



# **The Saint John River Muskellunge Tagging Project, 2006 - 2015**



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**Cover Photo:** A Saint John River Muskellunge (Muskies Canada photo).

## **Executive Summary**

This document has been prepared to summarize results of a muskellunge tagging project which has been conducted on the Saint John River, New Brunswick, from 2006 to 2015 (inclusive). During that period of time, 691 muskellunge have been angled, tagged and released by members of the Saint John River Chapter of Muskies Canada Inc. A total of 64 (9.3%) tagged muskellunge were recaptured by angling. An additional four tagged fish were captured at the Mactaquac Dam fishway.

Most muskellunge were observed to establish discrete summer home ranges from which there was little, if any, movement. Transitional movements are believed to occur during the spring and fall associated with spawning and the establishment of summer and winter ranges. Muskellunge movements which were documented in this study occurred in both upstream and downstream directions in almost equal proportion. Muskellunge also demonstrated the ability to move long distances both upstream and downstream including passage over/through the Mactaquac dam.

Results regarding muskellunge behaviour and movements from this study, to date, are generally consistent with observations (small home ranges, males more sedentary than females, movements seasonal in nature, capable of long distance movements, etc.) reported from similar tagging studies in other North American jurisdictions.

It is proposed that future efforts be directed to obtaining more information on recaptured fish. With additional recapture information, a more detailed analysis of muskellunge in the Saint John watershed can be completed.

## Table of Contents

Executive Summary .....	(i)
Table of Contents .....	(ii)
Introduction.....	1
Description of the Saint John River Watershed .....	1
Origin and Spread of Muskellunge.....	2
Management of the Muskellunge Fishery .....	3
Tagging Project Objectives .....	3
Methodology.....	3
Method of Capture and Tagging Procedure .....	3
Data Analysis .....	5
Results .....	5
Tagging Summary.....	5
Muskellunge Catch by Year .....	5
Location of Angled Muskellunge .....	6
Size of Angled Muskellunge.....	6
Recapture Summary .....	8
Muskellunge Recaptures .....	8
Movements of Tagged Muskellunge.....	9
Growth of Tagged Muskellunge .....	9
Discussion .....	9
Comparisons with Other Tagging Studies .....	9
Recommendations for Future Activities .....	11
Acknowledgements .....	11
References and Literature Cited .....	11

Appendix 1. Anglers who participated in the Saint John River muskellunge tagging project, 2006-2015.

Appendix 2. Growth of Tagged Muskellunge in the Saint John River, 2006-2015.

Appendix 3. Movements of Tagged Muskellunge in the Saint John River, 2006-2015.

Appendix 4. A Summary of Tagging and Telemetry Studies involving Muskellunge.

## Introduction

### Description of the Saint John River Watershed

The Saint John River is 696 km in length with a watershed of 55,160 km<sup>2</sup>. Upstream of Fredericton, the main stem of the river has been developed for hydroelectric power generation with dams at Mactaquac, Beechwood and Grand Falls. The Mactaquac dam's headpond extends upriver for approximately 100 kilometers. The river flows through the jurisdictions of Québec, Maine and New Brunswick and empties into the Bay of Fundy.

For the purposes of this study, the Saint John River flowing through the Province of New Brunswick was divided into three zones (see Figure 1):

**Zone 1** – That portion of the river above the Beechwood Dam, including the section of the river considered to be international waters.

**Zone 2** – That portion of the river from the Mactaquac Dam (Figure 2) upstream to the Beechwood Dam.

**Zone 3** – That portion of the river below the Mactaquac Dam.

All tributaries flowing into a given zone were considered as part of that zone.

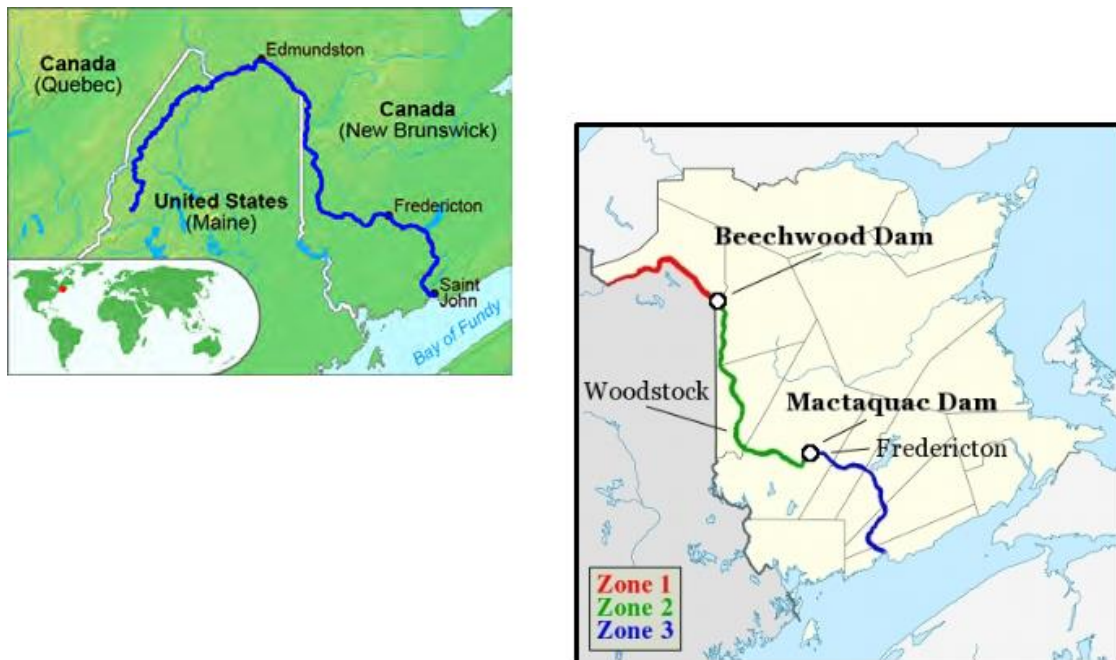


Figure 1. The Saint John River.



Figure 2. The Mactaquac Dam, Saint John River.

### **Origin and Spread of Muskellunge**

Muskellunge in the Saint John River are believed to have originated from the stocking of Lac Frontier (headwaters of the Saint John watershed) in the province of Québec (Jones and Wachelka 2014). Between 1970-79, a total of approximately 6,000 muskellunge fingerlings were released and a self-sustaining population was established. Muskellunge apparently emigrated downstream from Lac Frontier into the upper reaches of the Saint John River. By 1987, a muskellunge sport fishery had become established in Baker Lake, Maine (Johnson 1987). In Maine, additional populations have recently established in Fifth Saint John Pond, Fourth Saint John Pond, Third Saint John Pond, Beau Lake and Glazier Lake (Brautigam and Lucas 2008).

The first muskellunge collected in New Brunswick occurred in 1988 at a fish collection facility at the Mactaquac Dam near Fredericton. Muskellunge continued to be captured in the 1990s and seine netting indicated that natural reproduction was occurring. Stoczek et al. (1999) found that sexual maturity was attained as early as 3+ years. Biological analysis of sampled fish indicated rapid growth rates (Stoczek et al. 1999). In 2008 the first fifty inch fish was angled from the Saint John River. The fish measured 52 inches in length, had a 29 inch girth and was believed to weighed an estimated 48 pounds. In December, 2010, a dead muskellunge was found which measured approximately 51 inches with a 27 inch girth and a weight approaching 60 pounds (Jones and Wachelka 2014). One of the largest muskellunge caught in the State of Maine weighed 22.75 lbs. (<http://www.maine.gov/ifw/fishing/species/identification/muskellunge.htm>). There are also reports of a 48 inch (31.7 lb.) muskellunge caught in the Fort Kent area.

Muskellunge have continued to spread downstream into the freshwater tidal section of the Saint John River below Fredericton.

## **Management of the Muskellunge Fishery**

The quality of the developing Saint John River muskellunge fishery is attracting attention from anglers across North America. In 2005, this interest in muskellunge led to the establishment of an organization known as Muskies New Brunswick. This group later became the Saint John River Chapter of Muskies Canada Inc. in 2006.

Despite their popularity as a sport fish, muskellunge are currently designated as an invasive species by government management agencies. Muskellunge are only one of two esocids found in the province of New Brunswick (Stocek et al. 1999) and there are fears of the impact this top predator may have on indigenous stocks of Atlantic salmon and brook trout. The Department of Fisheries and Oceans destroy all muskellunge which are captured in fish traps at dams on the Saint John River.

In New Brunswick, muskellunge are designated as a non-sport fish. Angling seasons in Zones 1 and 2 extend from May 1 to November 30 each year. In Zone 3 (tidal waters) there is an all-year open season for muskellunge. The daily catch limit is five fish per day. There is also a 10 cm (3.9 inch) minimum and 170 cm (66.9 inch) maximum size limit in place.

## **Tagging Project Objectives**

This project was initiated to collect information on the muskellunge which is a new species in the Saint John River. Specifically, this included growth rates, movements and habitat selection. The ultimate goal was to provide detailed biological information to local management authorities so that muskellunge regulations and a new management regime could be established.

## **Methodology**

### **Method of Capture and Tagging Procedure**

This multi-year project was carried out under authority of a research permit issued to the University of New Brunswick (2006-2009) and, subsequently, to a scientific licence issued to the Saint John River (SJR) Chapter of Muskies Canada Inc. by the Department of Fisheries and Oceans (2010-2015). Muskellunge were angled either by casting or trolling. Angling dates and locations were not preselected. After the fish was landed, an alcohol swab was used to sterilize the needle. The tag was inserted while the fish was still in the net. Individually numbered T-type Floy tags were deployed with Mark II and Mark III pistol grip guns into the flesh of the fish slightly below the dorsal fin.

Not all angled muskellunge were tagged. The angler used his/her judgement on whether the fish could survive being handled and tagged. Fish that were deeply hooked and/or bleeding as well as those fish angled during extremely hot conditions were released immediately.

Length measures (total length) were taken using calibrated bump boards (Figure 3). Girth measurements were taken using a soft flexible tape. Sex determination was made using criteria described by Lebeau and Pageau (1989). If unsure, the sex of the fish was recorded as unknown. All relevant information was recorded at the capture site.



Figure 3. Gear utilized in the SJR muskellunge tagging study (MCI photo).



Figure 4. Release of a tagged fish in 2013. Note the location of the tag on the caudal peduncle immediately behind the dorsal fin (MCI photo).



## Data Analysis

Data on tagged fish was provided to the Release Director of the Saint John River Chapter of Muskies Canada Inc. All data was entered into an Excel database maintained by Muskies Canada Inc. Annual reports were prepared and submitted to the Department of Fisheries and Oceans (Burns 2011a, 2011b, Jones 2012, 2013, 2014, 2015 ).

## Results

### Tagging Summary

#### Muskellunge Catch by Year

At the conclusion of the 2015 fishing season, a total of 691 muskellunge had been angled, tagged and released (Table 1). Most (55.9%, 356 fish caught between 2006 and 2014) muskellunge were caught while trolling compared to casting (44.0%, 280 fish angled between 2006 and 2014). Female fish have predominated the angled catch (70.1% of the 351 fish whose sex was determined).

Table 1. Sex of muskellunge angled during the Saint John River tagging project, 2006-2015.

Year	Males	Females	Unknown	Total
2006	0	1	2	3
2007	4	12	10	26
2008	25	45	26	96
2009	18	38	33	89
2010	6	14	23	43
2011	11	30	44	85
2012	6	10	79	95
2013	22	46	48	116
2014	10	17	56	83
2015	3	33	19	55
<b>2006-2015 Summary</b>	<b>105 (15.2%)</b>	<b>246 (35.6%)</b>	<b>340 (49.2%)</b>	<b>691 (100.0%)</b>

The catch of tagged muskellunge has extended through the open water season (Table 2). One fish was also angled through the ice in February 2015. Despite the fact that angling dates were not pre-selected, catches are well represented across the spring to fall period.

Table 2. Date of capture for angled muskellunge marked in the Saint John River tagging project, 2006-2015.

Year	<u>Catch by Month of Year</u>								Total
	Feb.	May	June	July	Aug.	Sept.	Oct.	Nov.	
2006	0	0	0	0	1	0	2	0	3
2007	0	0	2	4	3	8	6	3	26
2008	0	0	13	27	10	19	26	1	96
2009	0	1	16	15	11	14	22	10	89
2010	0	0	7	12	4	3	17	0	43
2011	0	0	7	5	19	10	35	9	85
2012	0	0	4	13	19	22	24	13	95
2013	0	0	5	19	16	25	35	16	116
2014	0	0	16	8	17	15	16	11	83
2015	1	0	9	8	14	7	12	4	55
<b>Summary</b>	<b>1</b> <b>(0.1%)</b>	<b>1</b> <b>(0.1%)</b>	<b>79</b> <b>(11.4%)</b>	<b>111</b> <b>(16.1%)</b>	<b>114</b> <b>(16.5%)</b>	<b>123</b> <b>(17.8%)</b>	<b>195</b> <b>(28.2%)</b>	<b>67</b> <b>(9.7%)</b>	<b>691</b> <b>(100.0%)</b>

### Location of Angled Muskellunge

The majority of muskellunge tagged during this study originated from zones 2 and 3 (Table 3). This was probably indicative of where most angling occurred.

Table 3. Location of muskellunge angled during the Saint John River tagging project, 2006-2015.

Year	<u>Number of Fish Caught by Zone</u>			Total
	1	2	3	
2006	0	2	1	3
2007	1	19	6	26
2008	0	37	59	96
2009	0	22	67	89
2010	0	30	13	43
2011	0	40	45	85
2012	10	31	54	95
2013	11	71	34	116
2014	9	34	40	83
2015	2	34	19	55
<b>2006-2014</b>	<b>33</b>	<b>320</b>	<b>338</b>	<b>691</b>
<b>Summary</b>	<b>(4.8%)</b>	<b>(46.3%)</b>	<b>(48.9%)</b>	<b>(100.0%)</b>

### Size of Angled Muskellunge

The sizes of tagged muskellunge are summarized in Tables 4 and 5. The mean total lengths and girths were 35.1 inches (range 20-50 inches) and 15.8 inches (range 7.5-24 inches), respectively. At least four muskellunge, exceeding fifty inches in length, were angled from the Saint John River during the course of this study. The New Brunswick record muskellunge, angled in October 2008, measured 52 inches in length, 27 inches in girth and weighed 47.4 pounds.

Table 4. Length of angled and tagged muskellunge during the Saint John River tagging project, 2006-2015.

**Mean Total Length in Inches (Sample Size)**

<b>Year</b>	<b>Males</b>	<b>Females</b>	<b>Unknown</b>	<b>Total</b>
2006	- (0)	49.0 (1)	38.6 (2)	42.1 (3)
2007	36.5 (4)	37.8 (12)	35.6 (10)	36.7 (26)
2008	39.3 (25)	37.0 (45)	33.7 (26)	36.7 (96)
2009	33.7 (18)	39.4 (38)	33.8 (33)	36.2 (89)
2010	30.8 (6)	37.1 (14)	35.5 (23)	35.3 (43)
2011	31.7 (11)	40.2 (30)	33.7 (44)	35.8 (85)
2012	31.1 (6)	35.3 (10)	33.1 (79)	33.2 (95)
2013	29.4 (22)	36.3 (46)	33.8 (48)	34.0 (116)
2014	32.3 (10)	32.3 (10)	38.0 (56)	34.0 (83)
2015	32.1 (3)	36.0 (33)	31.0 (19)	34.1 (55)
<b>Summary</b>	<b>30.8 (105)</b>	<b>36.3 (246)</b>	<b>34.3 (340)</b>	<b>34.5 (691)</b>

Table 5. Girth of angled and tagged muskellunge during the Saint John River tagging project, 2006-2015.

**Mean Girth in Inches (Sample Size)**

<b>Year</b>	<b>Males</b>	<b>Females</b>	<b>Unknown</b>	<b>Total</b>
2006	- (0)	22.0 (1)	17.5 (2)	19.0 (3)
2007	18.4 (4)	17.8 (12)	16.5 (10)	17.3 (26)
2008	15.6 (25)	16.5 (45)	15.6 (26)	16.0 (96)
2009	14.8 (18)	18.2 (38)	15.8 (33)	16.6 (89)
2010	14.3 (6)	16.9 (14)	15.4 (23)	15.7 (43)
2011	14.3 (11)	18.9 (30)	15.2 (44)	16.4 (85)
2012	12.8 (6)	15.5 (10)	14.7 (79)	14.7 (95)
2013	13.2 (22)	16.8 (46)	15.4 (48)	15.5 (116)
2014	13.9 (10)	17.6 (17)	15.1 (56)	15.5 (83)
2015	13.6 (3)	17.7 (33)	14.8 (19)	16.5 (55)
<b>Summary</b>	<b>14.5 (105)</b>	<b>17.4 (246)</b>	<b>15.2 (340)</b>	<b>15.9 (691)</b>

Females comprised the bulk of larger muskellunge which were angled. Of ninety-four muskellunge, which exceeded 40 inches in length and for which sex information was available, female fish accounted for almost 90% of the catch. The largest muskellunge tagged during this study measured 50.0 inches in length.

## Recapture Summary

### Muskellunge Recaptures

A total of 68 tagged muskellunge have been recaptured. All but four of these recaptures have been through angling. Based on the fact that 691 fish were tagged and released, this represents an overall recapture rate to date of 9.8%. In a spring mark-recapture study in four Wisconsin lakes, 25.3% of marked fish were recaptured after one year post-release (Jennings et al. 2011). During an eleven year study on Kincaid Lake, Illinois, 34.2% of tagged fish (841 recaptured fish of 2,461 tagged) were recaptured at least once (Rude et al. 2011). In the Saugeen River, Ontario, where 105 muskellunge were tagged over a twelve year period, the recapture rate was 6.7% (7 fish) (A. McKee, Ontario Ministry of Natural Resources, Owen Sound. personal communication). Three muskellunge were recaptured twice in the Saint John River. One muskellunge (tag #611) was recaptured three different times.

The majority of recaptures, whose sex was determined, were female fish. Unfortunately, the sex of 34 recaptured muskellunge was not determined (Table 6).

Table 6. Sex of muskellunge recaptured during the Saint John River tagging study, 2006-2015.

<b><u>Number of Fish Recaptured</u></b>				
<b>Year</b>	<b>Males</b>	<b>Females</b>	<b>Unknown</b>	<b>Total</b>
2006	0	0	0	0
2007	0	1	0	1
2008	1	7	0	8
2009	0	5	3	8
2010	0	3	2	5
2011	3	1	2	6
2012	1	2	7	10
2013	1	2	4	7
2014	2	1	9	12
2015	2	2	7	11
<b>Summary</b>	<b>10 (14.7%)</b>	<b>24 (35.3%)</b>	<b>34 (50.0%)</b>	<b>68 (100.0%)</b>

The mean length of time from tagging to first recapture was 414.5 days (ranged from 1 day to 2,494 days). Twenty-two individual fish were recovered more than a year after being tagged and released. The longest period of time from release to recapture was almost seven years (tag #230). In a study involving the use of both passive integrated transponder (PIT) tags and external anchor tags, Rude et al. (2011) found that approximately 30% of tagged muskellunge had lost their external tag after a six year period.

## Movements of Tagged Muskellunge

The majority of recaptured muskellunge displayed little movement (i.e., < 1-2 km) from their tagging site (Table 7). Similar observations of inactivity have been reported from other waters (Landsman et al. 2015). In this study, some tagged muskellunge demonstrated significant movements, both upstream and downstream, however.

Table 7. Movements of recaptured muskellunge in the Saint John River, 2006-2015.

<b>Movement of Recaptured Muskellunge</b>	<b>Number of Recaptures</b>
No movement	33
Movements 1-2 km	22
Movements 2-10 km	6
Movements > 10 km	7
<b>Summary</b>	<b>68</b>

In 2013, two recaptured muskellunge had moved upstream a distance of 13 km and 14 km, respectively. In 2014, a muskellunge was recaptured near Fredericton (Zone 3). This fish had been tagged near Woodstock, New Brunswick, a distance of more than 97 km upstream including downstream passage over the Mactaquac Dam. Direction of movement, based on seventeen recaptures, was almost equally split between upstream and downstream.

## Growth of Tagged Muskellunge

The relatively small sample size of recaptured muskellunge whose sex was determined precluded a comprehensive review of muskellunge growth rates in the Saint John River. From fish which were examined, growth appears relatively rapid (i.e., 1.5 inches total length and 1.1 inches in girth per year) however.

Data from additional muskellunge recaptured in the future should enable more detailed analysis of muskellunge growth.

## Discussion

### Comparisons with Other Tagging Studies

It is interesting to compare results obtained from this study with observations from tagging studies in other waterbodies (see Appendix 4):

**Movements seasonal in nature** – Muskellunge movements commonly occur in the spring and fall as they transition between summer and winter home ranges (Dombeck 1979, Gillis et al.

2010, Wagner and Wahl 2011). Stoeck et al. (1999) suspected that most muskellunge movements in the Saint John River occurred during the spring and summer. The longest movements (> 10 km) observed in this study were fish which were recaptured in the fall (October and November).

**Muskellunge capable of long distance movements** - Morrison (2013) reported movements of tagged muskellunge in excess of 100 km in the Elk River, Virginia. The three longest movements documented in this study involved distances of 10, 46 and 97.25 km respectively.

Females are believed to travel greater distance than male muskellunge (Minor and Crossman 1978). In this study, seven fish moved distances greater than 10 km from their tagging site. Three of the four muskellunge whose sex was determined were female fish. Unfortunately, the sex of muskellunge, which travelled more than 97 km downstream, was not determined.

In addition to long distance movements, muskellunge have also demonstrated the ability to move through artificial barriers including locks (Gillis et al. 2010) and highway culverts (Stronks 1995). In the Saint John River, at least four muskellunge passed over/through the Mactaquac dam during the period of this project. Curry et al. (2007) noted similar observations.

**Preferential direction of movements** – Muskellunge movements can occur in both directions (upstream or downstream). In the Elk River, Virginia, Morrison (2013) found that muskellunge moved upriver to spawn and downriver to overwinter. Similar observations have been reported in the Saint John River (Curry et al. 2007). For directional movements recorded in this study, eleven upriver movements and fourteen downstream movements were documented. The longest movements seemed to be in a downstream direction however (upstream mean 9.1 km; downstream mean 14.4 km). Miles (1978) also reported equal upstream and downstream movements by muskellunge in the Ohio River drainage in West Virginia.

**Home ranges** – Muskellunge are known to develop relatively small home ranges during the summer and winter and display fidelity to those areas (Crossman 1977, Stronks 1995, Younk et al. 1996, Tipping 2001, Pyzer 2010). Jennings et al. (2011) reported that capture site fidelity (i.e., percentage of recaptured fish caught at the original point of capture) ranged from 55-93%. Many of the fish tagged and recaptured during this study also demonstrated well defined summer home ranges.

**Male muskellunge more sedentary than females** – Tagging studies in other North American waterbodies have indicated that male muskellunge tend to be more sedentary than female fish (Minor and Crossman 1978). In this study, two of the three fish having the longest movements were females (the third and longest migration involved a fish whose sex was undetermined).

## **Recommendations for Future Activities**

Having reviewed tagging activities and data collected over the past ten seasons, some recommendations are offered for consideration:

**Refocus Future Activities to Increasing Recaptures** – A large number of marked fish are now present in the Saint John River. It is recommended that future club efforts be redirected to collecting information on recaptured muskellunge. In addition to MCI angling activities, this could involve other non-affiliated anglers and interest groups. These efforts should continue for at least an additional 2-3 years in order to maximize the information which is collected.

**Improve Efforts to Determine Sex of Angled Fish** – A large proportion of the muskellunge captured during this project did not have the sex of the fish recorded. This precluded some additional data analysis as a result. Due to differences in movements, behaviour and growth between male and female muskellunge, this information is important. Using techniques involving external examination (Lebeau and Pageau 1989) anglers should be encouraged to collect and record this information in the future.

**Participate in the Cleithrum Project** – The Cleithrum project was initiated in 1979 to consolidate the collection of age and growth of muskellunge across their range. Several samples have already been submitted from the Saint John River. Continued participation is encouraged by extracting the cleithrum bone and recording other relevant information (length, girth, sex, stomach contents, etc.) from fish which are harvested or found dead.

## **Acknowledgements**

This study was conducted by a number of volunteer anglers associated with the Saint John River Chapter of Muskies Canada Inc. (see Appendix 1). Kaleb Zelman, University of New Brunswick, provided information on muskellunge which were captured at the Mactaquac Dam fishway in 2015. Andy McKee (Ontario Ministry of Natural Resources retired) provided comparative observations from a tagging study in the Saugeen River, Ontario.

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**Appendix 1. Anglers participating in the Saint John River Muskellunge Tagging Project, 2006-2015.**

Ackersley, Brian  
Anderson, Richard  
Arsenault, Paul  
Astle, Mark  
Beaton, Bruce  
Beliveau, Victor  
Blanchard, Dave  
Bobyk, Geoff  
Boone, Sheldon  
Burns, Charles  
Byrne, Joe  
Cormier, Mark  
Cormier, Peter  
Craig, Shannon  
Davis, Scott  
Doucette, Tim  
Eeuwes, Frank  
Eldridge, Steve  
Foley, Nick  
Fowler, James  
Goldie, Ray  
Golding, Trestan  
Greer, Max  
Greer, Mike  
Hayward, Casey  
Jones, Brandon  
Keys, Brian  
Lafranchise, Guy  
Landsman, Sean  
Leblanc, Isaac  
Lovean, Ron  
MacDonald, James  
Mason, Tim  
McIntosh, Walker  
McNeil, Robert  
Myers, Matt  
O'Donnell, Myra  
Porter, Erin  
Prince, Bill

Raynor, Ed  
Raynor, Clark  
Robinson, Anthony  
Rowe, Derek  
Sloat, Andrew  
Snyder, Charles  
Sonier, Matt  
Stuckless, Glenn  
Swim, Jeff  
Taylor, Terry  
Turner, Dustin  
Turner, Chris  
Wachelka, Hedrik  
Walsworth, Phil  
Williamson, Matt  
Yamazaki, Gordon  
Young, Mark

**Appendix 2. Growth of Tagged and Recaptured Muskellunge in the Saint John River, 2006-2015 (\* Fish recovered from the Mactaquac dam fishway).**

<b>Tag Number</b>	<b>Tagging Information Date</b>	<b>Location (Zone)</b>	<b>Recapture Information Date</b>	<b>Location (Zone)</b>	<b>Elapsed Time Since Fish Tagged</b>	<b>Growth Change</b>
41	July 17, 2007	2	October 23, 2007	2	97 days	Length increased from 38.0 to 38.5 inches; girth increased from 17.0 to 18.5 inches (female).
162	September 26, 2007	3	September 11, 2008	3	350 days	No measurable change in length; girth increased from 18.0 to 20.0 inches (sex unknown).
46	October 8, 2007	2	September 19, 2008	2	346 days	Length increased from 39.0 to 40.0 inches; girth increase (female).
127	November 3, 2007	3	October 10, 2008	3	341 days	Length increased from 30.0 to 31.5 inches; girth increased from 12 to 12.5 inches (male).
35	June 8, 2008	3	June 14, 2008	3	6 days	No measurable change in length; girth increased from 14.0 to 14.5 inches (female).
50	June 8, 2008	3	July 18, 2008	3	40 days	Length increased from 30.5 to 31.0 inches; girth increased from 13.0 to 13.25 inches (female).

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<b>Tag Number</b>	<b><u>Tagging Information</u></b> <b>Date</b>	<b>Location (Zone)</b>	<b><u>Recapture Information</u></b> <b>Date</b>	<b>Location (Zone)</b>	<b>Elapsed Time Since Fish Tagged</b>	<b>Growth Change</b>
34	June 8, 2008	3	June 9, 2012	3	1,461 days	Length increased from 32.25 to 38.25 inches; girth increased from 13.5 to 15.5 inches (male).
36	June 8, 2008	3	September 28, 2009	3	477 days	Length increased from 29.25 to 33.5 inches; girth increased from 13.5 to 15.5 inches (female).
128	June 14, 2008	3	October 10, 2008	3	117 days	Length increased from 38.0 to 38.25 inches; girth increased from 17.0 to 18.0 inches (female).
101	July 6, 2008	2	July 20, 2008	2	14 days	No measurable change in length; girth increased from 15.0 to 15.5 inches (female).
103	July 6, 2008	2	July 29, 2009	2	346 days	Length increased from 41.5 to 42.0 inches; girth increased from 19.0 to 20.0 inches (female).
110	July 23, 2008	3	June 12, 2009	3	345 days	Length increased from 35.0 to 37.0 inches; girth increased from 16.0 to 17.0 inches (unknown sex )

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<b>Tag Number</b>	<b><u>Tagging Information</u> Date</b>	<b>Location (Zone)</b>	<b><u>Recapture Information</u> Date</b>	<b>Location (Zone)</b>	<b>Elapsed Time Since Fish Tagged</b>	<b>Growth Change</b>
107	July 27, 2008	2	October 15, 2008	2	80 days	No measurable change in length; girth increased from 16.5 to 17.0 inches (female).
227	July 29, 2008	3	October 29, 2010	3	457 days	Length increased from 25.0 to 31.5 inches; girth increased from 12.5 to 14.0 inches (unknown sex).
228	September 6, 2008	3	July 24, 2011	3	1,051 days	Length increased from 28.75 to 32.0 inches; girth increased from 13.0 to 14.5 inches (female).
148	September 12, 2008	2	July 30, 2009	2	321 days	Length increased from 41.0 to 42.0 inches; girth increased from 19.0 to 19.5 inches (female).
229	September 17, 2008	3	June 2, 2009 July 14, 2009	3 3	258 days 300 days	No measurable change in length or girth (unknown sex)
230	September 19, 2008	3	July 19, 2015	3	2,494 days	Length increased from 40.25 to 46.4 inches; girth increased from 19.5 to 22.0 inches (unknown sex).
294	October 1, 2008	3	October 27, 2009	3	391 days	Length increased from 46.25 to 47.25 inches; girth increased from 22.0 to 25.5 inches (female).

<b>Tag Number</b>	<b><u>Tagging Information</u> Date</b>	<b>Location (Zone)</b>	<b><u>Recapture Information</u> Date</b>	<b>Location (Zone)</b>	<b>Elapsed Time Since Fish Tagged</b>	<b>Growth Change</b>
292	October 1, 2008	3	November 13, 2010	3	773 days	Length increased from 35.75 to 38.0 inches; girth increased from 14.0 to 16.75 inches (female).
296	October 16, 2008	3	November 6, 2008	3	21 days	Length increased from 32.0 to 32.5 inches; no measurable change in girth (female).
409	June 4, 2009	3	September 5, 2012	3	1,188 days	Length increased from 30.5 to 35.0 inches; girth increased from 12.5 to 15.0 inches (female).
500	June 14, 2009	3	October 6, 2010 November 25, 2011	3	479 days 894 days	Length increased from 28.25 to 32.75 to 33.25 inches; girth increased from 13.0 to 14.5 inches (female).
1348	June 30, 2009	2	June 27, 2010	2	362 days	Length increased from 41.5 to 42.5 inches; girth increased from 18.5 to 20.0 inches (female).
465	July 7, 2009	3	October 6, 2009	3	91 days	Length increased from 33.0 to 34.5 inches; girth was unchanged from 15.0 inches (unknown sex).

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<b>Tag Number</b>	<b>Tagging Information Date</b>	<b>Location (Zone)</b>	<b>Recapture Information Date</b>	<b>Location (Zone)</b>	<b>Elapsed Time Since Fish Tagged</b>	<b>Growth Change</b>
467	July 10, 2009	3	November 8, 2009	3	88 days	Length increased from 34.0 to 35.0 inches; girth increased from 14.5 to 16.0 inches (female).
			October 22, 2011	3	834 days	Length unchanged at 34 inches; girth increased from 14.5 to 15.0 inches (female).
490	August 12, 2009	3	September 27, 2009	3	45 days	Length increased from 33.0 to 34.5 inches; girth increased from 14.0 to 14.5 inches (unknown sex).
370	October 27, 2009	3	May 17, 2010	3	202 days	Length increased from 25.75 to 26.0 inches; girth increased from 10.25 to 11.25 inches (female).
579	June 15, 2011	3	July 24, 2011	3	39 days	Length increased from 24.75 to 25.0 inches; girth increased from 9.5 to 10.75 inches (male).
580	June 29, 2011	3	November 29, 2011	3	153 days	Length increased from 25.5 to 28.75; girth increased from 10.0 to 12.0 inches (unknown sex).

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<b>Tag Number</b>	<b><u>Tagging Information</u> Date</b>	<b>Location (Zone)</b>	<b><u>Recapture Information</u> Date</b>	<b>Location (Zone)</b>	<b>Elapsed Time Since Fish Tagged</b>	<b>Growth Change</b>
743	July 15, 2011	3	June 26, 2012	3	347 days	Length increased from 30.0 to 31.5 inches; girth increased from 10.0 to 11.5 inches (unknown sex).
620	September 1, 2011	3	September 28, 2014	3	1,123 days	Length increased from 30.0 to 35.0 inches; girth increased from 14.0-15.0 inches (unknown sex)
169	October 14, 2011	2	August 11, 2014	2	1,043 days	Length increased from 35.0 to 37.75 inches; girth increased from 17.0 to 18.0 inches (unknown sex).
593	October 15, 2011	3	November 15, 2011	3	31 days	No measurable change in length or girth (male).
594	October 15, 2011	3	October 16, 2011	3	1 day	No measurable change in length or girth (male)..
172	October 29, 2011	2	November 8, 2015*	3	1,710 days	Length increased from 40.0 to 42.0 inches (female)
764	November 7, 2011	2	August 22, 2014	2	1,019 days	Length increased from 36.5 to 41.0 inches; girth increased from 16.5 to 18.0 inches (unknown sex).

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<b>Tag Number</b>	<b><u>Tagging Information</u></b> <b>Date</b>	<b>Location (Zone)</b>	<b><u>Recapture Information</u></b> <b>Date</b>	<b>Location (Zone)</b>	<b>Elapsed Time Since Fish Tagged</b>	<b>Growth Change</b>
611	November 13, 2011	3	August 8, 2014	3	999 days	No measurable change in length or girth (unknown sex)
		3	September 13, 2014	3	1,035 days	Length increased from 31.0 inches to 35.5 inches; girth increased from 14.0 to 15.0 inches (unknown sex).
		3	July 27, 2015	3	1,351 days	Length increased from 31.0 to 35.35 inches; girth increased from 14.0 to 16.0 inches (unknown sex).
688	July 15, 2012	2	July 29, 2012	2	14 days	No measurable change in length; girth increased from 19.25 to 19.5 inches (unknown sex).
632	July 27, 2012	3	August 26, 2012	3	30 days	No measurable change in length or girth (unknown sex).
785	August 10, 2012	2	August 30, 2012	2	20 days	No measurable change in length or girth (unknown sex).
406	August 26, 2012	3	September 3, 2012	3	8 days	Length increased from 29.75 to 30.0 inches; girth increased from 12.25 to 13.0 inches (unknown sex).

<b>Tag Number</b>	<b><u>Tagging Information</u> Date</b>	<b>Location (Zone)</b>	<b><u>Recapture Information</u> Date</b>	<b>Location (Zone)</b>	<b>Elapsed Time Since Fish Tagged</b>	<b>Growth Change</b>
316	September 2, 2012	2	September 9, 2012	2	7 days	No measurable change in length or girth (unknown sex).
727	September 3, 2012	3	November 16, 2012	3	74 days	Length increased from 28.5 to 29.25 inches; girth increased from 11.0 to 12.0 inches (female).
730	September 9, 2012	2	July 4, 2014	2	663 days	Length increased from 25.75 to 31.0 inches; girth increased from 10.0 inches to 13.75 inches (unknown sex)..
511	October 8, 2012	3	July 8, 2013	3	272 days	Length increased from 27.0 to 28.0 inches; girth increased from 11.5 to 12.5 inches (unknown sex).
512	October 8, 2012	3	November 12, 2012	3	32 days	Length increased from 30.0 inches to 30.25 inches; girth increased from 12.0 to 12.5 inches (unknown sex).
513	October 9, 2012	3	September 7, 2013	3	332 days	Length increased from 26.5 to 30.75 inches; girth increased from 11.0 to 12.0 inches (female).

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<b>Tag Number</b>	<b><u>Tagging Information</u> Date</b>	<b>Location (Zone)</b>	<b><u>Recapture Information</u> Date</b>	<b>Location (Zone)</b>	<b>Elapsed Time Since Fish Tagged</b>	<b>Growth Change</b>
672	October 14, 2012	3	October 11, 2014	2	727 days	Length increased from 36.0 to 36.5 inches; no change in girth (unknown sex).
674	October 15, 2012	2	July 11, 2013	2	269 days	Length increased from 30.0 to 30.5 inches; no measurable change in girth (unknown sex).
661	November 3, 2012	2	July 9, 2013	2	248 days	No measurable change in length; girth increased from 14.75 to 15.5 inches (unknown sex).
518	November 7, 2012	3	July 14, 2013	3	249 days	Length increased from 28.25 to 31.75; girth increased from 11.0 inches to 14.5 inches (unknown sex).
524	November 28, 2012	3	July 14, 2013	3	228 days	Length increased from 30.5 to 31.0 inches; girth increased from 12.5 to 13.75 inches (male).
790	July 6, 2013	2	September 1, 2013	2	57 days	No measurable change in length or girth (female).
361	July 12, 2013	3	July 19, 2014	3	372 days	Length increased from 28.5 to 31.5 inches; girth increased from 12.0 to 13.0 inches (male).

<b>Tag Number</b>	<b><u>Tagging Information</u> Date</b>	<b>Location (Zone)</b>	<b><u>Recapture Information</u> Date</b>	<b>Location (Zone)</b>	<b>Elapsed Time Since Fish Tagged</b>	<b>Growth Change</b>
926	July 16, 2013	3	October 11, 2014	3	452 days	Length increased from 32.5 to 35.75 inches; girth increase (male).
656	August 26, 2013	2	November 8, 2015*	3	915 days	Length increased from 27.75 to 33.0 inches (male)
893	October 2, 2013	2	October 12, 2015	3	375 days	Length increased from 34.5 to 37.75 inches; girth increased from 15.0 to 17.0 inches (male)
645	October 11, 2013	2	November 8, 2015*	3	961 days	Length increased from 36.0 to 37.0 inches (female)
908	October 20, 2013	3	August 8, 2015	3	657 days	Length increased from 31.5 to 36.25 inches; girth increased from 12.5 to 16.0 inches (male)
861	October 28, 2013	3	November 10, 2014	3	378 days	Length increased from 28.75 to 35.5 inches; girth increased from 10.75 to 12 inches (unknown sex).
1152	June 22, 2014	3	September 11, 2014	3	81 days	Length increased from 30.5 to 30.75 inches; girth increased from 12.5 to 14.25 inches (female).

<b>Tag Number</b>	<b><u>Tagging Information</u> Date</b>	<b>Location (Zone)</b>	<b><u>Recapture Information</u> Date</b>	<b>Location (Zone)</b>	<b>Elapsed Time Since Fish Tagged</b>	<b>Growth Change</b>
760	July 12, 2014	3	November 13, 2014	3	124 days	Length increased from 31.5 to 34.25 inches; girth increased from 13.5 to 17.0 inches (unknown sex).
761	August 2, 2014	2	August 24, 2014	2	22 days	No measurable change in length or girth (unknown sex).
709	October 13, 2014	2	November 8, 2015*	3	312 days	Length increased from 29.0 to 34.0 inches (male).
940	October 25, 2014	2	October 24, 2015	2	364 days	Length increased from 27.75 to 31.5 inches; girth increased from 11 to 14 inches (unknown sex).
1157	August 24, 2014	3	June 29, 2015	2	309 days	Length increased from 35.25 to 36.5 inches; girth increased from 16.0 to 16.5 inches (unknown sex).
833	August 21, 2015	3	September 27, 2015	3	37 days	Length remained the same at 39.0 inches; girth remained the same at 18.0 inches (female).

### Appendix 3. Movements of Tagged Muskellunge in the Saint John River, 2006-2015

(\* Fish recovered from the Mactaquac dam fishway).

Tag #	Tagging Date	Recapture Date	Elapsed Time Since Fish Tagged	Sex of Fish	Movement of Fish Since Tagged
34	June 8, 2008	June 9, 2012	1,461 days	Male	• Fish recaptured at same spot where it was originally tagged (no movement).
35	June 8, 2008	June 14, 2008	6 days	Female	• Fish recaptured at same spot where it was originally tagged (no movement).
36	June 8, 2008	September 28, 2009	477 days	Female	• Fish recaptured at same spot where it was originally tagged (no movement).
41	July 17, 2007	October 23, 2007	97 days	Female	• Fish moved downriver approximately 2.5 km from capture site.
46	October 8, 2007	September 19, 2008	346 days	Female	• Fish had moved less than 1 km from capture site.
50	June 8, 2008	July 18, 2008	40 days	Female	• Fish recaptured at same spot where it was originally tagged (no movement).
101	July 6, 2008	July 20, 2008	14 days	Female	• Fish recaptured at same spot where it was originally tagged (no movement).
103	July 6, 2008	July 29, 2009	346 days	Female	• Fish had moved 1 km downstream from capture site.
107	July 27, 2008	October 15, 2008	80 days	Female	• Fish had travelled downstream approximately 2.5 km.

<b>Tag #</b>	<b>Tagging Date</b>	<b>Recapture Date</b>	<b>Elapsed Time Since Fish Tagged</b>	<b>Sex of Fish</b>	<b>Movement of Fish Since Tagged</b>
110	July 23, 2008	June 12, 2009	345 days	Unknown	<ul style="list-style-type: none"> <li>• Fish had moved 1 km upstream from capture site.</li> </ul>
127	November 3, 2007	October 10, 2008	341 days	Male	<ul style="list-style-type: none"> <li>• Fish had moved approximately 1 km downstream.</li> </ul>
128	June 14, 2008	October 10, 2008	117 days	Female	<ul style="list-style-type: none"> <li>• Fish had moved less than 1 km from capture site.</li> </ul>
148	September 12, 2008	July 30, 2009	321 days	Female	<ul style="list-style-type: none"> <li>• Fish had moved upstream approximately 10 km from capture site.</li> </ul>
162	September 26, 2007	September 11, 2008	350 days	Unknown	<ul style="list-style-type: none"> <li>• Fish recaptured at same spot where it was originally tagged (no movement).</li> </ul>
169	October 14, 2011	August 11, 2014	1,043 days	Unknown	<ul style="list-style-type: none"> <li>• Fish recaptured at same spot where it was originally tagged (no movement).</li> </ul>
172	October 29, 2011	November 8, 2015*	1,710 days	Female	<ul style="list-style-type: none"> <li>• Fish had moved downstream 23.3 km (over the Mactaquac dam).</li> </ul>
227	July 29, 2008	October 29, 2010	457 days	Unknown	<ul style="list-style-type: none"> <li>• Fish had moved upstream approximately 6 km from capture site.</li> </ul>
228	September 6, 2008	July 24, 2011	1,051 days	Female	<ul style="list-style-type: none"> <li>• Fish had moved downstream approximately 1 km from capture site.</li> </ul>
229	September 17, 2008	June 2, 2009	258 days	Unknown	<ul style="list-style-type: none"> <li>• Fish had moved downstream approximately 7 km to the mouth of a tributary stream .</li> </ul>
		July 14, 2009	300 days	Unknown	<ul style="list-style-type: none"> <li>• Fish had moved back upstream to original site of capture</li> </ul>
230	September 19, 2008	July 19, 2015	2,494 days	Unknown	<ul style="list-style-type: none"> <li>• Fish had moved less than 2 km from point of capture.</li> </ul>



<b>Tag #</b>	<b>Tagging Date</b>	<b>Recapture Date</b>	<b>Elapsed Time Since Fish Tagged</b>	<b>Sex of Fish</b>	<b>Movement of Fish Since Tagged</b>
292	October 1, 2008	November 13, 2010	773 days	Female	<ul style="list-style-type: none"> <li>• Fish recaptured at same spot where it was originally tagged (no movement).</li> </ul>
294	October 1, 2008	October 27, 2009	391 days	Female	<ul style="list-style-type: none"> <li>• Fish recaptured at same spot where it was originally tagged (no movement).</li> </ul>
296	October 16, 2008	November 6, 2008	21 days	Female	<ul style="list-style-type: none"> <li>• Fish had moved 1 km upstream from original capture site.</li> </ul>
316	September 2, 2012	September 9, 2012	7 days	Unknown	<ul style="list-style-type: none"> <li>• Fish recaptured at same spot where it was originally tagged (no movement).</li> </ul>
361	July 12, 2013	July 19, 2014	372 days	Unknown	<ul style="list-style-type: none"> <li>• Fish recaptured at same spot where it was originally tagged (no movement).</li> </ul>
370	October 22, 2009	May 17, 2010	202 days	Female	<ul style="list-style-type: none"> <li>• Fish had moved 1 km upstream to the mouth of a tributary.</li> </ul>
406	August 26, 2012	September 3, 2012	8 days	Unknown	<ul style="list-style-type: none"> <li>• Fish recaptured at same spot where it was originally tagged (no movement).</li> </ul>
409	June 4, 2009	September 5, 2012	1,188 days	Female	<ul style="list-style-type: none"> <li>• Fish recaptured at same spot where it was originally tagged (no movement).</li> </ul>
465	July 7, 2009	October 6, 2009	91 days	Unknown	<ul style="list-style-type: none"> <li>• Fish recaptured at same spot where it was originally tagged (no movement).</li> </ul>
467	July 10, 2009	November 8, 2009	88 days	Female	<ul style="list-style-type: none"> <li>• Fish had moved 2 km upstream from original capture site.</li> </ul>
		October 22, 2011	834 days	Female	<ul style="list-style-type: none"> <li>• No movement – still 2 km upstream of original capture site.</li> </ul>
490	August 12, 2009	September 27, 2009	45 days	Unknown	<ul style="list-style-type: none"> <li>• Fish had moved 5 km upstream from original capture site.</li> </ul>

<b>Tag #</b>	<b>Tagging Date</b>	<b>Recapture Date</b>	<b>Elapsed Time Since Fish Tagged</b>	<b>Sex of Fish</b>	<b>Movement of Fish Since Tagged</b>
500	June 14, 2009	October 6, 2010	479 days	Unknown	<ul style="list-style-type: none"> <li>• Fish had moved downstream approximately 0.5 km.</li> </ul>
		November 25, 2011	894 days	Unknown	<ul style="list-style-type: none"> <li>• Fish had moved an additional 0.5 km downstream.</li> </ul>
511	October 8, 2012	July 8, 2013	272 days	Unknown	<ul style="list-style-type: none"> <li>• Fish recaptured at same spot where it was originally tagged (no movement).</li> </ul>
512	October 8, 2012	November 12, 2012	32 days	Unknown	<ul style="list-style-type: none"> <li>• Fish recaptured at same spot where it was originally tagged (no movement).</li> </ul>
513	October 9, 2012	September 7, 2013	332 days	Female	<ul style="list-style-type: none"> <li>• Fish recaptured at same spot where it was originally tagged (no movement).</li> </ul>
518	November 7, 2012	July 14, 2013	249 days	Unknown	<ul style="list-style-type: none"> <li>• Fish recaptured at same spot where it was originally tagged (no movement).</li> </ul>
524	November 28, 2012	July 14, 2013	228 days	Male	<ul style="list-style-type: none"> <li>• Fish recaptured at same spot where it was originally tagged (no movement).</li> </ul>
579	June 15, 2011	July 24, 2011	39 days	Male	<ul style="list-style-type: none"> <li>• Fish was recaptured within 1 km of original capture site.</li> </ul>
580	June 29, 2011	November 29, 2011	153 days	Unknown	<ul style="list-style-type: none"> <li>• Fish was recaptured within 1 km of original capture site.</li> </ul>
593	October 15, 2011	November 15, 2011	31 days	Male	<ul style="list-style-type: none"> <li>• Fish was recaptured within 1 km of original capture site.</li> </ul>
594	October 15, 2011	October 16, 2011	1 day	Male	<ul style="list-style-type: none"> <li>• Fish was recaptured within 1 km of original capture site.</li> </ul>

<b>Tag #</b>	<b>Tagging Date</b>	<b>Recapture Date</b>	<b>Elapsed Time Since Fish Tagged</b>	<b>Sex of Fish</b>	<b>Movement of Fish Since Tagged</b>
611	November 13, 2011	August 8, 2014	999 days	Unknown	<ul style="list-style-type: none"> <li>Minimal movement since tagged.</li> </ul>
		September 13, 2014	1,035 days	Unknown	<ul style="list-style-type: none"> <li>Fish recaptured at same spot where it was originally tagged (no movement).</li> </ul>
		July 27, 2015	1,351 days	Unknown	<ul style="list-style-type: none"> <li>Fish had moved less than 2 km from capture site.</li> </ul>
620	September 1, 2011	September 28, 2014	1,123 days	Unknown	<ul style="list-style-type: none"> <li>Fish recaptured at same spot where it was originally tagged (no movement).</li> </ul>
632	July 27, 2012	August 26, 2012	30 days	Unknown	<ul style="list-style-type: none"> <li>Fish recaptured at same spot where it was originally tagged (no movement).</li> </ul>
645	October 11, 2013	November 8, 2015*	961 days	Female	<ul style="list-style-type: none"> <li>Fish had moved 37.0 km downriver (over the Mactaquac dam).</li> </ul>
656	August 26, 2013	November 8, 2015*	915 days	Male	<ul style="list-style-type: none"> <li>Fish had moved 3 km downstream (over the Mactaquac dam).</li> </ul>
661	November 3, 2012	July 9, 2013	248 days	Unknown	<ul style="list-style-type: none"> <li>Fish had moved 13 km upstream from original tagging site.</li> </ul>
672	October 14, 2012	October 11, 2014	727 days	Unknown	<ul style="list-style-type: none"> <li>Fish had moved approximately 97.25 km downstream from original capture site.</li> </ul>
674	October 15, 2012	June 11, 2013	269 days	Unknown	<ul style="list-style-type: none"> <li>Fish recaptured at same spot where it was originally tagged (no movement).</li> </ul>
688	July 15, 2012	July 29, 2012	14 days	Unknown	<ul style="list-style-type: none"> <li>Fish recaptured at same spot where it was originally tagged (no movement).</li> </ul>
709	October 13, 2014	November 8, 2015*	312 days	Male	<ul style="list-style-type: none"> <li>Fish had moved 13.4 km downstream (over the Mactaquac dam).</li> </ul>

<b>Tag #</b>	<b>Tagging Date</b>	<b>Recapture Date</b>	<b>Elapsed Time Since Fish Tagged</b>	<b>Sex of Fish</b>	<b>Movement of Fish Since Tagged</b>
727	September 3, 2012	November 16, 2012	74 days	Female	<ul style="list-style-type: none"> <li>• Fish recaptured at same spot where it was originally tagged (no movement).</li> </ul>
730	September 9, 2012	July 4, 2014	663 days	Unknown	<ul style="list-style-type: none"> <li>• Fish recaptured at same spot where it was originally tagged (no movement).</li> </ul>
743	July 15, 2011	June 16, 2012	347 days	Unknown	<ul style="list-style-type: none"> <li>• Fish had moved 6 km upstream from original capture site.</li> </ul>
760	July 12, 2014	November 13, 2014	124 days	Unknown	<ul style="list-style-type: none"> <li>• Fish recaptured at same spot where it was originally tagged (no movement).</li> </ul>
761	August 2, 2014	August 24, 2014	22 days	Unknown	<ul style="list-style-type: none"> <li>• Fish recaptured at same spot where it was originally tagged (no movement).</li> </ul>
764	November 7, 2011	August 22, 2014	1,019 days	Unknown	<ul style="list-style-type: none"> <li>• Fish recaptured at same spot where it was originally tagged (no movement).</li> </ul>
785	August 10, 2012	August 30, 2012	20 days	Unknown	<ul style="list-style-type: none"> <li>• Fish recaptured at same spot where it was originally tagged (no movement).</li> </ul>
790	July 6, 2013	September 1, 2013	57 days	Female	<ul style="list-style-type: none"> <li>• Fish had moved 46 km upstream from original tagging site.</li> </ul>
833	August 21, 2015	September 27, 2015	37 days	Unknown	<ul style="list-style-type: none"> <li>• Fish recaptured less than 2 km from tagging site.</li> </ul>
861	October 28, 2013	November 10, 2014	378 days	Unknown	<ul style="list-style-type: none"> <li>• Fish recaptured at same spot where it was originally tagged (no movement).</li> </ul>
893	October 2, 2013	October 12, 2015	375 days	Unknown	<ul style="list-style-type: none"> <li>• Fish recaptured less than 2 km from tagging site.</li> </ul>

<b>Tag #</b>	<b>Tagging Date</b>	<b>Recapture Date</b>	<b>Elapsed Time Since Fish Tagged</b>	<b>Sex of Fish</b>	<b>Movement of Fish Since Tagged</b>
908	October 20, 2013	August 8, 2015	657 days	Unknown	<ul style="list-style-type: none"> <li>• Fish recaptured less than 2 km for tagging site.</li> </ul>
926	July 16, 2013	October 11, 2014	452 days	Male	<ul style="list-style-type: none"> <li>• Fish recaptured at same spot where it was originally tagged (no movement).</li> </ul>
940	October 25, 2014	October 24, 2015	364 days	Unknown	<ul style="list-style-type: none"> <li>• Fish recaptured less than 2 km for tagging site. This fish never swam upstream but moved from one side of the river to the other (maximum 1 km lateral movement).</li> </ul>
1152	June 22, 2014	September 11, 2014	81 days	Female	<ul style="list-style-type: none"> <li>• Fish recaptured at same spot where it was originally tagged (no movement).</li> </ul>
1157	August 24, 2014	June 29, 2015	309 days	Unknown	<ul style="list-style-type: none"> <li>• Fish recaptured 12.3 km downstream from tagging site.</li> </ul>
1348	June 30, 2009	June 27, 2010	362 days	Female	<ul style="list-style-type: none"> <li>• Fish recaptured at same spot where it was originally tagged (no movement).</li> </ul>

#### **Appendix 4. A Summary of Tagging and Telemetry Studies involving Muskellunge.**

<b>Waterbody</b>	<b>Study Period</b>	<b>Tag Type</b>	<b>Number Fish Marked</b>	<b>Key Findings</b>	<b>Reference</b>
Black Lake and Moose Lake (Wisconsin)	1970s	External radio tags	18	<ul style="list-style-type: none"> <li>• Peak movements occurred in spring and fall.</li> <li>• Water temperatures were correlated with movements.</li> <li>• Home ranges varied in size from 0.2-37.7 ha.</li> <li>• Four spawning areas were documented.</li> </ul>	Dombeck (1979)
Elk River (West Virginia)	2008-2013	Unknown	194	<ul style="list-style-type: none"> <li>• Most movements occurred in the spring.</li> <li>• Muskellunge moved upriver to spawn and downriver to overwinter.</li> <li>• Movements of 100 km documented.</li> </ul>	Morrison (2013)
Forbes Lake (Illinois)	Unknown	Radio tags	Unknown	<ul style="list-style-type: none"> <li>• Movements greatest in the spring and lowest in summer.</li> <li>• Relatively small home ranges in summer.</li> </ul>	Wagner and Wahl (2011)
Kincaid Lake (Illinois)	2003	Radio tags	12	<ul style="list-style-type: none"> <li>• Tagged muskellunge selected specific habitats in different seasons.</li> <li>• Greatest movements (&gt; 13km/week) occurred during pre spawn and in early summer.</li> <li>• Overlap in home ranges.</li> </ul>	Beck and Brooks (undated)

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<b>Waterbody</b>	<b>Study Period</b>	<b>Tag Type</b>	<b>Number Fish Marked</b>	<b>Key Findings</b>	<b>Reference</b>
Little Green Lake (Wisconsin)	1960-1963	Peterson tags	285	<ul style="list-style-type: none"> <li>• 75% of tagged fish caught by anglers.</li> <li>• Maximum elapse between tag and recapture was 44 months</li> <li>• Nine of 45 fish captures were in exactly the same location.</li> </ul>	Hacker (1966)
Manitowish chain of lakes (Wisconsin)	2004-2005	Radio tags T-bar anchor tags	36 491	<ul style="list-style-type: none"> <li>• 2.1% loss of anchor tags.</li> <li>• 50-53% of tagged fish recaptured in lake where tagged.</li> </ul>	Weeks and Hansen (2009)
Mayfield Reservoir (Washington)	1992-1998	Internal radio tags	16	<ul style="list-style-type: none"> <li>• Year-to-year site fidelity.</li> <li>• Summer and fall range smaller than winter and spring range.</li> </ul>	Tipping (2001)
Melton Hill Lake (Tennessee)	2010-2011	Internal radio tags	30	<ul style="list-style-type: none"> <li>• Fish move to deeper waters to overwinter.</li> <li>• Fish widely distributed from spring to fall.</li> </ul>	Cole (undated)
Mississippi River (Minnesota)	1990-1991	Internal radio tags	13	<ul style="list-style-type: none"> <li>• Established discrete winter and summer home ranges and displayed site fidelity.</li> <li>• Seasonal movements and habitat use related to characteristics of river sections.</li> <li>• Distinct seasonal movements varied by fish.</li> <li>• Summer home range 2.7-25.2 km; winter range 0.6-8.2 km.</li> <li>• Transitional movements in spring and fall.</li> </ul>	Younk et al. (1996)

<b>Waterbody</b>	<b>Study Period</b>	<b>Tag Type</b>	<b>Number Fish Marked</b>	<b>Key Findings</b>	<b>Reference</b>
New River (Virginia)	2000-2003	Radio tags	42	<ul style="list-style-type: none"> <li>• Positive selection for deeper habitats.</li> <li>• Discharge affected both habitat use and selection.</li> </ul>	Brenden et al. (2006)
Nogies Creek (Ontario)	mid 1970s	Unknown	1	<ul style="list-style-type: none"> <li>• Displaced muskellunge moved 1.5 km downstream within 24 hours to original capture site.</li> </ul>	Crossman (1977)
	1951-53	Unknown	Unknown	<ul style="list-style-type: none"> <li>• Little movement during summer.</li> <li>• Fall movements mostly downstream.</li> </ul>	Crossman (1956)
Nogies Creek and Stoney Lake (Ontario)	1975-1976	Internal radio tags	14	<ul style="list-style-type: none"> <li>• Established small winter home ranges.</li> <li>• Moved upstream in spring to spawn.</li> <li>• Well defined summer home ranges.</li> <li>• Male fish more sedentary than females.</li> </ul>	Minor and Crossman (1978), Minor (1981)
North Bend Lake (West Virginia)	2010-2014	Acoustic transmitters	24	<ul style="list-style-type: none"> <li>• Consistent seasonal (spring and fall) movements.</li> <li>• Longest movement was 56 km downstream.</li> <li>• Dam escapement documented.</li> </ul>	Morrison and Warren (2015)
Rideau River (Ontario)	1993-1995	External radio tags	10	<ul style="list-style-type: none"> <li>• Several spawning sites were identified.</li> </ul>	Wachelka (1995)



<b>Waterbody</b>	<b>Study Period</b>	<b>Tag Type</b>	<b>Number Fish Marked</b>	<b>Key Findings</b>	<b>Reference</b>
Rideau River (cont'd)	2006-2009	Internal radio tags	10	<ul style="list-style-type: none"> <li>• Muskellunge moved through locks in canal.</li> <li>• Seasonal movements greatest in the spring.</li> <li>• Movements of up to 7 km in the summer.</li> <li>• Overwintered in deep water.</li> </ul>	Gillis et al. (2010)
	2009-2010	External radio tags	30	<ul style="list-style-type: none"> <li>• Seven fish recaptured.</li> <li>• Continuous short distance movements following release.</li> </ul>	Landsman et al. (2011, 2015)
Saint John River (New Brunswick)	2000-2001	Internal radio tags	18	<ul style="list-style-type: none"> <li>• Home ranges extended to 100 km in both riverine and lacustrine habitats (mean 29.9km).</li> <li>• Moved to deeper water for winter.</li> <li>• Displayed upstream and downstream movements.</li> <li>• Passed over/through Mactaquac dam.</li> </ul>	Curry et al. (2007)
Saugeen River (Ontario)	2000-2012	Internal radio tags	18	<ul style="list-style-type: none"> <li>• Fish moved up into small tributaries to spawn.</li> <li>• Discrete summer home ranges.</li> <li>• Overwintered in deep pools in main river channel.</li> </ul>	McKee (personal communication)
		Floy T-tags	87		
Scugog Lake (Ontario)	1987-1988	Internal radio tags	Unknown	<ul style="list-style-type: none"> <li>• Summer home ranges and pre-spawn staging documented.</li> <li>• Spawners moved through highway culverts to reach spawning sites.</li> <li>• Spawning migrations ranged from 1-20 kms.</li> <li>• Overlap in summer ranges.</li> </ul>	Stronks (1995)

<b>Waterbody</b>	<b>Study Period</b>	<b>Tag Type</b>	<b>Number Fish Marked</b>	<b>Key Findings</b>	<b>Reference</b>
St. Lawrence River (New York)	1984-1989	External radio tags	47	<ul style="list-style-type: none"> <li>• High degree of reproductive homing.</li> <li>• Post spawning movements to Lake Ontario and deeper water.</li> </ul>	LaPan et al. (1995)
Stoney Lake (Ontario)	1978-1986		667	<ul style="list-style-type: none"> <li>• Reproductive homing.</li> </ul>	Crossman (1977)
Thornapple Lake (Michigan)	2004-2005	Internal radio tags	22	<ul style="list-style-type: none"> <li>• Fish moved to deeper waters to overwinter.</li> <li>• Estimated home range varied from 18.8 to 39.0 ha.</li> </ul>	Eilers (2008)
Tomahawk Chain of Lakes (Wisconsin)	1987	External radio tags	1	<ul style="list-style-type: none"> <li>• A deliberately displaced female muskellunge travelled 10 km over three days to return to original summer capture site.</li> </ul>	Margenau (1994)
West Okoboji Lake (Iowa)	1978	Radio tags	9	<ul style="list-style-type: none"> <li>• Summer home ranges 39-443 ha (mean 146 ha) in area.</li> <li>• Evidence of reproductive and non-reproductive homing behaviour.</li> </ul>	Miller and Menzel (1986)