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Report on the Research Done on
Amphipoda of Michigan

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In ^ebeginning a study of the biology of the Amphipoda of Michigan, one of the first things to be discovered is the habitats and localities in which these animals are found.

Temperature was one factor considered. Hyaella knickerbockeri has been found in water registering as low as 10 c. in the spring water at the Gorge, and ranging as high as 25.5 C. in the Chara beds on the south-eastern shore of Ocqueoc Lake. Some of the extreme variation might be accredited to the fact that the spring water in the Gorge had had no opportunity to be heated by the sun, whereas the shore line of Ocqueoc Lake is openly exposed to sunlight for a good share of the day. The Gammarus species were found in water varying from 12.0 C. in Carp Creek to 15.5 C. in Mill Creek.

Most of the specimens were collected at a depth of from 2 in. to 8 in. in the water. A few were collected in water about 2 ft. deep, as in Mullet Lake, and one small collection was made in water of 4 ft. on the declivity of Grapevine Cove.

No chemical analyses were taken. That part of the survey will be made at a later date. It was observed, however, that these animals were especially abundant in marly waters.

The current varied in swiftness from the rapidly flowing waters of Mill Creek to the sheltered, quiet waters of the Hook Point cove on Douglas Lake, and the spring pond near the dam on Maple River. In the quieter waters only Hyaella knickerbockeri was found, whereas the species of Gammarus were found only in streams having decidedly strong flow, or in the constantly moving waters of the Straits of Mackinac.

The vegetation most frequented by the amphipods includes Kyriophyllum, Chara, Anacharis, and Ceratophyllum. Other plants found with amphipods among their foliage were Oedogonium, Utricularia, Nitella, an aquatic Ranunculus, and among the mosses Fontanalis and Amblystegium. Found associated with these plants, but not harboring the animals in any abundance are the various species of Potamogeton, Lemna, Ruphar, Nyphaea, Eleocharis, and Scirpus. Some of these latter plants may afford shelter and protection, but are not apparently of any importance as food.

Animals found in association with amphipods include various species of the Isopoda, larvae of the Odonata and various Diptera, colonial rotifers, Notonectidae, Hydrometridae, Hydrachnida, Porifera, and various species of clams and aquatic snails. No survey was made of the microscopic fauna in the localities from which collections were made.

Of the collections made, the following distribution was found to occur:

Locality	<i>Hyalella knickerbockeri</i>	<i>Gammarus limnaeus</i>	<i>Gammarus fasciatus</i>	Water Temp.	Date
Gorge springs	x			12.0	6-30
Grapevine Cove	x			21.0	7-6
Nigger Creek	x	x		17.0	7-2
Lancaster Lake (eastshore)	x			17.5	7-12
Bessey Creek (at source)	x			18.0	7-12
Black Lake (south end)	x			22.0	7-19
Mud Creek (at Black Lake)	x			22.0	7-19
Maple River spring pond	x			---	7-20
Ocqueoc Lake (south-east)	x			25.5	7-23
Ocqueoc River (near bridge)	x			23.5	7-23
Carp Creek (at iron bridge)	x	x		12.5	7-29
Carp River (east of bridge)	x			18.0	8-6
Carp Lake (west shore)	x			21.0	8-6
Straits of Mackinac (Mill Cr.)		x		---	8-6
Mill Creek (at highway bridge)		x	x	15.5	8-6
Hook Point	x			24.5	8-9
Deer Point	x			24.0	8-9
Lake Mary (Bois Blanc)	x			---	8-12
Echo Lake (Bois Blanc)	x			---	8-12
Pigeon River (at mouth)	x			---	8-16
Mullet Lake (at Pigeon R.)	x			---	8-16

Of the places surveyed, the following locations appeared to have no amphipods:

- Sedge Point Pool
- Smith's Bog
- Sphagnum mats of East Lake, West Lake, Little Lake Sixteen

Hyalella knickerbockeri was found to occur in the following

population figures:

Locality	Total	♂	♀	(GRAVID) ♀+	Immat. - sex undeter.	Date
Lancaster Lake (east shore)	13	1	10	2		7-12
Maple River spring pond	16	2	13	1		7-20
Black Lake (south end)	155	29	93	33		7-19
Mud Creek (at Black Lake)	41	10	28	3		7-19
Carp River (at bridge)	76	6	35	35		8-6
Carp River (east of bridge)	21	6	6	9		8-6
Carp River (in <u>Utricularia</u>)	156	68	43	40	4	8-6
Carp Lake (west shore)	11	4	4	3		8-6
Hook Point	41	11	14	15	1	8-9
Deer Point	77	16	27	34		8-9
Lake Mary (Bois Blanc)	5	1	3	1		8-12
Echo Lake (Bois Blanc)	2		1	1		8-12
Mullet Lake (At Pigeon River)	49	6	28	14	1	8-16
Pigeon River (near mouth)	397	35	271	91		8-16

Of the Pigeon River collection, many of the females examined were not full-sized, whereas the males were apparently full-grown, or nearly so.

Census surveys of the Gammarus limnaeus collected revealed the following

Locality	Total	♂	Q _x	Q _{x+}	Date
Carp Creek (at iron bridge)	45	6	7	1	8-29
Str. of Mackinac (Mill Cr.)	10	2	20	18	8-6

At Mill Creek a number of specimens of a Gammarus species were collected, some of which revealed characteristics of G. limnaeus, others of G. fasciatus. However, many of the specimens, a number of which were not full-sized, showed a mixture of characteristics of the two species. Further identification and determination has been left for a later date.

Collecting methods involved the use of a fine metal screening pan. This was held under the plants to be examined in such a way that the wash from the plants would be carried by whatever current was present into the pan. The debris, if any, was then screened out by washing and swirling the pan in the water, and the material remaining was put into collecting jars. Care had to be taken to avoid over-crowding the jars with either specimens or vegetation, especially if the collections had to remain in the jars for long periods of time. The jars were kept in the shade as much as possible, also, if the collection had to be left for several hours or more.

Preservation of collected material is in 4% formaldehyde.

The next problem encountered in this study is that of rearing the amphipods in the laboratory. Experiments were first tried using surface water pumped into the aquarium shelter and dripped off the top of the containers. When this proved unsatisfactory, rubber tubing was used to carry the incoming water to the base of the jars so that the water would be thoroughly mixed and the oxygen-less water drained off the top. This method was more successful, but not completely satisfactory. Perhaps the main difficulty in the arrangement was the wide variation in temperature. As the surface of the water was warmed and cooled by the varying intensities of sunlight, the water temperature would vary within the jars, rising sometimes to an almost lukewarm temperature.

The next attempt was in the use of an air pump of the magnetic field type. A tube carried the jet of air out through Y-tubes and into rubber tubing opening at the base of the jars. Two jars could be well aerated simultaneously, and for short periods of time, four jars could receive air from the same pump. In this way the temperature was maintained around 20.0° C. and there was a constant supply of fresh oxygen.

Wide-mouthed gallon jars were used as containers, with some type of vegetation suitable for food for the amphipods included in each jar.

Another method of culturing which was successful for the raising of small groups of animals, and for separating gravid females for observation, was to merely place them in finger-bowls or jars, even as small as 2 oz. packer jars, along with some vegetation for food. The amphipods seemingly lived and thrived, continuing to copulate and raise the young found in the brood pouches. The water was changed weekly, and replenished more frequently as it evaporated.

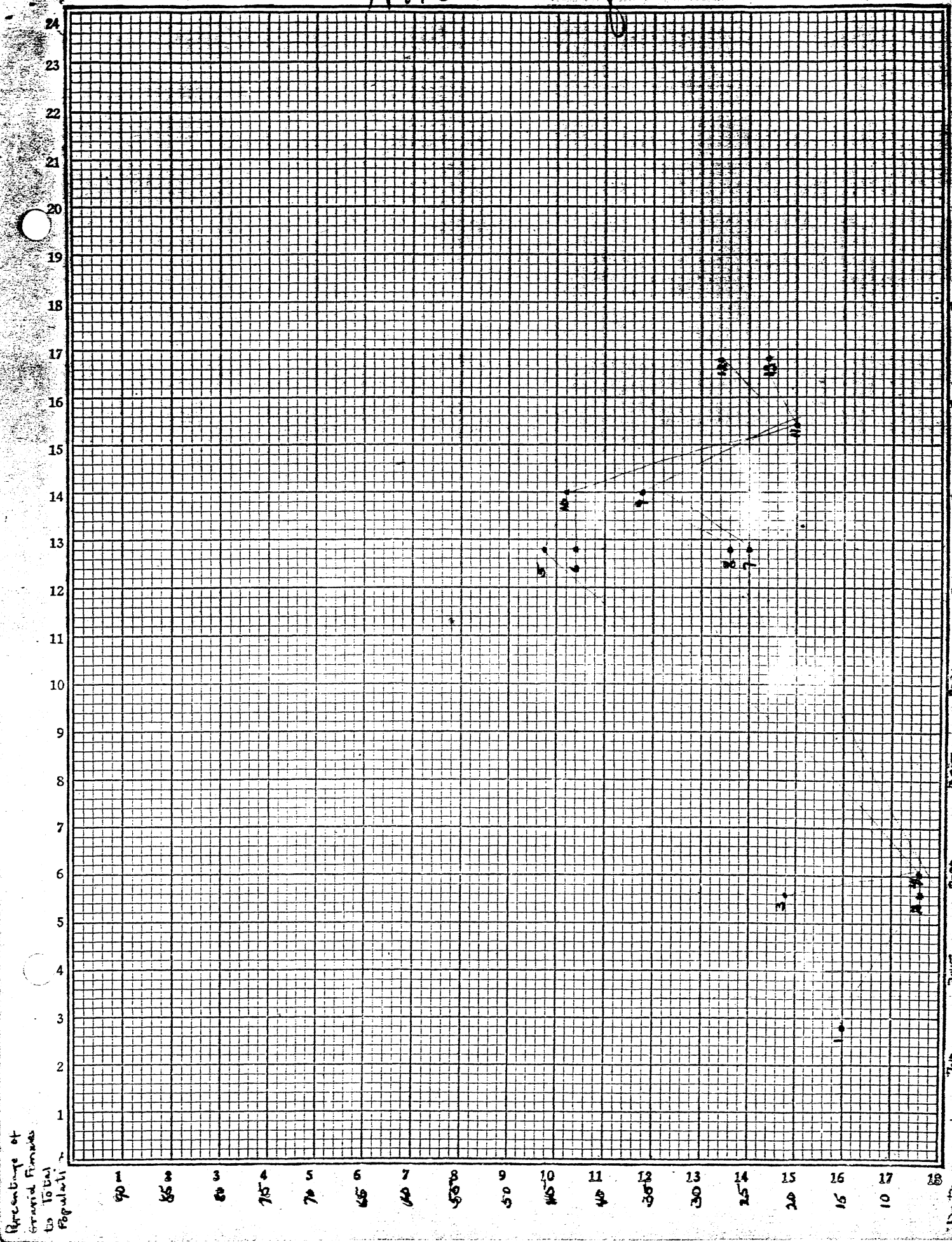
Not a great deal of the living habits of this animal were observed during this session. Copulation was found to be occurring at least among two specimens of every collection, from the earliest recorded date, June 30, until the latest date, August 16. This was found to be true of both Hyaella knickerbockeri and the Gammarus species. The percentage of gravid females apparently increased, however, as the season progressed. (See graph). From the census figures, it likewise appears that the percentage of males is considerably less than that of the females, but there seemed no correlation between the fluctuation in percent with any factors thus far observed.

Feeding habits of Gammarus limnaeus in nature

Feeding habits were observed from field collections. As has been noted, the favorite plant foods in nature seemed to be Ceratophyllum, Utricularia, Chara, and Anacharis. Other plant material may, however, be used in smaller quantities, as well as debris from decaying vegetation found in tiny particles in the water. It was likewise noted in the laboratory that the amphipods attacked the bodies of their deceased fellows, using them as food, along with the dead bodies of isopods and even a Nectid. There were no instances observed in which any living animals were attacked.

In observing gravid females, Hyaella was found to carry six or seven eggs in the brood pouch usually, whereas in Gammarus limnaeus the number was eight or often nine.

Not clear. Too faint



Percentage of Gravid Females to Total Population

Date

Percentage of Gravid Females to Total Population Through Summer Months

790 795 800 805 810 815 820 825 830 835 840 845 850 855 860 865 870 875 880 885 890 895 900 905 910 915 920 925 930 935 940 945 950 955 960 965 970 975 980 985 990 995

Localities

1. Lancaster Lake (east shore)
2. Mud Creek (at Black Lake)
3. Black Lake (south end)
4. Maple River spring pond
5. Carp River - at bridge
6. Carp River - east of bridge
7. Carp River - east of bridge, in straggles
8. Carp Lake
9. Boat Point
10. Deer Point
11. Lake Mary (Bas Blanc Island)
12. Mullet Lake (at mouth of Pigeon River)
13. Pigeon River (near mouth)

This evidence is not conclusive because of the varying localities. It does point to a peak, however, occurring in the first few weeks of August, and a decline following that.

Several molted skins were seen among the laboratory specimens, though the actual process of molting was not observed completely at any time. The exoskeleton is split transversely across the dorsal side at the region marking the anterior of the abdomen. The anterior portion is tilted forward over the head, with the pereopods and gnathopods and head appendages slipping out, whereas the posterior section is tilted back and slipped off in a similar manner, thus leaving the cast in two sections joined on the ventral side. No measurements were made of growth rate, nor records made of number of molts per season for an individual.

To be done
cases
color

The color of Hyaella knickerbockeri was found to vary considerably. In the Mud Creek collection, taken from Myriophyllum chiefly, specimens found varied from shell pink to bright green, including shades of tan and blue, also. The question arises as to the influence of types of food upon coloration. The specimens taken from the Chara-Myriophyllum beds in Pigeon River were a more uniformly green color, whereas amphipods kept in the laboratory with Lemna and Ablystiegium were ultimately a steel blue shade.

In summary, most of the work done this session was in locating habitats where amphipods were found, analyzing the localities for temperature and vegetation, and finding suitable means of keeping them alive in aquaria. The rest of the time was spent in a microscopic study of the external morphological features, and observations in the field and laboratory of their living habits.

Acknowledgement is here given to Dr. W. C. Steere for his identifications of mosses found harboring amphipods.