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A Preliminary Report on the Worms (Mostly Parasitic) Collected in Lakes St. Clair, in the Summer of 1893

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STUDIES FROM THE ZOOLOGICAL LABORATORY

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APPENDIX III.

A PRELIMINARY REPORT ON THE WORMS (MOSTLY PARASITIC) COLLECTED IN LAKE ST. CLAIR, IN THE SUMMER OF 1893.

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In the work done on the fauna and flora of Lake St. Clair during the summer of 1893, the group of Vermes was entrusted to the writer. The following is submitted as a preliminary report on the ground covered, the material obtained, and the results of this branch of the work so far as they can be seen at this stage.

Excluding the Rotifera, which were studied by another member of the party, the Vermes are represented in fresh water by three great classes: the Plathelminthes (Flat-worms), Nemathelminthes (Round or Thread-worms), and the Annelida (Segmented-worms). A synopsis of these classes gives the following orders occurring in fresh water:

Plathelminthes	Turbellaria. *Trematoda (Flukes). *Cestoda (Tape-worms).
Nemathelminthes	*Nematoda (Thread-worms). *Gordiacea (Hair-snakes). *Acanthocephala. Nemertini.
Annelida	Oligochaeta ("Earth-worms"). Hirudinea (Leeches).

The orders starred are found exclusively or very largely as endo-parasites, and the importance for fish culture of a full knowledge of these forms seemed to warrant the special attention which was paid to them; for it soon became evident that the amount of material was too great for one worker, so that the non-parasitic worms were collected only as occasion offered, while the parasitic forms were made the subject of special study.

To speak of the non-parasitic forms first: Of the *Turbellaria* only one

vial with a dozen specimens was preserved, and these have been sent to Dr. W. McM. Woodworth of Harvard for determination. The following forms were found in the tow and entered in the blanks without being preserved: *Mesostoma Ehrenbergii, Vortex* sp. Aug. 6; *Planaria maculata* Leidy, Sept. 1.

The group of Nemertini, which is represented in the ocean by numerous large worms great value as fish food, yields in fresh water only a very few small forms. One species about 3 to 5 mm. in length and 0.5 mm. in breadth, was found rarely on the plants collected from the shallow water of Lake St. Clair. Of the fifteen so-called species of fresh water Nemertini listed by various authors, hardly one can be recognized from the data given, and probably all may be reduced to two or three.* More accurate descriptions of these forms are necessary before any identification can be made.

Of the *Hirudinea* twelve vials were put up and afterwards sent to Prof. R. Blanchard of Paris for study.

The *Oligochaeta* were entrusted to Dr. G. Eisen of the California Academy of Sciences who has made the following preliminary report:

"The collection of *Oligochaeta*, contained in 17 vials, comprises about 8 or 9 species principally belonging to purely fresh water forms. There is one specimen of a genus related to *Thamnodrilus*, and about a dozen specimens of a new genus belonging to the family of the *Lumbriculidæ*. The collection contains besides two species of *Stylaria*, one of *Bohemilla*, one related to *Pristina*, one to *Naidium*, and one *Chætogaster*. These can only be properly determined, however, after dissection and sectioning. It is safe to say that most of the species are new to science. All the material is in first-class order well preserved with a view to anatomical and histological study. The collection was accompanied by many careful field notes and four sheets of detail drawings. A complete report will be made as soon as time permits."

My own attention was devoted particularly to the parasitic worms, both while collecting during the summer and in study then and since. In the tow was found but one helminth, a form which challenged attention the first of our stay. It is a free swimming *Cercaria*, closely allied to *C. mirabilis* Braun, having a prominent tail terminating in two flat blades at right angles to the main body. The *Distoma* is enclosed within the tail of the *Cercaria* which has then more or less the appearance of an anchor with wide flukes. From one to four of these were taken from both top and bottom tow every day from July 27 to August 5 when it suddenly ceased to be found. Efforts to find the intermediate and primary host were alike unsuccessful. This form differs considerably in size from those described by R. R. Wright and M. Braun and is probably a new species.

In shore collecting and dredging among the rushes in shallow water, immense numbers of *Gordius* were obtained. They belong to not more than two species. One specimen of *Mermis* was also found.

The bulk of the material collected consisted of fish parasites. Every day the fish brought from the nets were examined, and the parasites found were transferred to dishes of normal salt solution and provided with labels containing full details as to the host and the organ inhabited. This part of the work which I did personally at first was afterwards entrusted to D. Lydell who proved a most satisfactory assistant, and by whom the larger part of the collecting was subsequently done. The results of this examination of the fish were entered in a special blank which is here reproduced.

Compare Vaillant in the Zoölogischer Anzeiger, vol. xv, p. 125.

No......

Name .....

Size..... *Age* .....

Locality .....

Examined by.....*189*.....

PARASITES FOUND.

NAME.	No.	Organ Inhabited.	Condition.	Remarks.

Notes:

Each of the parasites was then subject to superficial examination, notes of evident peculiarities in shape or color made on the blank, and the worms then preserved. For this purpose an alcoholic solution of corrosive sublimate or picro-sulphuric acid was employed, followed by treatment in grades of alcohol. Forms which could be identified at once were entered by name, others referred to by number, and all were put up in vials for future study. Those which were peculiar were studied at the time so far as possible, and notes and drawings kept for reference.

The total amount of this material collected was *Trematoda* 59 vials, *Cestoda* 43 vials, *Nematoda* 15 vials, *Gordiacea* 9 vials, *Acanthocephala* 39 vials; in which one vial represents one order of parasites from one organ of one host at one date, so that two species may be in one vial or two vials may contain the same species collected on different days or from different hosts or organs of the same host. The examination of the bottles has gone far enough to show that a few of the forms represent new genera, many are new species probably, and nearly all are new in this country or in these hosts. When worked up the entire collection will form a valuable contribution to American helminthology.

The parasites from each host were counted and the results entered in the blanks. This was naturally laborious and demanded considerable time; but it is believed that it will furnish important evidence on the frequence of the parasites such as is lacking in previous lists which, so far as I know, rarely contain information even as to the number of infected hosts among those examined. The subjoined table presents in concise form the results of this study. From the list of hosts given it will be seen that nearly or

quite all the important food fish of the lakes were examined. As it was not possible at that time of year to obtain whitefish in Lake St. Clair, Professor Reighard was kind enough to make a special trip to Belle Isle in the fall when he examined ten of them and forwarded me the parasites obtained. They came in good condition and add materially to the completeness of the collection. In addition to the fish, a large number of fresh water mollusks were examined as well as a few gulls and turtles from the immediate vicinity. The results of this examination are appended to the table below. It may be mentioned that some well known parasites were not found, among others the thread worm which infests the muscles of the black bass; it does not seem to occur at this season in the bass from Lake St. Clair.

As might be expected, most of the parasites were found in some part of the alimentary canal; not a few occur encysted in the liver, and the body cavity and air-bladder harbored occasional specimens. In one instance (*Hiodon*) the only parasites found were in the body cavity; they are probably new to science and are *Trematoda* with the mouth and the single sucker at the middle of the ventral surface, in this like the *Gasterostomidæ*, but differing from that family in numerous particulars, especially the sexual organs and the absence of any modification of the anterior end. The structure of this form will be described in detail in another place.

Some interesting facts appear on examination of the table given. The number of hosts examined is in some cases too small for general statements but such are only tentatively included in general statements. In considering the abundance of parasites it may be said that those fish which contain less than ten parasites each may be regarded as practically free; these are species 2, 5, 8, 9, 12, 13, 14 (see note), 17, 19. On the other hand those containing more than one hundred are to be considered as badly infected. Such are 4, 6 and 15. Of 18, only one specimen was examined and the number cannot stand as an average. Three specimens of 6 were examined; two had about forty parasites each, the third contained 285 *Acanthocephala*, bringing the average above the hundred limit, but the number examined was evidently too small to warrant conclusions as to which was the exceptional occurrence, and this form may be set aside for the present. Of the others 4 and 15, *Amia* is not a food fish; the second, the small-mouth black bass, was, as the table shows, the most seriously infected of any fish.

It will be noticed in this connection that a comparison by number only is somewhat misleading. Not only is there a wide difference in volume, and hence in effect on the host, between different species of the same order, as e. g. one *Distoma* collected measured 17 x 1 mm., while the smallest was 1 x 0.2 mm., where the volume of the larger is more than 85 times that of the smaller; but it is also evident that one adult *Cestode* of moderate size is equal in volume to more than a hundred *Distomata*. A comparison by number omits also the important factor of the size of the host, and one can easily see that the 42 parasites of each sturgeon play a smaller part in its economy than do the six of each perch or pumpkin-seed. Having regard, then, to the size of the parasites and to the size of the hosts, the table gives a relative idea of the degree of infection.

Comparing the parasites within one host it appears that the *Cestodes* are most important only in 19 and 20; the *Acanthocephala* are distinctly most prominent in 6, 7, 15, and 16 while the *Trematodes* ruled in 4 and the

Nematodes in 17. In the other cases the number of parasites is either so small as to be unimportant or so nearly evenly divided that no one group could be called predominent. *Trematodes* alone were harbored by 10, 11, 13, *Acanthocephala* alone by 8 and 16. External parasites were rare, being obtained only in one instance, from the gills of the whitefish.

In the food of the fish is to be found of course the key to the distribution and frequence of parasites, and considerable time was spent in the study of this subject. The only extensive articles on the food of the American fresh water fish are those of S. A. Forbes in the Bulletin of the Illinois State Laboratory of Natural History, 1878–88. After collating the results given there it was evident that there is variation enough in the food of the same fish in different localities to influence materially the question at issue. Some of the statements given there directly contradict observations made last summer at New Baltimore so that it will be necessary to await the result of study on the fish foods collected by our own party.

All of the parasites found were obtained from organs which are removed in cleaning the fish so that they are not directly dangerous to man. Any influence must be indirect on the health of the food or in reducing the supply of the fish. As to the effect of the parasites on the host a few words may be said. In most cases the number is so small that they could not noticeably diminish the food supply of the host, especially in a season of abundant nourishment like the summer; and it is also probable that the irritation produced by movements of the parasites is immaterial. In a few cases, however, this is not true, and the great number found in *Micropterus dolomieu* must be a serious draft on the organism. The *Acanthocephala*, moreover, which are present here in such large numbers, are especially dangerous since they collect in such masses as to obstruct the alimentary canal and make their way out into the body cavity and up into the liver, in both of which places they were found repeatedly. The host would then be affected in more than one way and it may be seriously. At any rate the subject deserves the fullest investigation since it is one of the finest of our food fish which is threatened. I hope to be able to present further evidence on the influence of the parasites on the host at a later date.

Reference number.	Fish examined.					Parasites found.				
	Scientific name.	Common name.	No. infected.	No. free.	Total No. examined.	Total No.	No. of Trematoda.	No. of Cestoda.	No. of Acanthocephala.	No. of Nematoda.
1	Acipenser rubicundus Le Sueur	Lake Sturgeon	2	0	2	85	75	0	0	10
2	Ambloplites rupestris (Raf.)	Rock Bass	2	0	2	88	1	1	6	0
3	Ameiurus natalis [d] (Le Sueur)	Yellow Cat	1	0	1	19	17	1	1	0
4	Amia calva L.	Dog Fish	4	0	4	[a]3521	[a]3169	13	7	32
5	Aplodinotus grunniens (Raf.)	Sheep's Head	12	0	12	30	26	4	0	0
6	Catostomus teres (Mitch.)	Common Sucker	3	0	3	364	0	7	357	0
7	Coregonus clupeiformis (Mitch.)	White Fish	10	0	10	263	[e] 5	15	226	17
8	Cyprinus carpio L.	German Carp	2	0	2	5	0	0	5	0
9	Esox lucius L.	Pike	3	0	3	24	8	8	8	0
10	Esox masquinongy (Mitch.)	Muskallunge	1	0	1	15	15	0	0	0
11	Hiodon tergisus Le Sueur	Moon Eye	2	4	6	52	52	0	0	0
12	Ictalurus punctatus (Raf.)	White Cat	2	0	2	12	8	4	0	0
13	Lepidosteus osseus (L.)	Gar Pike	1	1	2	1	1	0	0	0
14	Lepomis gibbosus (L.)	Pumpkin Seed	4	0	4	[b] 24	6	[b] 1	6	[b] 11
15	Micropterus dolomieu (Lacep.)	Smallmouthed Black Bass	6	0	6	[c]1489	[c] 272	20	1194	3
16	Moxostoma aureolum (Le Sueur)	Lake Red Horse	2	2	4	154	0	0	154	0
17	Perca flavescens (Mitch.)	Yellow Perch	28	0	28	155	5	23	1	126
18	Roccus chrysops (Raf.)	White Bass	1	0	1	105	94	11	0	0
19	Stizostedion canadense (C. H. Smith)	Sauger	3	0	3	25	0	23	2	0
20	Stizostedion vitreum (Mitch.)	Wall Eye	6	0	6	227	0	96	130	1
	Total number of species, 20. Total number of individuals		95	7	102					
	Total number of species free from the parasite at the head of the column						5	6	7	13
	Total number of individuals free from the parasite at the head of the column						41	45	44	62
Also examined:										
	Merula migratoria (L.)	Robin	1	0	1	7	[f] 7	0	0	0
	Larus philadelphia Ord.	Bonaparte's Gull	13	0	13	[g] 51	28	11	0	0
	Chelydra serpentina (L.)	Snapping Turtle	2	0	2	[h]250	0	0	0	[h]250
	Chrysemys marginata (Agassiz)	Mud Turtle	1	0	1	[i] 16	[i] 16	0	0	0
	Anodonta ovata Barnes; Unio gracilis Lea	Mussel	[h]33	[h]17	50	[k]	[k]			

Names after Jordan, Manual of the Vertebrates, fifth edition, 1890.

a The number of Distomata in one specimen was estimated at 3,000; only one-third was counted with a result of 1,023.

b Also an indefinite number of cysts in the liver.

c The total number is too small since there was also an unknown (large) number of a very small Distoma, of which only a few were preserved and included in the figures given.

d Intermediate between A. natalis and A. nebulosus, having 23 rays in the anal fin.

e From gills of two specimens only.

f Distoma macrourum Rudolphi.

g Including 12 which cannot be assigned to any order at present.

h Estimated.

i Monostoma n. sp.

k The foot was filled with encysted Cercariea which have not been identified as yet. The number present in each specimen was almost incalculable. About two-thirds of the mussels were infected.