Trapping Activities and Population Estimates of Adult Sea Lamprey in Tributaries of Lake Superior During 2007

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ABSTRACT

The Great Lakes Section of the Great Lakes Indian Fish and Wildlife Commission (GLIFWC) has conducted a cooperative sea lamprey (*Petromyzon marinus*) trapping project with the U.S. Fish and Wildlife Service Sea Lamprey Control Station in Marquette, Michigan (USFWS-SLC) since 1986. The purpose of the project is to gather information on adult spawning-phase sea lamprey ascending various tributaries to Lake Superior. Results of the 2007 trapping season are reported.

The seven rivers sampled in 2007 were the Amnicon, Middle, Poplar, and Bad rivers in Wisconsin, and the Silver, Firesteel, and Misery rivers in Michigan. In 2007 3,708 sea lamprey were captured: 216 in the Poplar river and 3,492 in the other six tributaries combined. These six rivers have been trapped annually since 1988 and total catch in 2007 (3,492) was above the nineteen-year average (1988-2006) of 2,699 (range: 566-10,908). The majority of lamprey captured came from the Bad river (2,042) followed by the Misery river (617).

Schaefer estimates of adult spawner abundance were calculated for 6 of the 7 tributaries in 2007. Spawner abundance estimates were 15,531 in the Bad river, 1,724 in the Silver, 1,665 in the Poplar, 572 in the Misery, 434 in the Middle, and 14 in the Firesteel.

TABLE OF CONTENTS

FIGURES iii

TABLES iii

ACKNOWLEDGMENTS iv

INTRODUCTION 1

METHODS 2

Capture Gear and Sites 2

Data Collection 2

Population Estimates 2

RESULTS AND DISCUSSION 3

Trap catches 3

Biological Characteristics 3

Population Estimates 3

REFERENCES CITED 4

FIGURES

Figure 1. Location of rivers in which spawning-phase lamprey were trapped in 2007. . 5

Figure 2. Mean length (mm) for male and female lamprey from rivers trapped during 1986-2007. 6

Figure 3. Mean weight (grams) for male and female lamprey from rivers trapped during 1986-2007.. 7

TABLES

Table 1. Information on location of lamprey trapping conducted on Lake Superior tributaries during 2007. 8

Table 2. Type and combination of marks used on adult lamprey by week for rivers trapped during 2007. 9

Table 3. Water and air temperature for seven tributaries to Lake Superior during lamprey trapping in 2007. 10

Table 4. Annual catches of unmarked adult sea lamprey in spring spawning assessment traps and nets, in tributaries to Lake Superior monitored by GLIFWC from 1986 to 2007. 11

Table 5. Number of fish species, fish taxa, and other taxa captured during trapping in seven Lake Superior tributaries in 2007 12

Table 6. Calculated mean length (mm), weight (grams), and standard deviation (S.D.) for male and female lamprey captured during 2007. 13

Table 7 Population estimates for spawning phase sea lamprey in GLIFWC monitored streams tributary to Lake Superior during 2007. 14

Table 8. Population estimates for spawning lamprey from six GLIFWC monitored tributaries to Lake Superior from 1986-2007. 15

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INTRODUCTION

The Great Lakes Section of the Great Lakes Indian Fish and Wildlife Commission (GLIFWC) has conducted a cooperative sea lamprey (*Petromyzon marinus*) trapping project with the U.S. Fish and Wildlife Service Sea Lamprey Control Station (USFWS-SLC) in Marquette, Michigan since 1986. Results of this work have been reported in GLIFWC administrative reports (e.g. Mattes 2007, Mattes 2006). The purpose of the project is to gather information on and estimate the population size of adult spawning-phase sea lamprey ascending various tributary streams of Lake Superior during their May-June spawning run. Objectives of the project are: (1) to monitor the upstream spawning movements of sea lamprey, (2) to collect data on the biological characteristics of spawning sea lamprey, (3) to estimate the number of lamprey spawning in each tributary, and (4) to reduce the spawning potential of sea lamprey by removing a portion of the run.

Information collected by GLIFWC supplements that collected by USFWS-SLC and other agencies, and is included in a lake wide management plan to control and reduce the lamprey population. Results of the mark-recapture study are used in a Discharge Regression model developed by USFWS-SLC to estimate total number of spawning-phase lamprey in United States waters of Lake Superior, and to evaluate the effectiveness of regional lamprey control efforts (Mullet et al. 2003). This report presents results of the 2007 trapping season.

Tributaries selected for trapping by GLIFWC were known to contain spawning runs of adult sea lamprey and represent a range of stream sizes based on in-stream flows. Several of these tributaries contained natural or man-made barriers. The number of tributaries trapped by GLIFWC has varied from 5 rivers in 1986 and 1987 to 13 rivers in 1990 and 1991. Due to sampling difficulties and low catch in several streams, the number of rivers trapped was reduced to eight in 1992. These eight rivers were among those sampled annually between 1988 and 1996. In 1997, the Traverse river was dropped from the sampling schedule due to low catch rates since 1993. The Falls river was added in 1997 because of its comparability to the Traverse river in mean annual discharge and to determine if lamprey catches would be sufficient to calculate a mark-recapture population estimate. In 1998, the Falls and Huron rivers were dropped from the sampling schedule while the West Branch of the Ontonagon was added. These changes were made in response to a report by an independent review panel released in August 1997 which recommended sampling fewer mid-size streams and more small and large streams. In 2001, the West Branch of the Ontonagon river was dropped from sampling due to low catches. Since 2001, six streams have been trapped annually: the Amnicon, Middle, and Bad rivers in Wisconsin and the Firesteel, Misery, and Silver rivers in Michigan. In 2007, trapping resumed in the Poplar river, after being dropped from sampling in 2005 following two years of low catches (2003 and 2004).

METHODS

Capture Gear and Sites

Four tributaries in Wisconsin and three tributaries in the Upper Peninsula of Michigan were trapped from late April through early July (Figure 1). The Middle and Misery rivers possess man-made barriers that were specially built to prevent the upward movement of sea lamprey. The Amnicon and Silver rivers possess natural barriers which prevent sea lamprey from moving through the entire system. The Bad, Poplar, and Firesteel rivers possess no impassable barriers.

Portable assessment traps (PAT's) and fyke nets were used to capture lamprey (Table 1). PAT's were the preferred gear and were used in three tributaries with a suitable barrier. PAT's were set below and against the man-made barriers on the Middle and Misery rivers. From 2000-2007 four PAT's were set in the Middle river in an effort to increase the catch of male lamprey for the sterile male release program. Previously, two PAT's had been set in the Middle river. Two PAT's were set in the Misery river and three PAT's were set in the Bad river directly below and against a natural rock shelf which transects the river. In the remaining four tributaries (Amnicon, Poplar, Firesteel, and Silver rivers) without a suitable barrier for PAT's to be used, one fyke net was set in the lower portion of each river.

Data Collection

Traps or fyke nets were emptied at least three times per week (i.e., Monday, Wednesday, and Friday) in the Firesteel and Silver rivers, five days per week in the Bad and Misery rivers, and seven days per week in the Middle, Amnicon, and Poplar rivers. A sub-sample of live lamprey were transported downstream (Table 1) and marked by clipping one or both dorsal fins, then released back into the river. The fins were clipped with a v-notch tool and a different combination of clips was used to identify the week of capture and release (Table 2). Female lamprey not marked and released were destroyed, and male lamprey not marked and released were placed in holding cages in the rivers and later removed for use in the sterile male release program. Water and air temperature were recorded at the time traps or nets were emptied (Table 3).

The number of live and dead marked and unmarked lamprey captured each sampling day was counted, along with the number of fish species, fish genera, and other taxa in the traps or nets. All dead lamprey, and a sub-sample of female lamprey were measured to the nearest millimeter, weighed to the nearest gram, and sex determined. The fin clip combination on recaptured lamprey was also recorded.

Population Estimates

Mark-recapture population estimates were attempted based on the marking procedure described above. When sample size was sufficient population estimates were calculated using the modified Schaefer method (Ricker 1975). When the number of recaptures was deemed too low, no such estimate was calculated. Population estimates of adult spawning lamprey in these and other streams are made and combined to estimate the population in U.S. waters of Lake Superior for determining the effectiveness of efforts to control lamprey and the number of lean lake trout killed by lamprey (Heinrich et al. 2003).

RESULTS AND DISCUSSION

Trap Catches

The seven rivers sampled in 2007 were the Amnicon, Middle, Poplar, and Bad rivers in Wisconsin, and the Silver, Firesteel, and Misery rivers in Michigan. In 2007 3,708 sea lamprey were captured: 216 in the Poplar river and 3,492 in the other six tributaries combined. These six rivers have been trapped annually since 1988 and total catch in 2007 (3,492) was above the nineteen-year average (1988-2006) of 2,699 (range: 566-10,908) (Table 4). The majority of lamprey captured came from the Bad river (2,042) followed by the Misery river (617).

Other than sea lamprey, 25 fish species, 9 fish taxa, and 10 other taxa were captured during 2007 (Table 5). Bullhead (*Ictalurus sp.*) were captured most often (N=1,970). Fair numbers of crayfish (N=1,115) and white sucker (*Catostomus catostomus*) (N=1,175) were captured primarily from the Middle river. Other fish commonly captured were shiners (*Notropis*), chubs (*Cyprinidae*), and rainbow trout (*Oncorhynchus mykiss*).

Biological Characteristics

The mean length of male lamprey was 446 mm, while the mean length of female lamprey was 439 mm (Table 6). These lengths were within the range of lengths observed during the twenty year period from 1986 to 2006 (Figure 2).

The mean weight of male lamprey was 214 grams, while the mean weight of female lamprey was 207 grams (Table 6). These weights were within the range of weights observed during the previous twenty years (Figure 3). Mean weight of male and female lamprey has been similar within a year but has varied considerably between years.

Population Estimates

Modified-Schaefer estimates of adult spawner abundance were calculated for 6 of the 7 tributaries in 2007 (Table 7). Spawner abundance estimates were 15,531 in the Bad river, 1,724 in the Silver, 1,665 in the Poplar, 572 in the Misery, 434 in the Middle, and 14 in the Firesteel. The population estimate for the Silver river was the highest recorded, while the population estimate for the Bad river was second only to the 2006 estimate. Also for the Bad river, population estimates for the past ten years have been higher (1998 to 2007 average: 10,542) than they were in the previous ten years (1988 to 1997 average: 4,700) (Table 8).

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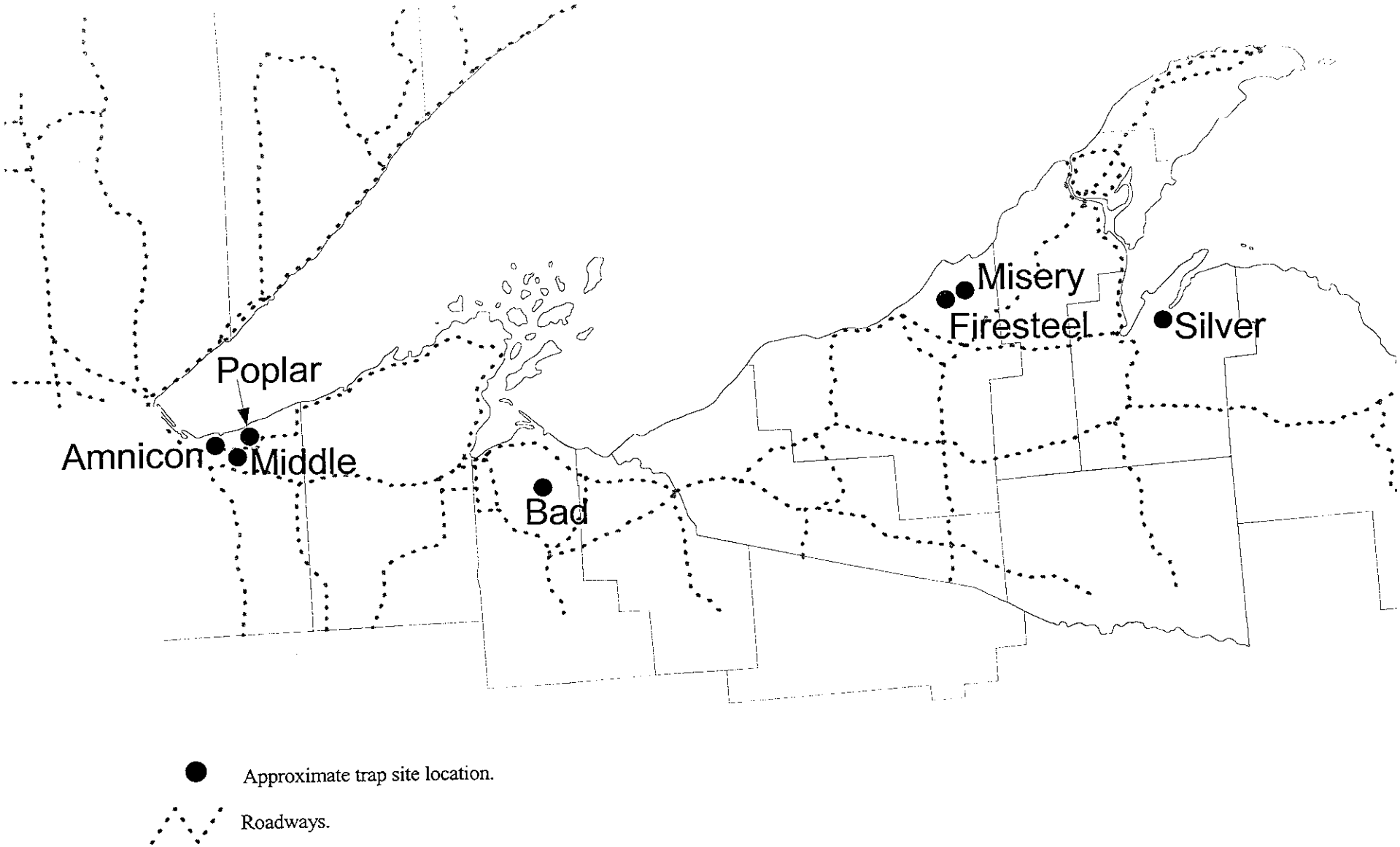

Figure 1. Location of tributaries in which spawning-phase lamprey were trapped in 2007.

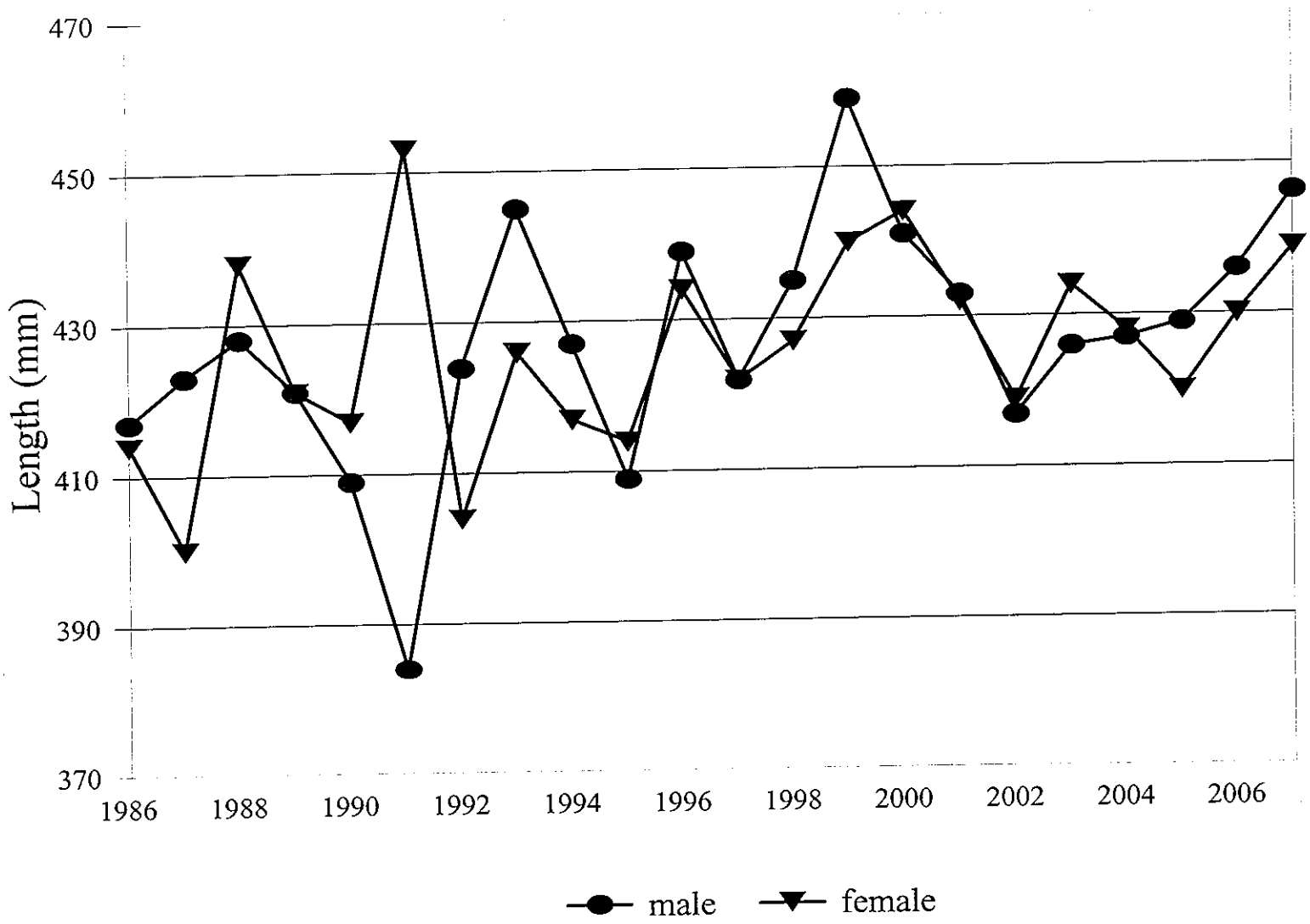

Figure 2. Mean length (mm) for male and female lamprey from rivers trapped during 1986-2007.

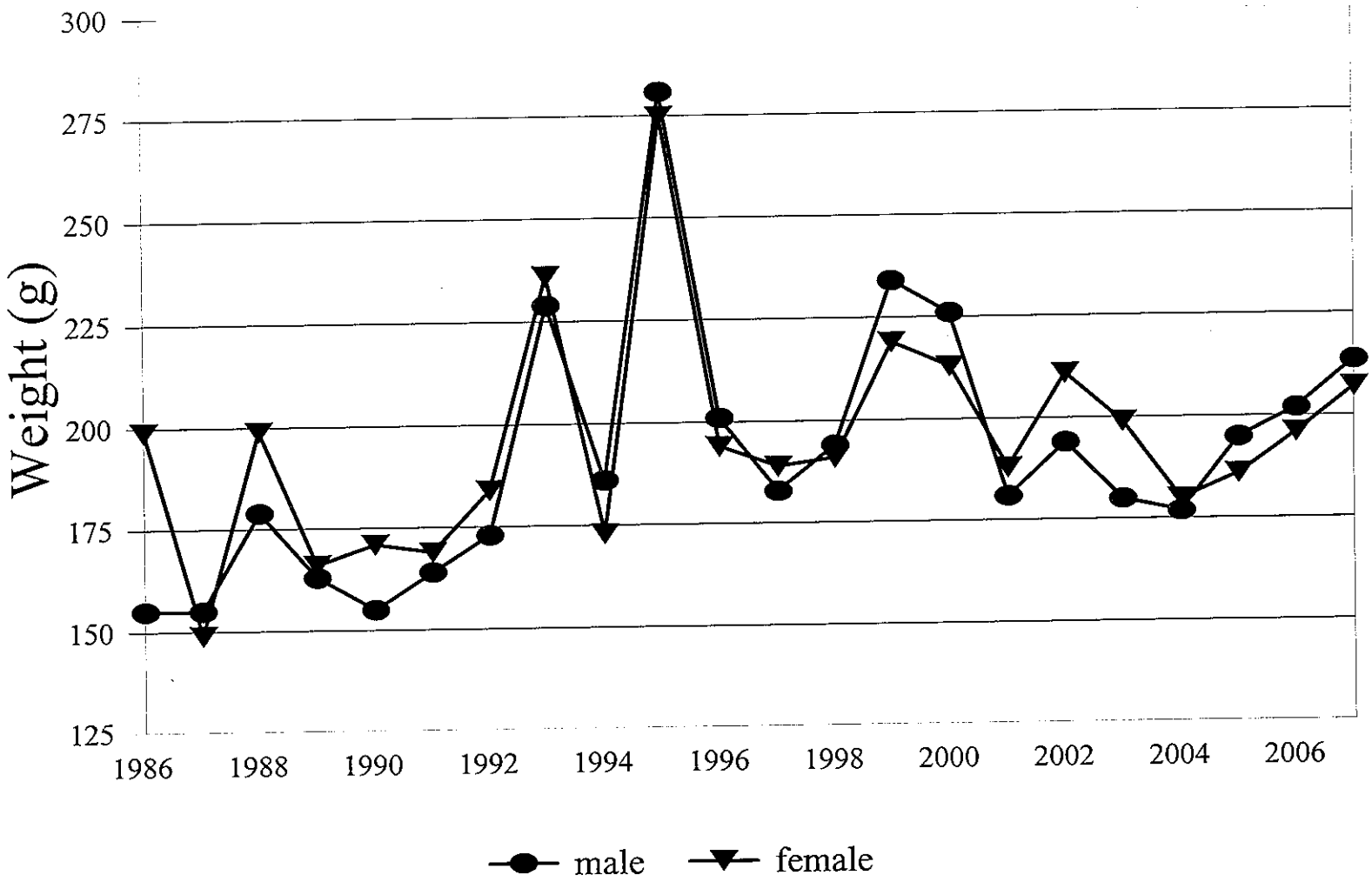

Figure 3. Mean weight (grams) for male and female lamprey from rivers trapped during 1986-2007.

Table 1. Information on location of lamprey trapping conducted on Lake Superior tributaries during 2007.

Tributary	State/County	Location trapped	Gear	Trap site distance from mouth	Barrier distance from mouth	Release site
Amnicon	WI/Douglas	T48N, R12W, Sec 8, SE 1/4	1-fyke net	5 km (3 miles)	11 km (7 miles)	0.1 km downstream from net
Middle	WI/Douglas	T48N, R12W, Sec 13, NE 1/4	4 traps	5 km (3 miles)	5 km (3 miles)	HWY 13 bridge
Poplar	WI/Douglas	T47N, R11w, Sec 6, SC	1-fyke net	5 km (3 miles)	no barrier	1.5 km below HWY 13 bridge
Bad	WI/Ashland	T47N, R3W, Sec 36, NE 1/4	3-traps	30 km (19 miles)	no barrier	0.8 km downstream from trap
Firesteel	MI/Ontonagon	T51N, R38W, Sec 27, SE 1/4	1-fyke net	11.2 km (7 miles)	no barrier	bridge 0.4 km below trap
Misery	MI/Ontonagon	T52N, R37W, Sec 15, NE 1/4	2-traps	1.6 km (1 mile)	1.6 km (1 mile)	0.4 km below trap
Silver	MI/Baraga	T51N, R31W, Sec 13, SE 1/4	1-fyke net	1.6 km (1 mile)	5 km (3 miles)	0.4 km below trap

Table 2. Type and combination of marks (v-notch fin clips) used on adult lamprey by week for rivers trapped during 2007.

Week of trapping	Dates in 2007			Mark (anterior, posterior)	Week of trapping	Dates in 2007			Mark (anterior, posterior)
1	04/22	-	04/28	(0,3)	7	06/03	-	06/09	(0,2)
2	04/29	-	05/05	(2,2)	8	06/10	-	06/16	(1,2)
3	05/06	-	05/12	(2,0)	9	06/17	-	06/23	(2,1)
4	05/13	-	05/19	(0,1)	10	06/24	-	06/30	(3,0)
5	05/20	-	05/26	(1,0)	11	07/01	-	07/07	(3,1)
6	05/27	-	06/02	(1,1)	12	07/08	-	07/14	(1,3)

Table 3. Water and air temperature (degrees Centigrade) for seven tributaries to Lake Superior during lamprey trapping in 2007.

Tributary	Code	Water Temperature 2005 N*	average	S.D.	min	max
Michigan Tributaries						
Firesteel	289	14	17.2	3.3	13	22
Misery	284	18	14.3	3.5	11	23
Silver	190	30	15.3	4.0	9	22
Wisconsin Tributaries						
Amnicon	705	44	14.6	3.3	9	22
Bad	611	33	17.4	3.7	11	26
Middle	703	46	14.3	3.2	9	22
Poplar	701	44	14.2	3.0	9	21
		Air Temperature 2005.0 N*	average	S.D.	min	max
Michigan Tributaries						
Firesteel	289	15	17.4	4.1	9	23
Misery	284	18	18.9	5.2	11	26
Silver	190	30	19.5	5.6	10	30
Wisconsin Tributaries						
Amnicon	705	44	12.8	4.1	2	20
Bad	611	36	18.6	7.1	9	37
Middle	703	46	17.6	6.0	6	32
Poplar	701	44	15.4	5.3	3	28

*N= number of days where measurement was recorded.

Table 4. Annual catches of unmarked adult sea lamprey in spring spawning assessment traps and nets, in tributaries to Lake Superior monitored by GLIFWC from 1986-2007.

Tributary	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
					Wisconsin Tributaries																	
Primary																						
Amnicon		61	14	3	118	67	101	7	39	24	40	83	83	79	278	132	31	59	137	178	707	62
Bad	184	439	972	684	465	121	236	84	114	280	316	272	471	646	293	563	1,050	1,446	831	1,124	1,638	2,042
Middle	315	16	11	249	1	4	12	46	11	24	42	47	408	2,235	8,481	2,633	3,026	41	29	620	2,212	387
Secondary																						
Arrowhead	1																					
Black					3	8																
Nemadji					0	1												27	0			216
Poplar	0																					
Raspberry						0																
Red Cliff Cr.					14	15																
Subtotal-3 primary	499	516	997	936	584	192	349	137	164	328	398	402	962	2,960	9,052	3,328	4,107	1,546	997	1,922	4,557	2,491
Total-WI	500	516	997	936	601	216	349	137	164	328	398	402	962	2,960	9,052	3,328	4,107	1,573	997	1,922	4,557	2,707
					Michigan Tributaries																	
Primary																						
Firesteel			17	40	44	86	43	74	24	21	0	37	79	35	375	7	97	8	94	27	3	36
Misery			261	265	164	336	907	4,871	455	197	672	1,131	406	1,753	1,238	1,100	695	39	155	33	946	617
Silver	0	4	0	6	26	29	36	0	6	20	6	42	42	59	243	6	7	24	14	12	47	348
Secondary																						
Huron		1	51	6	9	14	41	54	2	35	2	18										
Traverse			10	10	31	33	11	4	0	0	1											
Falls												3										
Ontonagon					56	18							0	9	13							
Otter				0	0																	
Subtotal- 3 primary	0	4	278	311	234	451	986	4,945	485	238	678	1,210	527	1,847	1,856	1,113	799	71	263	72	996	1,001
Total-MI	0	5	339	327	330	516	1,038	5,003	487	273	681	1,231	527	1,856	1,869	1,113	799	71	263	72	996	1,001
Total- 6 primary			1,275	1,247	818	643	1,335	5,082	649	566	1,076	1,612	1,489	4,807	10,908	4,441	4,906	1,617	1,260	1,994	5,553	3,492
Grand total	**500**	**521**	**1,336**	**1,263**	**931**	**732**	**1,387**	**5,140**	**651**	**601**	**1,079**	**1,633**	**1,489**	**4,816**	**10,921**	**4,441**	**4,906**	**1,644**	**1,260**	**1,994**	**5,553**	**3,708**
Average catch- 6 primary:				**1,261**	**1,113**	**996**	**1,064**	**1,733**	**1,578**	**1,452**	**1,410**	**1,430**	**1,436**	**1,717**	**2,424**	**2,568**	**2,724**	**2,654**	**2,572**	**2,540**	**2,699**	**2,739**

Table 5. Number of fish species, fish taxa, and other taxa captured during trapping in seven Lake Superior tributaries in 2007.

	Wisconsin Tributaries					Michigan Tributaries				Grand
	Bad	Amnicon	Middle	Poplar	*Total-WI*	Firesteel	Misery	Silver	*Total-MI*	Total
Fish Species										
Sea Lamprey adult	2,042	62	387	216	2,707	36	617	348	1,001	3,708
Silver Lamprey adult			1		1				0	1
Black Bullhead	2	1	81		84				0	84
Bluegill	3				3				0	3
Brook Trout			5		5	2	15	60	77	82
Burbot			32		32			1	1	33
Central Mudminnow			6		6				0	6
Common Shiner	4		2		6				0	6
Creek Chub	2	1	162	21	186			3	3	189
Creek Chubsucker	2				2				0	2
Hornyhead Chub		3	125		128				0	128
Lake Chub			32	46	78				0	78
Longnose Dace			23	3	26				0	26
Longnose Sucker	1			1	2				0	2
Muskellunge		1			1				0	1
Northern Pike	1		4		5				0	5
Pumpkinseed	14		90		104				0	104
Rainbow Trout					0	83	102	26	211	211
River Chub				60	60	5			5	65
Rock Bass	39	20			59	13		35	48	107
Ruffe		1	2		3				0	3
Shorthead Redhorse	1				1				0	1
Smallmouth Bass	7			6	13	4		1	5	18
Trout-perch	1	1	33		35				0	35
Walleye	1				1				0	1
White Sucker	14	2	863	236	1,115	7	28	25	60	1,175
Fish Taxa										
Bullhead		1	1,967	1	1,969	1			1	1,970
Madtom			10		10				0	10
Carp and Minnow Family	2			33	35				0	35
Dace	1				1				0	1
Chub (Cyprinidae)	3		133	4	140	39	98		137	277
Shiner	14		527		541				0	541
Sculpin					0		9		9	9
Sucker	1			23	24	88	24		112	136
Other taxa										
Crayfishes	11	2	999	4	1,016	2	19	78	99	1,115
Damselflies and Dragonflies			2		2				0	2
Frogs and Toads	1	1	6	1	9			1	1	10
Giant Water Bugs			7		7				0	7
Marsh Treaders			1		1				0	1
Mudpuppy				1	1		46		46	47
Predaceous Diving Beetles	2		9		11				0	11
Wood Turtle		1			1				0	1

Table 6. Calculated mean length (mm), weight (grams), and standard deviation (S.D.) for male and female lamprey captured during 2007.

River	River Code	Sex	Count	Length			Weight		
				Number	Average	S.D.	Number	Average	S.D.
Bad	611	Female	193	193	436	41	193	193	55
		Male	36	36	440	36	36	196	70
		All	229	229	437	41	229	194	58
Poplar	701	Female	7	7	465	25	7	233	34
		Male	9	9	461	30	9	226	36
		All	16	16	463	27	16	229	34
Middle	703	Female	27	27	447	39	27	221	40
		Male	43	43	447	47	43	210	59
		All	70	70	447	44	70	214	52
Silver	190	Female	12	12	443	30	11	250	39
		Male	33	33	452	37	33	238	41
		All	45	45	450	35	44	241	40
Misery	284	Female	162	162	438	43	162	215	54
		Male	4	4	410	49	4	181	89
		All	166	166	437	43	166	214	55
Firesteel	289	Female	13	13	456	35	13	235	50
All Rivers		Female	414	414	439	41	413	207	55
		Male	125	125	446	41	125	214	60
		All	539	539	441	41	538	209	56

Table 7. Population estimates for spawning phase sea lamprey in GLIFWC monitored streams tributary to Lake Superior during 2007.

Tributary	Population Estimates Schaefer Method Mark/Recapture
Wisconsin Tributaries	
Bad	15,531
Middle	434
Amnicon	N/A
Popular	1,665
Michigan Tributaries	
Firesteel	14
Misery	572
Silver	1,724

Estimates provided by the USFWS- Sea Lamprey Control Program in Marquette, Michigan.
N/A=Not available, population estimate could not be calculated due to low sample size.

Table 8. Population estimates for spawning lamprey from six GLIFWC monitored tributaries to Lake Superior from 1986-2007.

River	Year 1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Amnicon		647 S			1,368 S	413 SM	1,394 SM	1,216 SM			58 SM	673 SM	605 SM	600 SM	3,380 SM	904 SM	552 SM	138 SM		594 SM	7,437 SM	
Bad	6,026 S	4,654 S	7,762 S	9,818 S	3,138 S	3,806 SM	2,651 SM	2,428 SM	2,135 SM	2,048 SM	8,513 SM	4,700 SM	4,064 SM	12,552 SM	2,767 SM	8,679 SM	13,678 SM	8,297 SM	8,555 SM	12,383 SM	18,912 SM	15,531 SM
Middle	1,080 S	20 S	21 S	1,328 S			172 SM	184 SM		82 SM	31 SM	186 SM	1,081 SM	13,515 SM	6,900 SM	2,327 SM	3,327 SM	41 SM	28 SM	1,049 SM	3,017 SM	434 SM
Misery			610 S	1,124 S	800 S	737 SM	1,771 SM	8,859 SM	748 TE	413 TE	951 TE	2,881 TE	1,073 TE	2,339 SM	1,764 SM	1,975 SM	602 SM	39 SM	431 SM		855 SM	572 SM
Firesteel				220 P	462 S	265 SM	113 SM	256 SM				76 SM	274 SM	84 SM	1,036 SM		212 SM		31 SM			14 SM
Silver					56 S	61 SM	110 SM					170 SM	157 SM	651 SM	937 SM						182 SM	1,724 SM

Method of estimation:

Schaefer= S
Schaefer, Modified=SM
Peterson, adjusted=P
Trap Efficiency=TE