UNIVERSITY OF TORONTO STUDIES

PUBLICATIONS OF THE
ONTARIO FISHERIES RESEARCH LABORATORY
No. 38

THE ALEWIFE (*POMOLOBUS PSEUDOHARENGUS*) IN LAKE ONTARIO

BY

ANDREW L. PRITCHARD
OF THE DEPARTMENT OF BIOLOGY
UNIVERSITY OF TORONTO

TORONTO
THE UNIVERSITY LIBRARY
1929

THE ALEWIFE (*POMOLOBUS PSEUDOHARENGUS*) IN LAKE ONTARIO

In connection with a study of some of the commercial fishes of Lake Ontario, it early became apparent that the alewife (*Pomolobus pseudoharengus*) was of considerable importance. It was found to constitute the major portion of the food of the lake trout (*Cristivomer namaycush*) (Dymond 1928), one of the important species in the lake. The lake trout in many lakes subsists mainly on ciscoes (*Leucichthys* spp), which are almost as valuable commercially as the trout. It therefore seemed desirable to make some studies of the life history of the alewife in order to ascertain more definitely its relationships to other species, especially those of commercial value.

There is some doubt as to when this species first appeared in the lake. Wright (1891) says that it was "introduced into Lake Ontario since 1873 and is now very abundant." It has been stated by a number of writers that the alewife was introduced through an error when the intention was to plant shad (*Alosa sapidissima*). According to fishermen at Bronte, it was very common in the late seventies. In the eighties, because of the death of large numbers of them, they were used by the wagon-load as fertilizer. Periodically since that time, the alewives have died in great quantities. The cause of this is unknown.

No extensive study has been made of the history of the alewives in Lake Ontario in so far as it refers to the periodic epidemics mentioned above. The following records and observations are included in the hope that the information may be of use in the future in connection with a more detailed study of this aspect of the problem.

Evermann and Kendall (1903) report that "during June and July, 1894, this fish was found dead in considerable numbers at all places visited in the eastern part of the lake."

The following notes were taken from the diaries of the late C. W. Nash, the Provincial Biologist for the Province of Ontario:

"May 2, 1895—In Toronto Bay, today saw a number of large gaspereau (alewives) coming to the surface, struggling and dying. These are the first this season. I have looked for them.

Mar. 11, 1899—Saw one quite fresh washed up on the shore at east Toronto.

June 16, 1899—Dead gaspereau abundant, floating in Lake Ontario.

May 29, 1901—Saw first sickly and dead gaspereau in Toronto bay.

Oct. 28, 1901—Young gaspereau abundant along the shore of the eastern sandbar, Toronto.

June 8, 1906—Saw large numbers washed up on the shore of Lake Ontario at Port Hope, and from this date to July 10, as I am writing I see them everywhere. I see them in Toronto bay as if spawning.

Nov. 5, 1906—Saw several hundreds on the shore of Lake Ontario at Toronto East today. They were small specimens, very few being over 2 in. long and none over 3½ in."

Mr. John Townson has stated that alewives were first noticed by him in 1883. On May 20th of that year they died in large numbers at Fisherman's island. The same mortality occurred almost annually during the next twenty-five years. Large numbers blown in from the lake were used as fertilizer. From 1876 to 1886 the city of Toronto was asked to take measures toward burying them on Centre island. In 1908, the water in the lake was high and there was a noticeable epidemic.

Daniel McGwyn of Burlington Beach, speaking before a Dominion Fisheries Commission on Dec. 13, 1892, said with reference to the alewives, "The township has to pay for removing them. The stench from them is so great in the month of July and August they have to be shovelled off the shore and buried."

A serious epidemic occurred in 1922. Reference was made to piles of them on the shore at Ashbridge's bay in the Toronto *Daily Star* of May 25, 1922.

In 1927, there was no noticeable epidemic at Port Credit, although a few dead individuals were found on shore. In 1928, a heavy mortality was reported by fishermen from all parts of the lake. Dr. Paul Harrington reported that during the last week of June there were so many dead on the beach at Oshawa that it was necessary to bury them. On June 23, Prof. W. J. K. Harkness counted 54 dead specimens along 70 feet of river bank near the mouth of the Credit river and 71 in 350 feet along the lake shore to the east of the mouth of the Credit. On July 4 he also saw large numbers floating on the surface of the lake midway between Toronto and Port Dalhousie. He estimated that there were 300 dead fish in a space 20 by 700 yards over an area of 9 miles in one direction and as far as the eye could see in the other. In the Bay of Quinté region we found in some places as many as 25 decaying fish to the square yard of beach. They were so abundant as to constitute a serious nuisance to all the residents along the lake front.

MATERIALS AND METHODS

The study reported herein was directed chiefly toward obtaining information as to food, rate of growth, and inter-relationships with other species. Comparison was also made between alewives from the Atlantic coast and those in Lake Ontario.

The material examined was procured from our own nets, set off Port Credit in the summer of 1927, and from those of the commercial fishermen, lifted there at the same time. In 1928, a survey of conditions in the Bay of Quinté was conducted. Most of the fish obtained there were seined by members of the party from the Ontario Fisheries Research

Laboratory. The lake trout, ling, and other fish examined were provided by the commercial fishermen at both ends of the lake.

ACKNOWLEDGEMENTS

We wish to convey our thanks to the commercial fishermen at Port Credit, Pleasant Point, Bay of Quinté, and the Main Duck Islands, for providing the opportunity to examine the stomach contents of the commercial species of fish and for their co-operation in that work. We are also indebted to Dr. A. H. Leim for securing specimens of marine alewives from Halifax, N.S., and to Prof. J. R. Dymond for advice and assistance in connection with the conduct of the study.

DESCRIPTION

The alewife belongs to the family Clupeidae, which includes a number of important species some of which are wholly marine, *e.g.*, the herrings (*Clupea*), the pilchards (*Sardina*) and the menhadden (*Brevoortia*), while others such as the shad (*Alosa sapidissima*) live in the sea, but ascend rivers to spawn. Some have become permanently fluviatile or lacustrine. In the Ohio River, for instance, there occur *Alosa ohiensis* and *Pomolobus chrysochloris*. The latter has gained entrance through canals to Lake Erie.

The alewife is a common marine fish on the Atlantic coast, averaging about ten inches in length (Bigelow, 1924). For the purpose of spawning, it ascends the coastal rivers. A land-locked form also occurs in some of the lakes of New York State.

In tables 1 and 2 respectively, measurements for ten specimens from Lake Ontario and ten from Halifax Harbour, Nova Scotia, are presented. These measurements are expressed in thousandths of the body length. Except for the fact that the marine individuals are larger than those from fresh-water, these figures are therefore directly comparable.

Although the number of specimens examined is small,

TABLE 1—GIVING THE COMPARATIVE MEASUREMENTS OF 10 ALEWIVES TAKEN OFF PORT CREDIT IN LAKE ONTARIO DURING THE SUMMER OF 1927.

Specimen No.	3658	....	3660	....	3661	....	3657	....	3656	3629	Average
Length in mm.	130	133	137	139	140	145	146	148	152	176	145
Scales	44	45	44	45	47	45	44	44	45	44	45
Gill rakers	43+21	41+25	42+26	42+25	43+25	43+25	43+25	43+25	42+23	43+23	43+24
Head length	269	274	259	256	271	255	255	260	263	257	262
Body depth	269	274	277	272	268	262	277	276	307	256	273
Body width	92	113	115	108	120	101	110	105	128	97	109
Caud. ped. length	112	104	104	90	101	103	90	104	98	130	104
Caud. ped. depth	92	91	99	93	95	90	96	95	98	93	95
Eye	79	91	80	83	86	79	75	76	76	67	79
Snout	62	58	66	50	62	59	58	64	63	54	60
Interorbital	54	59	58	51	54	55	51	54	53	48	54
Maxillary	123	122	120	129	125	123	118	121	122	117	123
Pectoral length	208	203	211	205	212	211	206	209	197	202	206
Ventral length	131	128	131	133	132	138	137	132	128	128	132
Dorsal height	162	173	150	176	157	158	159	155	156	148	159
Dorsal base	154	152	149	155	150	145	151	148	153	145	151
Anal height	62	68	66	70	64	76	68	70	71	68	68
Anal base	154	152	153	165	161	158	157	140	141	165	155
Scutes	19+14	19+14	19+14	19+15	18+15	19+13	19+14	19+14	19+15	19+14	19+14
Dorsal rays	15	15	13	15	14	14	14	15	15	14	14
Anal rays	18	...	18	19	18	19	17	18	18	20	18

TABLE 2—Giving the Comparative Measurements of 10 Alewives taken in Halifax Harbour, Nova Scotia, in August, 1927.

Specimen No.	3708	3710	3709	3711	3713	3712	3714	3706	3705	3707	Average
Length in mm.	239	242	245	249	256	261	265	270	276	279	258
Scales	44	42	47	47	46	46	48	47	47	47	46
Gill rakers	41+23	41+25	41+22	41+25	43+24	42+22	43+24	44+24	46+26	44+24	43+26
Head length	238	243	245	233	230	231	243	235	221	238	236
Body depth	255	266	287	271	238	249	268	243	275	246	260
Body width	107	130	112	116	110	105	111	105	127	101	112
Caud. ped. length	126	119	122	116	109	113	102	111	112	119	115
Caud. ped. depth	92	96	92	101	92	90	95	89	85	86	92
Eye	61	58	63	56	57	57	57	59	51	58	58
Snout	55	52	57	52	47	53	52	55	51	55	53
Interorbital	48	52	48	48	45	41	45	50	49	47	47
Maxillary	117	111	118	111	109	115	122	108	101	109	112
Pectoral length	192	188	194	189	179	188	181	179	161	176	183
Ventral length	126	122	130	121	120	125	127	121	112	118	122
Dorsal height	144	150	151	142	147	140	151	144	127	143	144
Dorsal base	160	156	167	149	165	161	163	151	155	162	159
Anal height	66	66	65	62	67	65	68	63	52	69	65
Anal base	150	173	152	170	156	161	160	157	130	163	157
Scutes	19+14	20+14	20+14	20+14	19+14	20+14	21+14	19+14	20+17	20+14	20+14
Dorsal rays	15	15	15	15	15	14	16	15	15	16	15
Anal rays	17	18	18	20	19	19	19	18	16	19	18

certain differences seem to be fairly definitely indicated. The marine specimens have longer fins, more scales, more gill rakers, more scutes and more fin rays. They also have much shorter heads and smaller eyes, in proportion to the length, than the fresh-water representatives, but this difference may be due only to their larger size.

The Lake Ontario form may be described as follows: head short, nearly as deep as long, 3.8 (3.7-3.9) in length; depth of body, 3.7 (3.6-3.9); width 9.0 [(7.75-9.9) 10.9]; eye large, longer than snout, 3.3 [(2.8-3.5)3.9] in head; snout 4.4 [(3.9-4.8) 5.1]; maxillary 2.15 (2.0-2.2), almost reaching a vertical through the posterior margin of pupil; lower jaw somewhat projecting; dorsal fin with 14 to 16 rays, fairly high, 1.8 (1.65-1.85) in head, and base as long as height 1.0 (.96-1.1) in its own height; the lower lobe of the caudal fin usually longer than the upper; scutes 19+13 to 19+15; gill rakers 43+21 to 43+25.

The colour is bluish above, shading into silvery on the sides and belly. There is an indefinite blackish or bluish spot behind the opercle. The rows of scales on the sides are marked with longitudinal black stripes which become fainter below the lateral line. The peritoneum is pale.

In Lake Ontario, the alewife has been taken at all depths from the shallow water to a depth of 300 feet, but it appears to be more common inshore. It is believed to be somewhat pelagic.

Reference has been made to the fact that the fish in Lake Ontario are not as large as those from salt water. The largest specimen secured in the course of our investigation in 1927 and 1928, was 7½" long. The fishermen at Port Credit say that previously the alewife reached a larger size, specimens ten inches long being common. At that time, there was a certain demand for it as human food in this region. None are sold for that purpose at the present time.

Spawning

The time of spawning varies, apparently depending much on the temperature. In a favourable season, the fish run in

schools into shallow water to spawn in late May or early June. In the western end of Lake Ontario, spawning occurs in about eight feet of water, on sandy beaches sparsely covered with vegetation. In the Bay of Quinté, the spawning grounds are usually in shallow bays where the bottom may be similar to that noted above, or slightly more muddy. This inward migration is said to have an effect on the lake trout fishing, because the trout move inshore in quest of the alewives which usually constitute their chief food.

If the season is cool, the run may be irregular. In 1927, at Port Credit, the alewives came in when the water was warm, *e.g.*, 15.8°C. at the surface, and 11.9°C. at the bottom in 30 feet of water. Many of them, however, withdrew when the temperature fell slightly. At no time, were there any such numbers as usually occur. Spawning was late that year, taking place from July 9 to August 9.

The proportion of males and females on the spawning grounds changes markedly as shown in table 3 below. Towards the beginning of the run, the sexes are present in approximately equal numbers, but towards the close, the percentage of males rises to 80 or 90 per cent. These observations are in agreement with the predominance of males in late runs reported by Bigelow, (1926) for the marine form.

TABLE 3—GIVING THE PERCENTAGE OF MALE AND FEMALE ALEWIVES AT DIFFERENT DATES DURING THE SPAWNING RUN OFF PORT CREDIT IN 1927 AND IN THE BAY OF QUINTÉ IN 1928.

PORT CREDIT, 1927			BAY OF QUINTÉ, 1928		
Date	% Males	% Females	Date	% Males	% Females
July 28	48	52	June 16	48	52
" 29	68	32	" 20	55	45
Aug. 11	92	8	" 21	79	21
			" 27	82	18

Hatching takes place fairly rapidly, occupying less than a month. No definite idea was obtained as to the actual time taken, but on July 23, 1928, J. L. Hart procured young alewives in a seine on the north shore of Prinyer's cove, Bay

of Quinté. Some of these were as large as 15/16 of an inch, while the average for 28 specimens was 13/16 of an inch. Measurements of these are included in the rate of growth work.

RATE OF GROWTH

The ages of 205 specimens from Port Credit and the Bay of Quinté were determined by the scale method. The results are summarized below in tables 4 and 5. Specimens more than one year old, but not two years old, are indicated as 1+ years of age, those more than two, but less than three, as 2+, etc.

TABLE 4—GIVING THE AVERAGE WEIGHTS IN OUNCES AND LENGTHS IN INCHES OF ALEWIVES OF VARIOUS AGES TAKEN OFF PORT CREDIT IN 1927 AND IN THE BAY OF QUINTÉ IN 1928.

	PORT CREDIT, 1927						BAY OF QUINTÉ, 1928					
	Males			Females			Males			Females		
Age	No	Leng.	Wt.	No.	Leng.	Wt.	No.	Leng.	Wt.	No.	Leng.	Wt.
1+	7	3.88	..	..	..	..	..	..	..	..	..	..
2+	4	5.13	0.6	1	4.63	..	1	5.50	0.8	..	..	..
3+	7	5.50	1.1	4	5.88	1.5	2	5.63	..	..	..	..
4+	16	5.88	1.4	18	6.20	1.6	13	5.80	1.0	1	6.13	1.5
5+	18	6.13	1.4	17	6.63	1.85	14	6.13	1.25	3	6.29	1.42
6+	..	..	..	3	7.1	2.15	2	7.00	1.75	7	7.06	2.3
7+	..	..	..	..	..	..	..	..	..	1	7.38	3.0

TABLE 5—GIVING THE AVERAGE WEIGHTS IN OUNCES AND LENGTHS IN INCHES OF IMMATURE ALEWIVES TAKEN OFF PORT CREDIT IN 1927 AND IN THE BAY OF QUINTÉ IN 1928.

	PORT CREDIT, 1927			BAY OF QUINTÉ, 1928		
Age	Number	Length	Weight	Number	Length	Weight
0+	..	..	..	28	0.81	..
1+	4	3.75	..	25	3.13	0.25

The accompanying graph has been plotted from the above data for the Port Credit region. From a study of the tables and the graph, it is evident that the species grows rapidly

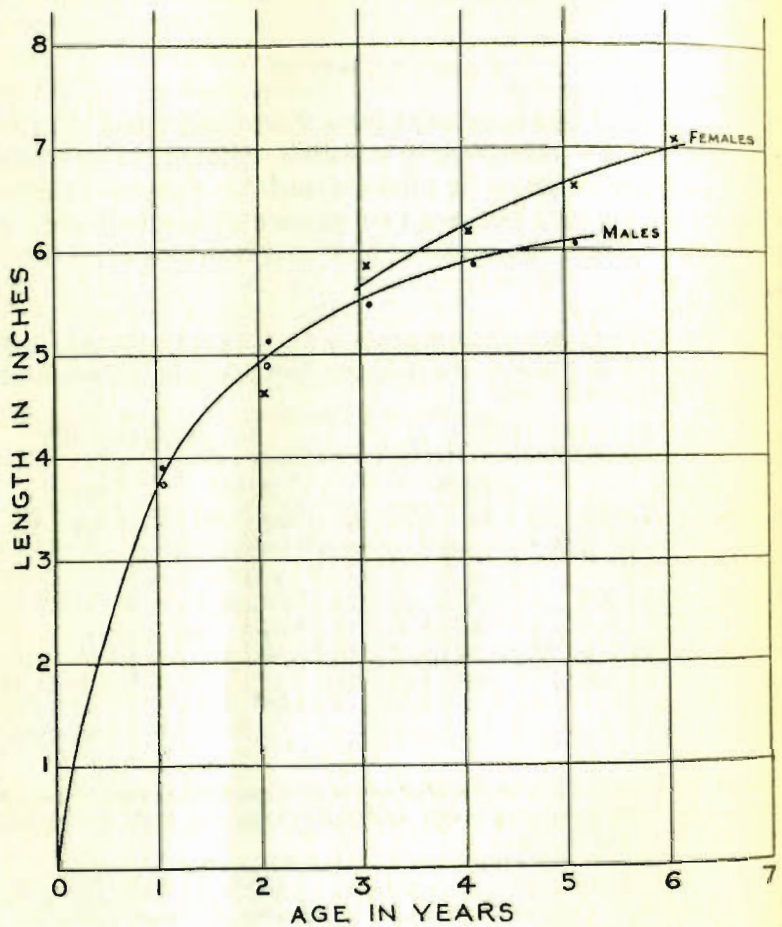

Figure 1—Illustrating the relation of length in inches to age in years in alewives taken in Lake Ontario off Port Credit.

∘Immature specimens; •Males ; ×Females.

at first, attaining in one year a length over half of that reached at the end of the fifth year. After the first year the rate of increase in length falls off. There is a difference between males and females in rate of growth both in length and weight, the latter being larger at any given age. The difference in environment between the Bay of Quinté and the open lake does not noticeably affect the rate of increase in length or weight.

Our data indicate that females mature a year later than males and attain a greater age. We found two males which were ripe in their second year, but no females. In fact, only one spawning female was taken which was in its third year. The smallest ripe male was 3 3/8 inches long, and the smallest ripe female 4 5/8 inches. All fish over 5¼ inches in length were sexually mature. The bulk of the spawning run was made up of individuals in their fifth and sixth years.

FOOD STUDIES

The results of the examinations of the contents of the alimentary tracts of 58 alewives from Port Credit are presented below in table 6. The specimens were procured by nets set on the surface of the water about two hundred yards offshore, on the bottom in 18 feet of water, and by seining in the mouth of the Credit river. About eighty per cent. of the alewife stomachs taken in this place during the summer, were empty.

Table 7 presents an analysis of the stomach contents of 58 alewives from the Bay of Quinté in the summer of 1928. Seventy-eight per cent. of the mature fish taken in this area were empty, but about seventy-five per cent. of the immature ones contained food.

The tables give the number and percentage of stomachs in which the various food organisms occur, the highest percentage which the organism in question constituted in any one stomach and the average percentage which it constituted in all of the stomachs in which it occurred. x denotes volumes of less than one per cent.

TABLE 6—Giving the Analysis of Contents of 58 Alewife Stomachs taken from Fish 4-6½ Inches in Length obtained off Port Credit in Lake Ontario in 1927.

Organism	Frequency of Occurrence		Greatest Quantity in any one stomach	Average Quantity
	No. of stomachs	% of total No. of stomachs		
Diatoms	6	10	×	×
Higher Plant Material	10	17	100	20
Stellate plant hair	3	5	1	×
Protozoa	1	2	3	3
Dinobryon	1	2	3	3
Nemathelminthes	1	2	×	×
Platyhelminthes	4	7	×	×
Trochelminthes	1	2	3	3
Keratella cochlearis	1	2	3	3
Crustacea	48	83	100	65
Cladocera	23	40	30	5
Bosmina longirostris	16	28	30	6
Daphnia longispina	2	4	×	×
Chydorus	2	4	×	×
Copepoda	47	81	100	61
Diaptomus	35	60	75	33
Cyclops	40	69	75	34
Limnocalanus macrurus	2	4	30	15
Ostracoda	1	2	×	×
Amphipoda	1	2	×	×
Mysidacea	1	2	100	100
Mysis relicta	1	2	100	100
Arachnida	3	5	×	×
Hydracarina	3	5	×	×
Insecta	28	47	100	38
Diptera	25	43	100	40
Culicidae	2	4	50	25
larvae	1	2	×	×
adults	1	2	50	50
Chironomidae	23	40	100	35
adults	1	2	50	50
pupae	13	23	100	38
larvae	4	7	100	47
miscellaneous	8	14	80	14
Miscellaneous Diptera	2	4	25	13
larvae	1	2	×	×
adults	1	2	25	25
Ephemeroptera	3	52	25	25
larvae	1	2	×	×
nymphs	1	2	×	×
miscellaneous	1	2	75	75
Egg-Like Masses (?)	2	4	×	×

TABLE 7—Giving the Analysis of the Contents of 37 Alewife Stomachs from Fish taken in the Bay of Quinte in 1928.

Organism	13 Fish, 2.63 to 3.88 Inches in Length.				19 Fish, 5.81 to 7.38 Inches in Length.			
	Frequency of Occurrence		Greatest Quantity in any one Stomach	Average Quantity	Frequency of Occurrence		Greatest Quantity in any one Stomach	Average Quantity
	No. of Stomachs	% of total No. of Stomachs			No. of Stomachs	% of total No. of Stomachs		
Diatoms	1	7	×	×	3	14	×	×
Multicellular Green Algae	..	..	..	..	7	32	×	×
Plant Material	2	13	×	×	..	..	..	..
Crustacea	13	100	100	98				
Cladocera	13	100	80	30	11	50	35	14
Bosmina longirostris	13	100	80	30	9	41	35	17
Daphnia longispina	1	8	×	×	2	9	×	×
Chydorus	1	8	×	×	1	5	×	×
Copepoda	13	100	95	52	16	74	100	53
Diaptomus	4	31	90	52	5	23	60	21
Cyclops	13	100	95	35	16	74	95	46
Limnocalanus macrurus	..	..	..	..	2	9	×	×
Ostracoda	..	..	..	..	1	5	1	1
Mysidaceae	..	..	..	..	3	14	90	38
Mysis relicta	..	..	..	..	3	14	90	38
Insecta	1	8	×	×	11	50	100	47
Diptera	1	8	×	×	9	41	100	37
Chironomidae	..	..	..	..	9	41	100	37
larvae	..	..	..	..	2	9	10	7
pupae	..	..	..	..	6	27	99	59
adults	..	..	..	..	2	9	75	63
miscellaneous	..	..	..	..	2	9	2	1
Misc. Diptera	1	8	×	×	1	5	×	×
Trichoptera	..	..	..	..	3	14	30	10
pupae	..	..	..	..	3	14	6	2
adults	..	..	..	..	1	5	24	24
Ephemeroptera	..	..	..	..	3	14	30	17
sub-imago (Heptageninae)	..	..	..	..	1	5	30	30
adults (*Ecdyonurus tripunctata*)	..	..	..	..	1	5	30	30
Misc. Ephemeroptera	..	..	..	..	1	5	×	×
Hymenoptera	..	..	..	..	1	5	×	×
Chalcidoidea adult	..	..	..	..	1	5	×	×

From the data given in the preceding tables, it is evident that the alewife feeds very largely on animal plankton. Other items appear only in very small quantities. The chief organisms are smaller crustaceans, especially the copepods. When the fish are caught in shallow water, either on exposed beaches or in protected bays, insects of various kinds are taken in some numbers. At no time, however, are these the principal portion of the food.

Among the fish from the three locations mentioned at Port Credit, no outstanding difference in the food could be discovered. Those taken at the surface contained a few terrestrial forms, such as chironomid adults, probably procured from the surface of the water. The fish seined in the mouth of the Credit river were practically all empty.

In the Bay of Quinté, there is a definite difference in the food of large and small fish. The larger, mature individuals contained more insect material, and some of the higher crustaceans, such as *Mysis* and ostracods, which were not present in the stomachs of the immature specimens. This difference was not apparent at Port Credit, possibly due to the small numbers of immature fish examined.

It is doubtful if the alewife is a competitor to any appreciable extent of any of the commercial species of fish in the lake. Lake trout are piscivorous and so are not affected; the whitefish are chiefly bottom feeders, confining themselves, in the main, to the larger planktonts, insect larvae and molluscs; the ciscoes eat, for the most part, *Mysis* and *Pontoporeia*. The only regions where it seems at all likely that competition would occur, are the Bay of Quinté and in other shallow bays, where the cisco and whitefish fry occur. These eat *Cyclops* and *Bosmina*, *i.e.* the smaller plankton forms. In most cases, however, the alewives are found on more exposed, gravelly shores than are the fry of the whitefish and ciscoes.

ECONOMIC ASPECTS

Since most of the economic value of the alewife in Lake Ontario seems to be of an indirect nature, it is hard to estimate

its importance. A few of its relationships are discussed below to convey some idea of its position in the ecology of the lake.

In considering some factors affecting the production of lake trout in Lake Ontario, Dymond (1928) found that during June, 75.5% of lake trout stomachs, in which food was found, contained alewives, whereas during July and August, the corresponding percentage was 36.7%. This indicates that in June, the lake trout fed chiefly on alewives. Later, however, alewives constituted a smaller proportion of their food. It was at this time that the alewives had come inshore to spawn. Some of the trout turned to the ciscoes, another valuable commercial species as a substitute. Thus, it is evident that the alewife not only supplies a food for the trout, but in doing so protects the ciscoe.

The same protection is afforded in another way. The ling (*Lota maculosa*) feeds chiefly upon alewives, but in their absence is forced to turn to the substitute most easily obtained *i.e.*, the ciscoes. Since the ling is probably the most predaceous fish in the lake, and since it is present in such large numbers, the result maybe a serious detriment to the ciscoes.

In the Bay of Quinté, a large eel fishery has been carried on for several years. In the spring, fishermen, who are taking advantage of this, are very dependent on the spawning run of the alewife for bait for the set lines. These fish are considered to be best for that purpose.

The periodic death in large numbers of these fish may affect the commercial fisheries of the lake seriously. Koelz (1926) says: "To the decay of these carcasses, the fishermen attribute in large part the decrease of the whitefish, and from personal observation, I believe, that it is not improbable that this may have been a factor. On Aug. 24th, 1923, while witnessing the lifting of a 3 inch gill net set for lake herring in 30 fathoms, off Sandy Point, from three to nine decayed fish were brought up between each two corks (about 8 feet) wrapped about the threads of the nets. The nets had been out two nights and a stiff breeze had induced the currents which swept the fish along the bottom and entangled some of

them in the nets." Whether this detrimental effect more than offsets the advantages arising from the presence of alewives in the lake cannot be determined.

ENEMIES

Lake trout—(*Cristivomer namaycush*)

This species feeds heavily on alewives in all parts of the lake. Dymond's work off Port Credit is reported above. Our researches in the Bay of Quinté region showed that of 79 stomachs which contained food, 48 contained alewives, *i.e.* 62 per cent.

Ling—(*Lota maculosa*)

At Port Credit in 1927, out of 37 ling stomachs, 29 were found to contain alewives, with an average of 8 in each. Our work in the Bay of Quinté showed a similar trend. At Consecon on July 9, 1927, seventeen ling stomachs chosen at random contained on the average seven alewives each.

Eel—(*Anguilla rostrata*)

One was taken in the Bay of Quinté containing alewives. It is likely that further studies would reveal that this fish preys heavily on the latter.

Pike—(*Esox lucius*)

In only one specimen did we find alewives. It is not probable that this species does much harm, as it is usually found in reedy bays not often frequented by the alewife.

SUMMARY AND CONCLUSION

(1) The alewife in Lake Ontario differs slightly from the marine form in size, number of scales, scutes and fin rays, and in length of head and eye.

(2) Spawning is erratic being evidently dependent on temperature.

(3) The spawning run is constituted chiefly of 5 and 6 year old fish.
(4) In the spawning runs the sexes are at first present in approximately equal numbers, but towards the close of the run the males greatly exceed the females in number.
(5) Males grow more slowly than females. The rate of increase in weight and length of either sex is approximately the same at both ends of the lake.
(6) The chief food of alewives is small crustacea. Insects were found to form a large part of the diet of some individuals taken in shallow water.
(7) Large and small individuals differ slightly in food preference, the large ones taking more insects and larger crustaceans, *e.g.*, *Mysis*.
(8) The alewife is very important as a food for lake trout, ling and eels and competes in no serious way with other species. Indirectly by supplying food for the ling and trout, it protects the ciscoes which are usually taken as a substitute by these piscivorous fish.

LITERATURE CITED

Bigelow, H. B. and Welsh, Wm. W. 1924. Fishes of the Gulf of Maine. Bull. U.S. Bur. Fish. Vol. XI, Pt. 1, pp. 107-110.

Dymond, J. R. 1928. Some factors affecting the production of lake trout (*Cristivomer namaycush*) in Lake Ontario. Univ. of Toronto Studies: Biological Series, Pub. Ont. Fisheries Research Lab. No. 33.

Evermann, B. W. and Kendall W. C. 1902. Notes on the fishes of Lake Ontario. Rep't. U.S. Fish Comm. for 1901, p. 213.

Koelz, W. 1926. Fishing industry of the Great Lakes. App. XI, Rept. U.S. Comm. Fish. for 1925, pp. 601-617.

Wright, R. R. 1891. Fishes of Ontario, p. 445.

Report of the Dominion Fishery Commission on the fisheries of the Province of Ontario. Pt. I, 1893 (1894).

UNIVERSITY OF TORONTO STUDIES

PUBLICATIONS OF THE
ONTARIO FISHERIES RESEARCH LABORATORY

No. 39

CANADIAN HYDRACARINA

BY

RUTH MARSHALL

OF THE DEPARTMENT OF BIOLOGY
ROCKFORD COLLEGE, ROCKFORD, ILLINOIS

TORONTO
THE UNIVERSITY LIBRARY
1929