



**Trapping Activities and Population Estimates of
Adult Sea Lamprey in Tributaries of Lake Superior
During 2006**

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Administrative Report 07-03
March 2007

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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 2006 trapping season are reported.

The six rivers sampled in 2006 were the Amnicon, Middle, and Bad rivers in Wisconsin, and the Silver, Firesteel, and Misery rivers in Michigan. In 2006 5,553 lamprey were captured, of which 2,212 were taken from the Middle river, 1,638 from the Bad river, 946 from the Misery river, and 707 from the Amnicon river. For these six rivers, the catch in 2006 was above the eighteen-year average of 2,615 from 1988 to 2005.

Schaefer estimates of adult spawner abundance were calculated for 5 of the 6 tributaries in 2006. Spawner abundance estimates were 182 in the Silver, 855 in the Misery, 3,017 in the Middle, 7,437 in the Amnicon river, and 18,912 in the Bad river.

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ACKNOWLEDGMENTS

I wish to thank Michael Plucinski (Great Lakes Technician), Jason Meacham and Kimberly Kocinski (Northland College Interns) for conducting the trapping operations in Wisconsin. I wish to thank Fisheries Aide Mike McMullens 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; Mike Twohey and Jessica Doemel in supplying equipment, personnel, and funding; Mary Henson in calculating population estimates for spawning phase sea lamprey; and Robert Kohl for providing data. 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 (e.g. Mattes 2006, Mattes 2005). 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, and (4) to reduce the spawning potential of sea lamprey by removing a portion of the run.

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 2006 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, Miscry, and Silver rivers in Michigan. The Poplar river was trapped in 2003 and 2004 but was dropped from sampling in 2005.

METHODS

Capture Gear and Sites

Three 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 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 2000-2006 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 three tributaries (Amnicon, 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, five days per week in the Bad and Misery rivers, and seven days per week in the Middle and Amnicon 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). Lamprey not marked and released were destroyed, except in the Bad and Middle rivers where male lamprey 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 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. 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

In 2006, 5,553 lamprey were captured in the six tributaries where trapping occurred which was above the eighteen-year average (1988-2005) of 2,615 for these six tributaries (Table 4). The majority of lamprey captured came from the Middle river (2,212) followed by the Bad river (1,638). Since 1988, annual catch for the six tributaries has ranged between 566 (1995) and 10,908 (2000), with total annual catch being largely driven by catch in the Middle, Misery, and Bad rivers.

Other than sea lamprey, 28 fish species, 9 fish genera, and 9 other taxa were captured during 2006 (Table 5). White suckers (*Catostomus catostomus*) were captured most often (N=1,477). Fair numbers of crayfish (N=605) and creek chub (*Semotilus atromaculatus*) (N=393) were captured primarily from the Middle river. Other fish commonly captured were bullhead (*Ictalurus sp.*), hornyhead chub (*Nocomis biguttatus*) and longnose dace (*Rhinichthys cataractae*).

Biological Characteristics

The mean length of male lamprey was 436 mm, while the mean length of female lamprey was 430 mm (Table 6). These lengths were within the range of lengths observed during the twenty year period from 1986 to 2006 (Figure 2).

The mean weight of male lamprey was 202 grams, while the mean weight of female lamprey was 196 grams (Table 6). These weights were within the range of weights observed during the previous twenty 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-Schacfer estimates of adult spawner abundance were calculated for 5 of the 6 tributaries in 2006 (Table 7). Spawner abundance estimates were 182 in the Silver, 855 in the Misery, 3,017 in the Middle, 7,437 in the Amnicon river, and 18,912 in the Bad river. The population estimates for the Bad and the Amnicon rivers are the highest ever recorded for the rivers. Also, the population estimates for the Bad river for the past ten years have been higher (1997 to 2006 average: 9,459) than they were in the previous ten years (1987 to 1996 average: 4,695) (Table 8).

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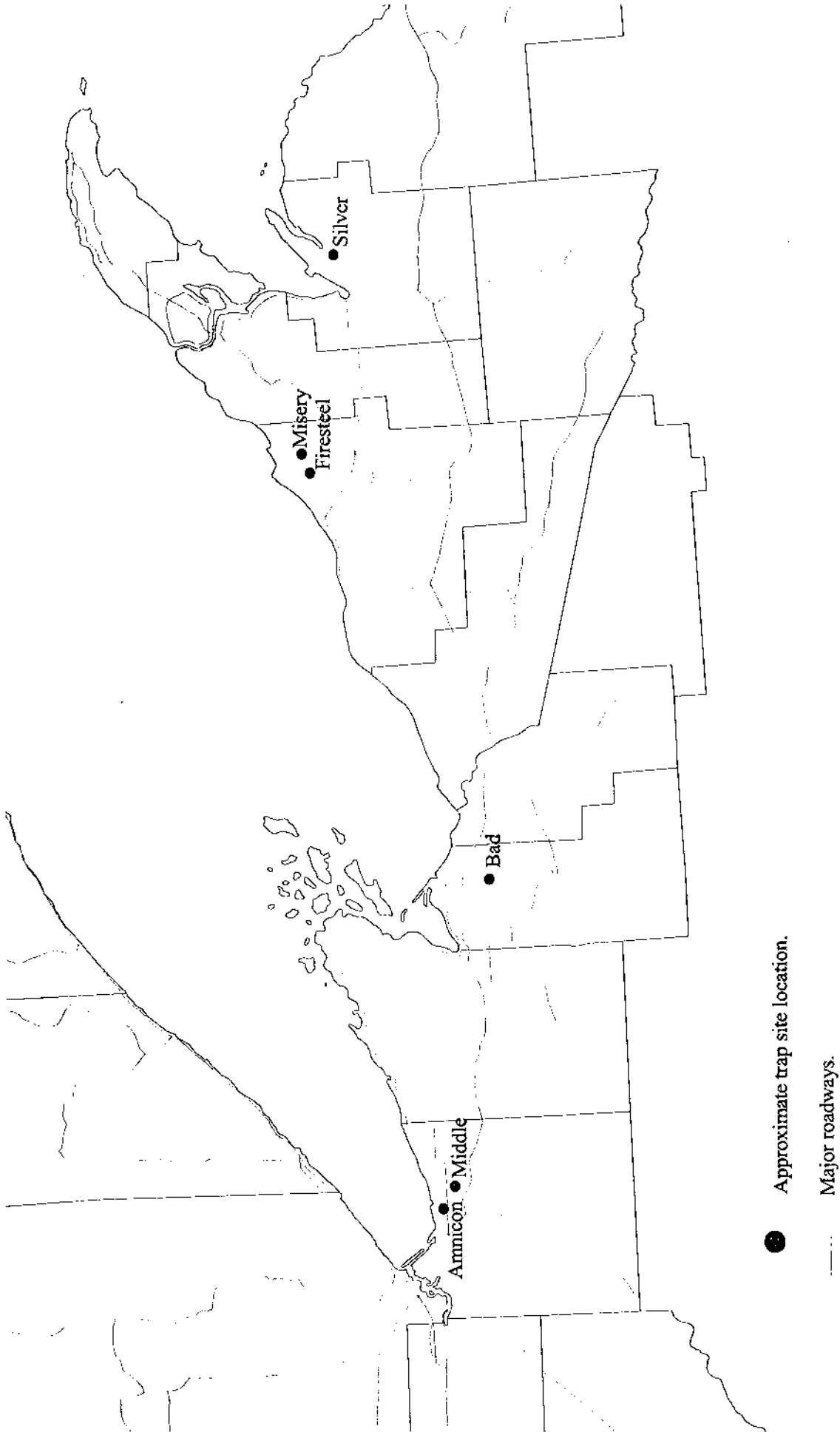


Figure 1. Location of rivers in which spawning-phase lamprey were trapped in 2006.

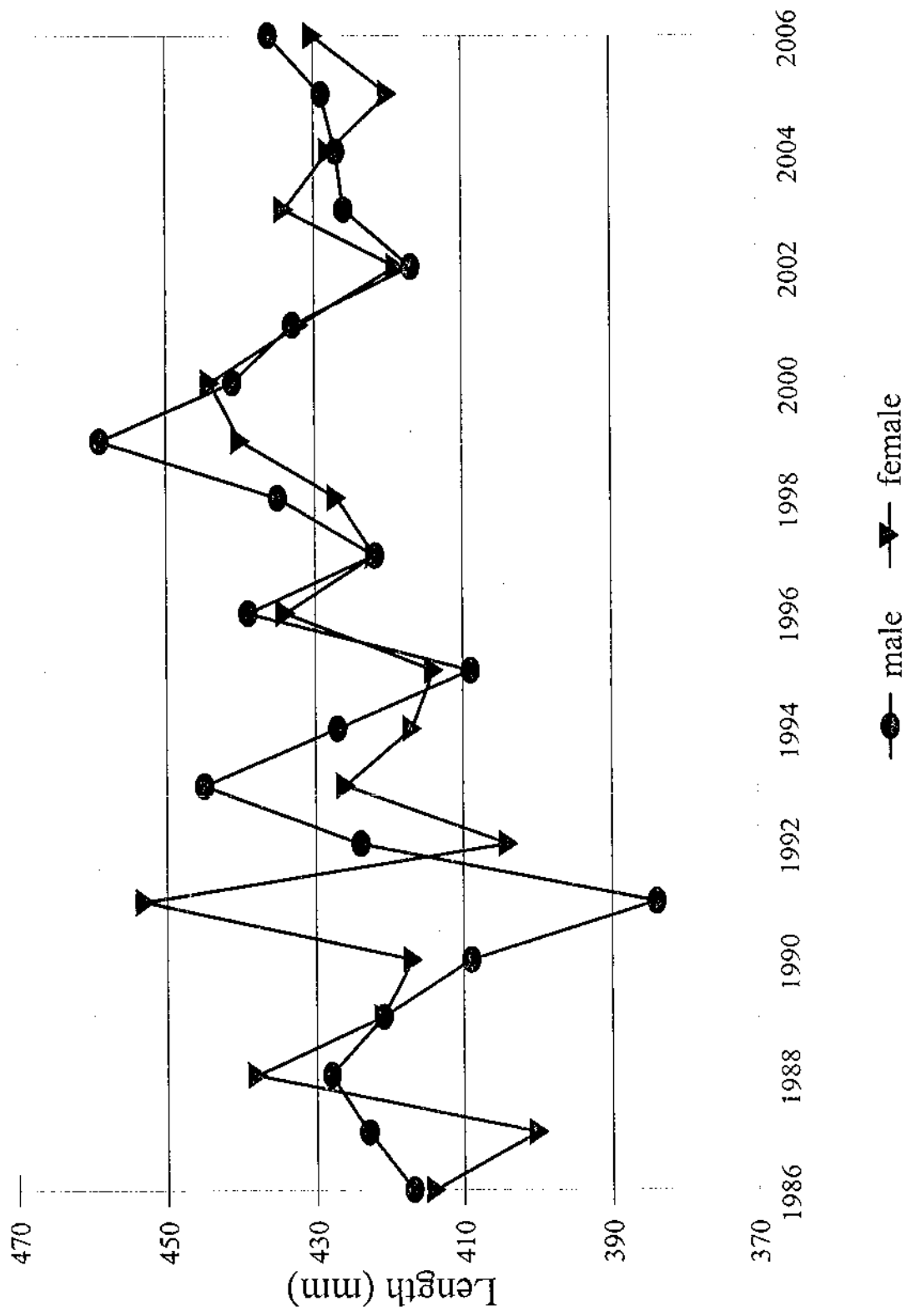


Figure 2. Mean length (mm) for male and female lamprey from rivers trapped during 1986-2006.

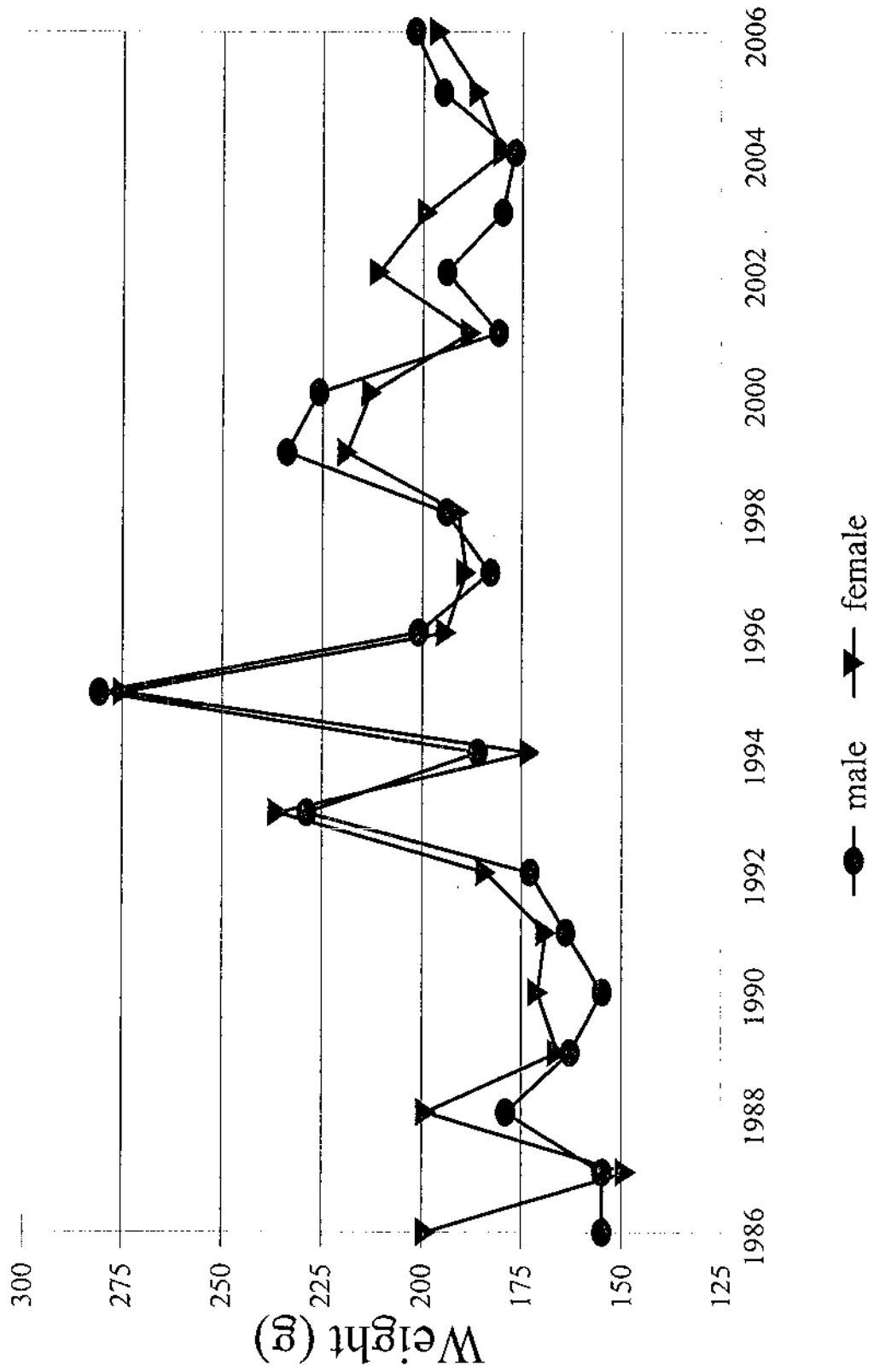


Figure 3. Mean weight (grams) for male and female lamprey from rivers trapped during 1986-2006.

Table 1. Information on location of lamprey trapping conducted on Lake Superior tributaries during 2006.

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)	11 km (7 miles)	0.1 km downstream from net
Middle	WI/Douglas	T48N, R12W, Sec 13, NE 1/4	4 traps	5 km (3 miles)	5 km (3 miles)	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 2006.

Week of trapping	Dates in 2005	Mark (anterior, posterior)	Week of trapping	Dates in 2005	Mark (anterior, posterior)
1	4/16-4/22	3,3	7	5/28-6/3	2,0
2	4/23-4/29	2,3	8	6/4-6/10	1,1
3	4/30-5/6	3,1	9	6/11-6/17	0,2
4	5/7-5/13	3,0	10	6/18-6/24	1,2
5	5/14-5/20	2,2	11	6/25-7/1	0,3
6	5/21-5/27	2,1	12	7/2-7/8	3,2

Table 3. Water and air temperature (degrees Centigrade) for six tributaries to Lake Superior during lamprey trapping in 2006.

Tributary	Code	N*	Water Temperature 2005		
			average	S.D.	min max
Michigan Tributaries					
Firesteel	289	20	21.2	4.2	12 26
Misery	284	23	14.5	5.3	2 22
Silver	190	17	16.2	2.2	13 21
Wisconsin Tributaries					
Amnicon	705	37	13.1	4.4	7 22
Bad	611	30	13.7	4.4	5 24
Middle	703	38	13.4	4.3	7 22
			Air Temperature 2005.0		
		N*	average	S.D.	min max
Michigan Tributaries					
Firesteel	289	21	21.3	4.0	13 30
Misery	284	28	20.8	5.8	8 29
Silver	190	16	18.9	5.3	10 28
Wisconsin Tributaries					
Amnicon	705	37	15.3	6.1	6 32
Bad	611	30	14.3	6.2	4 27
Middle	703	38	17.4	7.0	2 31

*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 1986-2006.

Tributary	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
Wisconsin Tributaries																					
<i>Primary</i>																					
Amnicon	61	14	3	118	67	101	7	39	24	40	83	83	79	278	132	31	59	137	178	707	
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
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
<i>Secondary</i>																					
Arrowhead	1																				
Black				3	8																
Nemadji				0	1																
Poplar	0																	27	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
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
Michigan Tributaries																					
<i>Primary</i>																					
Firesteel	17	40	44	86	43	74	24	21	0	37	79	35	375	7	97	8	94	27	3		
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		
Silver	0	4	0	6	26	29	36	0	6	20	6	42	42	59	243	6	7	24	14	12	47
<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												3									
Ontonagon				56	18								0	9	13						
Otter	0	0																			
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
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
Total-6 primary	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		
Grand total	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
Average catch-6 primary :	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	2,734	2,654	2,572	2,615	2,615	2,615	2,615	2,615

Table 5. Number of fish species, fish genera, and other taxa captured during trapping in six Lake Superior tributaries in 2006.

<i>Fish Species</i>	Wisconsin Tributaries			Michigan Tributaries				Grand Total	
	Bad	Annicon	Middle	Total-WI	Firesteel	Misery	Silver		Total-MI
Sca Lamprey adult	1,638	707	2,212	4,557	3	946	47	996	5,553
Silver Lamprey adult			15	15		9		9	24
Chestnut Lamprey adult				0		1		1	1
Banded Darter			1	1				0	1
Black Bullhead		1		1				0	1
Brook Trout			4	4		4	17	21	25
Brown Trout			11	11			1	1	12
Burbot	1		23	24				0	24
Coho Salmon				0		17		17	17
Creek Chub	28	9	355	392			1	1	393
Golden Shiner				0			2	2	2
Hornyhead Chub		14	188	202				0	202
Johnny Darter	1			1				0	1
Longnose Dace	6		143	149				0	149
Mottled Sculpin			2	2				0	2
Mudpuppy				0		36		36	36
Northern Pike		1	1	2				0	2
Pumpkinseed	2			2				0	2
Rainbow Trout	1		37	38	12	92	4	108	146
Rock Bass	12	21		33	41		27	68	101
Ruffe		2		2		7		7	9
Slender Madtom			1	1				0	1
Smallmouth Bass	1			1			1	1	2
Tadpole Madtom			2	2				0	2
Trout-perch	1	1	29	31				0	31
Walleye	1			1				0	1
White Sucker	2	23	1,431	1,456	11	10		21	1,477
Yellow Perch		1	1	2				0	2
<i>Fish Genera</i>									
Bullhead, sp.	2	2	356	360	1			1	361
Chub (Cyprinidae), sp.				0		22	3	25	25
Chub (Coregonus), sp.				0	28	21		49	49
Dace, sp.	21	5	25	51				0	51
Darter, sp.			1	1				0	1
Ichthyomyzon ammocete, sp.				0		8		8	8
Redhorse sucker, sp.	2	2		4		16		16	20
Sculpin sp.				0		2		2	2
Sucker, sp.	5			5	42	76		118	123
Shiner, sp.	11		105	116	2	11		13	129
<i>Other taxa</i>									
Fish, family not noted				0	1	2		3	3
Snapping Turtle	1			1				0	1
Caddisflies			1	1				0	1
Crayfish		5	481	486	3	22	94	119	605
Frogs, species not noted	2		4	6				0	6
Giant Water Bugs		1	15	16				0	16
Mink				0			1	1	1
Northern Leopard Frog			2	2				0	2
Predaceous Diving Beetles			2	2				0	2

Table 6. Calculated mean length (mm), weight (grams), and standard deviation (S.D.) for male and female lamprey captured during 2006.

River	River Code	Sex	Count	Length			Weight		
				Number	Average	S.D.	Number	Average	S.D.
Misery	284	Female	133	133	409	40	133	172	49
		Male	146	146	420	41	145	175	52
		All	279	279	415	41	278	174	51
Bad	611	Female	130	130	439	44	130	191	51
		Male	50	50	452	37	50	207	46
		All	180	180	443	42	180	195	50
Middle	703	Female	155	155	440	32	155	218	45
		Male	174	174	441	36	174	218	51
		All	329	329	441	34	329	218	48
Amnicon	705	Female	6	6	479	74	6	283	37
		Male	15	15	488	47	15	252	46
		All	21	21	486	54	21	261	45
Silver	190	All	4	4	429	29	0	0	0
Firesteel	289	All	1	1	356	--	1	85	--
All Rivers		Female	426	426	430	42	424	196	53
		Male	388	388	436	42	385	202	55
		All	814	814	433	42	809	199	54

Table 7. Population estimates for spawning phase sea lamprey in GLIFWC monitored streams tributary to Lake Superior during 2006.

Tributary	2006 Population Estimates
	Schaefer Method Mark/Recapture
Wisconsin Tributaries	
Bad	18,912
Middle	3,017
Amnicon	7,437
Michigan Tributaries	
Firesteel	N/A
Misery	855
Silver	182

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 1986-2006.

River	Year																				
	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
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
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
Middle	1,080 S	20 S	21 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
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
Firesteel				220 P	462 S	265 SM	113 SM	256 SM				76 SM	274 SM	84 SM	1,036 SM		212 SM		31 SM		
Silver					56 S	61 SM	110 SM					170 SM	157 SM	651 SM	937 SM						182 SM

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