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cc: Educ.-Game  
Inst. for Fish. Res.  
J. W. Moffett  
N. S. Baldwin  
C. T. Yoder  
W. C. Wagner  
Marquette Fish. Res. Sta.

INSTITUTE FOR FISHERIES RESEARCH  
DIVISION OF FISHERIES  
MICHIGAN DEPARTMENT OF CONSERVATION  
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GERALD P. COOPER PH.D.  
DIRECTOR

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ADDRESS  
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DISTRIBUTION AND ABUNDANCE OF SEA LAMPREY AMMOCOETES  
IN TRIBUTARIES OF MICHIGAN'S INLAND WATERWAY, 1958

By

Wilbert C. Wagner

The Inland Waterway is a chain of large inland lakes (Black, Mullett, Burt, Crooked, Pickerel, and Round) and their connecting rivers, which extends across the northern tip of Michigan's Lower Peninsula, and is tributary to Lake Huron via the Cheboygan River. The drainage area of this system is approximately 1,600 square miles.

Burt and Mullett lakes, which have the principal drainages involved in this study, are temperate lakes of the second order with nearly identical surface areas of 26 square miles and maximum depths of 60 and 148 feet, respectively. Important species of game fish in the lakes are: walleye (Stizostedion vitreum vitreum), northern pike (Esox lucius), muskellunge (Esox masquinongy), yellow perch (Perca flavescens), and rock bass (Ambloplites rupestris). Among other fish present are: smallmouth bass (Micropterus dolomieu), largemouth bass (Micropterus salmoides), pumpkinseed (Lepomis gibbosus), white sucker (Catostomus commersoni), yellow bullhead (Ictalurus natalis), and brown bullhead (Ictalurus nebulosus). A small population of rainbow trout (Salmo gairdneri) is present in Burt Lake.

Crooked, Pickerel, and Round lakes are comparatively small lakes with surface areas of 1/2 to 3 1/2 square miles and maximum depths of 20 to 50

feet. Important species in their fish populations are northern pike, walleyes, and yellow perch. Black Lake and its tributaries are not included in this study because they are isolated from the rest of the Inland Waterway by the Alverno Dam which is considered to be an effective barrier to upstream migration of the sea lamprey (Petromyzon marinus).

Original (perhaps continuing) sea lamprey infestation of the Inland Waterway probably occurred from Lake Huron via the Cheboygan River. Although a hydroelectric dam (head, 14 feet) is operated on this stream three-quarters of a mile above the mouth, a boat lock bypassing the dam presumably allows the upstream passage of sea lampreys when its operation coincides with the spawning run.

The spread of sea lampreys in the Inland Waterway was well documented by Applegate (1950). The first indication of their presence was the report of a dead sea lamprey found in Laperell Creek (a tributary of the Cheboygan River near Mullett Lake) in 1938. Direct evidence of a resident population was noted as early as 1945 when a feeding adult sea lamprey was caught in Mullett Lake. Later reports of feeding adults in Mullett and Burt lakes suggest that the sea lamprey population is well established in these lakes. Fourteen sea lamprey ammocoetes (length range, 2.1 to 4.2 inches) were collected with a shovel and screen by I. A. Rodeheffer and J. K. Day in Laperell Creek on July 27, 1956.

Spawning runs were first reported in the Sturgeon River, a tributary of Burt Lake, in 1947, and in the Pigeon River, a tributary of Mullett Lake, in 1948. Although these spawning runs have continued (indicated by later reports), they do not represent proof of resident populations in Burt and Mullett lakes since the spawning migrants could have originated from Lake Huron. There have been no reports of feeding adults in Crooked, Pickerel, and Round lakes or of spawning runs in tributaries of these lakes.

The present study was undertaken on August 13-28, 1958, to determine the approximate distribution and abundance of ammocoetes<sup>1</sup> in streams tributary to the Inland Waterway, in order to obtain some notion of the potential size of the adult sea lamprey population in this chain of lakes.

#### Methods

The occurrence of sea lamprey ammocoetes is closely associated with the occurrence of ammocoetes of other species and with certain ecological factors (Stauffer and Hansen, 1958a). In a study of 60 Lake Superior tributaries, they found that sea lamprey ammocoetes did not occur in systems where other species of lampreys were absent. Further, ammocoetes were rarely found in cool, spring-fed streams where brook trout (Salvelinus fontinalis) and/or slimy sculpins (Cottus cognatus) were abundant. Generally, ammocoetes occurred only in the main stream of the larger streams (volumes over 10 cubic feet per second) where coarse gravel was available for spawning and suitable ammocoete habitat (soft bottom types) was present.

Stream systems which are accessible to adult sea lampreys and which appeared grossly suitable for the reproduction of sea lampreys were studied to determine the relative abundance of ammocoetes and their distribution. A two-man crew (Paul Pristas and Albert Gabrielson) spent 25 to 60 minutes collecting ammocoetes and fish at each station with a 220-volt, direct-current shocker. To collect ammocoetes, the positive electrodes were passed slowly over suitable ammocoete habitat. When stimulated by the electric current, the ammocoetes emerged from their burrows and were picked up with small scap nets. Ammocoetes were kept alive until preserved in

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<sup>1</sup>Unless specified otherwise, the term ammocoete refers to the larva of the sea lamprey.

10-percent formalin for later identification.<sup>2</sup> Identifications, based on characters described by Stauffer and Hansen (1958a), were made by the author and verified by Martin J. Hansen.

#### Distribution and abundance

The locations of the collection stations in the Inland Waterway are shown in Figure 1. Relative abundance of ammocoetes is based on the number of ammocoetes collected per hour (rare = 1-25 per hour; common = 26-99 per hour). The data collected at each station are summarized in Table 1. Distribution and abundance of ammocoetes and pertinent ecological data for individual stream systems are discussed in the text. Game fish populations are mentioned in the discussion of streams containing ammocoetes because of their possible future importance in the selection and application of larvicides.

1. Myers Creek.--No ammocoetes were found in this small stream at a station one mile above its junction with the Black River.

2. Laperell Creek.--Ammocoetes were rare at the two stations within two miles of the junction with the Cheboygan River but were not found at a station three miles above the junction. Brook trout were present at all stations in this stream.

It is believed that the ammocoetes in Laperell Creek resulted from the spawning of adult sea lampreys from Lake Huron, which passed through the boat locks at Cheboygan. Since there are no known instances of adult sea lampreys migrating downstream to spawn, it is unlikely that adults would migrate downstream from Burt and Mullett lakes to spawn in Laperell Creek.

<sup>2</sup>In addition to the sea lamprey, the silver lamprey (Ichthyomyzon unicuspis), Michigan brook lamprey (Ichthyomyzon fossor), chestnut lamprey (Ichthyomyzon castaneus), and American brook lamprey (Lampetra lamottei) are found in tributaries of Lake Huron (Hubbs and Lagler, 1947).

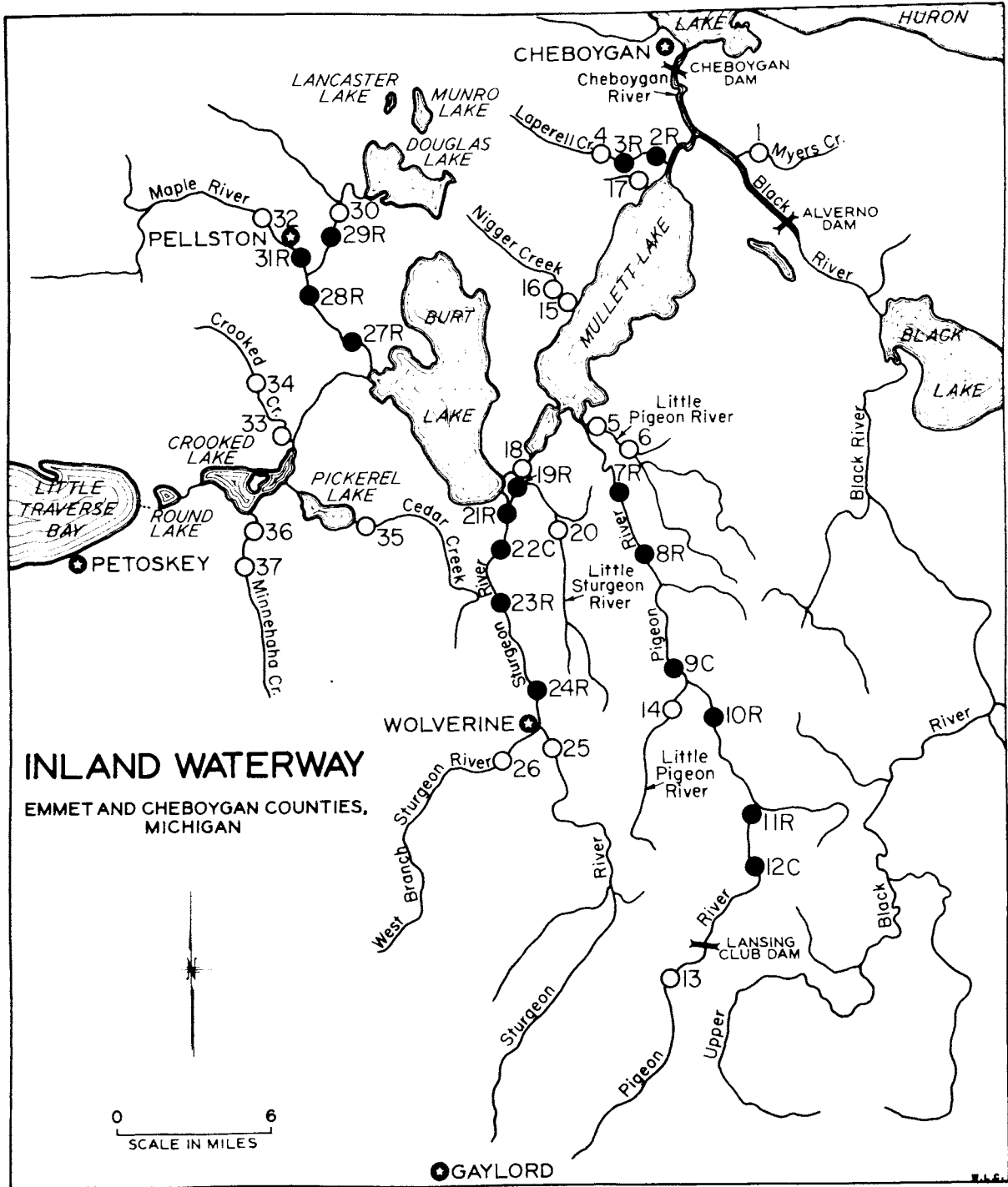


Figure 1.--Collection stations in the Inland Waterway, August 13-28, 1958. Solid circles are stations at which sea lamprey ammocoetes were collected; letters following station numbers indicate the abundance of ammocoetes (C = common; R = rare). Open circles are stations at which no sea lamprey larvae were taken.

Table 1.--Location of stations, collecting time, and number of sea lamprey ammocoetes collected in tributaries of the Inland Waterway, August 13-28, 1958

Stream system <sup>1</sup>	Station number <sup>2</sup>	Location				Collecting time (minutes)	Number of ammocoetes collected	Volume of stream (c.f.s.) <sup>3</sup>
1. Myers Creek	1	T37N	R1W	S22	50	..	1.5	
2. Laperell Creek	2	37	2	24	60	9	6	
	3	37	2	24	60	13	4	
	4	37	2	15	60	..	3	
	5	37	2	9	60	..	5	
3. Little Pigeon River	6	37	2	14	45	..	5	
	7	35	2	27	60	7	50	
4. Pigeon River	8	34	2	2	60	23	40	
	9	34	2	25	60	34	32	
	10	33	1	5	60	22	35	
	11	33	1	28	60	22	25	
	12	32	1	4	55	31	20	
	13	32	2	25	55	..	25	
	14	33	2	1	60	..	17	
5. Nigger Creek	15	36	2	16	50	..	0.5	
	16	36	2	8	60	..	0.5	
6. Unnamed tributary of Mullett Lake	17	37	2	24	60	..	1	
7. Indian River	18	35	3	24	60	..	300	
8. Little Sturgeon R.	19	35	3	24	30	1	5	
	20	35	2	32	45	..	7	
	21	35	3	25	60	14	200	
9. Sturgeon River	22	34	3	1	60	36	125	
	23	34	3	13	60	11	125	
	24	34	2	31	60	20	110	
	25	33	2	7	60	..	75	
	26	33	3	14	60	..	40	
	27	36	4	25	60	2	25	
10. Maple River	28	36	4	15	60	5	15	
	29	37	4	36	57	1	3	
	30	37	4	25	60	..	1.5	
	31	36	4	4	60	1	10	
	32	37	4	28	50	..	8	
11. Crooked Creek	33	35	4	10	25	..	1	
	34	36	4	32	35	..	3	
12. Cedar Creek	35	35	4	25	60	..	10	
13. Minnehaha Creek	36	35	4	29	60	..	10	
	37	34	4	8	60	..	15	

<sup>1</sup>Stream system number refers to the number arbitrarily assigned to each stream system in the text.

<sup>2</sup>Station number refers to the number arbitrarily assigned to each station in Figure 1.

<sup>3</sup>Estimated volume in cubic feet per second.

Although ammocoetes are present in this stream, it is doubtful whether they contribute to the adult population in Burt and Mullett lakes. Stauffer and Hansen (1958b) found that the migration of ammocoetes and recently transformed adults is predominantly downstream. Consequently, ammocoetes produced in Laperell Creek would be expected to contribute to the adult population in Lake Huron rather than to that in Burt and Mullett lakes.

3. Little Pigeon River.<sup>3</sup>--No ammocoetes were taken at two stations (one near the mouth and the other two miles upstream) on this stream. Low water temperatures (52° F. and 53° F. on August 27, 1958) indicate that this stream may be unsuitable (too cold) for sea lamprey production.

4. Pigeon River.--Ammocoetes were rare to common at six stations in the 30 miles of stream below the Lansing Club Dam, but none were collected at one station above it. The dam is considered to be a barrier to spawning sea lampreys but is of relatively little importance in limiting sea lamprey reproduction because it is located so far upstream. The Pigeon River probably produces the greatest number of sea lampreys entering the Inland Waterway, since ammocoetes were found in moderate numbers at six stations scattered along 30 miles of the main stream. Brook trout and brown trout (Salmo trutta) were present in small numbers in the upper portion of the area containing ammocoetes.

No ammocoetes were found in the Little Pigeon River<sup>4</sup> at the single station two miles above its junction with the Pigeon River.

5. Nigger Creek.--No ammocoetes were found at the two sampling stations on this small stream. It is doubtful that sea lampreys can spawn successfully because the entire stream bed is apparently covered by a deep deposit of silt.

6. Unnamed tributary of Mullett Lake.--No ammocoetes were found in this small tributary of Mullett Lake at the single station two-thirds of a mile above the mouth.

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<sup>3</sup>Tributary of Mullett Lake.

<sup>4</sup>Tributary of Pigeon River.

7. Indian River.--No ammocoetes were found in the single collection made on this large stream. The apparent lack of suitable spawning grounds and the presence of a warm-water fish population indicate poor conditions for sea lamprey reproduction.

8. Little Sturgeon River.--A single ammocoete was found near the junction of the Little Sturgeon River and the dredged canal connecting the Little Sturgeon River with the Sturgeon River. Because this station included a portion of both the Little Sturgeon River and the canal, it is not known where this ammocoete (identified after preservation) was taken. However, since spawning grounds (if any) in the canal were covered by a deep silt deposit and no ammocoetes of any species were collected from a station three miles upstream on the Little Sturgeon River, it seems probable that the ammocoete was collected in the canal and originated from the Sturgeon River.

9. Sturgeon River.--Ammocoetes were rare to common at the four stations on this river below Wolverine, but were not collected at two stations above Wolverine. The sampling indicated that ammocoetes were present in 15 miles of main stream, suggesting that this stream is a major contributor to the population of adult sea lampreys in the Inland Waterway. Rainbow trout were common and brown trout were abundant at all stations.

10. Maple River.--Ammocoetes were rare at two stations in the main stream and in two collections from the East and West branches below Pellston. No ammocoetes were found at two stations north of Pellston. With the exception of the West Branch, which has a warm-water fish population, the Maple River is a cold stream (temperatures ranged from 52° F. to 54° F. on August 22 and 25, 1958) containing large populations of brook trout and slimy sculpins. The small number of ammocoetes captured and the low



temperatures in portions of this stream indicate that it is of less importance than the Pigeon or Sturgeon rivers as a lamprey producer. Brook, brown, and rainbow trout were found in the Maple River and the East Branch.

11-13. Cedar, Crooked, and Minnehaha creeks.--Ammocoetes were absent at the five stations on these streams. The abundance of brook trout and slimy sculpins and/or low water temperatures indicate that these streams are unsuitable for sea lampreys. The possible occurrence of sea lamprey ammocoetes in Crooked Creek is further minimized by the absence of all species of ammocoetes.

#### Relative abundance and size of ammocoetes

The average catch of ammocoetes per hour at 16 stations<sup>5</sup> (4 stream systems) in the Inland Waterway was 13.5. This catch per hour was not significantly different from a catch of 21.4 per hour for 75 collections from 13 Upper Peninsula tributaries of Lake Michigan ( $t = 1.11$ ), or 11.5 for 90 collections from 21 Michigan tributaries of Lake Superior ( $t = 0.38$ ). The relatively large area (at least 50 miles of stream) inhabited by ammocoetes in the Inland Waterway and the apparent similarity of the population density to that in tributaries of Lakes Michigan and Superior suggest the possibility of a large adult population in Burt and Mullett lakes (unless the young migrate to Lake Huron and/or migrants from Lake Huron make up a large proportion of the spawning run).

The average length of 252 ammocoetes collected from tributaries of the Inland Waterway was 3.7 inches, nearly identical with the average length (3.9) of 2,058 individuals collected from Lake Michigan tributaries (1955, 1957-1958).

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<sup>5</sup>Only stations where ammocoetes were found are included in the calculations.

### Lamprey predation in Burt and Mullett lakes

In recent years anglers have reported that it is not unusual to take walleyes with a lamprey attached or bearing lamprey scars. Predation on walleyes may be of minor importance, however, since Fish Division records show that the scarring rate on walleyes taken in the Muskegon River (spawning migrants from Lake Michigan) remained at about two percent from 1954-1958 (Eschmeyer, 1959). In addition, general creel census data for 1940-1957 (on file at the Institute for Fisheries Research) do not show a progressive decrease in walleye fishing quality in Burt and Mullett lakes. Although these data do not provide a sensitive index (because of their variability and the relatively small number of fish involved), they suggest that the effect of lamprey predation on walleyes in the Inland Waterway has not been excessive.

Of 36 muskellunge caught in 1955 and 37 taken in 1956 during spawn-collecting operations in the Inland Waterway, a substantial (undetermined) percentage had lamprey scars; in the spring of 1957, nearly all muskellunge over two feet in length (about 80 percent of the 76 muskellunge caught) were scarred. Although the muskellunge fishing has held up rather consistently, the number of larger fish (30 to 40 pounds) taken by anglers and during netting operations seems to be decreasing.<sup>6/</sup>

In 1952, a scarred rainbow trout was taken in the mouth of the Sturgeon River, and in 1958 a rainbow trout with a sea lamprey (length about 12 inches) attached was observed near the mouth of the Sturgeon River. Information on lamprey predation on other species of fish is not available.

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<sup>6/</sup>Personal communication from District Fisheries Supervisor Jack R. Hammond. The larger number of muskellunge caught during the spawn-taking operations in 1957 was the result of greater fishing effort and improvement in technique, rather than to an increase in the population of muskellunge.

To summarize, the data are not adequate to determine precisely the effect of sea lamprey predation on game fish populations in the Inland Waterway. The large ammocoete population and high percentage of scarring on muskellunge suggest, however, that sea lamprey predation should be checked periodically, even though sea lampreys have long been established (at least since 1945) and may have reached their maximum numbers.

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INSTITUTE FOR FISHERIES RESEARCH

Wilbert C. Wagner

Report approved by G. P. Cooper

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