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SEA LAMPREY LARVAE IN LENTIC ENVIRONMENTS[1]

By

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[1] Investigation conducted under Dingell-Johnson Project F-18-R.

It has been assumed that sea lamprey larvae, Petromyzon marinus, inhabit only lotic environments (Applegate and Brynildson, 1952; Moffett, 1958; Anon., 1959). Consequently, sea lamprey control has been directed toward stream-dwelling ammocoetes. However, the accidental discovery of a single larval sea lamprey in Saginaw Bay (approximately 1 mile offshore) in 1956[2] cast considerable doubt on the assumption that larvae inhabit streams only. If ammocoetes are also common in lentic environments, their persistence in such areas could greatly hamper the sea lamprey control program.

To determine if larval populations commonly exist in lentic waters, surveys were conducted in June-September in certain portions of the Lake Superior (1960-1961), Lake Michigan (1957), and Lake Huron (1961) drainages (Figure 1). Because a heavy downstream migration of larvae had been noted in Carp Lake River, a tributary of Lake Michigan, it was assumed that lentic populations, if present, resulted from downstream drift of larvae hatched in streams. Most sampling was done in areas within 1 mile of the mouth of streams which produced sea lampreys. A 220-volt direct-current shocker was employed to sample along shore in water less than 3 feet deep, by methods described by Stauffer and Hansen (1958). The shocker, although useful for survey work, catches an unknown portion of the larvae actually present. A Peterson dredge (Welch, 1948) or an orange-peel dredge (Wagner and Stauffer, 1962) was used for sampling in the deeper water.

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[2] Personal communication from Stanford H. Smith, U. S. Bureau of Commercial Fisheries.

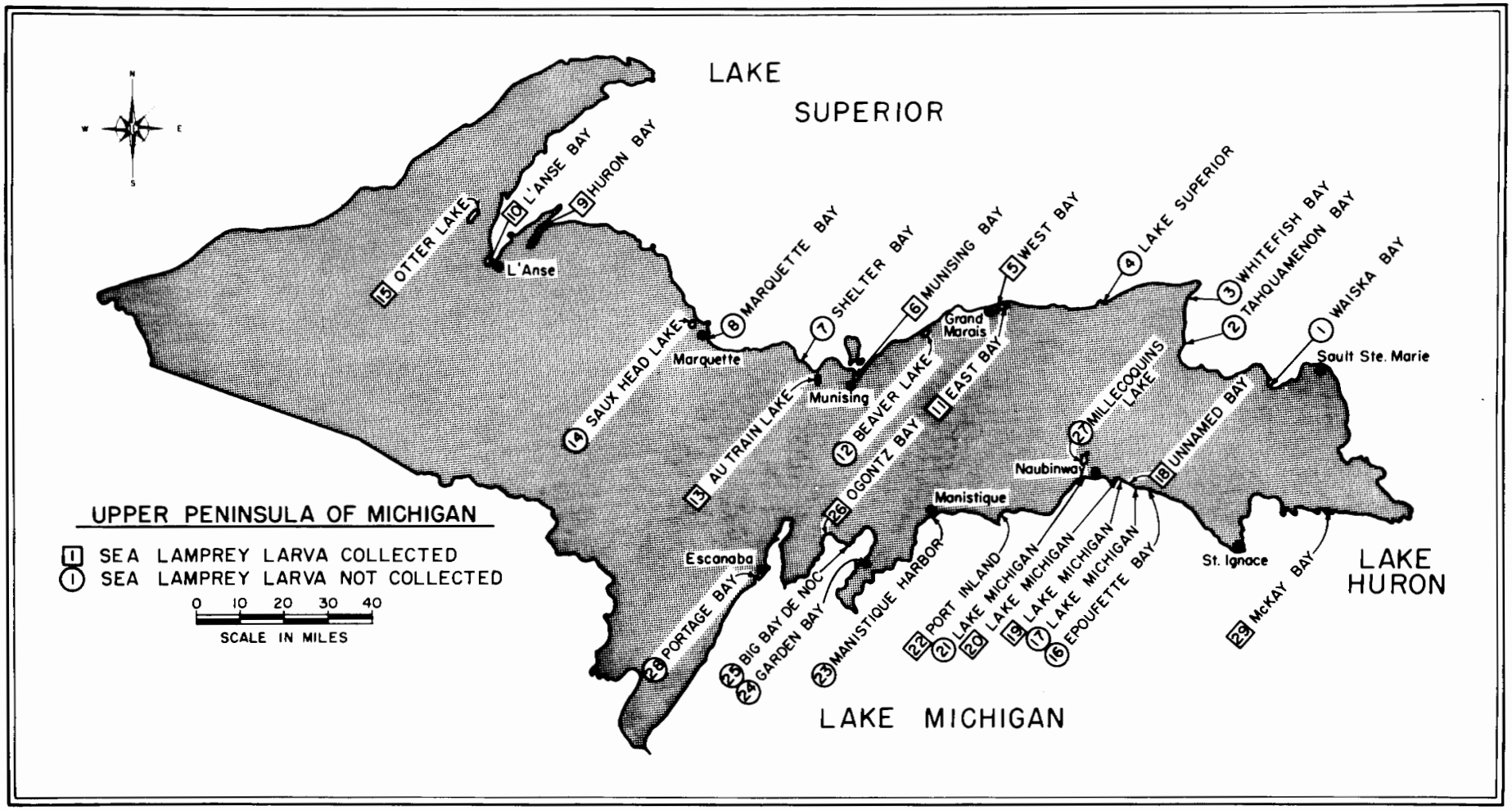

Figure 1.--Areas surveyed for sea lamprey larvae in lentic waters of the Upper Peninsula of Michigan.

Descriptive data for the collecting sites in lentic environments are summarized in Table 1. The occurrence of larvae is shown in Figure 1 and Table 1.

Lake Superior drainage

Shallow portions of study areas in Lake Superior proper were sampled by using the shocker along shore for a mile on each side of the stream mouth. Starting at each side of the mouth, a 10- by 1,000-foot area was shocked; then alternate 10- by 300-foot areas out to the 1-mile limit were sampled. In the deeper water at each study area, generally 50 orange-peel dredge lifts were taken at each of 20 stations. Five stations were spaced equally on each of four concentric arcs at distances of approximately 200, 660, 1,300, and 2,600 feet from the stream mouth. This pattern was modified when sea walls, boat landings, rocky bottom, and other obstacles were encountered.

In the 10 areas in Lake Superior that were studied, 8,225 dredge lifts (area sampled, 5,980 square feet) and 74 hours of collecting with the shocker (area sampled, about 25 acres) produced seven larvae (average length, 4.0 inches; range 3.1-4.6). The larvae were found in West Bay, Munising Bay, Huron Bay, and L'Anse Bay.

Sampling in inland lakes which drained into Lake Superior was most intensive near the mouths of tributary streams that contained larvae, but some sampling was done at other areas along shore. The electric shocker was used in all lakes, and in Otter and Beaver lakes both dredge and shocker

Table 1.--Areas studied, presumed source of larvae, sampling effort, and larvae collected

Study area[1]	Presumed source of larvae (abundance[2], [3] in parentheses)	Square feet dredged	Hours of electro-fishing	Number of larvae collected
Lake Superior				
1. Waiska Bay	Waiska River(C)	840	9	0
2. Tahquamenon Bay	Tahquamenon River(R)	760	11	0
3. Whitefish Bay	Betsy River(C)	760	7	0
4. Lake Superior	Two Hearted River(A)	730	6	0
5. West Bay	Sucker River(A)	---	4	2
6. Munising Bay	Anna River(R)	360	7	1
7. Shelter Bay	Rock River(A)	640	6	0
8. Marquette Bay	Chocolay River(A)	1,230	12	0
9. Huron Bay	Slate, Ravine, and Silver rivers(R)	---	9	3
10. L'Anse Bay	Falls River(R)	660	3	1
Inland lakes - tributary to Lake Superior				
11. East Bay	Sucker River(A)	---	6	82
12. Beaver Basin	Lowney Creek(R)	720	7	0
13. Au Train Lake	Buck Bay and Cole creeks(C)	---	7	29
14. Saux Head Lake	Garlic River(C)	---	2	0
15. Otter Lake	Sturgeon River(C)	180	7	2

(continued on next page)

Table 1.--continued

Study area[1]	Presumed source of larvae (abundance[2], [3] in parentheses)	Square feet dredged	Hours of electro-fishing	Number of larvae collected
Lake Michigan				
16. Epoufette Bay	Paquin Creek(R)	260	--	0
17. Lake Michigan	Davenport Creek(N)	260	--	0
18. Unnamed Bay	Hog Island Creek(R)	510	--	3
19. Lake Michigan	Sucker Creek(R)	260	--	1
20. Lake Michigan	Black River(C)	380	--	2
21. Lake Michigan	Millecoquins River(C)	280	--	0
22. Port Inland	Milakokia River(R)	230	--	4
23. Manistique Harbor	Manistique River(R)	130	--	0
24. Garden Bay	Garden Creek(N)	150	--	0
25. Big Bay de Noc	Sturgeon River(A)	450	--	0
26. Ogontz Bay	Ogontz River(C)	150	--	3
Inland lakes - tributary to Lake Michigan				
27. Millecoquins Lake	Millecoquins River(C)	---	1	0
28. Portage Bay	Portage Creek(R)	---	1	0
Lake Huron				
29. McKay Bay	McKay Creek(R)	380	--	6

[1] Stream number refers to the number arbitrarily assigned to each stream in Figure 1.

[2] As estimated from surveys of larval distribution made by Stauffer and Hansen (1958) and subsequent surveys by the U. S. Bureau of Commercial Fisheries (Harry Purvis, Personal Communication).

[3] Letters indicate relative abundance: N = none, R = rare, C = common, A = abundant.

were employed. In the five lakes that were surveyed, 1,175 orange-peel dredge lifts (area sampled, 900 square feet) were made and 29 hours were spent collecting with the shocker (area sampled, about 9 acres). Eighty-two ammocoetes (average length, 2.9 inches; range 1.2-5.4) were taken from East Bay, 29 (average length, 5.2 inches; range 4.0-6.0) from Au Train Lake, 2 (average length, 2.4 inches; range 2.1-2.8) from Otter Lake, and none from Beaver and Saux Head lakes. The population densities found in East Bay and Au Train Lake were much greater than any found in Lake Superior proper.

Lake Michigan and Lake Huron drainages

In Lake Michigan, the orange-peel and Peterson dredges were used to collect larvae. Within a study area, only apparently suitable larval habitat was sampled. In the 11 study areas, 4,094 dredge samples (area sampled, 3,060 square feet) took 13 ammocoetes (average length, 4.6 inches; range 3.2-5.5). Larvae were collected near Hog Island Creek, Sucker Creek, and Black River, and in Port Inland and Ogontz Bay. In the 2 inland lakes tributary to Lake Michigan that were studied, 2 hours of collecting with the shocker produced no ammocoetes.

In Lake Huron, only McKay Bay was sampled. Six ammocoetes (average length, 4.0 inches; range 2.6-5.1) were collected with 500 lifts of the orange-peel dredge (area sampled, 380 square feet) in good ammocoete habitat.

Habitat of lentic populations

Nearly all ammocoetes were found within 1/4 mile of the mouth of a stream containing ammocoetes; four larvae, however, were collected at Port Inland, 1 1/4 miles from the nearest known source of larvae. Bottom types inhabited by ammocoetes were usually of silty-sand, but ammocoetes were taken at two sites where the bottom was p re sand. Depths of 1 to 60 feet were sampled, and larvae were found at depths of ? to 15 feet. Temperatures of the substrate where larvae were caught ranged from 61° F. to 70° F. All of the samples which contained larvae were taken from areas protected from severe wave action by depth, bottom or shore contours, or man-made devices.

At most locations where ammocoetes were collected, aquatic vegetation (pondweeds, stoneworts, eel grasses, bulrushes, waterweeds) and bottom-dwelling animals (burrowing mayflies, aquatic earthworms, snails, crayfish, clams) were present. Frequently, ammocoetes of other lampreys (Ichthyomyzon spp. and Lampetra lamottei) were noted.

There was no observable relationship between the number of ammocoetes in the parent stream and the number found in adjacent lentic waters. For example, no ammocoetes were found off the Chocolay River (Lake Superior drainage) and Sturgeon River (Lake Michigan drainage), both of which produce many lampreys, but ammocoetes were found off the mouths of four very small producers. Factors which may favor lentic populations are: (1) suitable habitat in the lentic waters and (2) a parent stream with a short estuary and/or spawning grounds near the mouth.

Discussion

Our distribution surveys show that larval populations are not uncommon in lentic environments. In fact, the number of larvae collected undoubtedly represents substantial total populations. At East Bay, where we collected 82 larvae, Wagner and Stauffer (In press) subsequently estimated a population of 96,000. At Ogontz Bay, where we collected 3 larvae, Hansen and Hayne (In press) subsequently estimated a population of 30,000. The presence, in our collections, of many individuals smaller than the average metamorphosing size (5.7 inches) suggests that recruitment to parasitic populations of sea lampreys in the Great Lakes will persist for some years, even though stream populations of larvae are exterminated.

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