



**Trapping Activities and Population Estimates of
Sea Lamprey in Tributaries of Lake Superior
During 2016**

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ABSTRACT

The Great Lakes Section of the Great Lakes Indian Fish and Wildlife Commission (GLIFWC) conducts a sea lamprey (*Petromyzon marinus*) trapping project in cooperation with the U.S. Fish and Wildlife Service Sea Lamprey Control Station in Marquette, Michigan (USFWS-SLC), the Bad River Band of Lakes Superior Chippewa and the Keweenaw Bay Indian Community. The purpose of the project is to gather information on sea lamprey in various tributaries to Lake Superior. In 2016 work included adult spawning-phase (4 rivers) trapping lampreys. Results of the 2016 trapping season are reported.

The four rivers sampled in spring 2016 for adult spawning-phase sea lamprey were the Bad and Middle rivers in Wisconsin and the Misery and Silver rivers in Michigan. These four rivers have been trapped annually since 1988. In 2016 a total of 838 adult spawning-phase sea lampreys were captured in these four. The majority of spawning-phase sea lampreys captured came from the Middle River (671). Adjusted Petersen estimates of adult spawning-phase lamprey abundance calculated for each tributary in 2016 were 6,835 in the Middle River, 2,607 in the Bad River, 20 in the Misery River, and 18 in the Silver River.

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INTRODUCTION

The Great Lakes Section of the Great Lakes Indian Fish and Wildlife Commission (GLIFWC) conducts an annual cooperative sea lamprey (*Petromyzon marinus*) trapping project with the U.S. Fish and Wildlife Service Sea Lamprey Control Station in Marquette, Michigan (USFWS-SLC), the Bad River Band of Lakes Superior Chippewa Natural Resources Department (BR-NRD) and the Keweenaw Bay Indian Community Natural Resources Department (KB-NRD). Results of this work have been reported in GLIFWC administrative reports (e.g. Mattes 2016). The purpose of the project is to gather information on and index the number of adult spawning-phase sea lamprey ascending various tributary streams of Lake Superior during their April-July spawning run. Objectives of the project are: (1) to monitor the in-stream movements of sea lamprey, (2) to collect data on the length and weight of sea lamprey, (3) to estimate the number of sea lamprey spawning in a tributary, and (4) to reduce the effect of sea lamprey induced mortality to fish populations in Lake Superior by removing a portion of the spawning-phase sea lamprey population.

Information collected supplements that collected by USFWS-SLC and other agencies and is included in a lake wide management plan in order to control and reduce the lamprey population. Results of the monitoring efforts for each tributary are used to index the numbers of spawning-phase lampreys in United States waters of Lake Superior as an evaluation of the effectiveness of regional lamprey control efforts. This report presents results of 2016 trapping season for the four tributaries monitored cooperatively by GLIFWC, KB-NRD, USFWS-SLC, and BR-NRD.

In 2016 trapping was conducted in four streams tributary to Lake Superior to index the abundance of spawning-phase sea lamprey and when recaptures are sufficient generate a population estimate (Figure 1). The four selected index streams: the Bad and Middle rivers in Wisconsin and the Misery and Silver rivers in Michigan are known to contain spawning runs of adult sea lamprey and represent a range of stream sizes based on in-stream flows. These streams have been trapped in prior years, as well as other streams which are not currently being trapped (Mattes 2016).

In some years streams were trapped for transformer-phase lampreys were based upon USFWS assessment data which tracks sea lamprey abundance in tributaries. No tributaries in the GLIFWC work area were estimated to have high abundances of transformer-phase sea lampreys in 2016.

METHODS

Capture Gear and Sites

Two tributaries in Wisconsin and two tributaries in the Upper Peninsula of Michigan were trapped for spawning-phase sea lampreys from late April through early July (Figure 1). The Middle and Misery rivers have man-made barriers that were specially built to prevent the upward movement of sea lamprey. The Silver River has a natural barrier which prevents sea lampreys from moving through the entire system. The Bad River has no impassable barrier.

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. Four PAT's were set in the Middle River from 2000-2015 with catch of male lamprey through 2011 used for the sterile male release program. Prior to 2000 and currently, two PAT's have 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 Silver River, which does not have a suitable barrier, one fyke net was set in the lower portion of the river with the cod end upstream.

Data Collection

Traps or fyke nets were emptied at least three times per week (i.e., Monday, Wednesday, and Friday) in the four rivers fished for adult spawning-phase and two rivers fished for transformer-phase sea lamprey. A sub-sample of live spawning-phase 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). Spawning-phase lampreys not marked and released were destroyed. Water and air temperature were recorded at the time traps or nets were emptied (Table 3).

The numbers of live and dead marked and unmarked spawning-phase lampreys captured each sampling day were 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.

Population Estimates

Mark-recapture population estimates for spawning-phase sea lampreys were attempted based on the marking procedure described above. From 1986-2014, when sample size was sufficient population estimates were calculated using the modified Schaefer method and starting in 2015 the adjusted Petersen Estimator was calculated (Ricker 1975). In either instance, when the number of recaptures was deemed too low no such estimate was calculated.

RESULTS AND DISCUSSION

Trap Catches

Spawning-phase

A total of 838 adult spawning-phase sea lampreys were captured in the four sampled tributaries. Catches were highest in the Middle River (671) followed by the Bad River (134), Silver River (24) and Misery River (9) (Table 4).

Other than sea lamprey, 23 fish species, eight fish taxa, and six other taxa were captured during the 2016 spawning-phase trapping (Table 5). Sucker (*Catostomidae species*) (N=1,501) were captured most often followed by shiner (*Notropis species*) (N=537) both captured primarily from the Middle River. Rainbow Trout (*Oncorhynchus mykiss*, N=515), Black Bullhead (*Ameiurus melas*, N=493) and White Sucker (*Catostomus commersoni*, N=478) were also commonly captured.

Length and Weight

For spawning-phase sea lampreys mean length was 401 mm for male lampreys, while the mean length of female lamprey was 414 mm (Table 6). These lengths were within the range of lengths observed during the period from 1988 to 2015 (Figure 2). The mean weight of male lamprey was 182 grams, while the mean weight of female lamprey was 190 grams (Table 6). These weights were within the range of weights observed during the period from 1988 to 2015 (Figure 3).

Population Estimates

Adjusted Petersen estimates of adult spawning-phase lamprey abundance calculated for each tributary in 2016 (Table 7). Abundance estimates were 6,835 in the Middle River, 2,607 in the Bad River, 20 in the Misery River, and 18 in the Silver River. The Bad River estimate was near the lower end of population estimates for the river since trapping began in 1986 (range: 2,048-18,912), while the Middle River estimate was the fourth highest recorded (range: 20-13,515). Estimates in the Silver and Misery rivers were the lowest recorded since 1986 (Table 7).

REFERENCES CITED

- Mattes, W.P. 2016. Trapping activities and population estimates of adult sea lamprey in tributaries of Lake Superior during 2015. Biological Services Division Administrative Report 16-12. Great Lakes Indian Fish and Wildlife Commission, Odanah, WI. 14 p.
- Ricker, W.E. 1975. Computation and Interpretation of Biological Statistics of Fish Populations. Bulletin of the Fisheries Research Board of Canada. Department of Fisheries and Oceans. Bulletin 191.

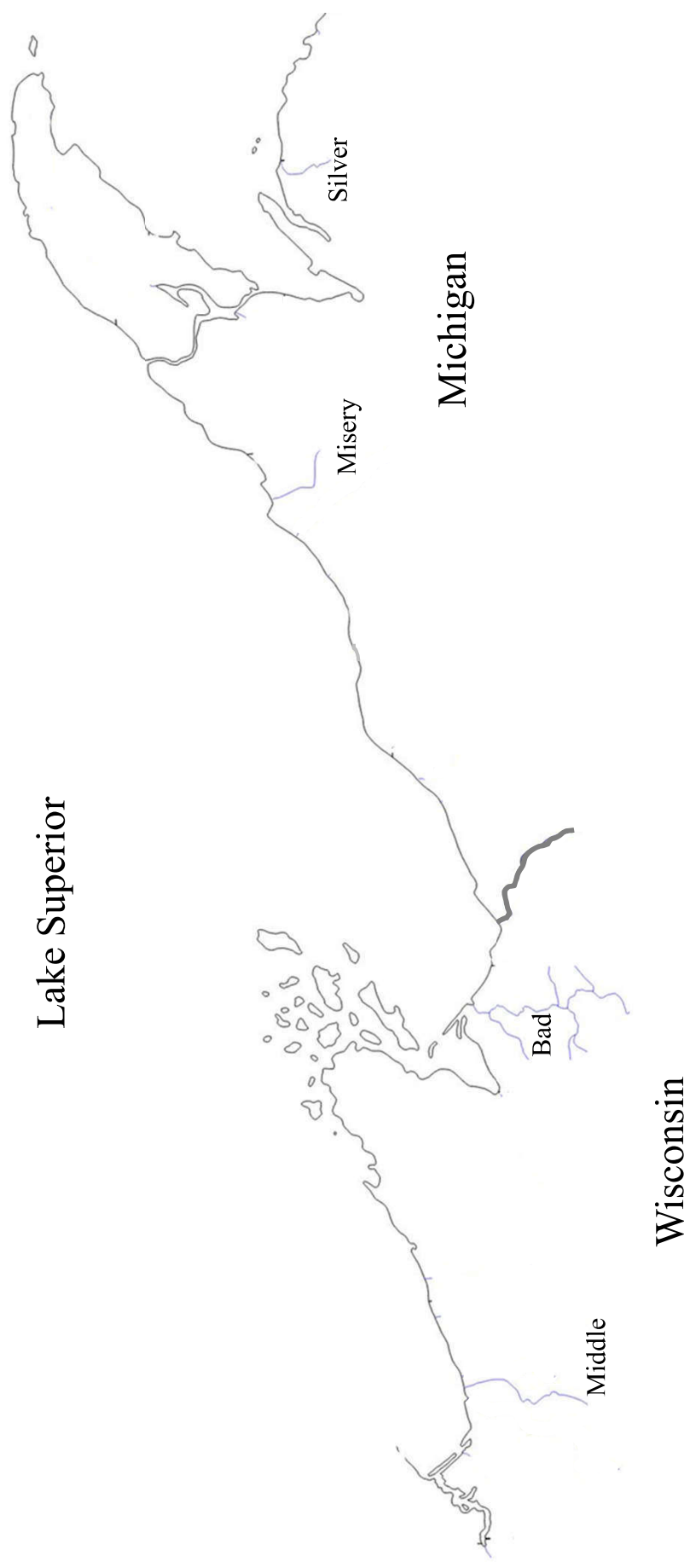


Figure 1. Location of rivers in which sea lampreys were trapped in 2016.

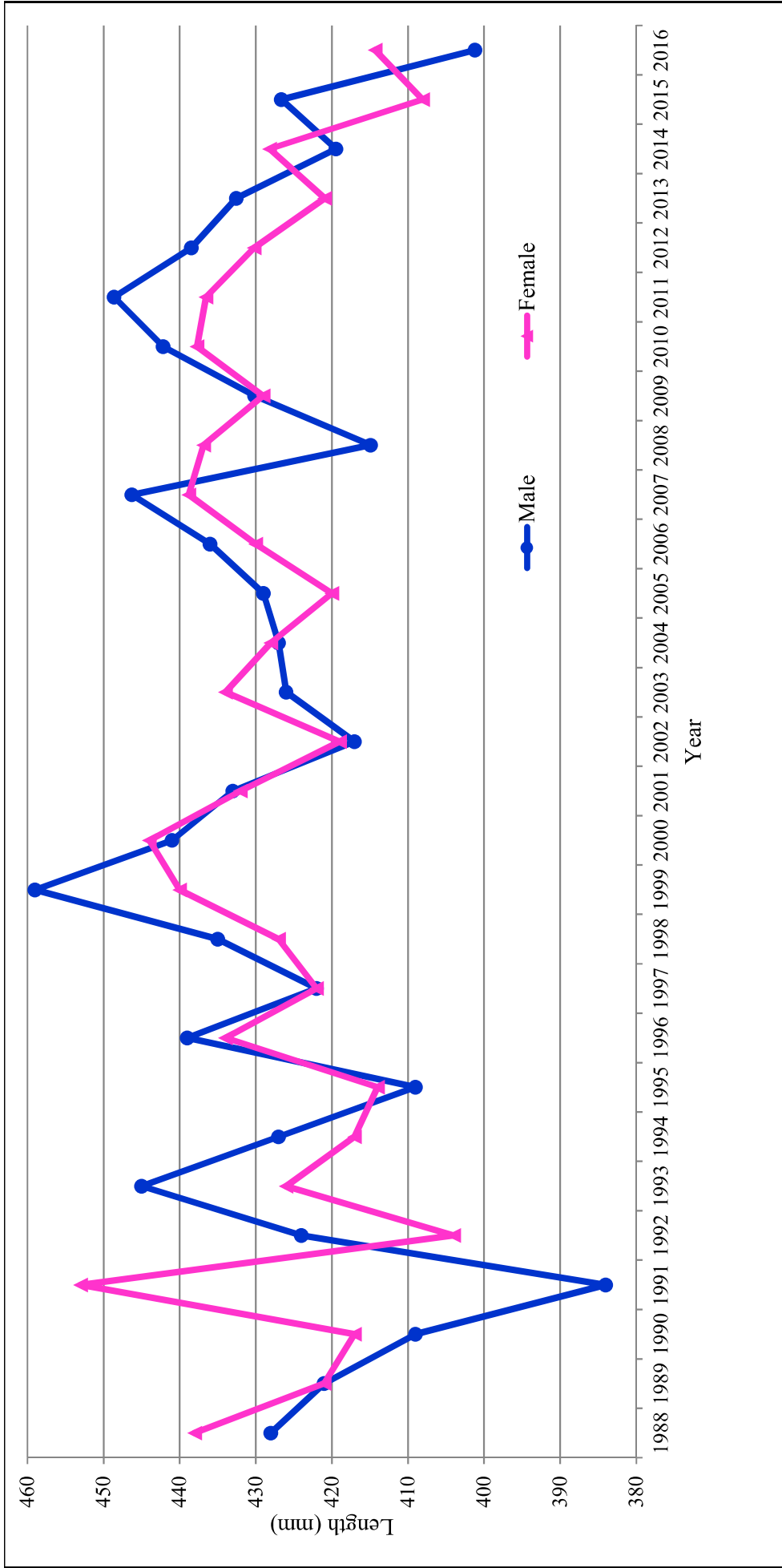


Figure 2. Mean length (mm) for male and female spawning-phase lamprey from rivers trapped during 1988-2016.

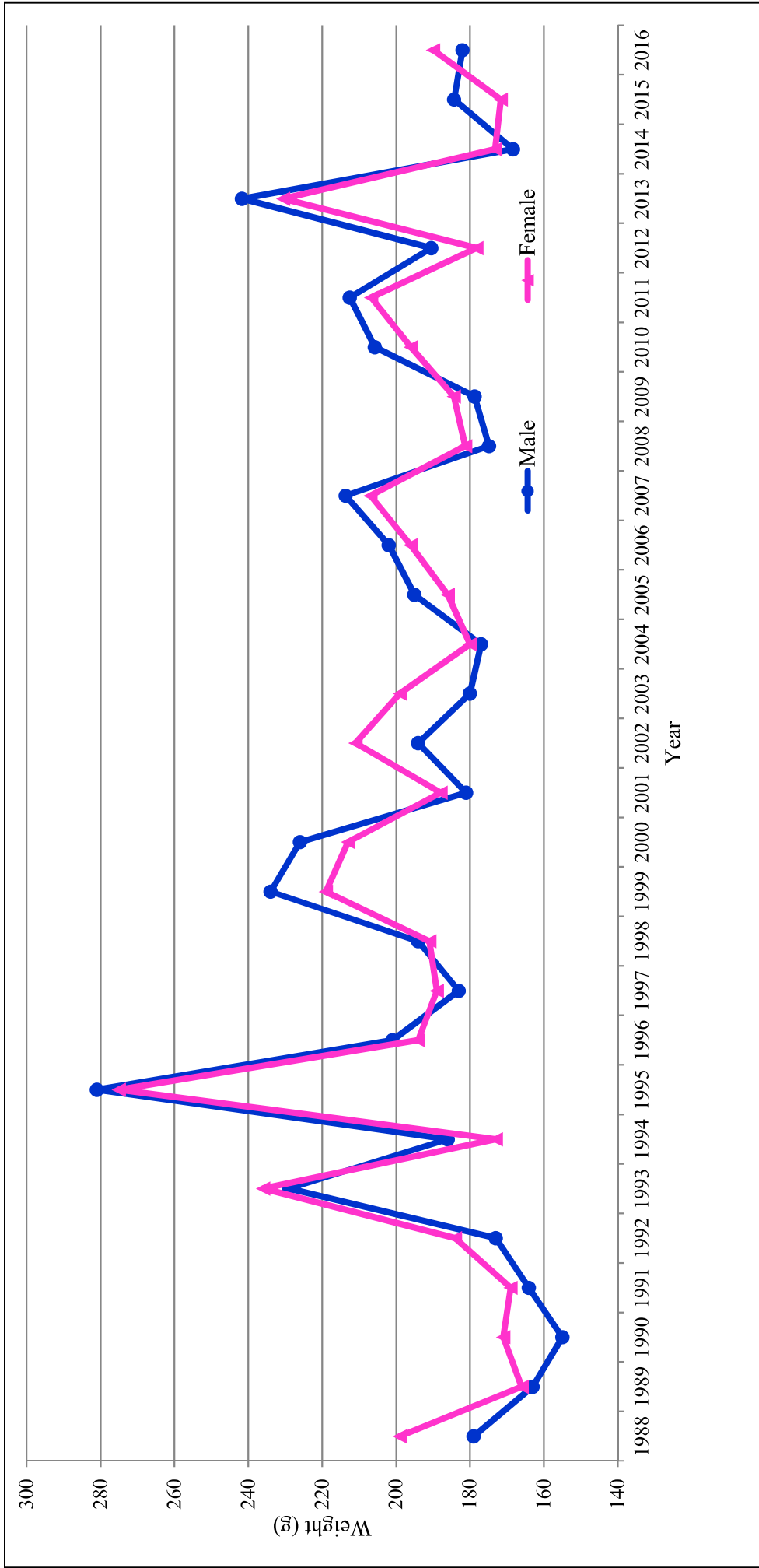


Figure 3. Mean weight (grams) for male and female spawning-phase lamprey from rivers trapped during 1988-2016.

Table 1. Information on location and gear used during spawning-phase sea lamprey trapping conducted on Lake Superior tributaries during 2016.

Tributary	State/County	Location trapped	Gear	Trap site distance from mouth	Barrier distance from mouth	Release Site
Middle	WI/Douglas	46° 38' 48" N 91° 48' 19" W	4 traps	5 km (3 miles)	8.4 km (5 miles)	Mouth of Middle River
Bad	WI/Ashland	46° 30' 53" N 90° 40' 54" W	3-traps	30 km (19 miles)	no barrier	Government Road Crossing
Misery	MI/Ontonagon	46° 58' 56" N 88° 59' 00" W	2-traps	1.6 km (1 mile)	1.6 km (1 mile)	Misery Bay Park (river mouth)
Silver	MI/Baraga	46° 48' 18" N 88° 18' 59" W	1-fyke net	1.6 km (1 mile)	5 km (3 miles)	Townline Road Crossing

Table 2. Type and combination of marks (v-notch fin clips) used on adult lamprey by week for rivers trapped during 2016.

Week of trapping	Dates in 2016	Mark (anterior, posterior)	Week of trapping	Dates in 2016	Mark (anterior, posterior)
1	4/11/2016 - 4/17/2016	(0,3)	7	5/23/2016 - 5/29/2016	(0,2)
2	4/18/2016 - 4/24/2016	(2,2)	8	5/30/2016 - 6/5/2016	(1,2)
3	4/25/2016 - 5/1/2016	(2,0)	9	6/6/2016 - 6/12/2016	(2,1)
4	5/2/2016 - 5/8/2016	(0,1)	10	6/13/2016 - 6/19/2016	(3,0)
5	5/9/2016 - 5/15/2016	(1,0)	11	6/20/2016 - 6/26/2016	(3,1)
6	5/16/2016 - 5/22/2016	(1,1)	12	6/27/2016 - 7/3/2016	(1,3)

Table 3. Water and air temperature (degrees Centigrade) for tributaries to Lake Superior sampled during spawning-phase lamprey trapping in 2016.

Tributary	<u>Water Temperature</u>				
	N*	average	S.D.	min	max
Michigan Tributaries					
Misery	22	13.9	2.7	9	18
Silver	20	13.9	3.4	8	21
Wisconsin Tributaries					
Bad	27	14.7	3.3	9	22
Middle	34	13.9	3.2	8	22
	<u>Air Temperature</u>				
	N*	average	S.D.	min	max
Michigan Tributaries					
Misery	23	17.3	5.2	6	26
Silver	19	16.7	4.8	8	24
Wisconsin Tributaries					
Bad	27	16.2	4.8	7	24
Middle	34	14.7	5.2	6	25

*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 four tributaries to Lake Superior monitored during 1986-2016.

Year	Wisconsin Tributaries			Michigan Tributaries			Grand Total
	Bad	Middle	Subtotal	Misery	Silver	Subtotal	
1986	184	315	499		0	0	499
1987	439	16	455		4	4	459
1988	972	11	983	261	0	261	1,244
1989	684	249	933	265	6	271	1,204
1990	465	1	466	164	26	190	656
1991	121	4	125	336	29	365	490
1992	236	12	248	907	36	943	1,191
1993	84	46	130	4,871	0	4,871	5,001
1994	114	11	125	455	6	461	586
1995	280	24	304	197	20	217	521
1996	316	42	358	672	6	678	1,036
1997	272	47	319	1,131	42	1,173	1,492
1998	471	408	879	406	42	448	1,327
1999	646	2,235	2,881	1,753	59	1,812	4,693
2000	293	8,481	8,774	1,238	243	1,481	10,255
2001	563	2,633	3,196	1,100	6	1,106	4,302
2002	1,050	3,026	4,076	695	7	702	4,778
2003	1,446	41	1,487	39	24	63	1,550
2004	831	29	860	155	14	169	1,029
2005	1,124	620	1,744	33	12	45	1,789
2006	1,638	2,212	3,850	946	47	993	4,843
2007	2,042	387	2,429	617	348	965	3,394
2008	2,154	4	2,158	70	63	133	2,291
2009	1,249	9	1,258	145	100	245	1,503
2010	983	704	1,687	64	31	95	1,782
2011	257	744	1,001	144	5	149	1,150
2012	741	363	1,104	20	32	52	1,156
2013	293	722	1,015	33	30	63	1,078
2014	660	58	718	113	122	235	953
2015	56	1	57	49	17	66	123
2016	134	671	805	9	24	33	838

Table 5. Number of fish by species, fish taxa, and other taxa captured during spawning-phase sea lamprey trapping in four Lake Superior tributaries in 2016.

	Wisconsin Tributaries			Michigan Tributaries			Grand Total
	Bad	Middle	Total	Misery	Silver	Total	
<i>Fish Species</i>							
Sea Lamprey adult	134	671	805	9	24	33	838
Silver Lamprey adult		1	1			0	1
Black Bullhead		492	492	1		1	493
Bluegill		22	22			0	22
Brook Trout			0	17	8	25	25
Brown Bullhead		271	271			0	271
Brown Trout		24	24	1		1	25
Burbot		41	41	23		23	64
Central Mudminnow	10	3	13	6		6	19
Coho Salmon			0	1		1	1
Common Shiner			0	11	1	12	12
Creek Chub	18		18	127	5	132	150
Hornyhead Chub	3		3			0	3
Longnose Dace			0	34	11	45	45
Longnose Sucker	1		1		77	77	78
Mottled Sculpin			0	11		11	11
Rainbow Trout	1	28	29	475	11	486	515
River Chub			0	19		19	19
Rock Bass	5	1	6	51	15	66	72
Round Whitefish			0		1	1	1
Smallmouth Bass	1		1			0	1
Trout-perch	31		31	9		9	40
White Sucker	1	60	61	189	228	417	478
Yellow Bullhead		15	15	1		1	16
<i>Fish taxa</i>							
Bullhead			0	21	1	22	22
Chub (Cyprinidae)	23	239	262			0	262
Chubs (Coregonus)		18	18			0	18
Dace	3		3	72		72	75
Sculpin		3	3	5		5	8
Shiner	12	525	537			0	537
Stickleback	2		2			0	2
Sucker	2	1,499	1,501			0	1,501
<i>Other taxa</i>							
Crayfishes	9	104	113	4	11	15	128
Frogs, species not noted		2	2	1		1	3
Predaceous Diving Beetles		1	1			0	1
Snapping Turtle	2		2			0	2
Tadpoles (Frogs and Toads)		5	5			0	5
Toads and Frogs			0	1		1	1

Table 6. Calculated mean length (mm), weight (grams), and standard deviation (S.D.) for male and female spawning-phase lamprey captured during 2016.

River	Sex	Length (mm)			Weight (grams)		
		Number	Mean	S.D.	Number	Average	S.D.
Middle	Female	85	408	37	85	193	50
	Male	35	400	62	35	186	58
	All	120	406	46	120	191	52
Bad	Female	16	421	34	16	170	42
	Male	5	409	12	5	156	14
	All	21	418	30	21	167	37
Misery	Female	1	443	n/a	1	179	n/a
	Male	1	456	n/a	1	240	n/a
	All	2	450	9	2	210	43
Silver	Female	0	n/a	n/a	0	n/a	n/a
	Male	2	383	3	2	148	22
	All	2	383	3	2	148	22
All Rivers	Female	115	414	37	115	190	47
	Male	43	401	57	43	182	54
	All	145	408	44	145	187	50

Table 7. Population estimates (PE) and method of estimation for spawning-phase lamprey from four monitored tributaries to Lake Superior during 1986-2016.

Year	Bad		Middle		Misery		Silver	
	PE	Method	PE	Method	PE	Method	PE	Method
1986	6,026	S	1,080	S	-		-	
1987	4,654	S	20	S	-		-	
1988	7,762	S	21	S	610	S	-	
1989	9,818	S	1,328	S	1,124	S	-	
1990	3,138	S	-		800	S	56	S
1991	3,806	SM	-		737	SM	61	SM
1992	2,651	SM	172	SM	1,771	SM	110	SM
1993	2,428	SM	184	SM	8,859	SM	-	
1994	2,135	SM	-		748	TE	-	
1995	2,048	SM	82	SM	413	TE	-	
1996	8,513	SM	31	SM	951	TE	-	
1997	4,700	SM	186	SM	2,881	TE	170	SM
1998	4,064	SM	1,081	SM	1,073	TE	157	SM
1999	12,552	SM	13,515	SM	2,339	SM	651	SM
2000	2,767	SM	6,900	SM	1,764	SM	937	SM
2001	8,679	SM	2,327	SM	1,975	SM	-	
2002	13,678	SM	3,327	SM	602	SM	-	
2003	8,297	SM	41	SM	39	SM	-	
2004	8,555	SM	28	SM	431	SM	-	
2005	12,383	SM	1,049	SM	-		-	
2006	18,912	SM	3,017	SM	855	SM	182	SM
2007	15,531	SM	434	SM	572	SM	1,724	SM
2008	12,922	SM	-		156	SM	276	SM
2009	4,754	SM	-		156	SM	370	SM
2010	7,905	SM	2,024	SM	141	SM	98	SM
2011	2,514	TE	1,177	SM	281	SM	-	
2012	17,080	SM	1,683	SM	-		-	
2013	4,131	SM	6,984	SM	59	SM	78	SM
2014	10,886	SM	320	SM	175	SM	227	SM
2015	570	P	-		59	P	-	
2016	2,607	P	6,835	P	20	P	18	P

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