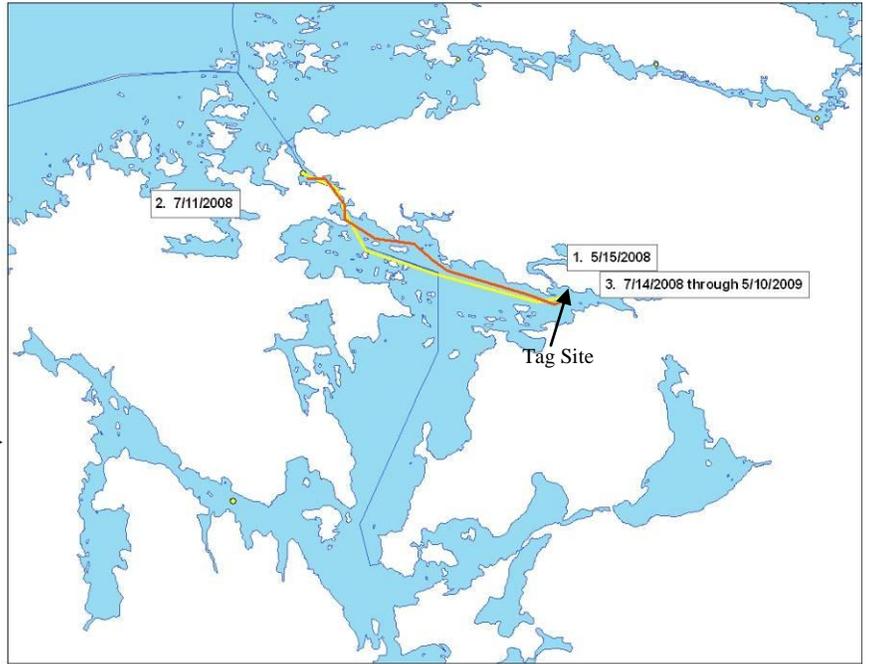
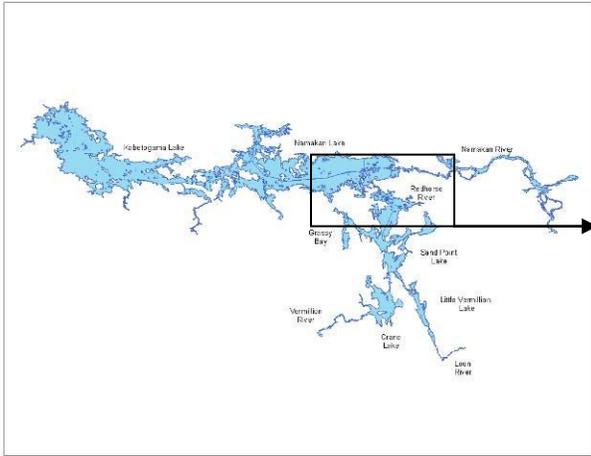
Fish - 49650  
 Final Assigned Age - 40  
 Sex - Female  
 Tag Site - Grassy Bay  
 Tag Date - 5/14/08  
 Agency - VNP



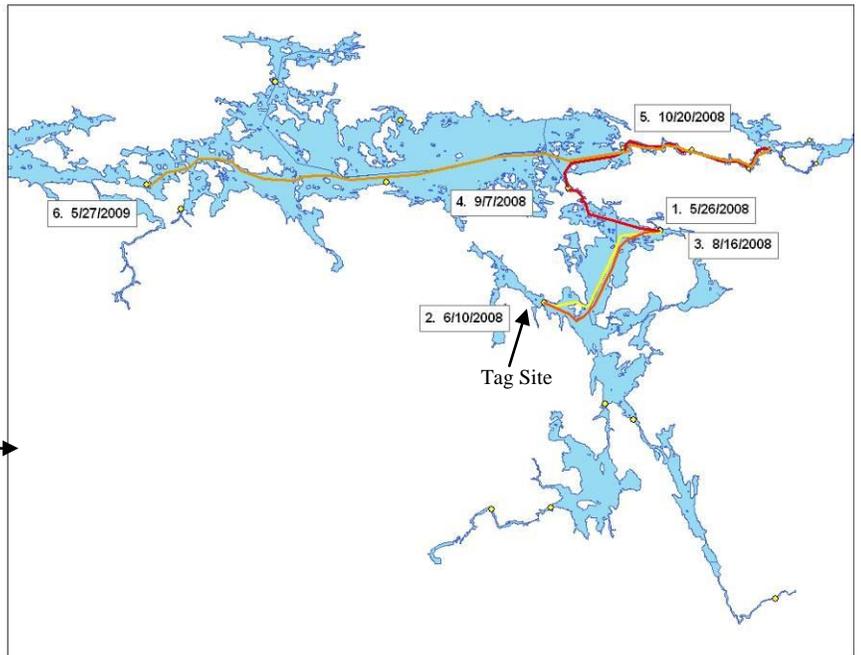
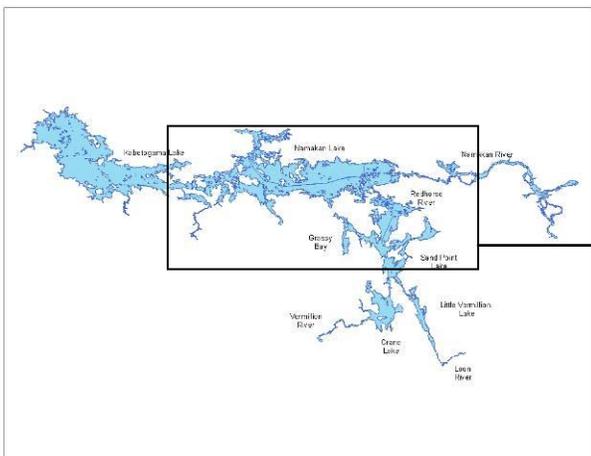
Fish - 49651  
 Final Assigned Age - 35  
 Sex - Male  
 Tag Site - Loon River, 56 Rapids  
 Tag Date - 5/15/08  
 Agency - VNP



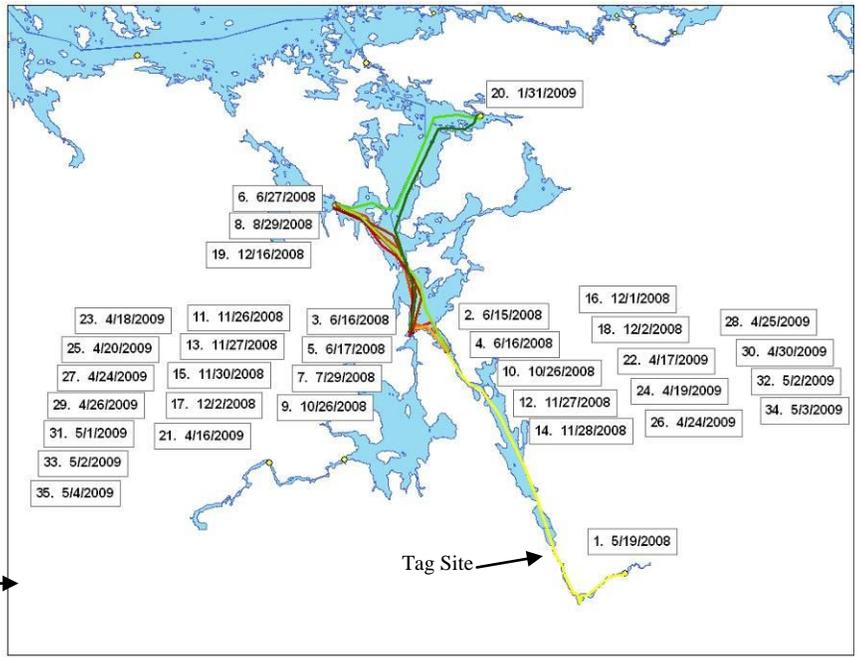
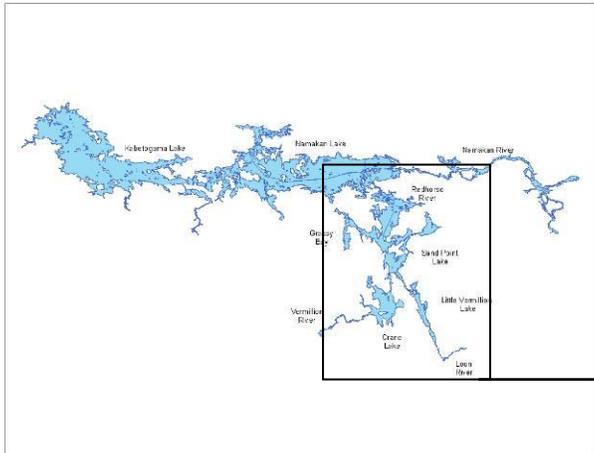
Fish - 49652  
 Final Assigned Age - 54  
 Sex - Female  
 Tag Site - Redhorse River, Ont.  
 Tag Date - 5/14/08  
 Agency - VNP



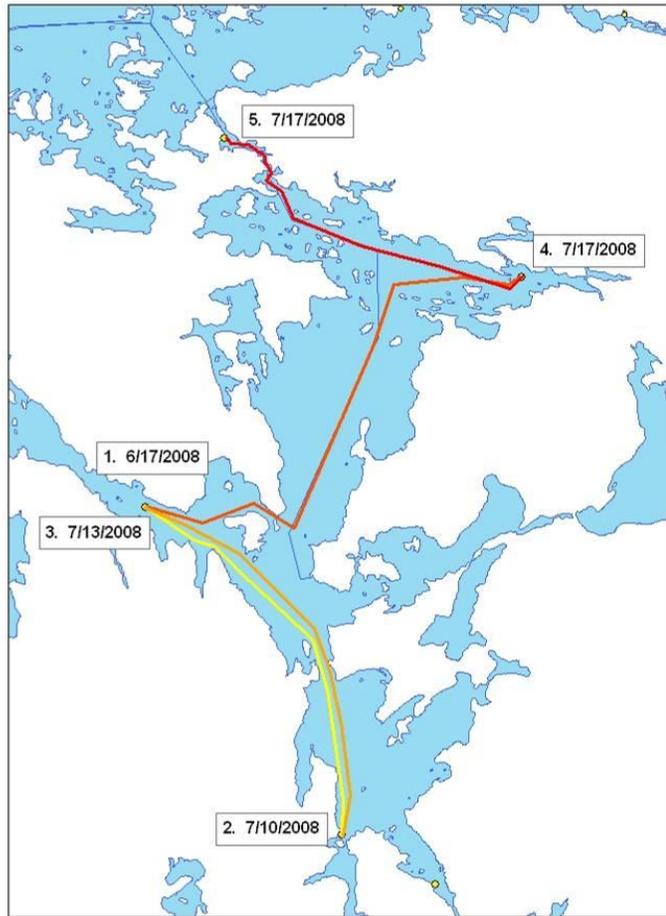
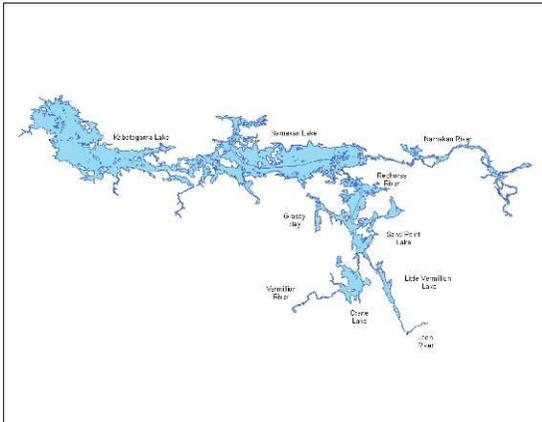
Fish - 49653  
 Final Assigned Age - 45  
 Sex - Male  
 Tag Site - Grassy Bay, Monroe Pt.  
 Tag Date - 5/14/08  
 Agency - VNP



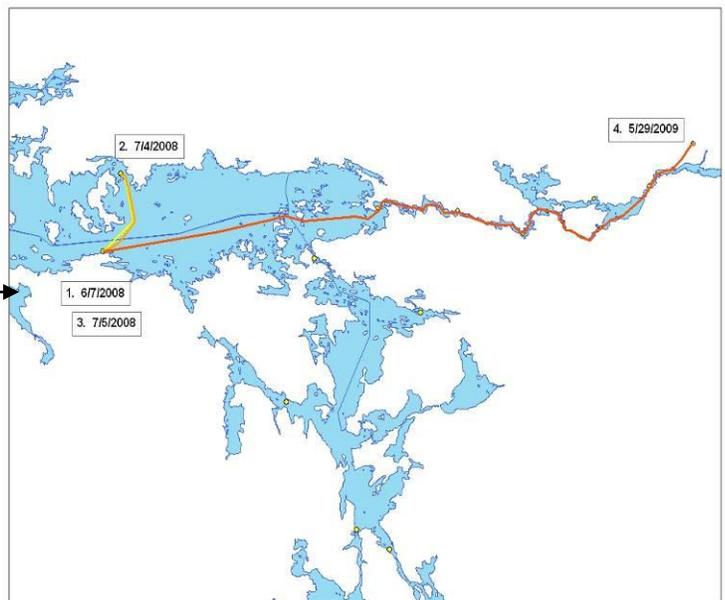
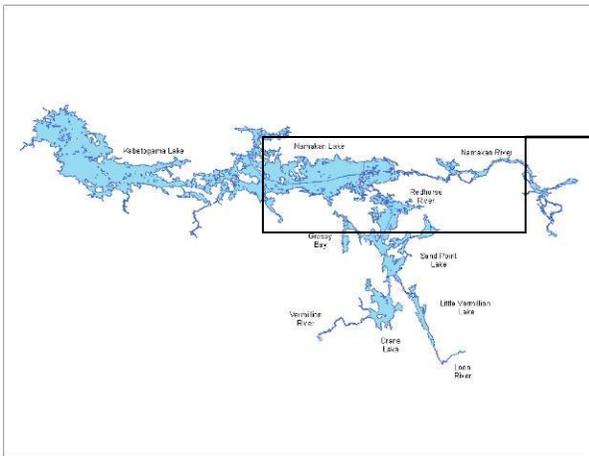
Fish - 49654  
 Final Assigned Age - 55  
 Sex - Female  
 Tag Site - Loon River Mouth  
 Tag Date - 5/14/08  
 Agency - VNP



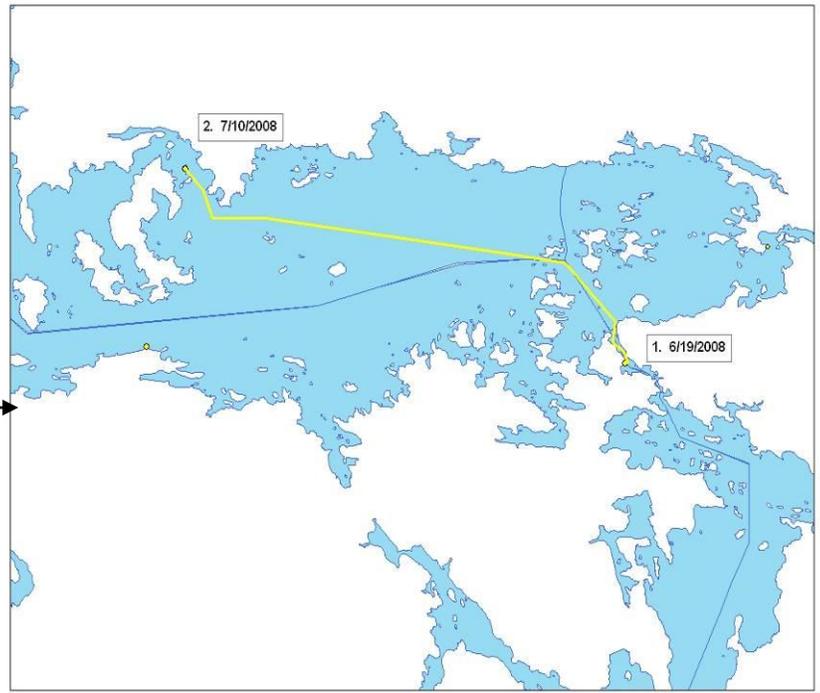
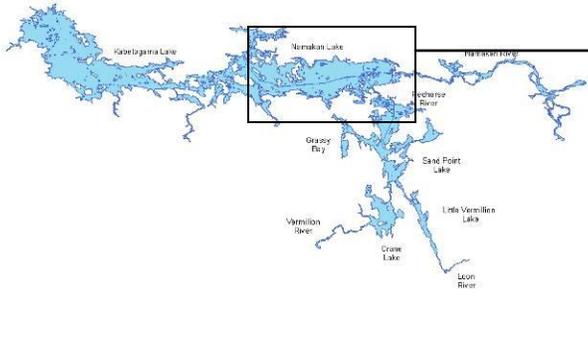
Fish ID- 4588  
 Final Assigned Age - 30  
 Sex - Unknown  
 Tag Site - Little Eva Lake  
 Tag Date – 5/18/07  
 Agency - OMNR



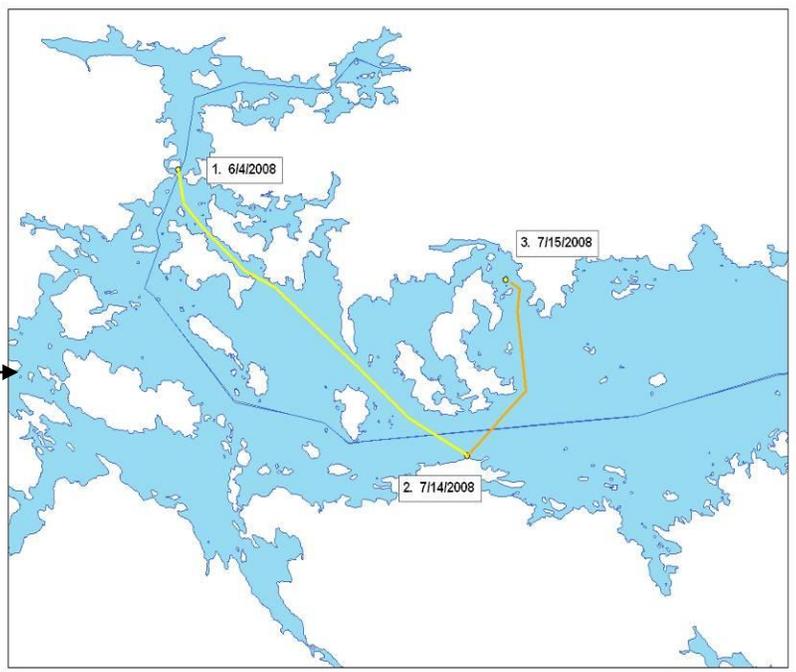
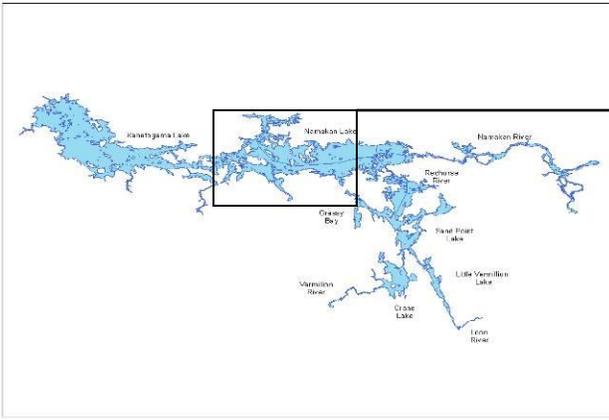
Fish - 4589  
 Final Assigned Age – 19  
 Sex – Unknown  
 Tag Site - Little Eva Lake  
 Tag Date – 5/18/07  
 Agency - OMNR



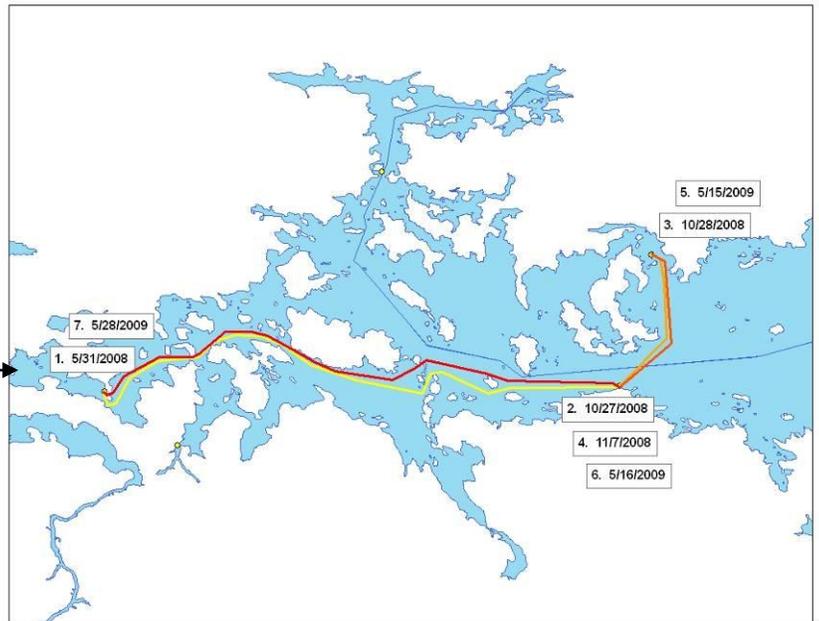
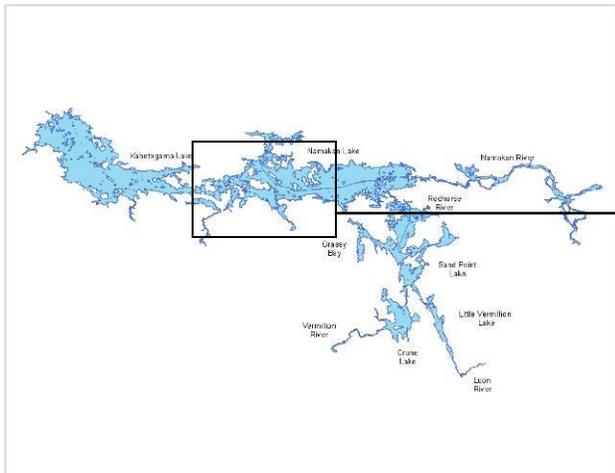
Fish - 4590  
Final Assigned Age - 19  
Sex - Unknown  
Tag Site - Little Eva Lake  
Tag Date - 5/18/07  
Agency - OMNR



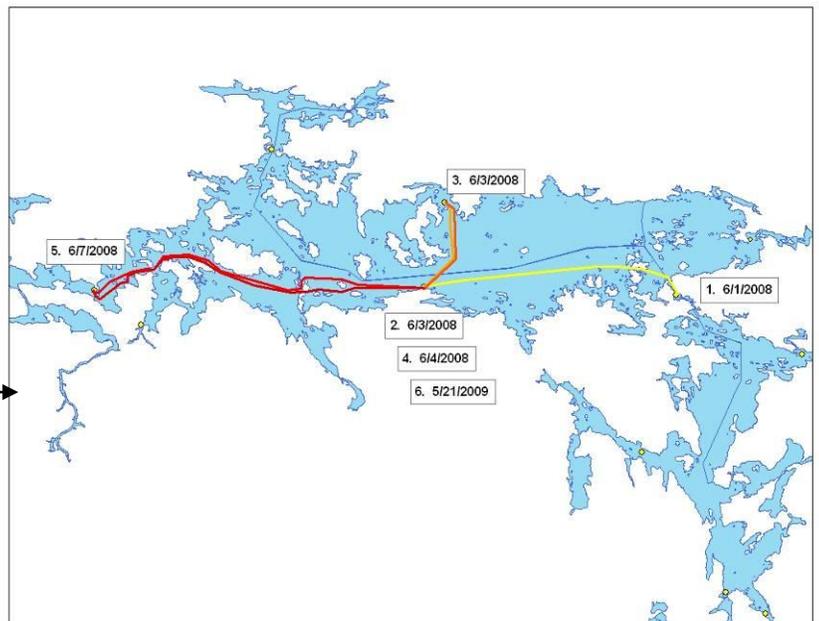
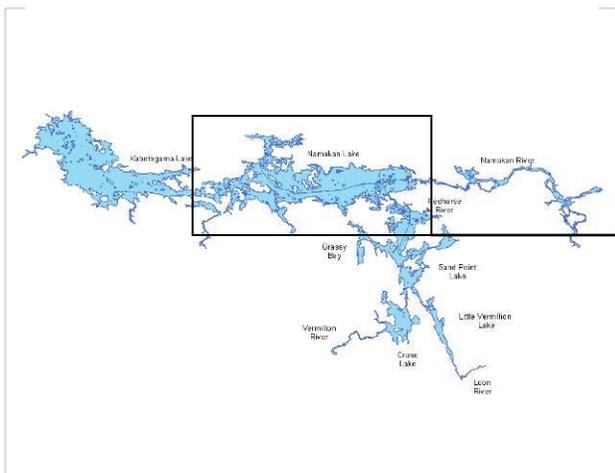
Fish - 4591  
Final Assigned Age - 19  
Sex - Male  
Tag Site - Little Eva Lake  
Tag Date - 5/18/07  
Agency - OMNR



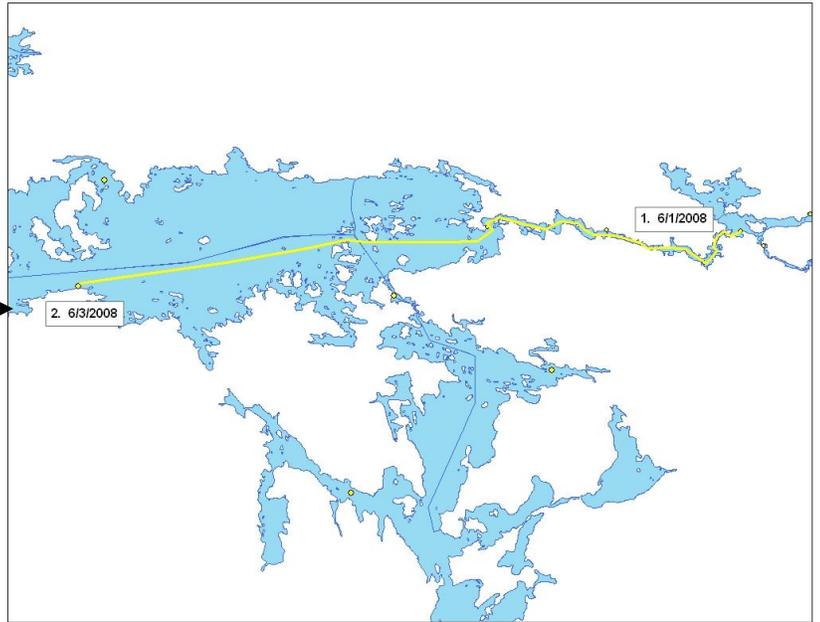
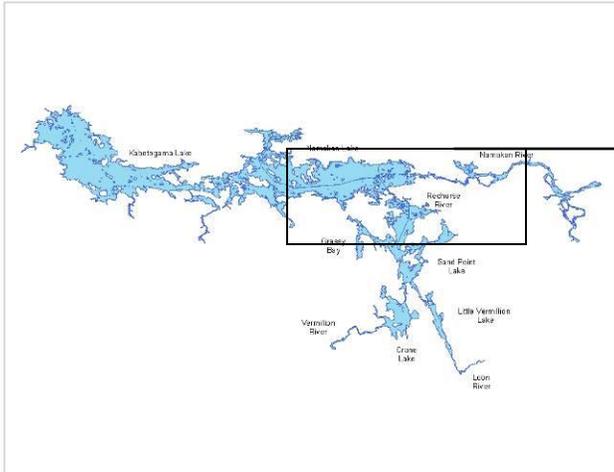
Fish - 4593  
 Final Assigned Age - 31  
 Sex - Male  
 Tag Site - Bill Lake  
 Tag Date - 5/23/07  
 Agency - OMNR



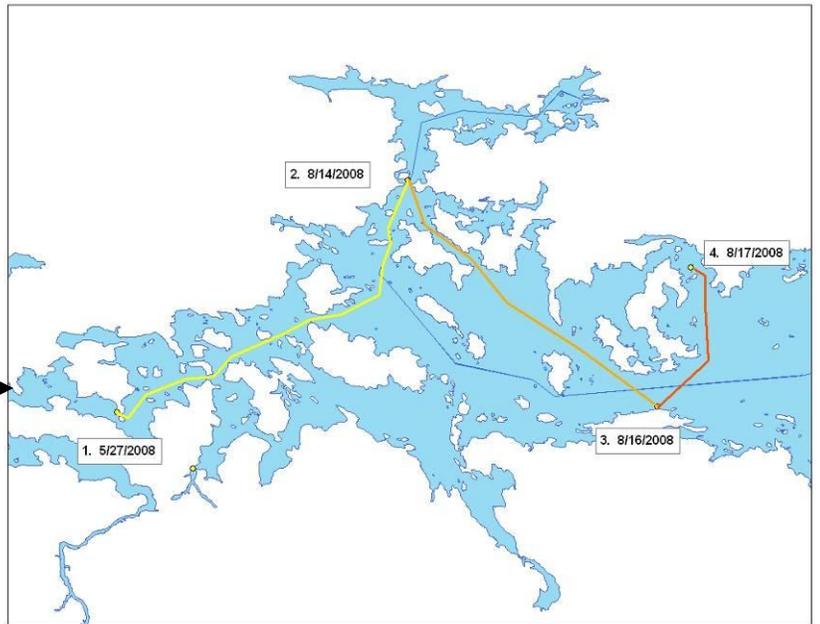
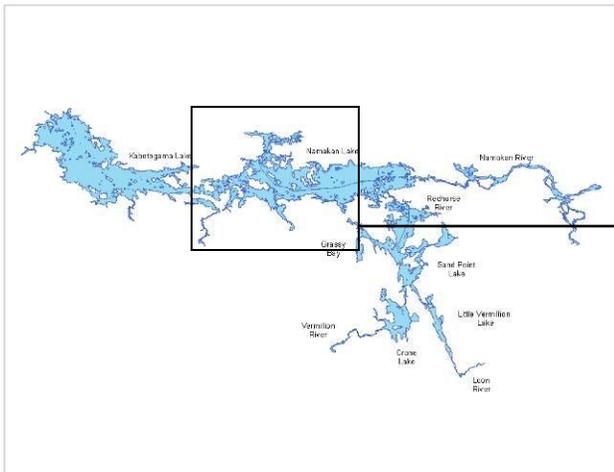
Fish - 4601  
 Final Assigned Age - 34  
 Sex - Male  
 Tag Site - Three Mile Lake  
 Tag Date - 5/25/07  
 Agency - OMNR



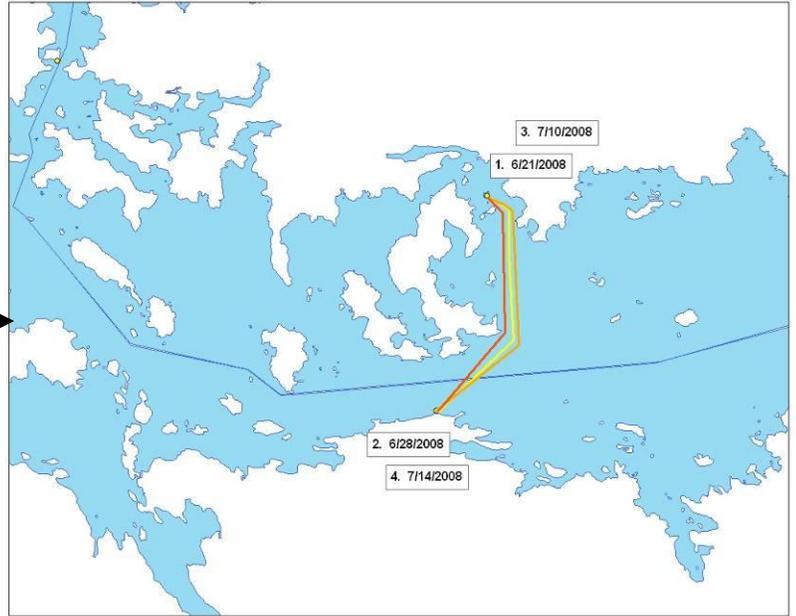
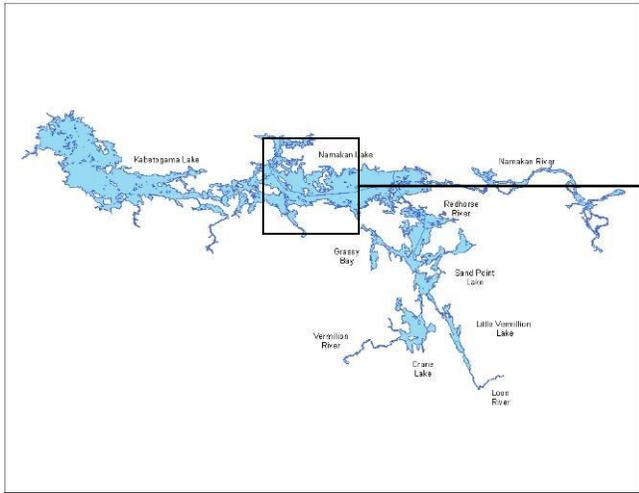
Fish - 4602  
Final Assigned Age - 32  
Sex - Female  
Tag Site – Three Mile Lake  
Tag Date – 5/25/07  
Agency - OMNR



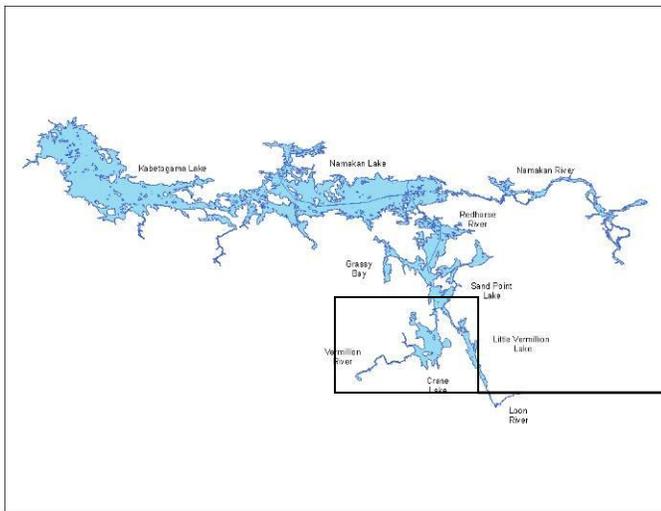
Fish - 4739  
Final Assigned Age - 25  
Sex - Unknown  
Tag Site – Below Hay Rapids  
Tag Date – 5/15/07  
Agency - OMNR



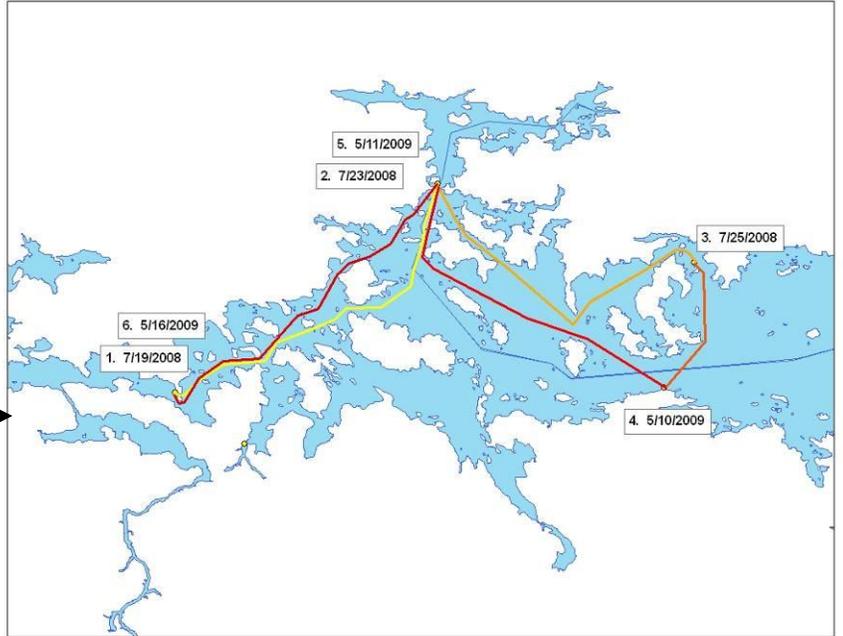
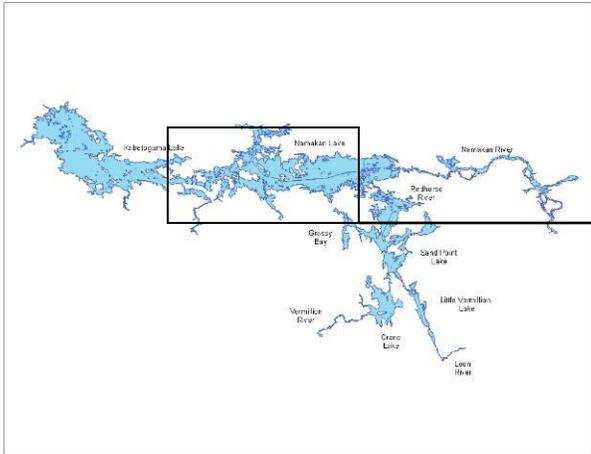
Fish - 4740  
Final Assigned Age - 35  
Sex - Female  
Tag Site – Below Hay Rapids  
Tag Date – 5/15/07  
Agency - OMNR



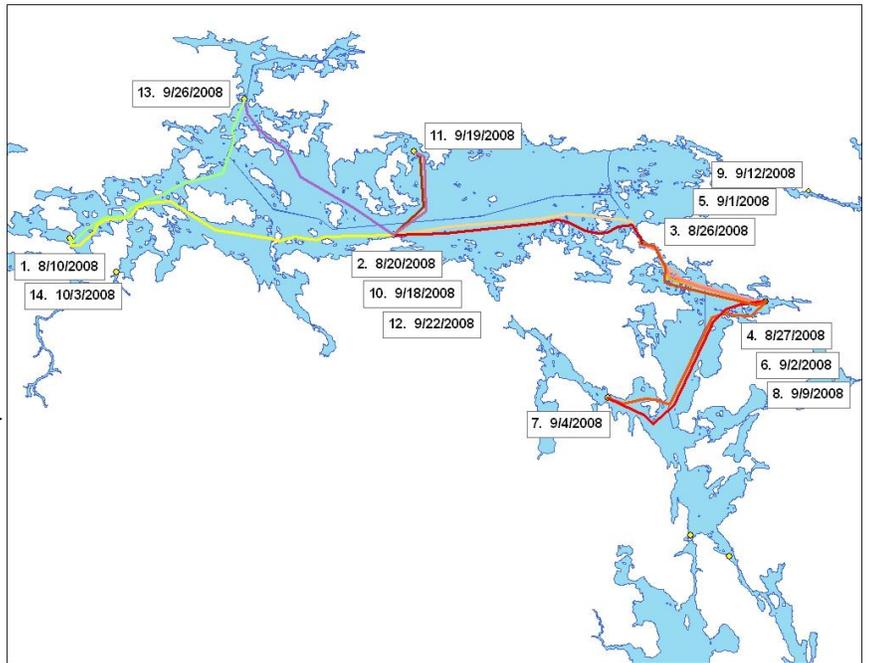
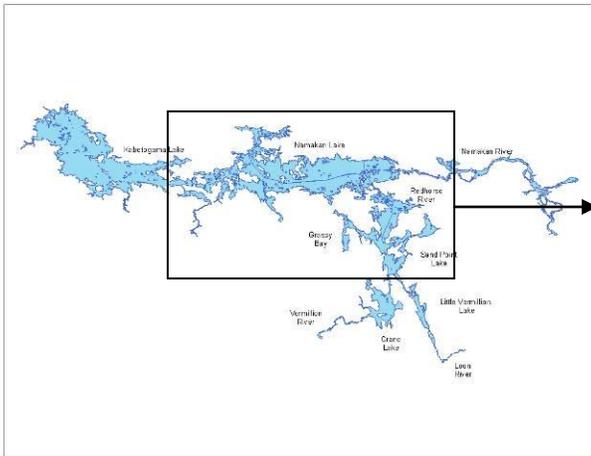
Fish - 4743  
Final Assigned Age - 32  
Sex - Unknown  
Tag Site – Below Hay Rapids  
Tag Date – 5/15/07  
Agency - OMNR



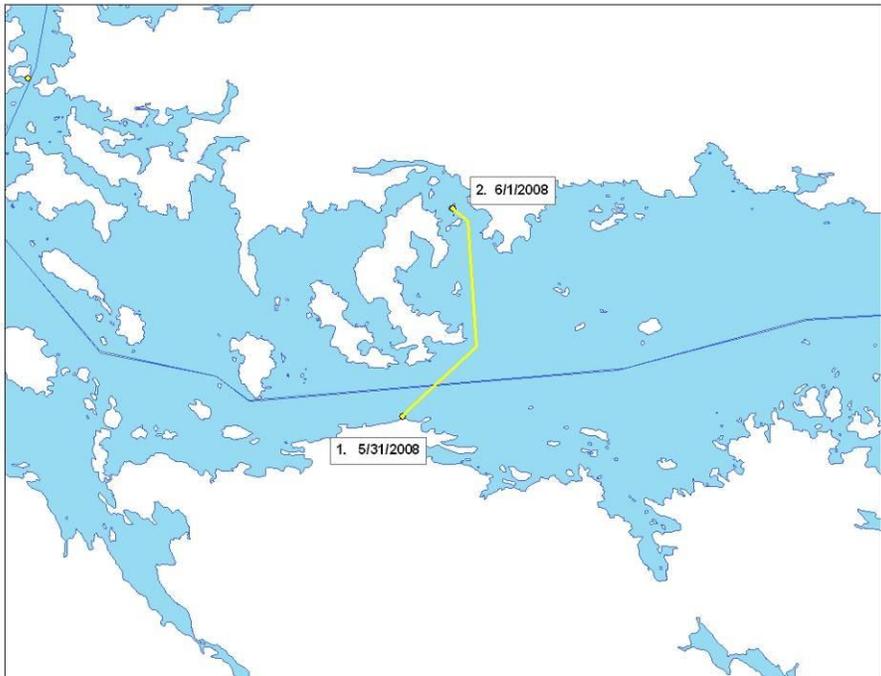
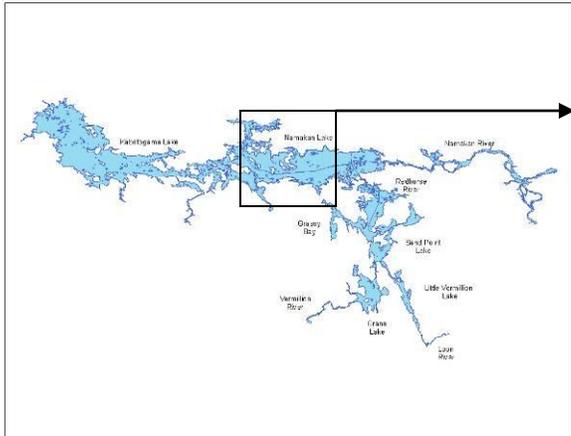
Fish - 4744  
 Final Assigned Age - 54  
 Sex - Unknown  
 Tag Site – Below Hay Rapids  
 Tag Date – 5/15/07  
 Agency - OMNR



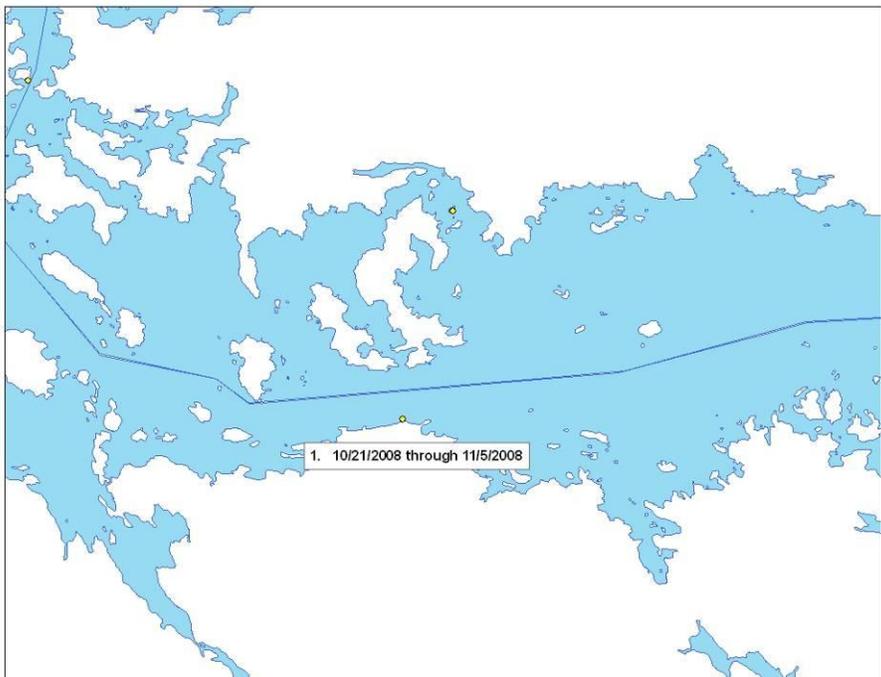
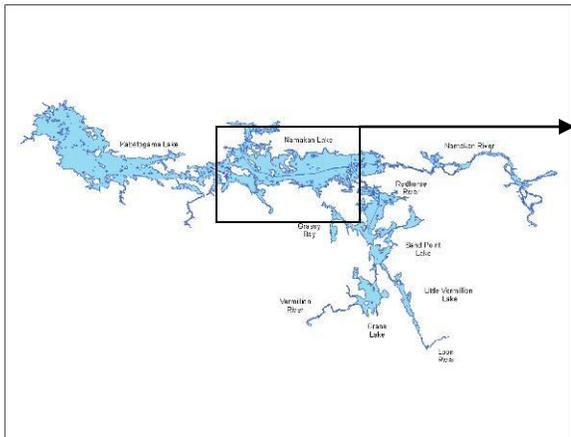
Fish - 4745  
 Final Assigned Age - 32  
 Sex - Female  
 Tag Site – Below Hay Rapids  
 Tag Date – 5/16/07  
 Agency - OMNR



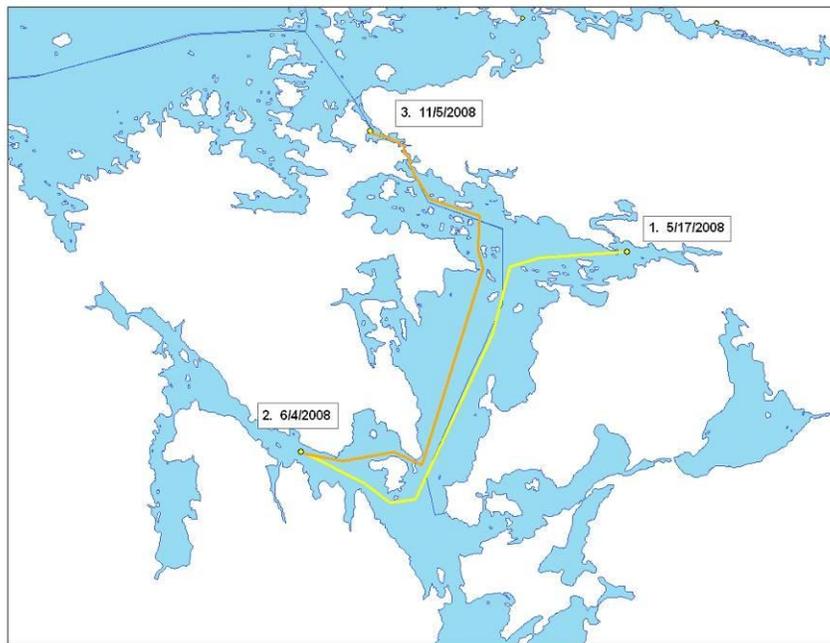
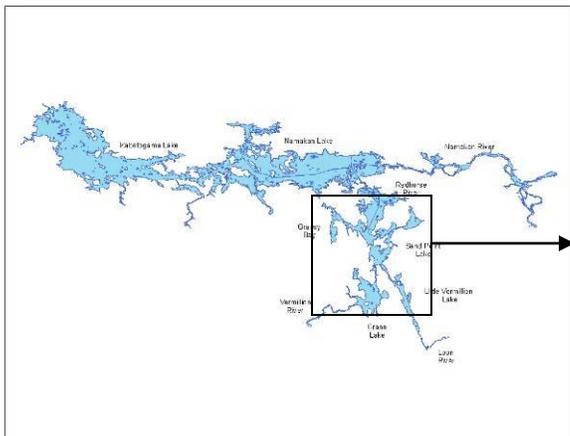
Fish - 4747  
Final Assigned Age - Unknown  
Sex - Unknown  
Tag Site – Below Hay Rapids  
Tag Date – 5/16/07  
Agency - OMNR



Fish - 4748  
Final Assigned Age - 41  
Sex - Male  
Tag Site – Below Hay Rapids  
Tag Date – 5/16/07  
Agency - OMNR



Fish - 4749  
Final Assigned Age - 52  
Sex - Unknown  
Tag Site - Little Eva Lake  
Tag Date - 5/17/07  
Agency - OMNR



Fish - 4751  
Final Assigned Age - 25  
Sex - Unknown  
Tag Site - Little Eva Lake  
Tag Date - 5/17/07  
Agency - OMNR

