



**Trapping Activities and Population Estimates of
Sea Lamprey in Tributaries of Lake Superior
During 2017**

by
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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 2017 work included adult spawning-phase (4 rivers) trapping lampreys. Results of the 2017 trapping season are reported.

The four rivers sampled in spring 2017 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 2017 a total of 1,264 adult spawning-phase sea lampreys were captured in these four tributaries. The majority of spawning-phase sea lampreys captured came from the Bad River (743). Adjusted Petersen estimates of adult spawning-phase lamprey abundance calculated for each tributary in 2017 were 9,343 in the Middle River, 8,052 in the Bad River and 108 in the Misery River. A population estimate could not be calculated in the Silver River due to insufficient recaptures.

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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 2017 trapping season for the four tributaries monitored cooperatively by GLIFWC, KB-NRD, USFWS-SLC, and BR-NRD.

In 2017 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 2017.

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 1,264 adult spawning-phase sea lampreys were captured in the four sampled tributaries. Catches were highest in the Bad River (743) followed by the Middle River (493), Misery River (26) and Silver River (2) (Table 4).

Other than sea lamprey, 21 fish species, six fish taxa, and three other taxa were captured during the 2017 spawning-phase trapping (Table 5). Crayfishes (N=791) were captured most often followed by White Sucker (*Catostomus commersonii*) (N=560) and Creek Chub (*Semotilus atromaculatus*, N=211), primarily from the Middle River. Other commonly captured fish were the Rainbow Trout (*Oncorhynchus mykiss*, N=208) and Longnose Dace (*Rhinichthys cataractae*, N=114), primarily from the Misery River.

Length and Weight

For spawning-phase sea lampreys mean length was 455 mm for male lampreys, while the mean length of female lamprey was 428 mm (Table 6). These lengths were within the range of lengths observed during the period from 1988 to 2016 (Figure 2). The mean weight of male lamprey was 202 grams, while the mean weight of female lamprey was 184 grams (Table 6). These weights were within the range of weights observed during the period from 1988 to 2016 (Figure 3).

Population Estimates

Adjusted Petersen estimates of adult spawning-phase lamprey abundance calculated for each tributary in 2017 (Table 7). Abundance estimates were 9,343 in the Middle River, 8,052 in the Bad River and 108 in the Misery River. A population estimate could not be calculated in the Silver River due to insufficient recaptures. The Bad River estimate was within the range of population estimates given for the river since trapping began in 1986 (range: 2,048-18,912), while the Middle River estimate was the second highest recorded (range: 20-13,515). The estimate in the Misery River was the fourth lowest since 1986 (Table 7).

REFERENCES CITED

- Mattes, W.P. 2018. Trapping activities and population estimates of adult sea lamprey in tributaries of Lake Superior during 2016. Biological Services Division Administrative Report 18-17. 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.

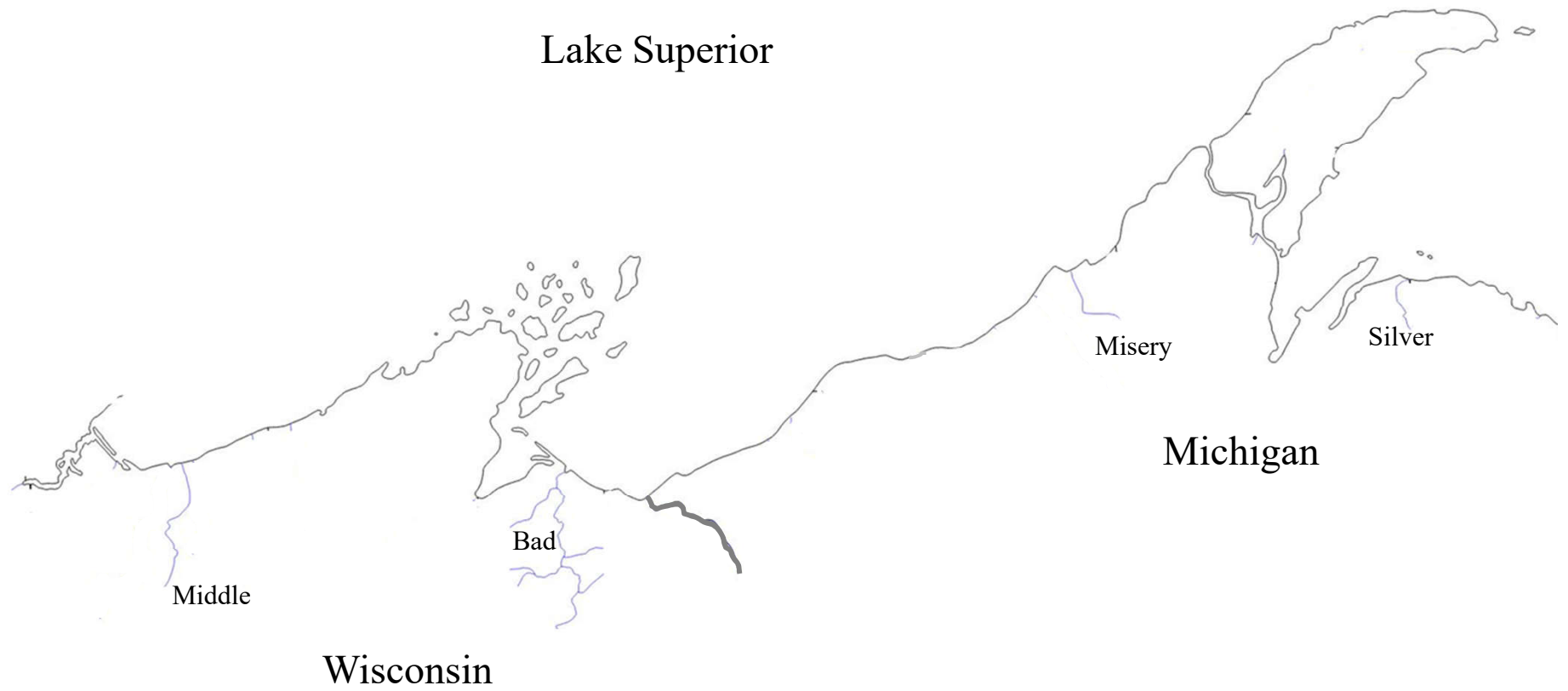


Figure 1. Location of rivers in which sea lampreys were trapped in 2017.

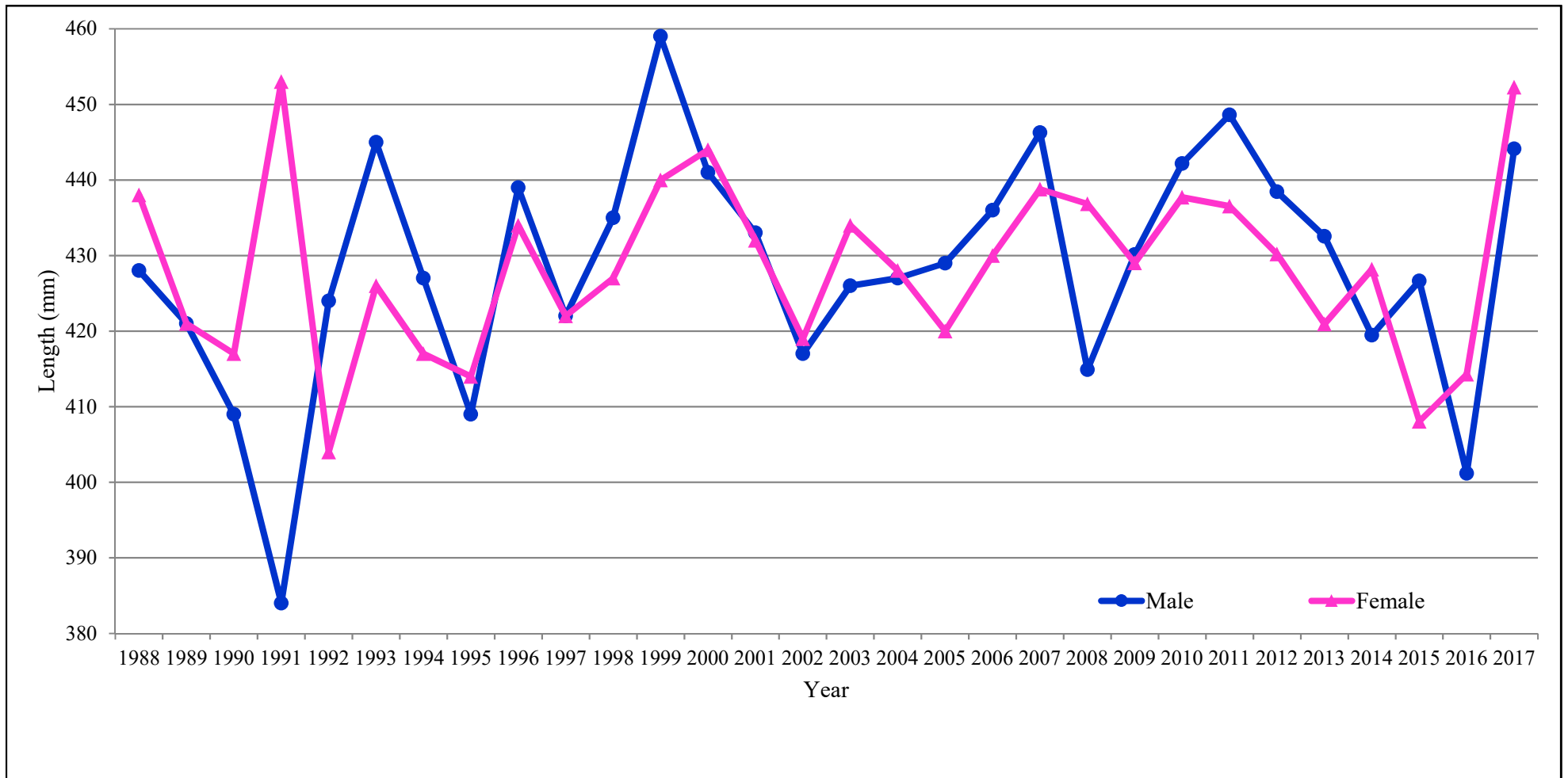


Figure 2. Mean length (mm) for male and female spawning-phase lamprey from rivers trapped during 1988-2017.

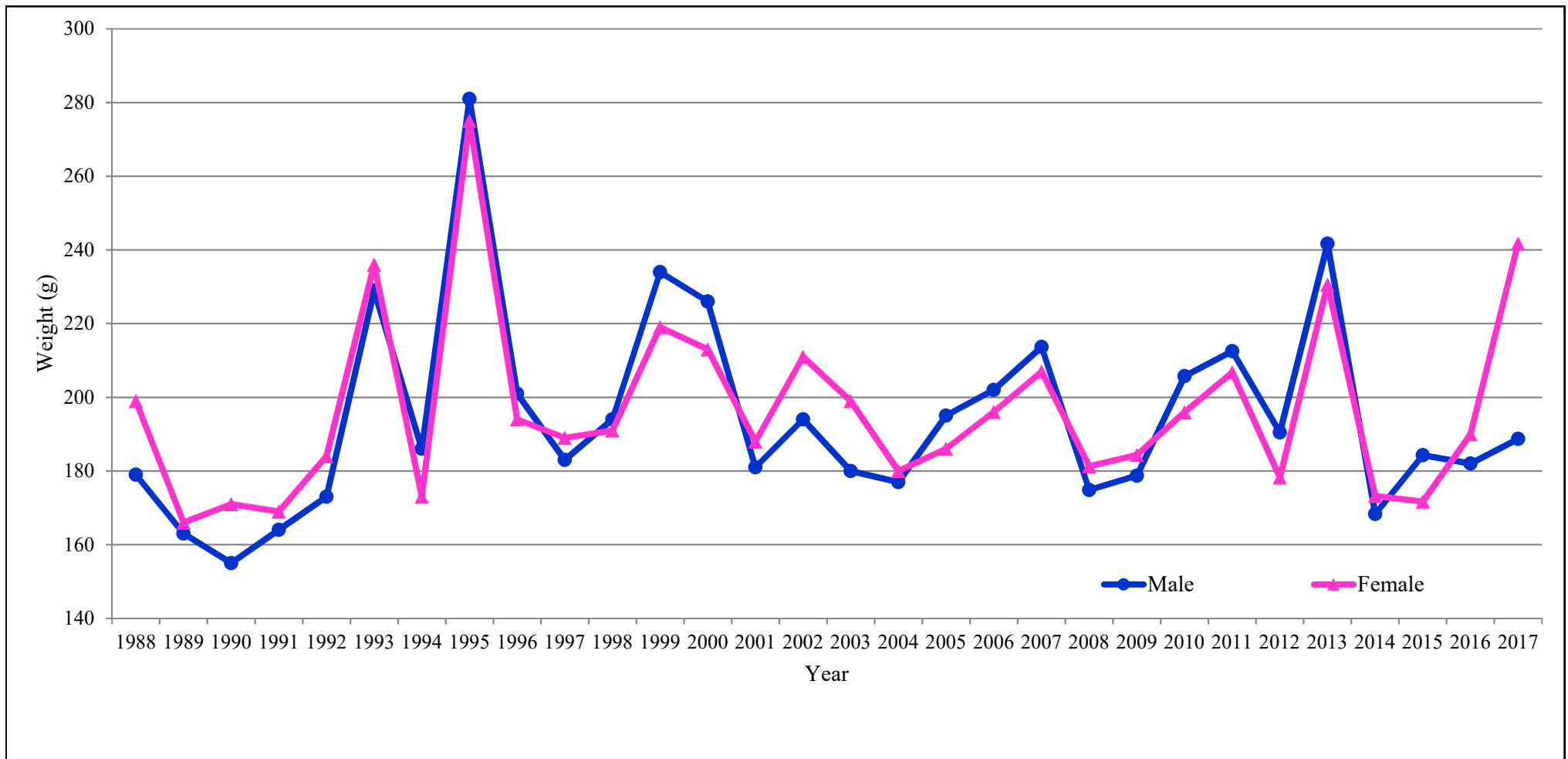


Figure 3. Mean weight (grams) for male and female spawning-phase lamprey from rivers trapped during 1988-2017.

Table 1. Information on location and gear used during spawning-phase sea lamprey trapping conducted on Lake Superior tributaries during 2017.

| 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 2017.

| Week of trapping | Dates in 2016 | Mark (anterior, posterior) | Week of trapping | Dates in 2016 | Mark (anterior, posterior) |
|------------------|-----------------------|----------------------------|------------------|-----------------------|----------------------------|
| 1 | 4/16/2017 - 4/22/2017 | (2,3) | 7 | 5/28/2017 - 6/3/2017 | (1,0) |
| 2 | 4/23/2017 - 4/29/2017 | (3,2) | 8 | 6/4/2017 - 6/10/2017 | (1,1) |
| 3 | 4/30/2017 - 5/6/2017 | (0,3) | 9 | 6/11/2017 - 6/17/2017 | (0,2) |
| 4 | 5/7/2017 - 5/13/2017 | (2,2) | 10 | 6/18/2017 - 6/24/2017 | (1,2) |
| 5 | 5/14/2017 - 5/20/2017 | (2,0) | 11 | 6/25/2017 - 7/1/2017 | (2,1) |
| 6 | 5/21/2017 - 5/27/2017 | (0,1) | 12 | 7/2/2017 - 7/8/2017 | (3,0) |

Table 3. Water and air temperature (degrees Centigrade) for tributaries to Lake Superior sampled during spawning-phase lamprey trapping in 2017.

| Tributary | <u>Water Temperature</u> | | | | |
|-----------------------|--------------------------|---------|------|-----|-----|
| | N* | average | S.D. | min | max |
| Michigan Tributaries | | | | | |
| Misery | 101 | 13.7 | 2.8 | 9 | 18 |
| Silver | 17 | 12.0 | 0.9 | 10 | 13 |
| Wisconsin Tributaries | | | | | |
| Bad | 27 | 14.7 | 3.3 | 9 | 22 |
| Middle | 161 | 15.2 | 3.3 | 4 | 20 |
| | <u>Air Temperature</u> | | | | |
| | N* | average | S.D. | min | max |
| Michigan Tributaries | | | | | |
| Misery | 101 | 21.8 | 3.6 | 15 | 28 |
| Silver | 17 | 15.2 | 1.9 | 13 | 19 |
| Wisconsin Tributaries | | | | | |
| Bad | 27 | 16.2 | 4.8 | 7 | 24 |
| Middle | 161 | 17.1 | 4.8 | 0 | 28 |

*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 1986-2017.

| 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 |
| 2017 | 3,603 | 2,368 | 5,971 | 258 | 9 | 267 | 6,238 |

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 2017.

| | Wisconsin Tributaries | | | Michigan Tributaries | | | Grand Total |
|------------------------|-----------------------|--------|-------|----------------------|--------|-------|-------------|
| | Bad | Middle | Total | Misery | Silver | Total | |
| <i>Fish Species</i> | | | | | | | |
| Sea Lamprey adult | 743 | 493 | 1,236 | 26 | 2 | 28 | 1,264 |
| Brook Trout | | 1 | 1 | 23 | 8 | 31 | 32 |
| Brown Trout | | 1 | 1 | | 2 | 2 | 3 |
| Burbot | 2 | 45 | 47 | 18 | | 18 | 65 |
| Central Mudminnow | | | 0 | 2 | | 2 | 2 |
| Common Shiner | | 88 | 88 | 1 | | 1 | 89 |
| Creek Chub | | 142 | 142 | 66 | 3 | 69 | 211 |
| Eastern Blacknose Dace | | | 0 | 27 | | 27 | 27 |
| Longnose Dace | 3 | 37 | 40 | 73 | 1 | 74 | 114 |
| Longnose Sucker | 1 | | 1 | | 7 | 7 | 8 |
| Mottled Sculpin | | | 0 | 7 | | 7 | 7 |
| Northern Pike | | 2 | 2 | | | 0 | 2 |
| Pumpkinseed | 1 | 1 | 2 | | | 0 | 2 |
| Rainbow Trout | | 5 | 5 | 200 | 3 | 203 | 208 |
| Redear Sunfish | | 21 | 21 | | | 0 | 21 |
| River Chub | | | 0 | 4 | | 4 | 4 |
| Rock Bass | 1 | 4 | 5 | 3 | | 3 | 8 |
| Ruffe | | | 0 | 2 | | 2 | 2 |
| Smallmouth Bass | 2 | | 2 | | | 0 | 2 |
| Stonecat | | 28 | 28 | | | 0 | 28 |
| Walleye | 1 | | 1 | | | 0 | 1 |
| White Sucker | 1 | 272 | 273 | 159 | 128 | 287 | 560 |
| <i>Fish taxa</i> | | | | | | | |
| Bullhead | | 40 | 40 | 2 | | 2 | 42 |
| Chub (Cyprinidae) | 12 | | 12 | | | 0 | 12 |
| Dace | | | 0 | 12 | | 12 | 12 |
| Salmon | | | 0 | 5 | | 5 | 5 |
| Sculpin | | 2 | 2 | | | 0 | 2 |
| Sucker | | | 0 | 1 | | 1 | 1 |
| <i>Other taxa</i> | | | | | | | |
| Crayfish | | 280 | 280 | | | 0 | 280 |
| Frogs | | 510 | 510 | 1 | 1 | 2 | 512 |
| Snakes | 1 | | 1 | | | 0 | 1 |

Table 6. Calculated mean length (mm), weight (grams), and standard deviation (S.D.) for male and female spawning-phase lamprey captured during 2017.

| River | Sex | Length (mm) | | | Weight (grams) | | |
|------------|--------|-------------|------|------|----------------|---------|------|
| | | Number | Mean | S.D. | Number | Average | S.D. |
| Middle | Female | 0 | 0 | n/a | 0 | 0 | n/a |
| | Male | 0 | 0 | n/a | 0 | 0 | n/a |
| | All | 0 | 0 | n/a | 0 | 0 | n/a |
| Bad | Female | 86 | 427 | 48 | 86 | 184 | 64 |
| | Male | 59 | 453 | 45 | 59 | 200 | 57 |
| | All | 145 | 438 | 48 | 145 | 190 | 62 |
| Misery | Female | 1 | 447 | n/a | 1 | 238 | n/a |
| | Male | 1 | 590 | n/a | 1 | 309 | n/a |
| | All | 2 | 519 | n/a | 2 | 274 | 50 |
| Silver | Female | 0 | 0 | n/a | 0 | 0 | n/a |
| | Male | 0 | 0 | n/a | 0 | 0 | n/a |
| | All | 0 | 0 | n/a | 0 | 0 | n/a |
| All Rivers | Female | 87 | 428 | 48 | 87 | 184 | 64 |
| | Male | 60 | 455 | 48 | 60 | 202 | 58 |
| | All | 147 | 439 | 50 | 147 | 192 | 62 |

Table 7. Population estimates (PE) and method of estimation for spawning-phase lamprey from four monitored tributaries to Lake Superior during 1986-2017.

| 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 |
| 2017 | 8,052 | P | 9,343 | P | 108 | P | - | |

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