THE BIOLOGY OF THE ISOPODA OF THE REGION OF DOUGLAS LAKE, MICHIGAN (CONTINUATION)

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General Statement of the Problem

This study, a continuation,of the problem begun last summer, was made from June 27 to August 16, 1939. During this time, the places visited last year were revisited in order to determine if the same results would be obtained. Other areas were also visited. Collections were made in only Emmet, Cheboygan and Presque Isle Counties. Besides collecting, an attempt was made in rearing two species of terrestrial and one species of Aquatic Isopods. Size distribution and growth curves were also worked out for a population of Cylisticus convexus.

TERRESTRIAL ISOPODS

Local Species

The list of local species has been unchanged. Only the four species recorded last year were collected this summer. They are Cylisticus convexus, Porcellio rathkei, Porcellio scaber and Oniscus asellus.

DISTRIBUTION

Terrestrial Isopods were collected along the shores of still and running waters, in hard-woods, open fields, gutters along roads, in abandoned farm yards and in comparable situations.

Isopods were absent from all collections made in the Aspens and in the Pine Woods. The former situations were usually dry and there was little protection afforded on the forest floor. There were two exceptions to the above, however; the apsens along Ocqueoc River, and those north of Vincent Lake. In both of the above cases there was an abundance of rotting wood and other debris on the forest floor for protection, and both situations were as moist as comparable situations were specimens were taken. Hence lack of necessary moisture and desired protection do not seem to be the limiting factors in the aspens. All pine woods visited have had dry floors, with little else except a thick covering of needles.

Habitats

Lake and stream shores: These situations proved to be the best collecting situations of all the places studied. The beaches, where collections were made, can be divided into two groups: sandy shores with debris, and gravel shores. A rather stricking specificity was noted in regards to these two situations. Cylistcus convexus dominated or was found alone on gravel shores. While Porcellio rathkei was found as the dominant species on the sandy shores.

Gravel Beaches: As already mentioned Cylisticus convexus was the dominant species in this habitat. Occassionally a solitary Porcellio rathkei was collected with a group of C. convexus. Most collections were taken from the area of the middle beach. Here under partly buried drift wood, under

rocks, and debris, Cylisticus convexus was to be found in large numbers. Usually those rocks which were barely embedded in the gravel were best for collecting. Several collections were made by merely digging away the top gravels. Aggregations of Cylisticus convexus were the ordinary occurrence and solitary specimens rather rare.

Sandy Shores: In this type of situation Porcellio rathkei dominated, with a rare Cylisticus convexus and at times groups of Porcellio scaber. Here too, most collections were made on the middle beach. Under drift wood and fallen timbers most of the specimens were collected. Along the shores of Munro Lake, Porcellio rathkei were taken under cow manure, occassional rocks as well as under drift wood. Aggregations were not usual as was the case of Cylisticus convexus on gravel beaches, instead specimens were found scattered along the length of the drift wood.

Deciduous Woods: With the exception of the Aspens, Isopods were found in all the deciduous woods studied. In these situations no one species dominated. Porcellio rathkei, Porcellio scaber, and Cylisticus convexus were all collected and in approximately the same numbers. These Isopods were found under rotting wood and in adjacent leaf mold. Oniscus asellus was collected in similar habitats, but only on Mackinac Island.

Open fields, farm yards, along roads, etc.: Porcellio rathkei was the dominant species in these localities, however, Cylisticus convexus was also collected but not in as sparse numbers as in other situations where it was not dominant.

The following chart is a recapitulation of the habitats studied, and species found in each.

CHART I

Localities of Terrestrial Isopods collected summer 1939

LOCALITY	HABITAT	SITUATION	SPECIES FOUND
W.Shore,S. Fishtail Bay	Gravel Beach	Under stones, wood,& debris moist	Cylisticus convexus
Mackinac Is.	Birch wood	Under liter of forest floor	Oniscus asellus
E.Burt Lake	Field	Under stones, logs.Moist to dry	Cylisticus convexus, Porcellio rathkei, Porcellio scaber
E.Munro Lake	Sandy shore	Under manure, drift wood, decaying wood. Moist to wet.	Porcellio rathkei, Porcellio scaber
W.Lancaster Lake	Weedy shore	Under drift on margin near woods. Wet	Porcellio rathkei
W.of Maple R.	Field	Under logs,& wood in moist depressions, rotting tree stumps.	Porcellio rathkei
E .Shore Vincent L.	Weedy shore	Under planks. Wet.	Porcellio rathkei
Banks Occueoc Falls	Banks of R.	In moss along river bank.Wet	Porcellio rathkei

Habitat - General Type of Location
Situation - Specific location in the habitat
Is. - Island E. - East
L. - Lake S. - South
R. - River W. - West

Laboratory Studies:

Besides the field observations and the collecting, laboratory studies were also attempted. Plaster of paris cups,placed in pans of water, were set up as rearing cages. In 24 of these cups were placed female Porcellio rathkei and in the other 24 were placed female Cylisticus convexus. All females were carrying eggs or young in marsupia. Leaves beginning to disintergrate were placed in the cups as food. These cups were observed daily, but since there was no noticeable daily differences, weekly observations are charted below. The times of molting, as well as number of young are shown on the following charts.

CHART II

PORCELLIO RATHKEI
Showing number of young and times of molts. July 3 to August 16
* Molting took place in this week

Con. No.	7-6	7-13	7-20	7-27	8-5	8-12	8-16
5	-	36	*15	2	1	1	1
7	-	10	2	0	0	0	0
8	-	28	*28	26	24	23	23
9	-	16	4	4	1	1	1
10	-	-	35	20	15	12	9
12	-	2	2	2	0	0	0
13	-	-	25	15	2	0	0
16	-	-	6	2	0	0	0
19	-	15	12	11	9	*3	0
21	-	17	10	3	0	0	0

Con. - Container. 7-6 - July 6, week of

Only those containers sited that contained young.

CHART III

CYLISTICUS CONVEXUS
Showing number of young and times of molt
Rearing from July 3 to August 16

Con.	WEEK OF					
	7-13	7-20	7-27	8-5	8-12	8-16
25	17	10	10	5	3	0
26	25	25	25	25	*20	20
27	20	20	15	15	*13	13
28	32	32	28	*27	24	22
29	35	32	30	30	*30	30
30	12	4	0	0	0	0
32	-	15	15	15	15	15
33	-	20	*15	15	*15	5
34	2	18	20	20	*15	12
36	-	20	20	15	15	* 9
37	17	10	10	10	10	*10
38	15	*15	11	11	11	9
39	23	*40	39	35	*32	30
40	17	10	5	5	5	4
41	31	*30	30	30	*25	23
42	7	* 7	2	2	2	2
43	-	-	8	10	*10	9
44	30	30	5	5	* 4	3
46	17	12	10	5	* 5	3
47	30	*30	20	17	*15	12
48	20	9	5	* 5	2	2

Only those containers that contained young were sited

It will be noted in both charts that there is a wide range in the number born, as well as in the death rate of these young. The number of young as shown in the above charts is lower than the figure obtained last year. But in contrast, more survived this summer than last. As these observations are on laboratory specimens, and as influences were hard to control, and since the food was different each year, these differences may not be significant. Last year in a similar laboratory study, but feeding potato instead of rotting leaves, it was found that the young were born over a period of time. This year, however, all young left the marsupium at about the same time. There were a few exceptions to this: young of cups # 34 and 39 being outstanding exceptions.

Growth of Young:

There was no noticeable differences between the growth of the young of the two genera studied. At birth the young were approximately 1.5 mm. in length. They continued to grow and in some cases it would appear that at this early stage molting is not necessary for growth. The above charts show (by a *) the weeks in which molting definitely occured. But since the small size of these specimens makes it very difficult to determine actual molting, there were several groups where molting was not observed, and where it may have occurred. At the end of the seventh week most of the young were 3 to 4 mm. long and orange in color.

~~Number of Broods:~~

~~Observations from the sixth week on showed that~~

Number of Broods

Observations from the sixth week on, showed that about half of the females were carrying developing eggs. In other words there appears to be at least two broods during the summer, with a possible third appearing before observations were begun. (Size of measured specimens seem to point to this.)

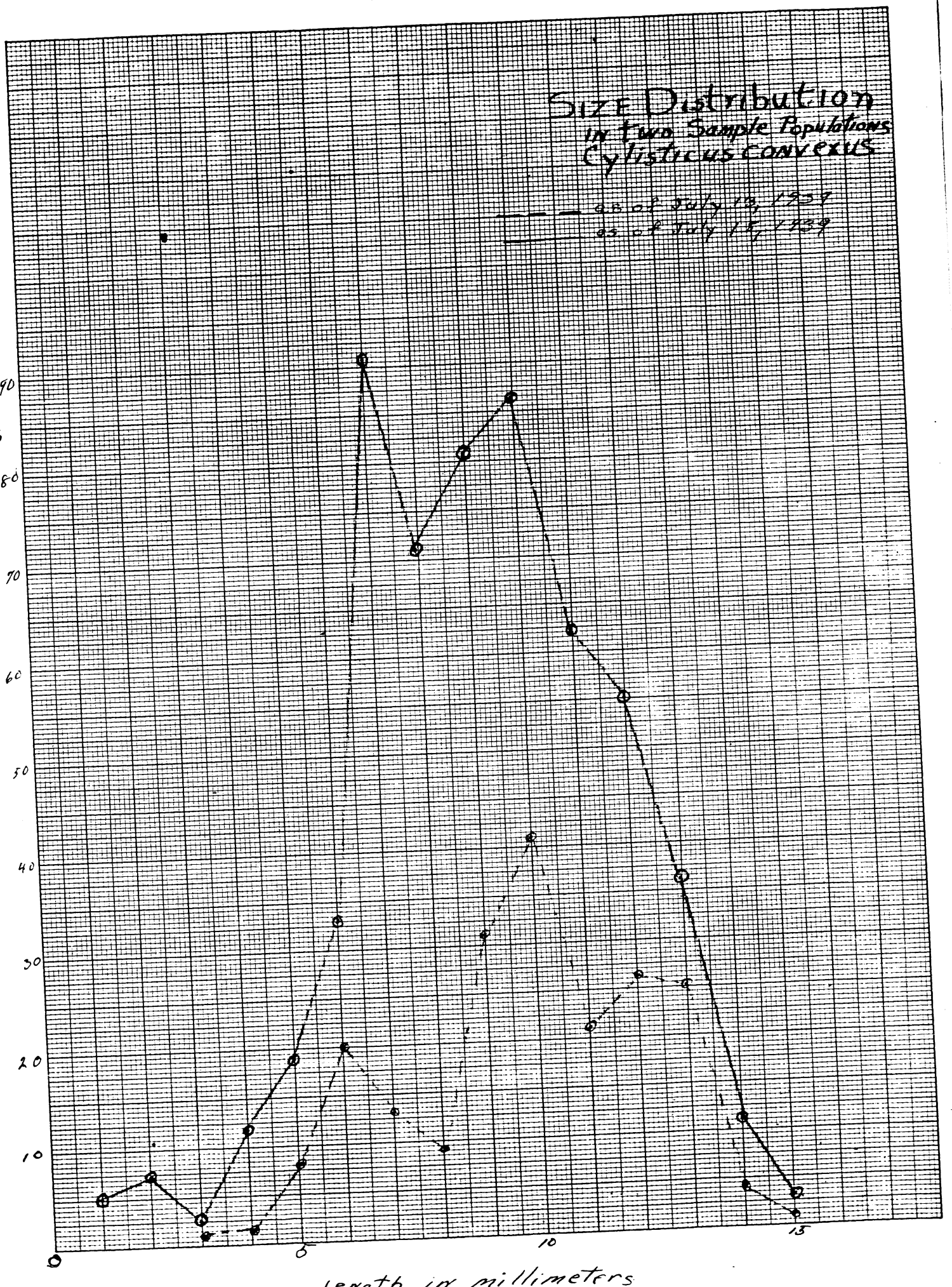
Moulting

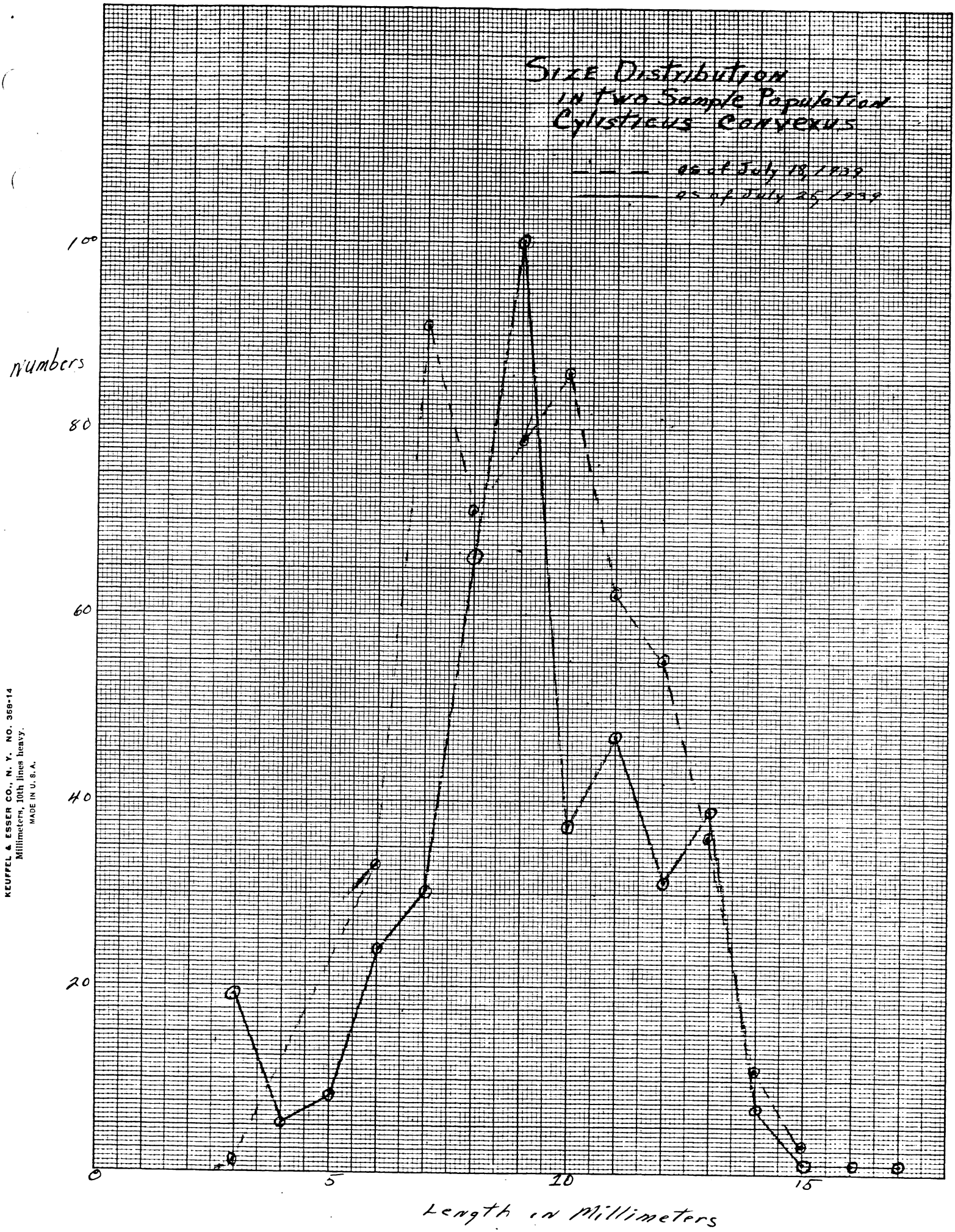
Last year it was found that following the emptying of the marsupium the female molted. This was not the case this summer - food differences may be one of the reasons. Half of the females molted this summer from the sixth to the seventh week after giving birth to young. The method of moulting was found to be as follows. The head and the first four thoracis segments moult first. The exuviae thus formed may come off as an entity or be broken into several pieces. About a day later, when the anterior part has become normal again, the last three thoracic segments and the abdomen moulted. These exuviae usually pass off over the posterior end as a whole cast. Exuviae were never noticed to be eaten by the adults, but several of the young at various times were found to be breaking the exuviae up and probably feeding on them.

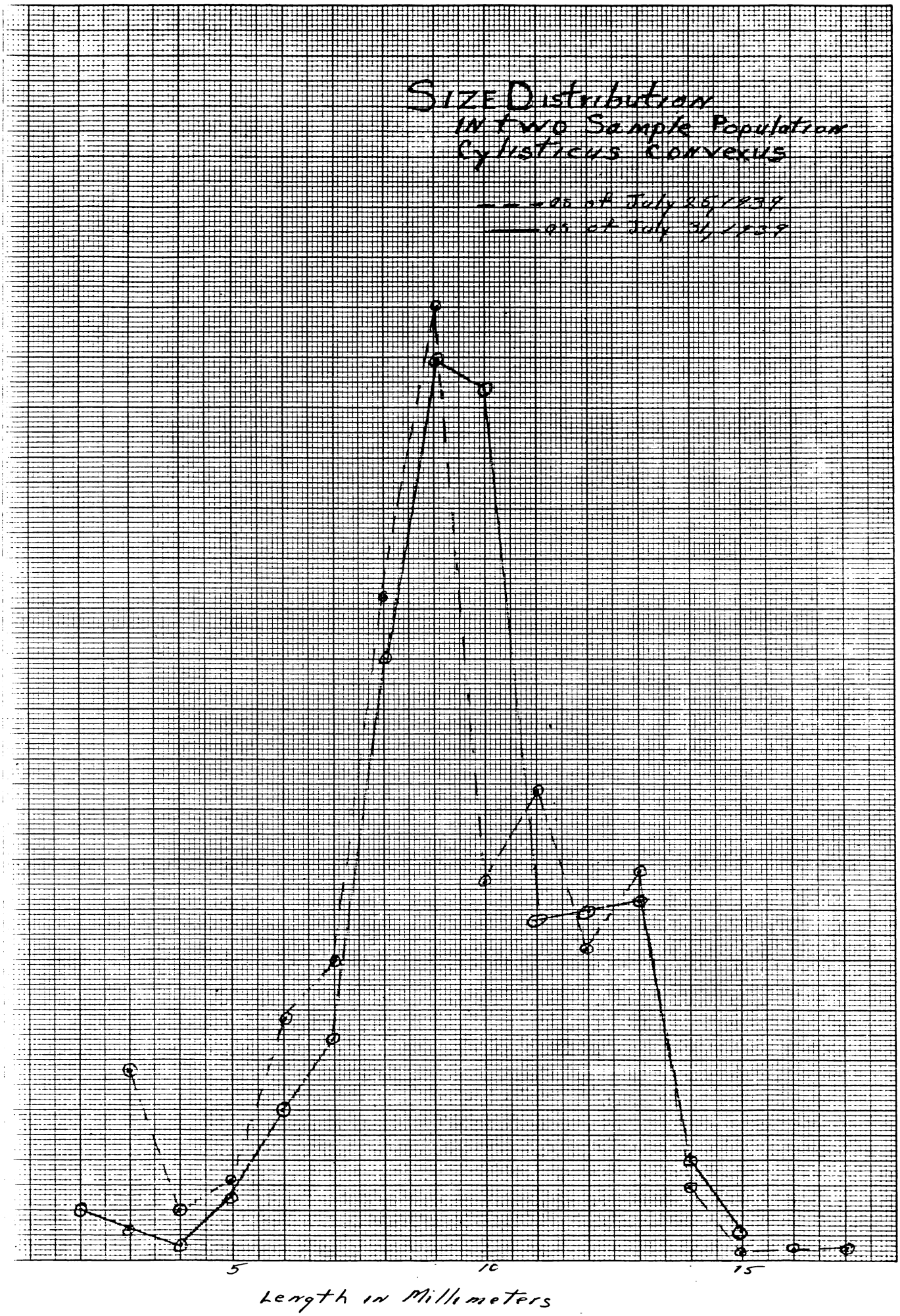
Size Distribution

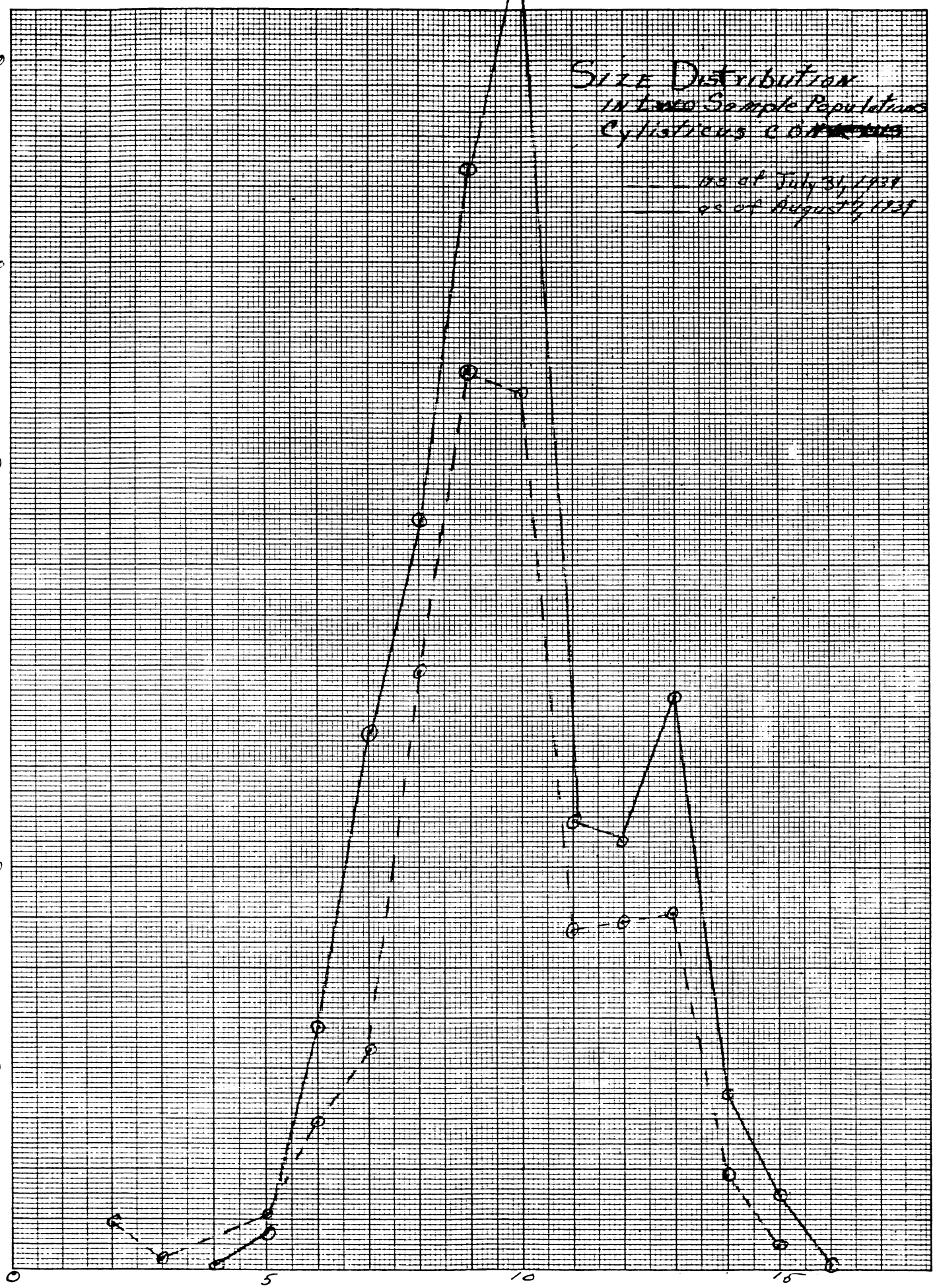
An attempt was made to show the size variation or distribution of Cylisticus convexus, from week to week. No one set of organisms was used as measurements usually entailed lose of appendages. Therefore in order to eliminate this factor of regeneration, a separate set of specimens

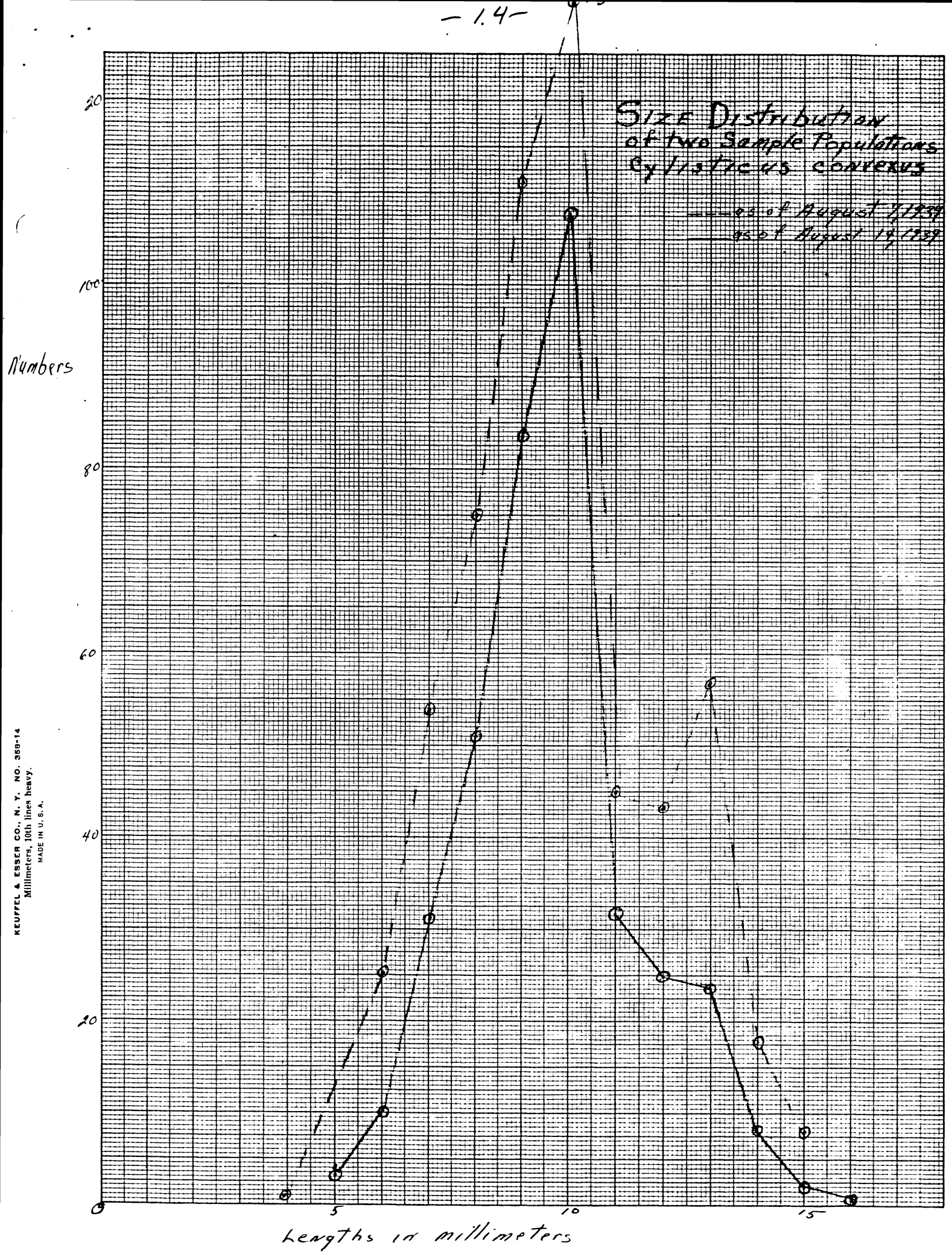
was used for each set of measurements. However, all specimens were collected from the same area (middle beach of the western shorenof South Fishtail Bay, Douglas Lake, Michigan), and under approximately the same conditions. (Changes in moisture and other weather factors were not controlled and were not always the same.) The following graphs show the size distribution of Cylisticus convexus at various dates. It will be noted that most of the modes of these graphs have approximately the same shape, although not located on the points. There is a minimum number of 3 to 5mm. specimens in all counts; then a gradual rise to the peak (counts of July 13 and 18 have a secondary peak first); following the peak there is a drop and then a gradual rise or slight decrease in the drop; followed by a continued drop and finally a leveling off of the numbers above 15mm in length. No special method of collection was used for taking these "sample populations".



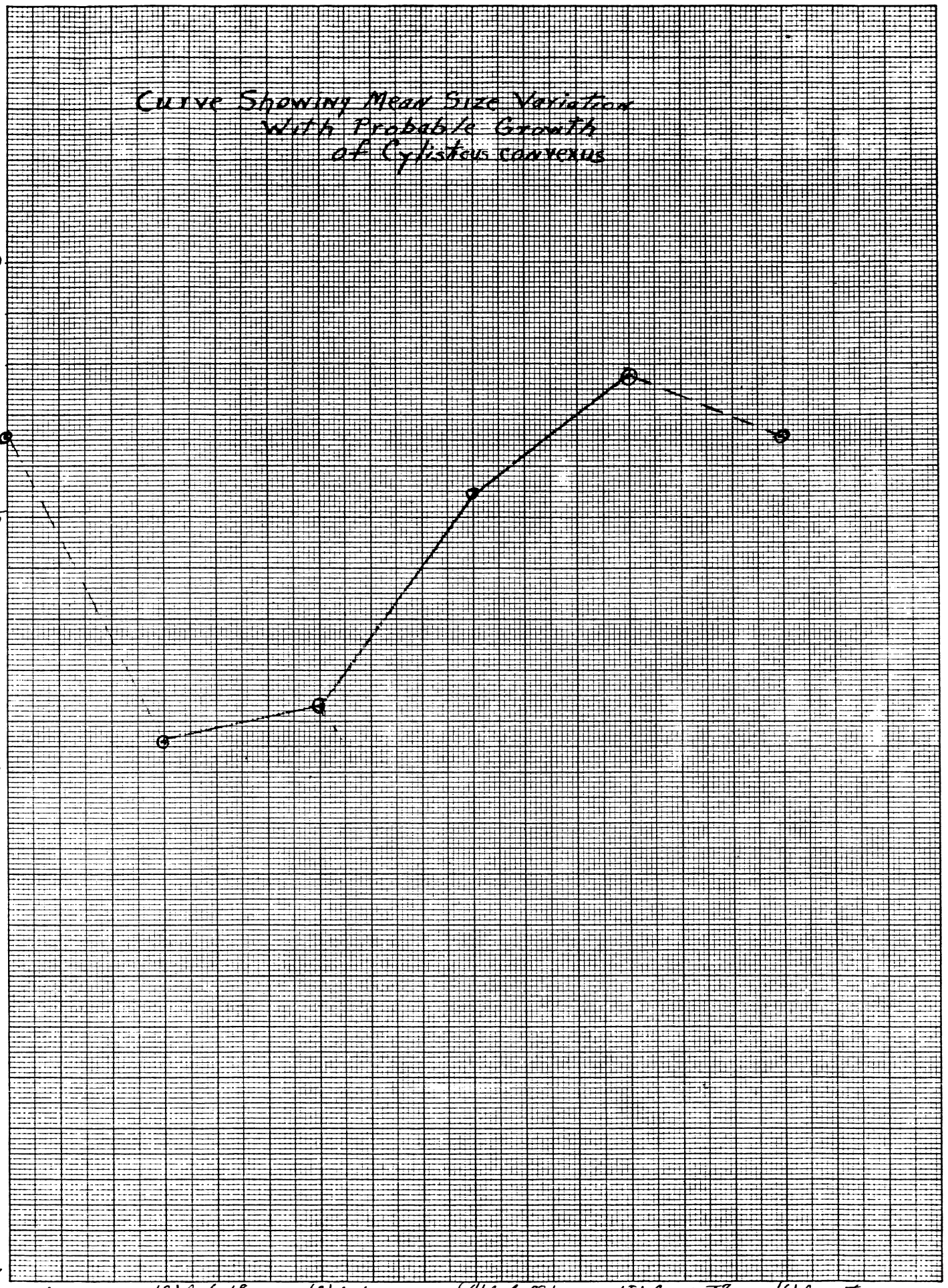



SIZE Distribution
in two Sample Populations
Cylistrcus Convexus
— — — ♂s at July 25, 1939
——— ♂s at July 31, 1939
5
10
15
Length in Millimeters





These above curves do not show much as individual curves, except the size distribution of that set of organisms on that specific date. By figuring out, however, the mean size ($M = a + i\frac{\Sigma fd'}{N}$) on these specific dates and plotting these calculations, one can show growth over the entire period. The following graph (#6) was such an attempt. Omitting the first and last counts, the plotted means show a gradual growth over the four weeks period. If, however, these first and last means are plotted, the graph might show a decrease and a dying off of one generation with an increase in the succeeding generation following.(The larger specimens being the ones that have died). Both the first and last counts were rather low in the number of specimens collected (116 and 379 respectfully) and it may be that the crudeness of the collecting method eliminated the larger specimens.



AQUATIC ISOPODS

Local Species

During the summer of 1938, 3 species of aquatic Isopods were collected - Asellus communis, Mancasellus tenax and Mancasellus macrourus. This summer, however, only the first two were collected. Mancasellus macrourus not being found.

Distribution

The specimens collected were found in muddy and clear creeks (heavy and sparse vegetation), in lakes at mouth of stream and along wind swept shore (?), and in the waters of the Straits of Mackinac.

As yet no determining factors have been found that will link these collecting grounds together.

Habitats

Clear running waters: Asellus communis was the only Isopod collected in this type of habitat. At Carp Creek it was found sparsely among the vegetation (Chara and Potomageton) and abundantly in crevices in submerged wood on the bottom. At Mill Creek they were collected from under surfaces of rocks and among the submerged moss.

Muddy sluggish streams; Mancasellus tenax was collected here and only here. Nigger Creek was the only habitat of this sort studied. Mancasellus tenax was collected from off the under surfaces of lily pads and in the crevices in submerged water soaked wood.

Lakes: Two collections were made in lakes, but [illegible] of them by the writer. One collection - a slime [illegible] the back of a Lymnea from Grapevine Point, Douglas [illegible] ined Asellus communis and Mancasellus tenax. The [illegible] however after repeated searching the shoal has failed [illegible] ny Isopods and is inclinded to discredit the above [illegible]. The other collection was taken at the mouth of [illegible] k at Burt Lake and these specimens were probably [illegible] n there from the creek in the storm the day [illegible] collection was made. The writer has also searched [illegible] at other times and has found nothing. Asellus [illegible], however, is to be found in large numbers in the [illegible] llections made by the Invertebrate Class in the [illegible], contained Asellus communis, which was found in and [illegible] mosses along the shore, but in the water.

The following chart is a recapitulation of these [illegible] abitats.

CHART IV

[illegible]S OF AQUATIC ISOPODS COLLECTED JULY THROUGH AUGUST

[illegible]TY.	HABITAT	SITUATION	SPECIES FOUND
[illegible]ek	Along the edges in plants and on wood	On Plant leaves, In rotting wood	Asellus communis
[illegible]eek	Along margins heavy plant growth abundant mud	Undersurface of lily pads	Mancasellus tenax
[illegible]nd [illegible]k		Under mosses & stones	Asellus communis

Laboratory studies

Asellus communis was reared in the laboratory in two gallon aquaria. Those placed in finger bowls did not survive even the first week. Those in the aquaria, however, lived and gave birth to the first brood of young, and began brooding or incubating a second cluster of eggs. No definite observations were made on these specimens, but this was merely an attempt to try rearing them.

SUMMARY

1. Six species of Isopods were collected; Oniscus asellus, Cylisticus convexus, Porcellio rathkei, Porcellio scaber, Asellus communis and Mancasellus tenax.

2. Terrestrial Isopods were not found in pine and aspen woods.

3. There are at least two broods of young each year for Cylisticus convexus, with a possible third.

4. Female Cylisticus convexus moult between broods, generally.

5. In moulting the exuviae from head and first 4 thoracic segments are shed first, entire or broken. The last three thoracic segments and the abdomen exuviae are shed later by the animal crawling out of it.

6. The majority of Cylisticus convexus collected were from 9.5 to 9.7mm. in length.

7. From July 18 to August 7, Cylisticus convexus grwe in length from a mean of 9.06 to 9.77mm in length.

KEY TO THE LOCAL SPECIES OF THE ISOPODS OF DOUGLAS LAKE REGION, MICHIGAN

A. Abdominal appendages exposed (not covered with an operculum). Body not extremely flattened dorso-ventrally. Tribe Oniscoidea.

B. Uropoda long, reaching beyond the terminal segment of the abdomen. Family Oniscidae.

C. Flagellum of conspicuous antennae triarticulate (3 divisions). No special respiratory organs visible on abdominal appendages. ONISCUS ASELLUS Linnaeus.

C'. Flagellum of conspicuous antennae biarticulate (2 divisions). Tracheae present on at least the first and second abdominal segments.

D. Body very convex, capable of being rolled into a a perfect ball. Body segments nearly smooth (color pattern - longitudional row of yellowish spots on either side of body. Between median line and rows of spots are yellowish wavy lines CYLISTICUS CONVEXUS (De Geer)

D'. Body somewhat flat and broad, not very convex. Body segments rough, from low granules to tubercles. Color pattern different from above. Genus Porcellio.

E. Body usually with 3 longitudional lines of whitish spots, or two marginal lines with scattered spots over remainder of body. Surface of body covered with low granules. PORCELLIO RATHKEI Brandt.

E'. Body without spots, generally uniform in color; with occassionally lighter margin al borders. Body covered with tubercles, visible without magnification. PORCELLIO SCABER Latreille

B'. Uropoda short, not reaching beyond the terminal segment of the abdomen. ARMADILLIDIUM VULGARE (Latreille)

A'. Abdominal appendages covered with an operculum. Body definitely flattened dorso-ventrally. Tribe Aselloidea

B. Lateral margins of head entire. Next to last segment of first pair of legs with a prominent process on its inferior margin. Mandibles with a palp. ASELLUS COMMUNIS Say.

B'. Lateral margins of head not entire. Mandibles without a palp.

C. Lateral margins of head with a cleft on either side. 2 triangular processes on next to last segment of first pair of legs. MANCASELLUS MACROURUS Garman.

C'. Lateral margins of head expanded into an anterior and posterior lobe. The posterior lobe may be produced laterally beyond the anterior lobe. One triangular process on next to last segment of the first pair of legs. MANCASELLUS TENAX (Smith). 7-31-39.