



**Trapping Activities and Population Estimates of
Adult Sea Lamprey in Tributaries of Lake Superior
During 2011**

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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 2011 trapping season are reported.

The seven rivers sampled in 2011 were the Amnicon, Middle, Poplar, and Bad rivers in Wisconsin, and the Silver, Firesteel, and Misery rivers in Michigan. Except for the Poplar, these six rivers have been trapped annually since 1988. In 2011 a total of 1,171 sea lampreys were captured in these six tributaries which was below the twenty-three year average (1988-2010) of 2,650 (range: 566-10,908). The majority of lamprey captured came from the Middle river (744) followed by the Bad river (257). An additional 53 sea lamprey were caught in the Poplar river.

Modified Schaefer or trap efficiency estimates of adult spawner abundance were calculated for 4 of the 7 tributaries in 2011. Spawner abundance estimates were 2,514 in the Bad, 1,177 in the Middle, 358 in the Poplar, and 281 in the Misery river.

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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 2009, Mattes 2008). 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, (4) to reduce the spawning potential of sea lamprey by removing a portion of the run, and (5) to provide lamprey to research and alternate control programs (i.e. sterile male release program for the St. Mary's river, Michigan).

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 2011 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 2000-2011 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, and five days per week in the Bad, Misery, 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. In the Bad and Poplar rivers population size was estimated based on trap efficiency in years with a mark-recapture estimate. An average for the percent of the population caught by traps was determined based on the total catch in a given year divided by the mark-recapture estimate for that year. The 2011 catch was then assumed to be this percent of the total run. 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

A total of 1,171 sea lampreys were captured in the six tributaries which have been trapped annually since 1988, below the twenty-three year average (1988-2010) of 2,650 (range: 566-10,908). The majority of lamprey captured came from the Middle river (744) followed by the Bad river (257). An additional 53 sea lamprey were caught in the Poplar river (Table 4).

Other than sea lamprey, 22 fish species, 10 fish taxa, and 6 other taxa were captured during 2011 (Table 5). White sucker (*Catostomus catostomus*) and sucker species were captured most often (N=1,906 and N=754, respectively) followed by chubs (*Cyprinidae*) (N=544). Next in abundance were crayfish (N=336), captured primarily from the Middle river and rainbow trout (*Oncorhynchus mykiss*) (N=292), captured primarily from the Misery river.

Biological Characteristics

The mean length of male lamprey was 449 mm, while the mean length of female lamprey was 437 mm (Table 6). These lengths were within the range of lengths observed during the twenty-five year period from 1986 to 2010 (Figure 2).

The mean weight of male lamprey was 213 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-five 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 or trap efficiency estimates of adult spawner abundance were calculated for 4 of the 7 tributaries in 2011 (Table 7). Spawner abundance estimates were 2,514 in the Bad, 1,177 in the Middle, 358 in the Poplar, and 281 in the Misery river. Low sample size led to no population estimate for the other three rivers. For the Bad river, the population estimate (2,514) was the lowest seen since 1995 (Table 8).

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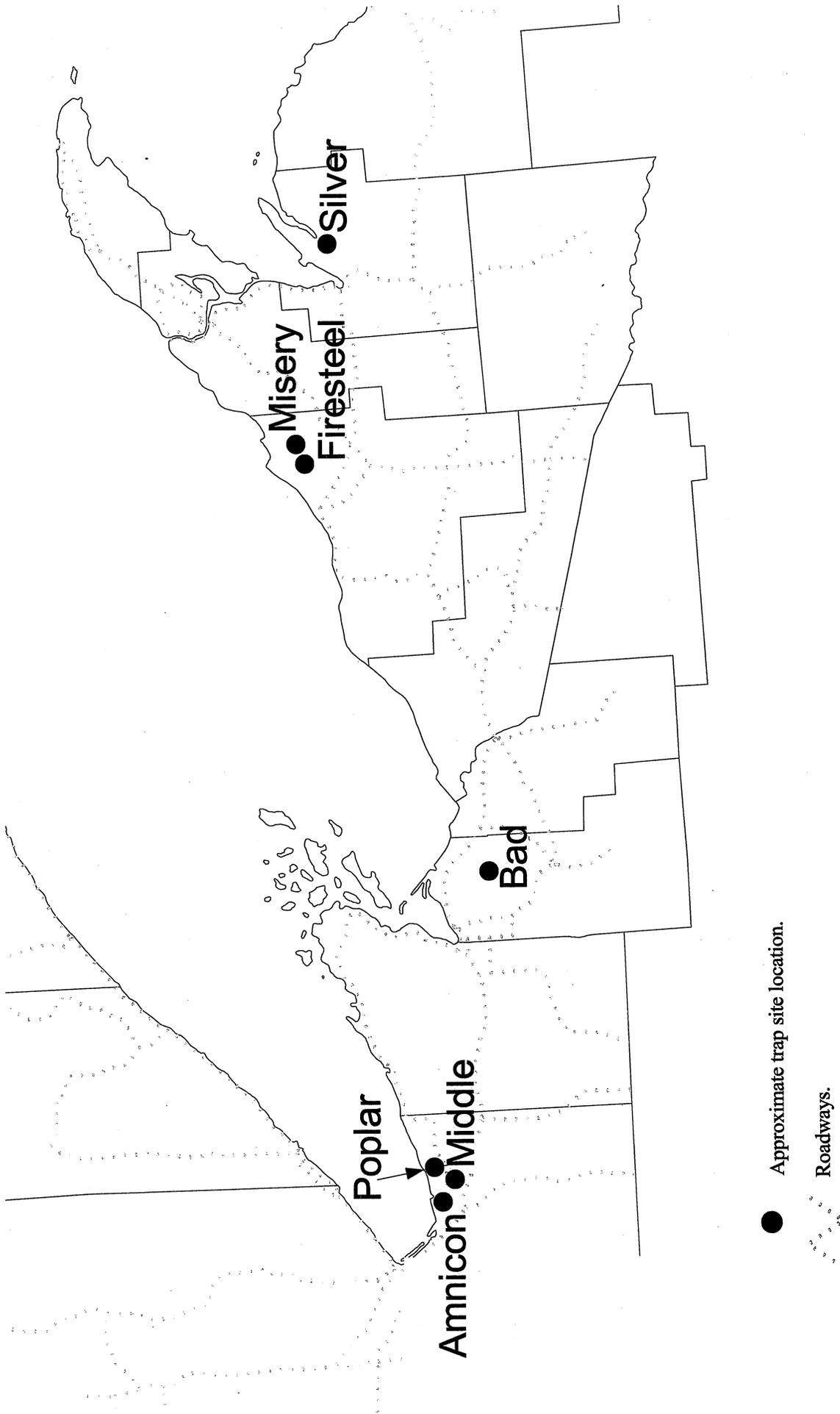


Figure 1. Location of tributaries in which spawning-phase lamprey were trapped in 2011.

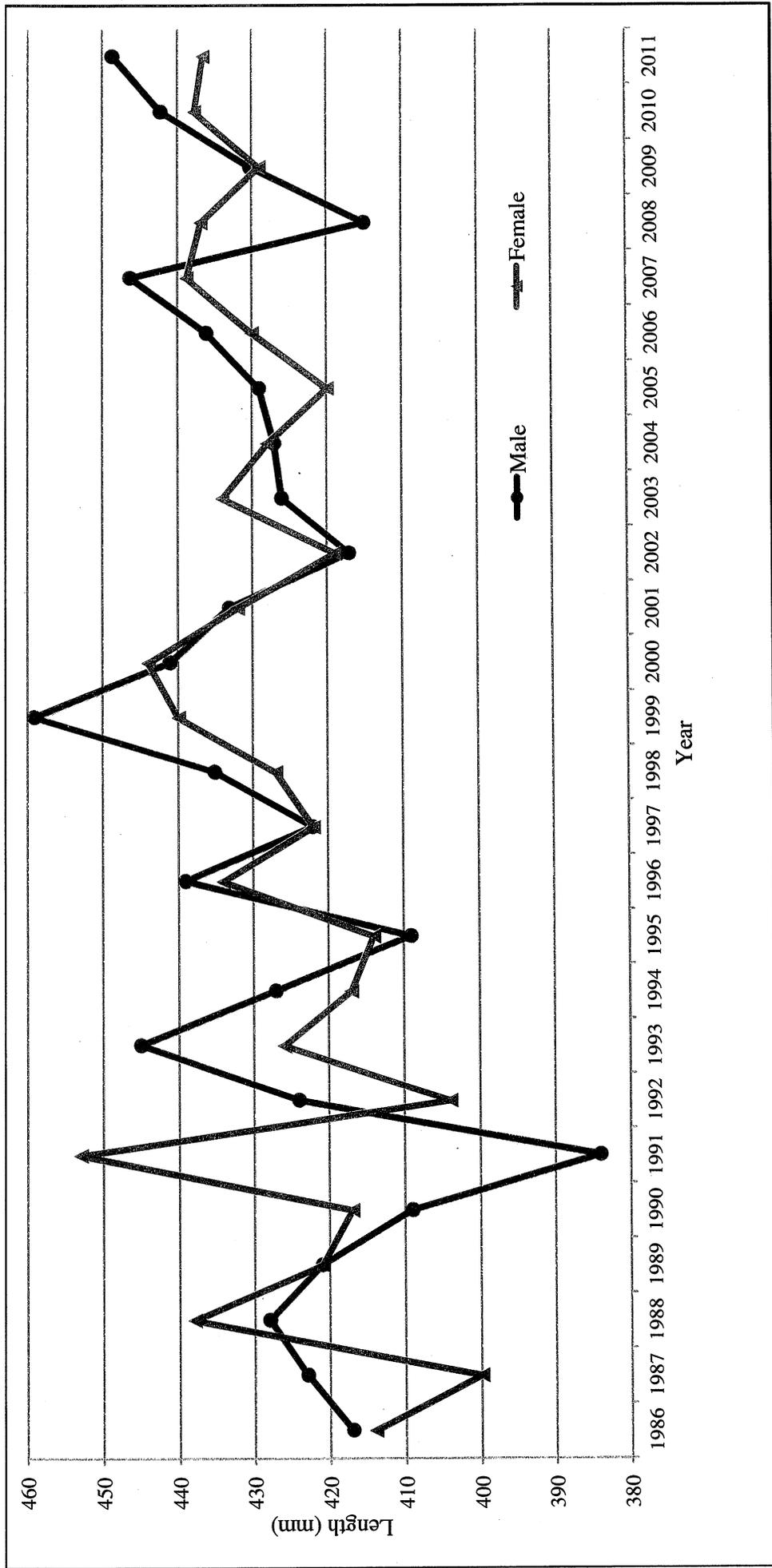


Figure 2. Mean length (mm) for male and female lamprey from rivers trapped during 1986-2011.

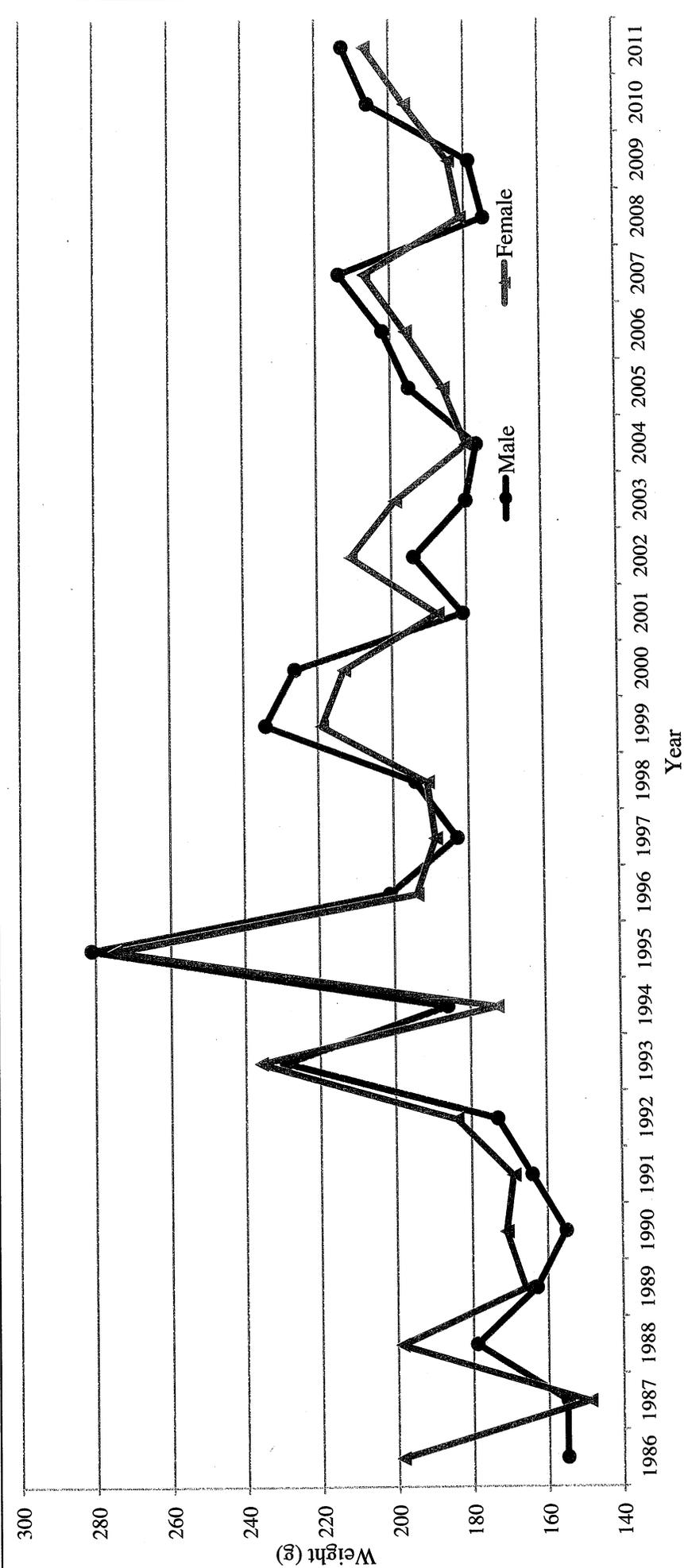


Figure 3. Mean weight (g) for male and female lamprey from rivers trapped during 1986-2011.

Table 1. Information on location of lamprey trapping conducted on Lake Superior tributaries during 2011.

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)	17.4 km (11 miles)	0.1 km downstream from net
Middle	WI/Douglas	T48N, R12W, Sec 13, NE 1/4	4 traps	5 km (3 miles)	8.4 km (5 miles)	HWY 13 bridge
Poplar	WI/Douglas	T47N, R11w, Sec 6, SC	1-fyke net	5 km (3 miles)	23 km (14 miles)	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 2011.

Week of trapping	Dates in 2011	Mark (anterior, posterior)	Week of trapping	Dates in 2011	Mark (anterior, posterior)
1	4/17/2011 - 4/23/2011	(0,3)	7	5/29/2011 - 6/4/2011	(0,2)
2	4/24/2011 - 4/30/2011	(2,2)	8	6/5/2011 - 6/11/2011	(1,2)
3	5/1/2011 - 5/7/2011	(2,0)	9	6/12/2011 - 6/18/2011	(2,1)
4	5/8/2011 - 5/14/2011	(0,1)	10	6/19/2011 - 6/25/2011	(3,0)
5	5/15/2011 - 5/21/2011	(1,0)	11	6/26/2011 - 7/2/2011	(3,1)
6	5/22/2011 - 5/28/2011	(1,1)	12	7/3/2011 - 7/9/2011	(1,3)

Table 3. Water and air temperature (degrees Centigrade) for seven tributaries to Lake Superior during lamprey trapping in 2011.

Tributary	Code	Water Temperature				
		N*	average	S.D.	min	max
Michigan Tributaries						
Firesteel	289	21	15.4	3.3	10	22
Misery	284	63	12.3	3.6	3	19
Silver	190	21	14.1	3.5	8	21
Wisconsin Tributaries						
Amnicon	705	31	13.7	2.6	8	19
Bad	611	31	14.1	4.5	5	23
Middle	703	31	13.9	2.3	9	19
Poplar	701	31	13.9	2.1	9	18
Air Temperature						
		N*	average	S.D.	min	max
Michigan Tributaries						
Firesteel	289	21	17.1	5.9	5	27
Misery	284	63	13.5	5.2	4	29
Silver	190	21	16.9	4.6	11	26
Wisconsin Tributaries						
Amnicon	705	31	12.1	3.5	6	20
Bad	611	31	16.0	5.1	3	25
Middle	703	31	13.7	3.3	6	22
Poplar	701	31	15.4	3.2	9	22

*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 1986-2011.

Tributary	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	
Wisconsin Tributaries																											
<i>Primary</i>																											
Amnicon	61	14	3	118	67	101	7	39	24	24	40	83	83	79	278	132	31	59	137	178	707	62	48	517	69	2	
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	2,154	1,249	983	257	
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	4	9	704	744	
<i>Secondary</i>																											
Arrowhead	1																										
Black				3	8																						
Nemadji				0	1																						
Poplar	0																										
Raspberry																											
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	2,206	1,775	1,756	1,003	
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	2,206	1,775	1,764	1,056	
Michigan Tributaries																											
<i>Primary</i>																											
Firesteel	17	40	44	86	43	74	24	21	0	37	79	35	375	7	97	8	94	8	94	27	3	36	7	33	33	19	
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	70	145	64	144			
Silver	0	4	0	6	26	29	36	0	6	20	6	42	42	59	243	6	7	24	14	12	47	348	63	100	31	5	
<i>Secondary</i>																											
Huron	1	51	6	9	14	41	54	2	35	2	18																
Traverse	10	10	31	33	11	4	0	0	1																		
Falls																											
Ontonagon																											
Otter																											
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	140	278	128	168	
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	140	278	128	168	
<i>Total-6 primary</i>																											
	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	2,346	2,053	1,884	1,171			
<i>Grand total</i>																											
	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	2,346	2,053	1,892	1,224	
<i>Average catch- 6 primary:</i>																											
	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	2,720	2,690	2,654	2,654	2,650			

Table 5. Number of fish species, fish taxa, and other taxa captured during trapping in seven Lake Superior tributaries in 2011.

<i>Fish Species</i>	Wisconsin Tributaries					Michigan Tributaries				Grand Total
	Bad	Amnicon	Middle	Poplar	Total-WI	Firesteel	Misery	Silver	Total-MI	
Sea Lamprey	257	2	744	53	1,056	19	144	5	168	1,224
Black Bullhead					0	1			1	1
Bluegill					0	34	2		36	36
Brook Trout	1				1	19	11	18	48	49
Brown Bullhead					0		1		1	1
Brown Trout			3		3		3		3	6
Burbot			185		185		27		27	212
Chinook Salmon					0		2		2	2
Common Shiner			12		12	4	20	1	25	37
Creek Chub	5				5		24	3	27	32
Hornyhead Chub				32	32	41	11	2	54	86
Longnose Dace					0		70		70	70
Longnose Sucker					0	100	2	12	114	114
Mottled Sculpin			2		2		3		3	5
Northern Pike		1			1		1		1	2
Pumpkinseed			1		1				0	1
Rainbow Trout			3	1	4	29	254	5	288	292
Rock Bass	1	6		9	16			17	17	33
Ruffe					0		10		10	10
Shorthead Redhorse					0	3			3	3
Smallmouth Bass	1	1			2	5			5	7
Trout-perch			2		2				0	2
White Sucker	14		3		17	588	147	1,154	1,889	1,906
<i>Fish Taxa</i>										
Bullhead			14	3	17	3			3	20
Chubs (Cyprinidae)			424	118	542			2	2	544
Chubs (Coregonus)			224	16	240				0	240
Dace			117	1	118		1		1	119
Redhorse		14			14	7			7	21
Sculpin			48		48		3		3	51
Shiner		1	186	10	197				0	197
Sucker		66	537	151	754				0	754
Sunfish		7			7	1			1	8
Trout	1				1				0	1
<i>Other taxa</i>										
Crayfishes			324	2	326			10	10	336
Ducks		1			1				0	1
Frogs			6		6				0	6
Green Frog			1		1				0	1
Predaceous Diving Beetles			1		1				0	1
Turtles		5		1	6				0	6

Table 6. Calculated mean length (mm), weight (grams), and standard deviation (S.D.) for male and female lamprey captured during 2011.

River	River Code	Sex	Length			Weight		
			Number	Average	S.D.	Number	Average	S.D.
Amnicon	705	Female	0			0		
		Male	0			0		
		All	0			0		
Bad	611	Female	41	455	42	41	210	56
		Male	14	461	46	14	210	64
		All	58	455	43	58	208	58
Misery	284	Female	12	395	49	12	163	39
		Male	9	442	42	9	171	54
		All	21	415	51	21	166	45
Firesteel	289	Female	0			0		
		Male	0			0		
		All	0			0		
Silver	190	Female	0			0		
		Male	1	421		1	196	
		All	1	421		1	196	
All Rivers		Female	91	437	45	91	207	51
		Male	60	449	39	60	213	55
		All	151	441	43	151	209	52

Table 7. Population estimates for spawning phase sea lamprey in GLIFWC monitored streams tributary to Lake Superior during 2011.

Tributary	Population Estimate
Wisconsin Tributaries	
Bad	2,514
Middle	1,177
Poplar	358
Amnicon	N/A
Michigan Tributaries	
Firesteel	N/A
Misery	281
Silver	N/A

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 1986-2011.

River	Year																										
	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	
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			4,474 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	12,922 SM	4,754 SM	7,905 SM	2,514 TE	
Middle	1,080 S	20 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			2,024 SM	1,177 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	156 SM	156 SM	141 SM	281 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		128 SM	98 SM		
Silver					56 S	61 SM	110 SM					170 SM	157 SM	651 SM	937 SM						182 SM	1,724 SM	276 SM	370 SM	98 SM		

Method of estimation: Schaefer=S
 Schaefer, Modified=SM
 Peterson, adjusted=P
 Trap Efficiency=TE