Trapping Activities and Population Estimates of Adult Sea Lamprey in Tributaries of Lake Superior During 2003 and 2004

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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 2003 and 2004 trapping seasons are reported.

The seven rivers sampled in both 2003 and 2004 were the Amnicon, Middle, Poplar and Bad rivers in Wisconsin, and the Silver, Firesteel, and Misery rivers in Michigan. In 2003 and 2004, 1,644 and 1,260 lamprey, respectively were captured. These catches were below the fifteen-year average of 2,748 from 1988 to 2002.

Schaefer estimates of adult spawner abundance were calculated for 5 of the 7 tributaries in 2003 and 2004. In 2003, spawner abundance estimates ranged from 41 in the Middle river to 8,297 in the Bad river and in 2004 they ranged from 28 in the Middle to 8,555 in the Bad river.

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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 a series of administrative reports of GLIFWC's Biological Services Division. 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. This report presents results of the 2003 and 2004 trapping seasons.

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 (Mattes 2003). In 2001 and 2002, six streams were trapped; the Amnicon, Middle, and Bad rivers in Wisconsin and the Firesteel, Misery, and Silver rivers in Michigan. These same streams were trapped in 2003 and 2004 with the addition of the Poplar river, which is a small stream.

METHODS

Rivers and Trapping 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 possessed 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. Traps were placed below barriers where they occurred and in the lower portion of rivers in which no barriers existed.

Location and type of traps used within tributaries depended on the suitability of the site for trapping (Table 1). The man-made barriers on the Middle and Misery rivers allowed portable steel cage traps to be abutted against the barriers. On the Bad river portable steel cage traps were placed directly below and against a natural rock shelf which transects the rivers. The Amnicon, Poplar, Firesteel, and Silver rivers were trapped using fyke nets.

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, Poplar, and Amnicon rivers. Live lamprey were transported downstream (Table 1), and a sub-sample was marked by clipping one or both dorsal fins then released back into the river (Table 2). 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 within the year (Table 3). Lamprey not marked and released were destroyed, except in the Misery and Middle rivers where male lamprey were placed in holding cages in the rivers and later transported for use in the sterile male release program. Water and air temperature were recorded at the time traps or nets were emptied (Table 4).

The number of live and dead marked and unmarked lamprey captured each sampling day was counted, along with the number of other fish species in the traps or nets. Lamprey or a sub-sample of lamprey were measured to the nearest millimeter, weighed to the nearest gram, and sex determined each day in all rivers. The fin clip combination on recaptured lamprey was also recorded.

Population Estimates

Mark-recapture population estimates were attempted based on the tagging procedure described above. When sample size was sufficient population estimates were calculated using the modified Schaefer method (Ricker 1975, 3.18). 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 extractions of lean lake trout.

RESULTS AND DISCUSSION

Trap Catches

In 2003 and 2004, 1,644 and 1,260 lamprey, respectively were captured. These catches were below the fifteen-year average of 2,748 from 1988 to 2002 (Table 4). The majority of lamprey captured came from the Bad river where 1,446 lamprey were captured in 2003 and 831 were captured in 2004.

Average trap catch in 2003 and 2004 in the Middle river (35) was similar to the average from 1986 to 1997 (65), and well below the average catch of 3,357 during the previous five years (1998 to 2002). Starting in 2000 and continuing through 2004, four traps were set in the Middle river in an increased effort to capture male lamprey for the sterile male release technique program (SMRT). Previously, only two traps had been set in the Middle river.

Other than sea lamprey, 19 fish species, 9 fish genera, and 4 other taxa were captured during 2003 while 19 fish species, 12 fish genera, and 8 other taxa were caught during 2004 (Tables 5 and 6). Suckers (*Catostomus sp.*) were captured most often (N=1,169 in 2003 and N=2,386 in 2004). Fair numbers of brook trout (*Salvelinus fontinalius*) (N=382 in 2003 and N=134) and rainbow trout (*Oncorhynchus mykiss*) (N=51 in 2003 and N=506 in 2004) were captured primarily from the Misery river. Other fish commonly captured in the traps or nets were shiners and minnows (*Cyprinidae sp.*) including species such as the creek chub (*Semotilus atromaculatus*) and longnose dace (*Rhinichthys cataractae*).

Biological Characteristics

The average lengths of male lamprey were 426 mm and 427 mm in 2003 and 2004, respectively, while the respective mean lengths of female lamprey were 434 mm and 428 mm (Table 7). These lengths were within the range of lengths observed during the previous seventeen year period from 1986 to 2002 (Figure 2). Sex ratio was not calculated in 2003 and 2004 because sex information was not collected in an unbiased manner. For instance, in the Bad and Misery rivers the number of male and female lamprey to be sampled for length, weight, and sex each day was set at ten.

The mean weights of male lamprey were 181 g and 194 g in 2003 and 2004, respectively, while female lamprey were 188 g and 211 g (Table 7). These weights were within the range of weights observed during the previous seventeen years. Mean weight of male and female lamprey has been similar within years but has varied considerably between years (Figure 3).

Population Estimates

Schaefer estimates of adult spawner abundance were calculated for 5 of the 7 tributaries in 2003 and 2004 (Table 8). In 2003, spawner abundance estimates ranged from 39 in the Misery river to 8,297 in the Bad river and in 2004 they ranged from 28 in the Middle to 8,555 in the Bad river. The population estimates for the Middle river in 2003 (41) and 2004 (28) were below the 1986 to 1997 average (345) and well below those during the five year period from 1998-2002 (average: 5,430) (Table 9).

REFERENCES CITED

Mattes, W.P. Trapping activities and population estimates of adult sea lamprey in tributaries of Lake Superior. Biological Services Division Administrative Reports: 95-2, 97-3, 98-2, 99-2, 03-11, 03-13.

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.

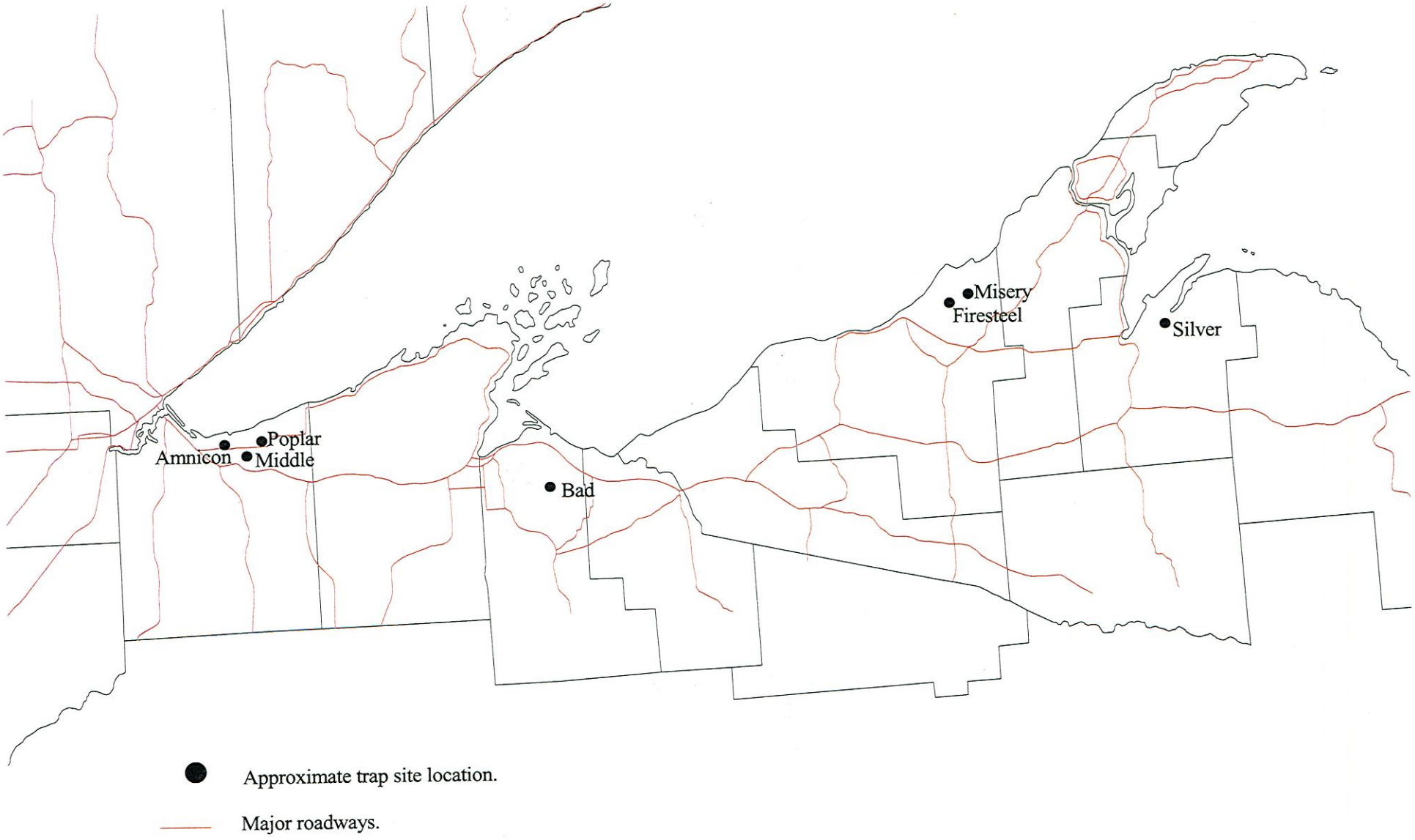

Figure 1. Location of tributaries in which spawning-phase lamprey were trapped in 2003 and 2004.

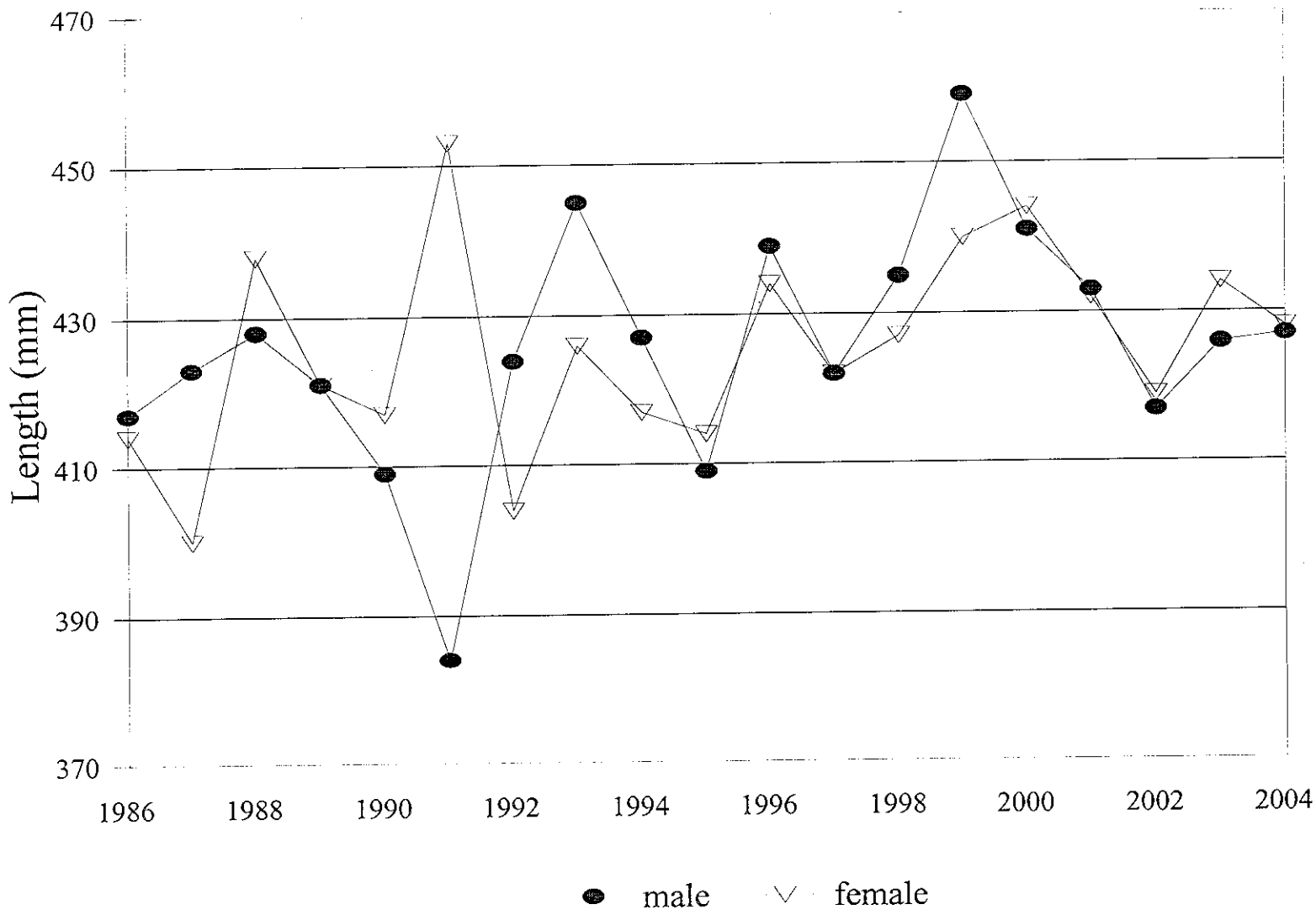

Figure 2. Mean length (mm) for male and female lamprey from rivers trapped during 1986-2004.

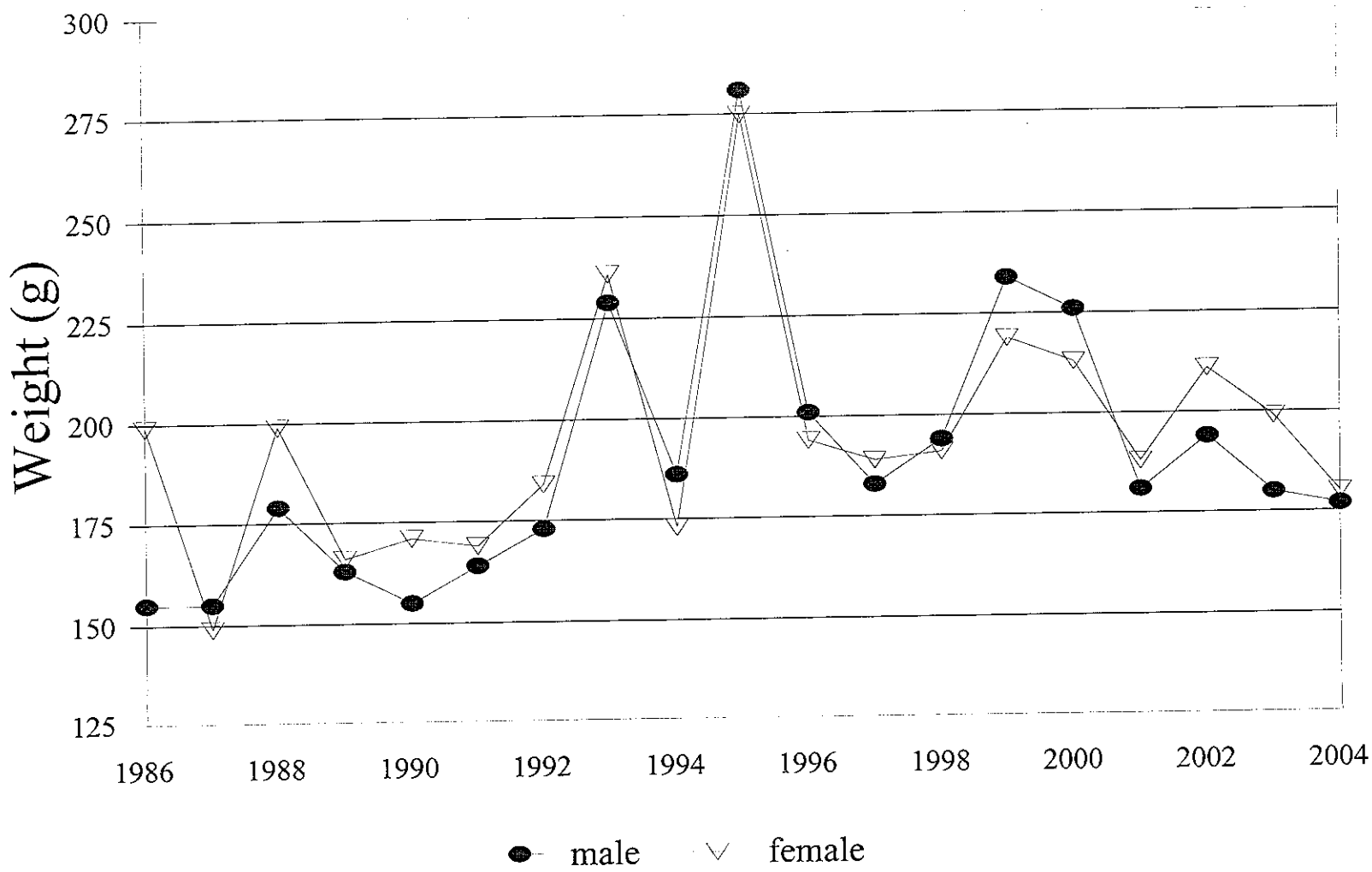

Figure 3. Mean weight (grams) for male and female lamprey from rivers trapped during 1986-2004.

Table 1. Information on location of lamprey trapping conducted on Lake Superior tributaries during 2003 and 2004.

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	2-4 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
Poplar	WI/Douglas	T47N, R11w, Sec 6, SC	1-fyke net	5 km (3 miles)	no barrier	1.5 km below HWY 13 bridge
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.A Type and combination of marks used on adult lamprey by week for Wisconsin and Michigan rivers trapped during 2003.

Week of trapping	Dates in 2003	Mark (anterior, posterior)	Week of trapping	Dates in 2003	Mark (anterior, posterior)
1	4/27-5/03	0,1	6	6/01-6/07	0,3
2	5/04-5/10	2,0	7	6/08-6/14	2,1
3	5/11-5/17	2,2	8	6/15-6/21	1,4
4	5/18-5/24	1,1	9	6/22-6/28	3,2
5	5/25-5/31	1,2			

Table 2.B Type and combination of marks used on adult lamprey by week for Wisconsin and Michigan rivers trapped during 2004.

Week of trapping	Dates in 2004	Mark (anterior, posterior)	Week of trapping	Dates in 2004	Mark (anterior, posterior)
1	5/02-5/08	3,1	6	6/06-6/12	1,1
2	5/09-5/15	3,0	7	6/13-6/19	0,2
3	5/16-5/22	2'2	8	6/20-6/26	1,2
4	5/23-5/29	2,1	9	6/27-7/03	0,3
5	5/30-6/05	2,0	10	7/04-7/10	3,2

Table 3. Water and air temperature (degrees Centigrade) for seven tributaries to Lake Superior in 2003 and 2004.

		Water Temperature 2003					Water Temperature 2004				
Tributary	Code	N*	average	S.D.	min	max	N*	average	S.D.	min	max
Michigan Tributaries											
Firesteel	289	16	19.6	3.3	14	27	30	18.2	3.9	8	25
Misery	284	24	15.8	2.7	11	21	48	15.3	2.9	9	20
Silver	190	17	15.3	3.3	9	22	34	16.2	3.3	10	23
Wisconsin Tributaries											
Amnicon	705	44	15.5	3.9	6	24	39	13.4	4.0	8	26
Bad	611	29	16.4	4.3	9	25	40	15.0	4.4	7	22
Middle	703	46	14.8	4.0	6	25	48	13.8	3.2	7	21
Poplar	701	37	16.1	3.0	11	23	41	13.3	3.3	8	22
			Air Temperature 2003					Air Temperature 2004			
		N*	average	S.D.	min	max	N*	average	S.D.	min	max
Michigan Tributaries											
Firesteel	289	17	20.8	3.8	10	25	30	18.9	5.3	9	30
Misery	284	24	19.8	2.9	13	24	49	18.5	6.1	5	29
Silver	190	16	20.3	5.7	12	34	35	20.1	6.3	8	33
Wisconsin Tributaries											
Amnicon	705	44	18.1	4.3	10	26	39	15.9	6.5	7	33
Bad	611	26	17.5	6.5	8	34	40	13.6	5.7	4	28
Middle	703	46	19.2	5.2	9	34	47	18.3	5.6	6	30
Poplar	701	38	18.9	4.2	8	26	41	17.0	5.8	6	32

*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 1986-2004.

Tributary	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
						Wisconsin Tributaries													
Primary																			
Amnicon		61	14	3	118	67	101	7	39	24	40	83	83	79	278	132	31	59	137
Bad	184	439	972	684	465	121	236	84	114	280	316	272	471	646	293	563	1,050	1,446	831
Middle	315	16	11	249	1	4	12	46	11	24	42	47	408	2,235	8,481	2,633	3,026	41	29
Secondary																			
Arrowhead	1																		
Black					3	8													
Nemadji					0	1												27	0
Poplar	0																		
Raspberry						0													
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
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
						Michigan Tributaries													
Primary																			
Firesteel			17	40	44	86	43	74	24	21	0	37	79	35	375	7	97	8	94
Huron		1	51	6	9	14	41	54	2	35	2	18							
Misery			261	265	164	336	907	4,871	455	197	672	1,131	406	1,753	1,238	1,100	695	39	155
Silver	0	4	0	6	26	29	36	0	6	20	6	42	42	59	243	6	7	24	14
Secondary																			
Traverse			10	10	31	33	11	4	0	0	1								
Falls												3							
Ontonagon					56	18							0	9	13				
Otter				0	0														
Subtotal- 4 primary	0	5	329	317	243	465	1,027	4,999	487	273	680	1,228	527	1,847	1,856	1,113	799	71	263
Total-MI	0	5	339	327	274	498	1,038	5,003	487	273	681	1,228	527	1,847	1,856	1,113	799	71	263
Primary total			1,326	1,253	827	657	1,376	5,136	651	601	1,078	1,630	1,489	4,807	10,908	4,441	4,906	1,617	1,260
Grand total	**500**	**521**	**1,336**	**1,263**	**875**	**714**	**1,387**	**5,140**	**651**	**601**	**1,079**	**1,630**	**1,489**	**4,807**	**10,908**	**4,441**	**4,906**	**1,644**	**1,260**
Average catch after 1988:				**1,300**	**1,158**	**1,047**	**1,115**	**1,786**	**1,624**	**1,496**	**1,450**	**1,468**	**1,470**	**1,748**	**2,452**	**2,594**	**2,748**	**2,679**	**2,596**

Table 5. Number of fish and other taxa captured during trapping on seven Lake Superior tributaries in 2003.

	Wisconsin Tributaries					Michigan Tributaries				Grand
	Bad	Amnicon	Middle	Poplar	*Total-WI*	Firesteel	Misery	Silver	*Total-MI*	Total
Fish Species										
Sea lamprey	1,446	59	41	27	1,573	8	39	24	71	1,644
American brook lamprey			2		2				0	2
Brook trout			4		4	69	303	6	378	382
Brown trout			1		1	4		2	6	7
Burbot	1		25		26		14		14	40
Coho salmon					0	2			2	2
Creek chub	20	36	176	9	241	18	64		82	323
Creek chubsucker					0		67		67	67
Hornyhead chub		24	16	1	41				0	41
Log perch			1		1				0	1
Longnose dace			5		5				0	5
Mottled sculpin			1		1				0	1
Pumpkinseed		2	51		53				0	53
Rainbow trout			3		3		41	7	48	51
Redhorse sucker		5		2	7				0	7
Rock bass	7	39	1	1	48	1		4	5	53
Ruffe		1			1				0	1
Trout perch			19		19				0	19
Walleye	2	4			6				0	6
White sucker	4	3	731	1	739	3	3	361	367	1,106
Fish Genus										
Bullhead sp.	3	42	215	2	262			1	1	263
Cyprinidae		31	223	1	255				0	255
Dace sp.			19		19				0	19
Ichthyomyzon sp.			1		1				0	1
Perch sp.					0			13	13	13
Sculpin sp.			2		2				0	2
Shiner sp.		39	259	7	305				0	305
Sucker sp.					0		12	44	56	56
Trout sp.					0		32		32	32
Other taxa										
Crayfish		32	13		45	2		1	3	48
Ducks					0	13			13	13
Frogs			1		1		2		2	3
Turtle		5			5				0	5

Table 6. Number of fish and other taxa captured during trapping on seven Lake Superior tributaries in 2004.

	Wisconsin Tributaries					Michigan Tributaries				Grand
	Bad*	Amnicon	Middle	Poplar	*Total-WI*	Firesteel	Misery	Silver	*Total-MI*	Total
Fish Species										
Sea lamprey	831	137	29		997	94	155	14	263	1,260
American brook lamprey			2		2				0	2
Bluegill			1		1				0	1
Brook trout		1	21		22	19	63	30	112	134
Brown trout			2		2				0	2
Burbot			49		49	2	4		6	55
Central Mudminnow			1		1				0	1
Creek chub		4	141	20	165	29	41		70	235
Hornyhead chub			32	3	35				0	35
Longnose dace			304		304				0	304
Mottled sculpin				1	1				0	1
Mudpuppy					0	2	6		8	8
Northern Pike			1		1				0	1
Pumpkinseed			15		15	10	2	16	28	43
Rainbow trout			7		7	17	476	6	499	506
Redhorse sucker			1		1		72	201	273	274
Rock bass		17			17	35	1	3	39	56
Ruffe		2	2		4		1		1	5
Trout perch		2	13		15				0	15
White sucker		8	252	433	693	58	1	35	94	787
Fish Genus										
Bullhead sp.		26	16		42	2	7		9	51
Cyprinidae			6		6	42	50	2	94	100
Dace sp.			6		6				0	6
Ichthyomyzon sp.			2		2				0	2
Perch sp.					0	2		1	3	3
Pike sp.			1		1				0	1
Sculpin sp.					0		15		15	15
Shiner sp.		5	360	1	366	54	45	7	106	472
Stickleback sp.					0		1		1	1
Sucker sp.					0	218	161	946	1,325	1,325
Sunfish sp.			14		14	7			7	21
Trout sp.					0		3		3	3
Other taxa										
Crayfish		7	33	1	41	2	19	6	27	68
Dragonflies					0	5			5	5
Ducks					0	13			13	13
Fish					0		1		1	1
Frogs and tadpoles			1		1		1		1	2
Giant Water Bugs			7		7				0	7
Water Beetles			3		3				0	3
Turtle					0			1	1	1

Table 7. Average length (mm), weight (grams), and standard deviation (S.D.) for male and female lamprey during 2003 (a) and 2004 (b).

a.

River	River Code	Sex	Count	Length			Weight		
				Number	Average	S.D.	Number	Average	S.D.
Silver	190	Female							
		Male	1	1	450	-	1	216	-
		All	1						
Misery	284	Female	2	2	439	9	2	154	31
		Male							
		All	2	2	439	39	2	154	31
Bad	611	Female	190	190	436	38	161	202	51
		Male	178	178	427	39	156	179	48
		All	368	368	431	39	317	190	51
Poplar	701	Female							
		Male	2	2	424	71	2	199	86
		All	2						
Middle	703	Female	10	10	412	31	8	165	44
		Male	6	6	415	44	5	173	26
		All	16	16	413	35	13	168	37
Amnicon	705	Female							
		Male	2	2	450	14	2	201	4
		All	2						
All Rivers		Female	202	202	434	38	171	199	51
		Male	187	189	426	39	166	180	48
		All	389	391	431	39	337	190	50

b.

River	River Code	Sex	Count	Length			Weight		
				Number	Average	S.D.	Number	Average	S.D.
Silver	190	Female							
		Male	1	1	381	-	1	111	-
		All	1						
Misery	284	Female	14	14	419	39	12	156	40
		Male	7	7	441	71	6	266	65
		All	21	21	426	51	18	193	72
Firesteel	289	Female	10	10	415	42	10	190	55
		Male	4	4	422	25	4	169	47
		All	14	14	417	37	14	184	52
Bad	611	Female	105	105	432	36	105	183	46
		Male	93	93	428	35	92	173	47
		All	198	198	430	36	197	179	47
Middle	703	Female	4	4	390	21	3	132	13
		Male	5	5	412	54	4	186	88
		All	9	9	402	42	7	163	69
Amnicon	705	Female							
		Male	1	1	388	-	1	104	-
		All	1						
All Rivers		Female	133	133	428	38	130	180	47
		Male	111	111	427	38	108	177	54
		All	244	244	428	38	238	179	50

Table 8. Population estimates for spawning phase sea lamprey in GLIFWC monitored streams tributary to Lake Superior during 2003 and 2004.

Tributary	2003 Population Estimates Schaefer Method Mark/Recapture	2004 Population Estimates Schaefer Method Mark/Recapture
Wisconsin Tributaries		
Bad	8,297	8,555
Poplar	55	N/A
Middle	41	28
Amnicon	138	2,120
Michigan Tributaries		
Firesteel	N/A	31
Misery	39	431
Silver	N/A	N/A

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 9. Population estimates for spawning lamprey from six GLIFWC monitored tributaries to Lake Superior from 1986-2004.

River	Year 1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
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	
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
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
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
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				

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