



# **Trapping Activities and Population Estimates of Sea Lamprey in Tributaries of Lake Superior During 2013**

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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 sea lamprey in various tributaries to Lake Superior. In 2013 work included both adult spawning-phase and downstream trapping for transformer-phase lamprey. Results of the 2013 trapping season are reported.

The seven rivers sampled in spring 2013 for adult spawning-phase sea lamprey 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 2013 a total of 1,093 adult spawning-phase sea lampreys were captured in these six tributaries which was below the twenty-five year average (1988-2012) of 2,554 (range: 566-10,908). The majority of spawning-phase sea lampreys captured came from two rivers: the Middle (722) and the Bad (293). Modified Schaefer estimates of adult spawning-phase lamprey abundance were calculated for 4 of the 7 tributaries in 2013. Abundance estimates were 6,984 in the Middle, 4,131 in the Bad, 78 in the Silver, and 59 in the Misery rivers.

Five rivers were sampled for transformer-phase lamprey in fall 2013; the Traverse river in Michigan and the Potato, Bad, Marengo, and Amnicon rivers in Wisconsin. In 2013 a total of 216 transformer-phase sea lampreys were captured. The majority of these lampreys came from the Bad river (133).

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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 (Mattes 2012). 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 and to remove pre-adult transformer-phase sea lamprey migrating downstream during October-November. Objectives of the project are: (1) to monitor the in-stream movements of sea lamprey, (2) to collect data on the biological characteristics of sea lamprey, (3) to estimate the number of lamprey spawning in a tributary, and (4) to reduce the impact of sea lamprey by removing a portion of the spawning-phase and transformer-phase sea lamprey population.

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 spawning-phase estimates for each tributary are used in a Discharge Regression model developed by USFWS-SLC to estimate total numbers of spawning-phase lampreys 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 GLIFWC'S 2013 trapping season.

For spawning-phase sea lamprey trapping, tributaries selected 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).

Tributaries trapped by GLIFWC for transformer-phase lampreys were based upon USFWS assessment data which tracks sea lamprey abundance in tributaries. Tributaries that were estimated to have high abundances of transformer-phase sea lampreys were selected for trapping.

## METHODS

### Capture Gear and Sites

Four tributaries in Wisconsin and three tributaries in the Upper Peninsula of Michigan were trapped for spawning-phase sea lampreys from late March through early July while four tributaries in Wisconsin and one in Michigan were trapped for transformer-phase sea lampreys from October through November (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.

For spawning-phase sea lampreys portable assessment traps (PAT's) and fyke nets were used to capture lamprey (Table 1a). 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 2000-2012 four PAT's were set in the Middle river with catch of male lamprey through 2011 used 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. 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 with the cod end upstream. For transformer-phase sea lampreys fyke nets were used for capture and set in the lower portion of each river with the cod end downstream (Table 1b).

### 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 other rivers fished. A sub-sample of live spawning-phase lamprey were transported downstream (Table 1a) 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). Spawning-phase lampreys not marked and released were destroyed. Live transformer-phase lampreys were provided to the Marquette Sea Lamprey control 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 spawning-phase lampreys captured each sampling day was counted, along with the number of fish species, fish genera, and other taxa in the traps or nets. In addition, dead and recaptured lampreys, as well as, a sub-sample of female and male lampreys from the Bad river were measured to the nearest millimeter, weighed to the nearest gram, and sex determined. The fin clip combination on recaptured spawning-phase lamprey was also recorded. The number of transformer-phase sea lampreys was counted each sampling day and all were measured to the nearest millimeter.

### Population Estimates

Mark-recapture population estimates for spawning-phase sea lampreys 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 were made and combined to estimate the population in all 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

#### *Spawning-phase*

A total of 1,093 spawning-phase sea lampreys were captured in the six tributaries which have been trapped annually since 1988, below the twenty-six year average (1988-2013) of 2,488 (range: 566-10,908) (Table 4). The majority of spawning-phase sea lampreys captured came from two rivers: the Middle (N=722) and Bad (N=293) rivers.

Other than sea lamprey, 19 fish species, 9 fish taxa, and three other taxa were captured during the 2013 spawning-phase trapping (Table 5). White sucker (*Catostomus commersoni*) and chub (*Cyprinidae species*) were captured most often (N=771 and N=710, respectively) followed by brook trout (*Salvelinus fontinalis* N=446). Next in abundance were sucker (*C. species*, N=358), shiner (*Notropis species*, N=236), and bullhead (*Ameiurus species*, N=160), all captured primarily from the Middle river.

#### *Transformer-phase*

A total of 216 transformer-phase sea lampreys were captured in the five tributaries trapped in 2013 (Table 6b). The majority of the transformer-phased lampreys came from the Bad river (N=133) followed by the Traverse river (N=38) and Potato river (N=38). Also seven transformer-phase lampreys were captured in Marengo river while none were captured in the Amnicon river during 2013.

### Biological Characteristics

For spawning-phase sea lampreys mean length was 438 mm for male lampreys, while the mean length of female lamprey was 430 mm (Table 6a). These lengths were within the range of lengths observed during the twenty-six year period from 1986 to 2011 (Figure 2). The mean weight of male lamprey was 190 grams, while the mean weight of female lamprey was 178 grams (Table 6a). These weights were within the range of weights observed during the previous twenty-six years (Figure 3). Mean weight of male and female lamprey has been similar within a year but has varied considerably between years. All captured transformed lampreys were measured and had a mean length of 153 mm (range: 127 to 183 mm) (Table 6b).

### Population Estimates

Modified-Schaefer estimates of adult spawning-phase abundance were calculated for 4 of the 7 tributaries in 2013 (Table 7). Abundance estimates were 6,984 in the Middle, 4,131 in the Bad, 78 in the Silver, and 59 in the Misery rivers. For each of these rivers the population estimate was within the range recorded during the 27 year period 1986-2012 (Table 8). Low sample size led to no population estimate for the other three rivers.



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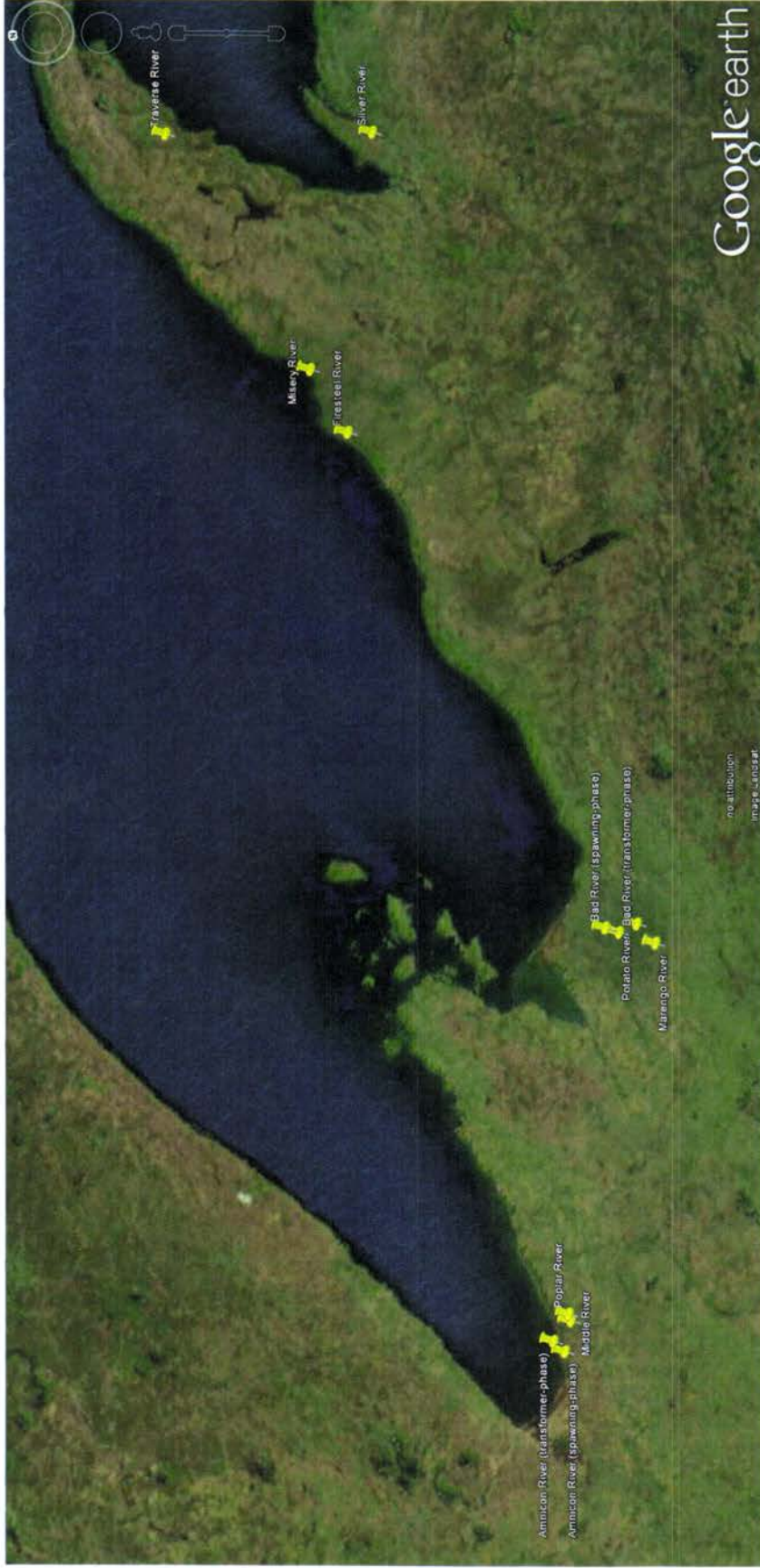


Figure 1. Location of rivers in which sea lampreys were trapped in 2013.

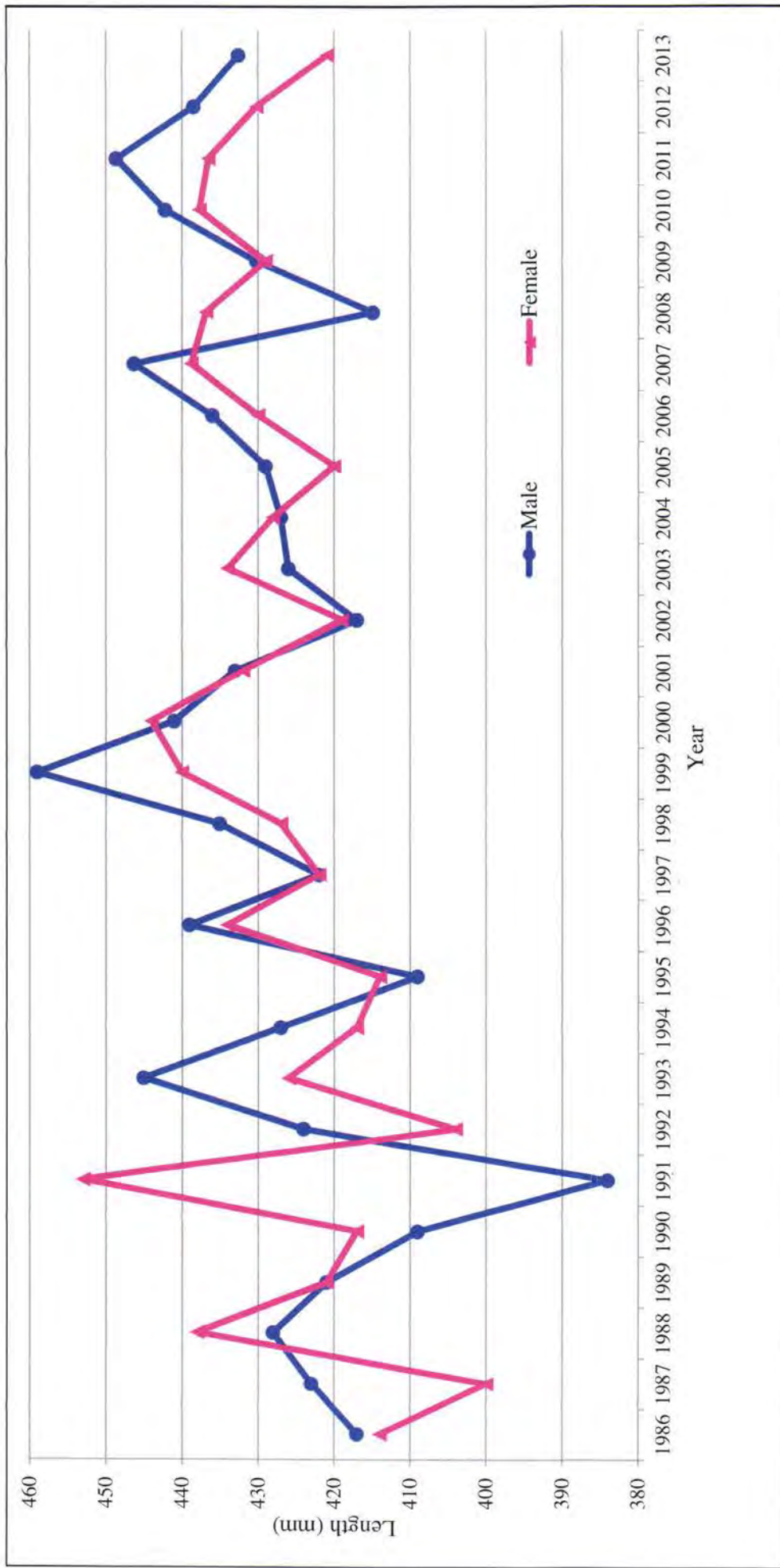


Figure 2. Mean length (mm) for male and female spawning-phase lamprey from rivers trapped during 1986-2013.



Figure 3. Mean weight (grams) for male and female spawning-phase lamprey from rivers trapped during 1986-2013.

Table 1. Information on location of spawning-phase (a) and transformer-phase (b) sea lamprey trapping conducted on Lake Superior tributaries during 2013.

(a)

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)	Mouth of Amnicon River
Middle	WI/Douglas	T48N, R12W, Sec 13, NE 1/4	4 traps	5 km (3 miles)	8.4 km (5 miles)	Mouth of Middle River
Poplar	WI/Douglas	T47N, R11w, Sec 6, SC	1-fyke net	5 km (3 miles)	23 km (14 miles)	Halkett Road Crossing
Bad	WI/Ashland	T47N, R3W, Sec 36, NE 1/4	3-traps	30 km (19 miles)	no barrier	Government Road Crossing
Firesteel	MI/Ontonagon	T51N, R38W, Sec 27, SE 1/4	1-fyke net	11.2 km (7 miles)	no barrier	Lake Shore Road Crossing
Misery	MI/Ontonagon	T52N, R37W, Sec 15, NE 1/4	2-traps	1.6 km (1 mile)	1.6 km (1 mile)	Misery Bay Park (river mouth)
Silver	MI/Baraga	T51N, R31W, Sec 13, SE 1/4	1-fyke net	1.6 km (1 mile)	5 km (3 miles)	Townline Road Crossing

(b)

Tributary	State/County	Location trapped	Gear
Amnicon	WI/Douglas	Mouth of river	2-fyke nets
Bad	WI/Ashland	Elm Hoist Road Bridge	3-fyke nets
Marengo	WI/Ashland	Government Road Bridge	2-fyke nets
Potato	WI/Ashland	Mouth of river	1-fyke net
Traverse	MI/Keweenaw	Gay-Lake Linden Road Bridge	2-fyke nets

Table 2. Type and combination of marks (v-notch fin clips) used on adult lamprey by week for rivers trapped during 2013.

Week of trapping	Mark (anterior, posterior)		Week of trapping	Mark (anterior, posterior)	
	Dates in 2012	Mark (0,3)		Dates in 2012	Mark (0,2)
1	4/14/2013 - 4/20/2013	(0,3)	7	5/26/2013 - 6/1/2013	(0,2)
2	4/21/2013 - 4/27/2013	(2,2)	8	6/2/2013 - 6/8/2013	(1,2)
3	4/28/2013 - 5/4/2013	(2,0)	9	6/9/2013 - 6/15/2013	(2,1)
4	5/5/2013 - 5/11/2013	(0,1)	10	6/16/2013 - 6/22/2013	(3,0)
5	5/12/2013 - 5/18/2013	(1,0)	11	6/23/2013 - 6/29/2013	(3,1)
6	5/19/2013 - 5/25/2013	(1,1)	12	6/30/2013 - 7/6/2013	(1,3)

Table 3. Water and air temperature (degrees Centigrade) for spawning-phase (a) and transformer-phase (b) tributaries to Lake Superior sampled during lamprey trapping in 2013.

Tributary	Water Temperature			
	N*	average	S.D.	min max
Michigan Tributaries	6	21.8	5.1	15 27
Firesteel	13	13.4	3.2	10 20
Misery	15	14.8	3.4	8 20
Wisconsin Tributaries	26	12.8	2.6	8 17
Amnicon	23	16.1	3.1	8 21
Bad	35	13.0	3.1	6 18
Middle	24	13.1	2.8	7 18
Poplar				
		<u>Air Temperature</u>		
	N*	average	S.D.	min max
Michigan Tributaries	7	19.1	3.9	12 24
Firesteel	13	16.2	6.3	6 31
Misery	15	17.4	5.8	8 29
Wisconsin Tributaries	26	10.8	3.9	5 19
Amnicon	22	18.5	5.0	11 28
Bad	35	13.4	4.4	7 22
Middle	24	13.8	4.3	8 24
Poplar				

Tributary	Water Temperature			
	N*	average	S.D.	min max
Michigan Tributaries	0	-	-	-
Traverse	19	3.2	2.1	0 6
Wisconsin Tributaries	34	5.3	3.6	-1 13
Amnicon	34	5.6	3.6	-1 14
Bad	21	3.2	2.1	-1 7
Marengo				
Potato				
		<u>Air Temperature</u>		
	N*	average	S.D.	min max
Michigan Tributaries	16	6.0	3.3	6 12
Traverse	19	3.2	3.7	-4 10
Wisconsin Tributaries	34	6.0	4.1	-1 16
Amnicon	34	6.0	4.3	-1 15
Bad	21	4.3	2.6	1 12
Marengo				
Potato				

\*N= number of days where measurement was recorded.

Table 4. Annual catches of unmarked adult spawning-phase sea lamprey in spring spawning assessment traps and nets in tributaries to Lake Superior monitored by GLJFWC from 1986-2013.

Year	Wisconsin Tributaries										Michigan Tributaries										Total 6 primary	Grand total	Average 6 primary				
	Primary					Secondary					Total WI	Primary					Secondary							Total MI			
	Amnicon	Bad	Middle	Arrowhead	Black	Nemadji	Poplar	Raspberry	Red Cliff Cr.	Subtotal 3 primary		Subtotal 5 secondary	Total WI	Firesteel	Misery	Silver	Huron	Traverse	Falls	Ontonagon					Other	Subtotal 3 primary	Subtotal 5 secondary
1986												500												0	500		
1987	61	439	16									516	17	261	4	1	51	10				278	4	5	1,275	521	1,275
1988	14	972	11								997	40	265	6	6	6	10				311	31	327	1,247	1,263	1,261	
1989	3	684	249								936	44	164	26	9	31	31		56	0	234	451	330	818	931	1,113	
1990	118	465	1					14			601	86	336	29	14	33		18			451	986	516	643	732	996	
1991	67	121	4					15			216	43	907	36	41	11					986	1,038	1,038	1,335	1,387	1,064	
1992	101	236	12								349	74	4,871	0	54	4					4,945	5,003	5,003	5,082	5,140	1,733	
1993	7	84	46								137	24	455	6	2	0					485	487	487	649	651	1,578	
1994	39	114	11								164	21	197	20	35	0					238	273	273	566	601	1,452	
1995	24	280	24								328	0	672	6	2	1					678	681	681	1,076	1,079	1,410	
1996	40	316	42								398	37	1,131	42	18						1,210	1,231	1,231	1,612	1,633	1,430	
1997	83	272	47								402	79	406	42							527	527	527	1,489	1,489	1,436	
1998	83	471	408								962	35	1,753	59							1,847	1,856	1,856	4,807	4,816	1,717	
1999	79	646	2,235								2,960	375	1,238	243							1,856	1,869	1,869	10,908	10,921	2,424	
2000	278	293	8,481								9,052	7	1,100	6							1,113	1,113	1,113	4,441	4,441	2,568	
2001	132	563	2,633								3,328	97	695	7							799	799	799	4,906	4,906	2,724	
2002	31	1,050	3,026								4,107	8	39	24							71	71	71	1,617	1,644	2,654	
2003	59	1,446	41								1,546	94	155	14							263	263	263	1,260	1,260	2,572	
2004	137	831	29								997	27	33	12							72	72	72	1,994	1,994	2,540	
2005	178	1,124	620								1,922	3	946	47							996	996	996	5,553	5,553	2,699	
2006	707	1,638	2,212								4,557	36	617	348							1,001	1,001	1,001	3,492	3,708	2,739	
2007	62	2,042	387								2,707	7	70	63							140	140	140	2,346	2,346	2,720	
2008	48	2,154	4								2,206	33	145	100							278	278	278	2,053	2,053	2,690	
2009	517	1,249	9								1,775	33	64	31							128	128	128	1,884	1,892	2,654	
2010	69	983	704								1,764	19	144	5							168	168	168	1,171	1,224	2,593	
2011	2	257	744								1,056	13	33	30							71	71	71	1,383	1,384	2,544	
2012	208	741	363								1,313	13	33	30							76	76	76	1,093	1,093	2,488	
2013	2	293	722								1,017	13	33	30							76	76	76	1,093	1,093	2,488	



Table 5. Number of fish species, fish taxa, and other taxa captured during spawning-phase sea lamprey trapping in seven Lake Superior tributaries in 2013.

<i>Fish Species</i>	Wisconsin Tributaries					Michigan Tributaries				Grand Total
	Bad	Amnicon	Middle	Poplar	Total-WI	Firesteel	Misery	Silver	Total-MI	
Sea Lamprey adult	293	2	722		1,017	13	33	30	76	1,093
Black Bullhead		1	1		2		2		2	4
Brook Trout					0	8	105	333	446	446
Brown Bullhead					0			5	5	5
Brown Trout			22		22	6	3	2	11	33
Burbot					0		2		2	2
Creek Chub	19		2		21		1	2	3	24
Hornyhead Chub	2			7	9	9	2		11	20
Longnose Dace	3				3		6		6	9
Longnose Sucker	1			43	44	1			1	45
Northern Pike		2			2		1		1	3
Pumpkinseed			1		1			4	4	5
Rainbow Trout			3		3	1	88	5	94	97
Rock Bass	4	63			67	16		37	53	120
Round Whitefish					0			1	1	1
Shorthead Redhorse	1				1				0	1
Smallmouth Bass	1				1	1			1	2
Splake					0			2	2	2
Trout-perch	1				1				0	1
White Sucker	4		12		16	84	172	499	755	771
<i>Fish taxa</i>					0					
Bullhead		1	155		156		4		4	160
Chub (Cyprinidae)	10	4	628	68	710				0	710
Dace			1		1				0	1
Perch		2			2				0	2
Redhorse	3				3	2			2	5
Sculpin			42		42				0	42
Shiner	3		222	11	236				0	236
Sucker			321	37	358				0	358
Sunfish		1			1				0	1
<i>Other taxa</i>					0					
Crayfishes			61		61		5	15	20	81
Frogs			1		1				0	1
Mudpuppy					0		2		2	2

Table 6. Calculated mean length (mm), weight (grams), and standard deviation (S.D.) for male and female spawning-phase (a) and calculated mean length (mm) for all transformer-phase (b) lamprey captured during 2013.

(a)

River	Sex	Length (mm)			Weight (grams)		
		Number	Mean	S.D.	Number	Average	S.D.
Amnicon	Female	0			0		
	Male	0			0		
	All	0			0		
Middle	Female	8	441	40	8	233	50
	Male	10	423	61	10	255	83
	All	18	431	52	18	245	69
Bad	Female	4	407	35	4	165	43
	Male	3	443	27	3	200	48
	All	7	423	35	7	180	46
Misery	Female	2	370	141	2	325	134
	Male	1	420		1	153	
	All	3	387	104	3	268	137
Firesteel	Female	0			0		
	Male	1	420		1	253	0
	All	1	420		1	253	
Silver	Female	1	414		1	280	
	Male	3	463	46	3	266	46
	All	4	451	45	4	270	39
All Rivers	Female	15	421	56	15	231	42
	Male	18	433	51	18	242	54
	All	33	427	53	33	237	48

(b)

River	Length (mm)				
	Number	Mean	S.D.	Min.	Max
Amnicon	0	-	-	-	-
Bad	133	150	10	127	172
Potato	38	151	7	140	167
Marengo	7	166	10	152	181
Traverse	38	167	9	142	183
All Rivers	216	153	12	127	183

Table 7. Population estimates for spawning-phase sea lamprey in GLIFWC monitored streams tributary to Lake Superior during 2013.

Tributary	Population Estimate
Wisconsin Tributaries	
Bad	4,131
Middle	6,984
Poplar	N/A
Amnicon	N/A
Michigan Tributaries	
Firesteel	N/A
Misery	59
Silver	78

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 (PE) and method of estimation for spawning-phase lamprey from six GLJFWC monitored tributaries to Lake Superior from 1986-2013.

Year	Ammicon		Bad		Middle		Misery		Firesteel		Silver	
	PE	Method	PE	Method	PE	Method	PE	Method	PE	Method	PE	Method
1986			6,026	S	1,080	S						
1987	647	S	4,654	S	20	S						
1988			7,762	S	21	S						
1989			9,818	S	1,328	S	610	S	220	P		
1990	1,368	S	3,138	S			1,124	S	462	S	56	S
1991	413	SM	3,806	SM			800	S	265	SM	61	SM
1992	1,394	SM	2,651	SM	172	SM	737	SM	113	SM	110	SM
1993	1,216	SM	2,428	SM	184	SM	1,771	SM	256	SM		
1994			2,135	SM			8,859	SM				
1995			2,048	SM	82	SM	748	TE				
1996	58	SM	8,513	SM	31	SM	413	TE				
1997	673	SM	4,700	SM	186	SM	951	TE				
1998	605	SM	4,064	SM	1,081	SM	2,881	TE	76	SM	170	SM
1999	600	SM	12,552	SM	13,515	SM	1,073	TE	274	SM	157	SM
2000	3,380	SM	2,767	SM	6,900	SM	2,339	SM	84	SM	651	SM
2001	904	SM	8,679	SM	2,327	SM	1,764	SM	1,036	SM	937	SM
2002	552	SM	13,678	SM	3,327	SM	1,975	SM				
2003	138	SM	8,297	SM	41	SM	602	SM	212	SM		
2004			8,555	SM	28	SM	39	SM	31	SM		
2005	594	SM	12,383	SM	1,049	SM	431	SM				
2006	7,437	SM	18,912	SM	3,017	SM	855	SM			182	SM
2007			15,531	SM	434	SM	572	SM	14	SM	1,724	SM
2008			12,922	SM			156	SM			276	SM
2009	4,474	SM	4,754	SM			156	SM	128	SM	370	SM
2010			7,905	SM	2,024	SM	141	SM	98	SM	98	SM
2011			2,514	TE	1,177	SM	281	SM				
2012	156	SM	17,080	SM	1,683	SM						
2013			4,131	SM	6,984	SM	59	SM	23	SM	78	SM

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