Trapping Activities and Population Estimates of Sea Lamprey in Tributaries of Lake Superior During 2014

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Administrative Report 15-3
January 2015

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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 2014 work included both adult spawning-phase and downstream trapping for transformer-phase lamprey. Results of the 2014 trapping season are reported.

The seven rivers sampled in spring 2014 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 2014 a total of 988 adult spawning-phase sea lampreys were captured in these six tributaries which was below the twenty-seven year average (1988-2014) of 2,433 (range: 566-10,908). The majority of spawning-phase sea lampreys captured came from the Bad river (660). Modified Schaefer estimates of adult spawning-phase lamprey abundance were calculated for 4 of the 7 tributaries in 2014. Abundance estimates were 10,866 in the Bad, 320 in the Middle, 227 in the Silver, and 175 in the Misery rivers.

The Bad river was sampled for transformer-phase lamprey in fall 2014. A total of 8 transformer-phase sea lampreys were captured.

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ACKNOWLEDGMENTS

I wish to thank Michael Plucinski (Great Lakes Technician), Marissa Neitzke (Northland College Intern), Jalyn LaBine (Great Lakes Intern), and Peter Houle (Lac Courte Oreilles Ojibwa Community College Intern) for conducting the adult spawning-phase trapping operations on the Bad river in Wisconsin; David and James Parisian (Fisheries aides) for conducting the transformer-phase trapping operations on the Bad river; Acorn Armagost (Fisheries aide) for conducting and assisting with the trapping operations on the Amnicon, Middle, and Poplar rivers in Wisconsin; Kyle and David Seppanen (Fisheries aide) for conducting the trapping operations in the Firesteel and Misery rivers in Michigan; and the Keweenaw Bay Indian Community Natural Resources Department for conducting the trapping operation on the Silver river, Michigan.

The cooperation of U.S. Fish and Wildlife Service- Sea Lamprey Control Program personnel from Marquette, Michigan is appreciated; Jessica Barber supplied equipment, personnel, data and the calculated population estimates for spawning phase sea lamprey. I thank Neil Kmiecik (GLIFWC Biological Services Director) for editing this report.

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 2014). 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 2014 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 the Bad river in Wisconsin was 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. Since 2000 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 3-fyke nets were used for capture and set in the lower portion of the river with the cod end downstream (Table 1b). Nets were set from September 30 to October 23, 2014.

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. During fall sampling in the Bad River 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 988 spawning-phase sea lampreys were captured in the six tributaries which have been trapped annually since 1988, below the twenty-seven year average (1988-2014) of 2,433 (range: 566-10,908) (Table 4). The majority of spawning-phase sea lampreys captured came from the Bad river (N=660). No lamprey were captured in the Poplar river in 2014.

Other than sea lamprey, 26 fish species, 11 fish taxa, and five other taxa were captured during the 2014 spawning-phase trapping (Table 5). White sucker (*Catostomus commersoni*) and dace (*Rhinichthys species*) were captured most often (N=1,683 and N=849, respectively) followed by creek chub (*Semotilus atromaculatus*, N=629). Next in abundance were common shiner (*Luxilus cornutus,* N=405), crayfish (Cambaridae family) (N=142), and rainbow trout (*Oncorhynchus mykiss*, N=128) all captured primarily from the Middle and Misery rivers.

Transformer-phase

A total of eight transformer-phase sea lampreys were captured in the Bad river during the fall of 2014 (Table 6b). The Bad river was trapped for the four weeks prior to the 2014 lampricide treatment.

Biological Characteristics

For spawning-phase sea lampreys mean length was 419 mm for male lampreys, while the mean length of female lamprey was 428 mm (Table 6a). These lengths were within the range of lengths observed during the twenty-eight year period from 1986 to 2013 (Figure 2). The mean weight of male lamprey was 168 grams, while the mean weight of female lamprey was 173 grams (Table 6a). These weights were within the range of weights observed during the previous twenty-eight years (Figure 3). Mean weight of male and female lamprey has been similar within a year but has varied considerably between years.

All eight of the captured transformed lampreys were measured and had a mean length of 152 mm (range: 140 to 163 mm) (Table 6b).

Population Estimates

Modified-Schaefer estimates of adult spawning-phase abundance were calculated for 4 of the 7 tributaries in 2014 (Table 7). Abundance estimates were 10,866 in the Bad, 320 in the Middle, 227 in the Silver, and 175 in the Misery rivers. For each of these rivers the population estimate was within the range recorded during the 28 year period 1986-2013 (Table 8). Low sample size led to no population estimate for the other three rivers.

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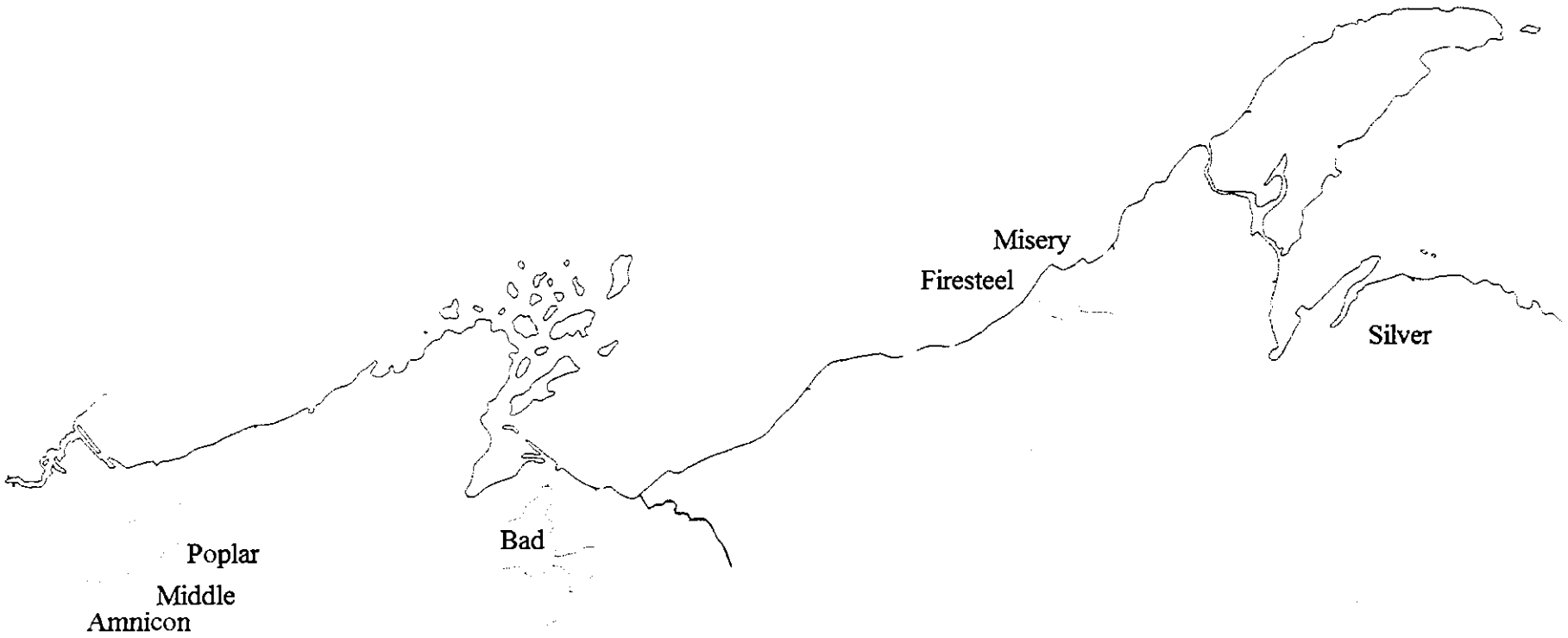

Figure 1. Location of rivers in which sea lampreys were trapped in 2014.

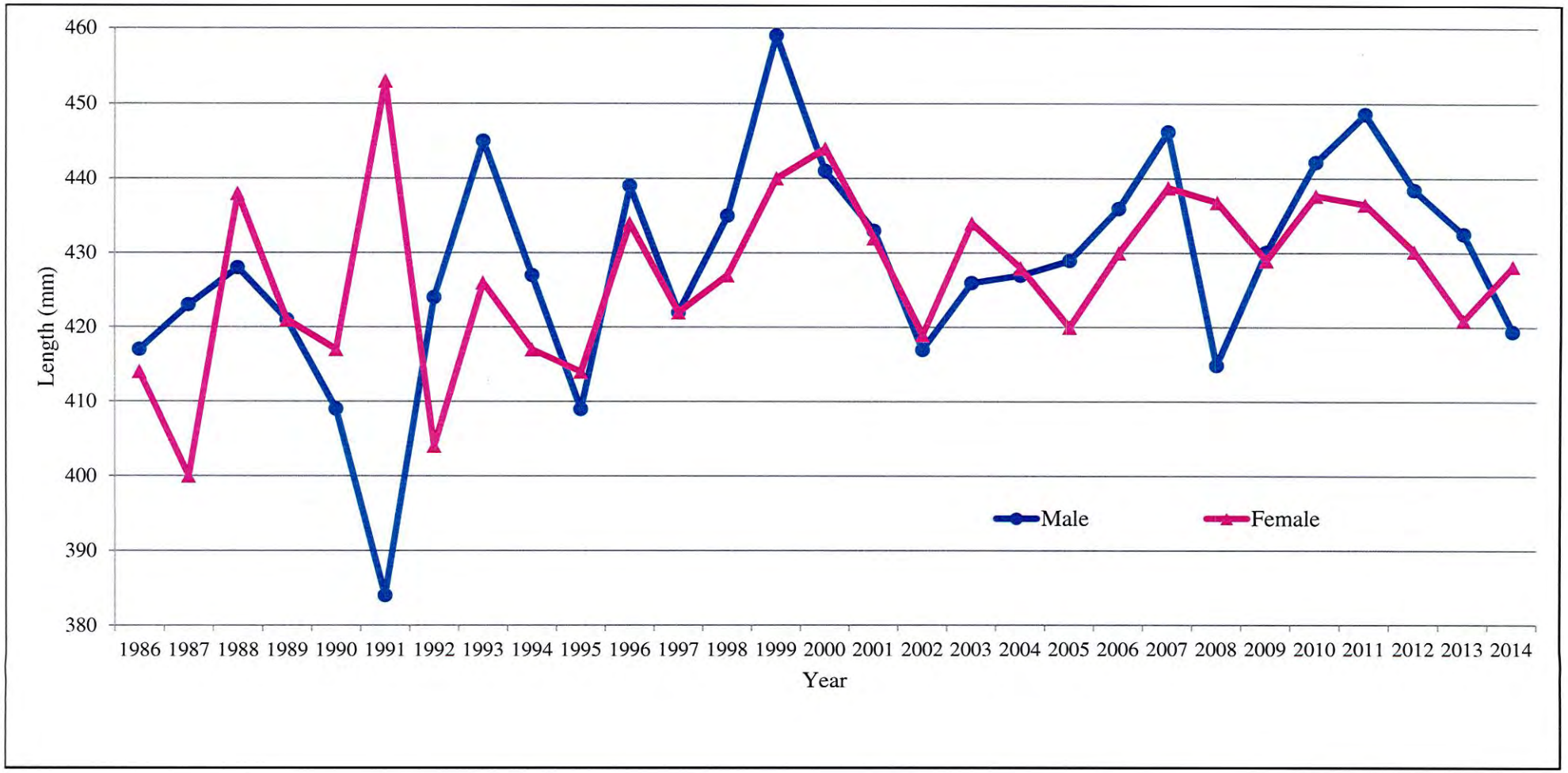

Figure 2. Mean length (mm) for male and female spawning-phase lamprey from rivers trapped during 1986-2014.

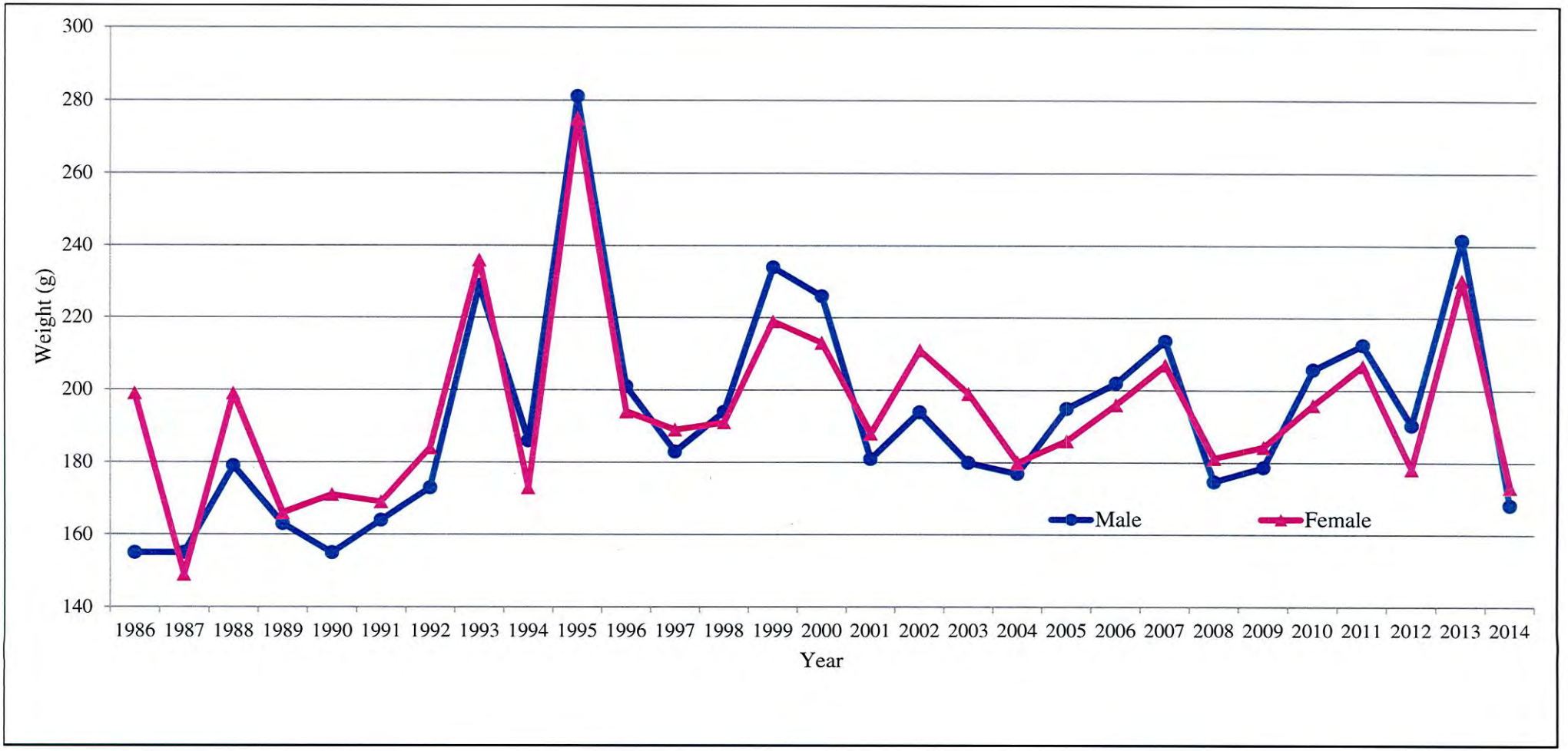

Figure 3. Mean weight (grams) for male and female spawning-phase lamprey from rivers trapped during 1986-2014.

Table 1. Information on location of spawning-phase (a) and transformer-phase (b) sea lamprey trapping conducted on Lake Superior tributaries during 2014.

(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
Bad	WI/Ashland	Elm Hoist Road Bridge	3-fyke nets

Table 2. Type and combination of marks (v-notch fin clips) used on adult lamprey by week for rivers trapped during 2014.

Week of trapping	Dates in 2014			Mark (anterior, posterior)	Week of trapping	Dates in 2014			Mark (anterior, posterior)
1	4/13/2014	-	4/19/2014	(0,3)	7	5/25/2014	-	5/31/2014	(0,2)
2	4/20/2014	-	4/26/2014	(2,2)	8	6/1/2014	-	6/7/2014	(1,2)
3	4/27/2014	-	5/3/2014	(2,0)	9	6/8/2014	-	6/14/2014	(2,1)
4	5/4/2014	-	5/10/2014	(0,1)	10	6/15/2014	-	6/21/2014	(3,0)
5	5/11/2014	-	5/17/2014	(1,0)	11	6/22/2014	-	6/28/2014	(3,1)
6	5/18/2014	-	5/24/2014	(1,1)	12	6/29/2014	-	7/5/2014	(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 2014.

(a)

Tributary	Water Temperature N*	average	S.D.	min	max
Michigan Tributaries					
Firesteel	18	19.6	2.4	15	24
Misery	30	17.1	2.6	12	22
Silver	25	14.1	3.1	7	20
Wisconsin Tributaries					
Amnicon	31	15.2	3.8	2	20
Bad	35	16.4	3.7	8	23
Middle	40	14.2	3.8	2	20
Poplar	30	14.7	3.8	2	20
	Air Temperature				
	N*	average	S.D.	min	max
Michigan Tributaries					
Firesteel	18	18.1	3.9	12	26
Misery	30	18.7	4.5	10	27
Silver	25	16.0	3.7	7	22
Wisconsin Tributaries					
Amnicon	29	12.3	3.7	2	22
Bad	35	15.9	4.3	5	22
Middle	39	12.2	3.6	5	22
Poplar	28	13.1	4.5	2	22

*N= number of days where measurement was recorded.

(b)

Tributary	Water Temperature N*	average	S.D.	min	max
Bad	22	7.7	2.2	5	12
	Air Temperature				
	N*	average	S.D.	min	max
Bad	22	10.1	2.9	4	14

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 GLIFWC from 1986-2014.

Year	Wisconsin Tributaries											Michigan Tributaries										Total	Grand	Average
	Primary			*Secondary*						Subtotal	Total	*Primary*			*Secondary*					Subtotal	Total	6 primary	total	6 primary
	Amnicon	Bad	Middle	Arrowhead	Black	Nemadji	Poplar	Raspberry	Red Cliff Cr.	3 primary	WI	Firesteel	Misery	Silver	Huron	Traverse	Falls	Ontonagon	Otter	3 primary	MI			
1986		184	315	1			0			499	500			0						0	0		**500**	
1987	61	439	16							516	516			4	1					4	5		**521**	
1988	14	972	11							997	997	17	261	0	51	10				278	339	1,275	**1,336**	**1.275**
1989	3	684	249							936	936	40	265	6	6	10			0	311	327	1,247	**1,263**	**1.261**
1990	118	465	1		3	0			14	584	601	44	164	26	9	31		56	0	234	330	818	**931**	**1.113**
1991	67	121	4		8	1		0	15	192	216	86	336	29	14	33		18		451	516	643	**732**	**996**
1992	101	236	12							349	349	43	907	36	41	11				986	1,038	1,335	**1,387**	**1,064**
1993	7	84	46							137	137	74	4,871	0	54	4				4,945	5,003	5,082	**5,140**	**1,733**
1994	39	114	11							164	164	24	455	6	2	0				485	487	649	**651**	**1,578**
1995	24	280	24							328	328	21	197	20	35	0				238	273	566	**601**	**1,452**
1996	40	316	42							398	398	0	672	6	2	1				678	681	1,076	**1,079**	**1,410**
1997	83	272	47							402	402	37	1,131	42	18		3			1,210	1,231	1,612	**1,633**	**1,430**
1998	83	471	408							962	962	79	406	42				0		527	527	1,489	**1,489**	**1,436**
1999	79	646	2,235							2,960	2,960	35	1,753	59				9		1,847	1,856	4,807	**4,816**	**1,717**
2000	278	293	8,481							9,052	9,052	375	1,238	243				13		1,856	1,869	10,908	**10,921**	**2,424**
2001	132	563	2,633							3,328	3,328	7	1,100	6						1,113	1,113	4,441	**4,441**	**2,568**
2002	31	1,050	3,026							4,107	4,107	97	695	7						799	799	4,906	**4,906**	**2,724**
2003	59	1,446	41				27			1,546	1,573	8	39	24						71	71	1,617	**1,644**	**2,654**
2004	137	831	29				0			997	997	94	155	14						263	263	1,260	**1,260**	**2,572**
2005	178	1,124	620							1,922	1,922	27	33	12						72	72	1,994	**1,994**	**2,540**
2006	707	1,638	2,212							4,557	4,557	3	946	47						996	996	5,553	**5,553**	**2,699**
2007	62	2,042	387				216			2,491	2,707	36	617	348						1,001	1,001	3,492	**3,708**	**2,739**
2008	48	2,154	4				0			2,206	2,206	7	70	63						140	140	2,346	**2,346**	**2,720**
2009	517	1,249	9				0			1,775	1,775	33	145	100						278	278	2,053	**2,053**	**2,690**
2010	69	983	704				8			1,756	1,764	33	64	31						128	128	1,884	**1,892**	**2,654**
2011	2	257	744				53			1,003	1,056	19	144	5						168	168	1,171	**1,224**	**2,593**
2012	208	741	363				1			1,312	1,313	19	20	32						71	71	1,383	**1,384**	**2,544**
2013	2	293	722				0			1,017	1,017	13	33	30						76	76	1,093	**1,093**	**2,488**
2014	11	660	58				0			729	729	24	113	122						259	259	988	**988**	**2,433**

Table 5. Number of fish species, fish taxa, and other taxa captured during spawning-phase sea lamprey trapping in seven Lake Superior tributaries in 2014.

	Wisconsin Tributaries					Michigan Tributaries				Grand
	Bad	Amnicon	Middle	Poplar	*Total-WI*	Firesteel	Misery	Silver	*Total-MI*	Total
Fish Species										
Sea Lamprey adult	660	11	58		729	24	113	122	259	988
Black Bullhead		1	35		36	1	12		13	49
Black Crappie		1			1				0	1
Bluegill					0		2		2	2
Brook Trout	1		1		2	5	23	16	44	46
Brown Trout			2		2	9	2		11	13
Burbot	1		26		27	1	4		5	32
Chestnut Lamprey adult			3		3				0	3
Common Shiner		6	329	36	371	16	18		34	405
Creek Chub	17	1	469	52	539	11	73	6	90	629
Golden Shiner			2		2				0	2
Hornyhead Chub					0	4	51		55	55
Lake Chub			1		1				0	1
Logperch			4		4				0	4
Longnose Dace			53	18	71		25		25	96
Longnose Sucker					0			24	24	24
Mottled Sculpin			17		17				0	17
Northern Pike		2	1		3				0	3
Pumpkinseed			4		4				0	4
Rainbow Trout			8	3	11	4	93	20	117	128
Rock Bass	1	13	1	1	16	26	3	23	52	68
Ruffe		6		1	7		3		3	10
Smallmouth Bass	3				3			1	1	4
Spottail Shiner		2			2				0	2
Stonecat			96		96				0	96
Walleye	3				3				0	3
White Sucker	21		717	118	856	33	370	424	827	1,683
Fish taxa										
Bullhead			4		4			49	49	53
Chub (Cyprinidae)	1		40	14	55				0	55
Chub (Coregonus)			42	2	44				0	44
Dace			547	302	849				0	849
Madtom				1	1				0	1
Redhorse sucker	1			1	2				0	2
Salmon					0		1		1	1
Sculpin			5		5				0	5
Shiner	1		54		55				0	55
Sucker			63	7	70				0	70
Sunfish					0		16		16	16
Other taxa										
Crayfishes			95		95		29	18	47	142
Ducks				1	1			2	2	3
Snapping Turtle					0		1	1	2	2
Toads and Frogs	1		2		3		1	1	2	5
Water Beetles					0		1		1	1

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 2014.

(a)

River	Sex	Length (mm)			Weight (grams)		
		Number	Mean	S.D.	Number	Average	S.D.
Amnicon	Female						
	Male	No data					
	All						
Middle	Female	2	440	14	2	182	19
	Male	4	442	37	4	217	32
	All	6	441	29	6	205	32
Bad	Female	87	428	35	87	171	43
	Male	73	417	39	73	162	48
	All	160	423	37	160	167	46
Misery	Female	1	435	0	1	198	0
	Male	5	416		5	176	
	All	6	419	27	6	180	31
Firesteel	Female						
	Male	No data					
	All						
Silver	Female	5	428	31	5	198	22
	Male	8	436	44	44	8	196
	All	13	433	38	13	197	48
All Rivers	Female	95	428	34	173	40	42
	Male	90	419	39	168	49	54
	All	185	424	37	185	171	48

(b)

River	Length (mm)				
	Number	Mean	S.D.	Min.	Max
Bad	8	152	9	140	163

Table 7. Population estimates for spawning-phase sea lamprey in GLIFWC monitored streams tributary to Lake Superior during 2014.

Tributary	Population Estimate
Wisconsin Tributaries	
Bad	10,886
Middle	320
Poplar	N/A
Amnicon	N/A
Michigan Tributaries	
Firesteel	N/A
Misery	175
Silver	227

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 GLIFWC monitored tributaries to Lake Superior from 1986-2014.

	Amnicon		Bad		Middle		Misery		Firesteel		Silver	
Year	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	610	S				
1989			9,818	S	1,328	S	1,124	S	220	P		
1990	1,368	S	3,138	S			800	S	462	S	56	S
1991	413	SM	3,806	SM			737	SM	265	SM	61	SM
1992	1,394	SM	2,651	SM	172	SM	1,771	SM	113	SM	110	SM
1993	1,216	SM	2,428	SM	184	SM	8,859	SM	256	SM		
1994			2,135	SM			748	TE				
1995			2,048	SM	82	SM	413	TE				
1996	58	SM	8,513	SM	31	SM	951	TE				
1997	673	SM	4,700	SM	186	SM	2,881	TE	76	SM	170	SM
1998	605	SM	4,064	SM	1,081	SM	1,073	TE	274	SM	157	SM
1999	600	SM	12,552	SM	13,515	SM	2,339	SM	84	SM	651	SM
2000	3,380	SM	2,767	SM	6,900	SM	1,764	SM	1,036	SM	937	SM
2001	904	SM	8,679	SM	2,327	SM	1,975	SM				
2002	552	SM	13,678	SM	3,327	SM	602	SM	212	SM		
2003	138	SM	8,297	SM	41	SM	39	SM				
2004			8,555	SM	28	SM	431	SM	31	SM		
2005	594	SM	12,383	SM	1,049	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			23	SM		
2013			4,131	SM	6,984	SM	59	SM			78	SM
2014			10,886	SM	320	SM	175	SM			227	SM

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