RELATIVE DAILY ABUNDANCE OF PLANKTONIC CRUSTACEA IN THE ISLAND REGION OF WESTERN LAKE ERIE*

JERRY H. HUBSCHMAN

Department of Zoology and Entomology, Ohio State University, Columbus 10

INTRODUCTION

The abundance and distribution of plankton crustacea in western Lake Erie has been discussed by several investigators in the past thirty years. Wright and Tidd (1933) found, "The crustacea were not uniformly distributed in the Island Section, but there was no evidence that they were consistantly abundant at certain stations and consistantly rare in others." Chandler (1939) showed great fluctuations in the abundance of plankton at specific localities throughout the year. Jahoda (1949) studied only the genus *Diaptomus* in an area overlapping that of the other investigators. In all cases the sampling by these workers was done at weekly or, in some cases, longer intervals. None considered in detail daily fluctuations.

Many recent limnological studies have emphasized the role of plankton in the productivity of natural bodies of water. This approach has resulted in concern with the bulk of various components of the plankton but overlooks numerical relationships between component groups and short term fluctuations in abundance of certain important species.

Damage to fish fry by cyclopoid copepods was reported by Davis (1959). The role of cyclopoids as predators of fry has been further evaluated by Fabian (1960). In view of the possible importance of population densities of carnivorous species in specific localities during certain critical periods, it seemed advisable to have some basis for comparing herbivore-carnivore plankton populations and evaluating the accuracy of sampling at weekly intervals.

METHODS

The period covered by this study was from June 30, to August 21, 1959. A single collection station was selected between Gibraltar and Middle Bass Islands which was considered to represent open water conditions of the island region. The station was located about one fourth of a mile west of the northeast end of Gibraltar Island at the intersection of ranges formed by the sign on the Cities Service fuel pier on South Bass Island and the tip of Gibraltar, and by the Middle Bass Island water tower and the number 2 bell buoy at the entrance to Put-In-Bay harbor.

Plankton was collected with the Juday Plankton Trap. Ten-liter samples were taken daily at three different depths. The depths of these samples were 0 meters (surface), 5 meters below the surface, and at the bottom. Due to oscillations in the lake, the depth at which the bottom sample was taken varied from day to day about an estimated mean of seven and one-half meters (Krecker, 1928). Regardless of lake level this sample was taken about one foot above the bottom.

The plankton concentrate was emptied from the bucket of the trap and immediately fixed in five percent formalin. The sample was taken back to the laboratory where distilled water was added to adjust the volume of concentrate to 25 ml. When a count was to be made, the organisms were shaken into suspension each time that an aliquot was drawn off. Five 1-ml aliquots were drawn off with a wide mouth volumetric pipette and delivered to the counting chamber.

*This study was carried out at the Franz Theodore Stone Laboratory, Put-In-Bay, Ohio.

A total differential count was then made of the crustacea present (see Welch, 1948).

Two groups of crustacea are dominant in the open water plankton of western Lake Erie. These are the Copepoda and the Cladocera. Other crustecea, namely Amphipoda and Ostracoda, occur in such small numbers that they may be considered insignificant. (These occured in concentrations far less than one organism per ten liters of water in the open lake.) Both carnivorous and herbivorours species of copepods and Cladocera are known. This differentiation seemed to be an appropriate one in view of possible support of the above mentioned investigations (Davis, 1959; Fabian, 1960). Accordingly, four categories of crustacea were considered in this study: calanoid copepods, cyclopoid copepods, Cladocera other than *Leptodora*, and *Leptodora*. The basis for these distinctions will be discussed later. Nauplii of copepods were not included in the tabulations, but both adult and copepodid stages were counted. Data from three different levels were added and means of each category were determined to give an average number per unit volume throughout the column (see table 1).

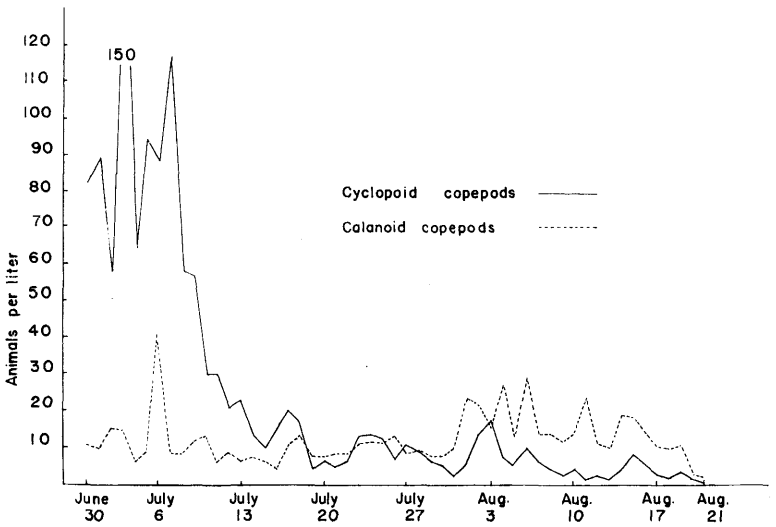

FIGURE 1. The daily population densities of cyclopoid and calanoid copepods collected at the same location daily in the Bass Island region of Lake Erie in 1959.

RESULTS

In past studies of Lake Erie, copepods have been categorized in different ways. Chandler (1939), while discussing copepods on the species level, summarized his quantitative data under one broad heading of "Copepods." Collection data were tabulated as "Cyclops" and "Diaptomus" by Wright and Tidd (1933) who recognized these as "dominant genera." It is assumed that "Cyclops" (also see Birge and Juday, 1912) includes other cyclopoid genera and that "Diaptomus" was used as a categorization of all calanoid genera.

There is a sound basis for such a division but the proper designation should be given to the groups. The two suborders of limnetic copepods are generally quite distinct in their feeding habits. The Calanoida, represented in Lake Erie by *Diaptomus*, *Limnocalanus*, and *Epischura*, are filter feeders which graze on small phytoplankters and debris (Marshall and Orr, 1955). The Cyclopoida are represented by several species of *Cyclops* and *Mesocyclops* which are particulate

TABLE 1

*Average daily populations of plankton crustacea in Lake Erie during the summer of 1959**

Date	Calanoida	Cyclopoida	*Leptodora*	Other Cladocera
June				
30	11.1	82.3	0	13.1
July				
1	10.2	89.4	0	9.0
2	15.5	58.3	1.0	24.2
3	15.1	150.3	1.8	17.1
4	6.0	66.5	0.2	24.2
5	9.0	94.4	1.5	49.1
6	41.2	88.0	0.2	120.5
7	8.5	117.4	2.1	18.1
8	8.3	58.3	0.8	59.5
9	12.2	57.0	19.3	183.0
10	13.4	30.2	1.5	63.3
11	6.0	30.4	2.6	34.3
12	9.3	21.1	2.0	37.1
13	6.0	23.3	1.1	24.4
14	7.2	13.3	1.2	27.1
15	6.3	10.6	0.2	10.1
16	4.0	15.3	0	30.2
17	11.3	20.0	1.0	25.1
18	13.4	17.4	0.2	19.3
19	7.4	4.4	1.3	29.3
20	7.5	6.5	1.5	92.0
21	8.3	4.9	0.8	23.6
22	8.3	6.0	0.5	11.8
23	11.3	8.7	0.7	11.3
24	11.7	9.1	2.0	16.3
25	11.3	8.0	2.0	25.5
26	13.2	6.8	0.3	21.5
27	8.6	11.2	0.5	11.0
28	9.0	9.0	0.2	18.8
29	7.8	6.3	0.7	23.2
30	7.8	5.3	0.2	6.5
31	10.3	2.7	0	11.0
August				
1	23.7	5.5	1.3	9.0
2	21.2	9.0	0.2	25.7
3	15.8	12.8	1.3	25.7
4	27.3	7.3	0.5	30.8
5	13.0	5.7	0.2	28.3
6	29.5	10.3	0.5	71.3
7	13.7	6.3	0.2	34.7
8	14.0	4.0	0.3	45.8
9	11.5	2.7	0.3	40.8
10	13.8	4.8	1.0	27.2
11	23.8	1.5	0.5	56.0
12	11.2	2.8	0	52.5
13	10.0	1.2	0.2	41.3
14	19.2	4.0	0	66.5
15	18.3	8.5	1.3	118.7
16	No sample			
17	10.3	2.7	0.1	69.0
18	9.8	1.8	0	32.3
19	10.8	3.3	0.3	71.2
20	2.3	1.2	0.2	11.0
21	2.0	0.5	0.2	6.0

*Animals per liter, exclusive of copepod nauplii.

feeders of omnivorous habit. The suborder designation has been followed in this paper.

Among the Cladocera, *Leptodora* (one species, *L. kindtii*) is sufficiently distinct to draw attention wherever it is found. Since it is a carnivore, it is listed separately from other cladocera. *Leptodora* was not found in the large numbers implied by Andrews (1949). The largest group of cladocera was of the genus *Daphnia*, but *Bosmina*, *Chydorus*, and *Diaphanosoma* showed periodic pulsations during the summer.

I found that cyclopoid copepods exhibited a pulse in early July (average density of about 90 per liter). The population then dropped to a low in mid-July and remained at a near level of less than 15 per liter for the rest of the survey (fig. 1).

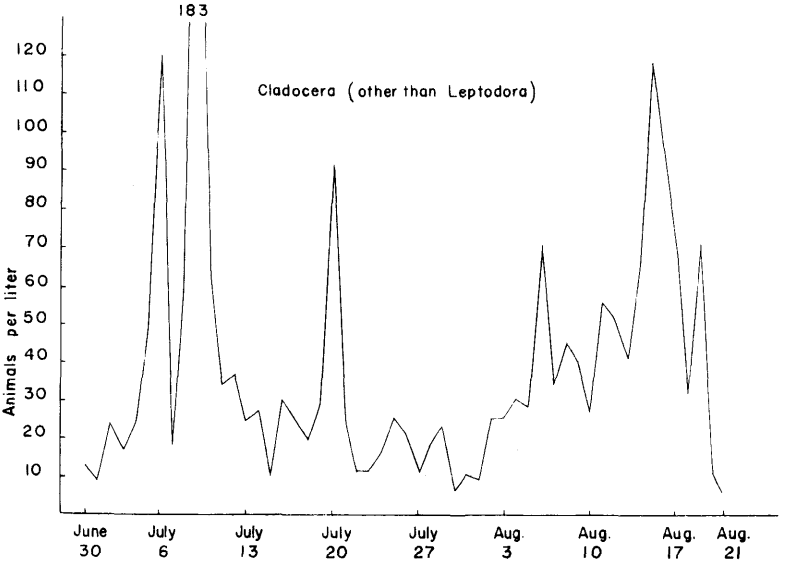

FIGURE 2. Daily population densities of Cladocera other than *Leptodora*.

The population of calanoid copepods reached a maximum in early July and another in early August, but otherwise was very stable (fig. 1). The daily figures, when examined for seasonal trends, demonstrate a change in copepod population during the summer. This was a progressive shift from a predominantly carnivorous (Cyclopoida) to a largely herbivorous (Calanoida) population (fig. 1).

Cladocera (other than *Leptodora*) showed a sizable population surge in early July (one day's average was over 180 per liter). A substantial but smaller pulse was evident in early August. Cladocera showed tremendous day to day fluctuations suggestive of the "swarms" of early authors (Needham and Lloyd, 1916). While the day's average density on July 9 was 183 cladocera per liter, it should be stated that the surface density was 447 animals per liter! The following day the cladoceran population at the same location was 63 animals per liter. These figures indicate the possible errors inherent in taking plankton samples at weekly intervals. A striking illustration of this point can be made by considering the conclusions that might have been reached from a series of weekly collections of Cladocera begun on June 30, contrasted to weekly collections begun one day later, on July 1 (fig. 3).

Leptodora exhibited little in the way of population change during the summer. Numbers of this animal were too low to permit plotting them on a scale comparable to that of other cladocera. Qualitative collections made at night near the surface might lead one to believe that much larger populations are present, an assumption not borne out by the present quantitative data.

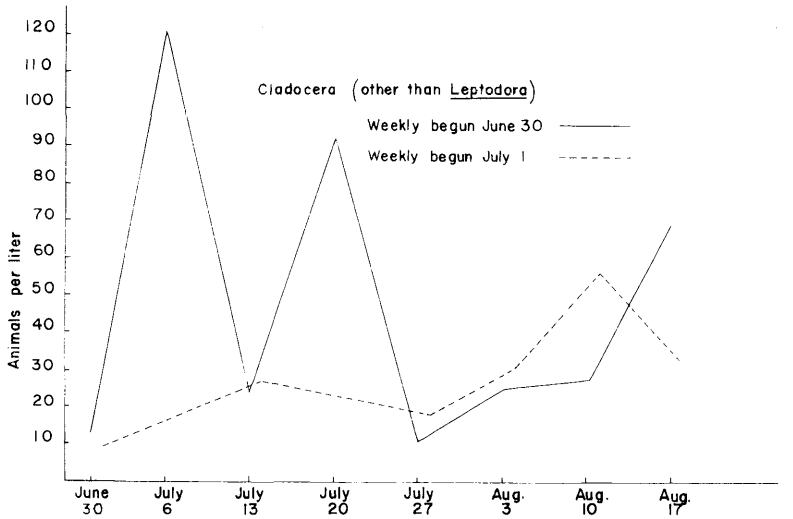

FIGURE 3. The interpretation resulting when data included in figure 2 are plotted at weekly intervals. The solid line connects points representing a series of collections begun on June 30. The broken line represents a similiar series begun one day later, on July 1, 1959.

SUMMARY

1. Planktonic crustacea populations showed great variation when sampled daily at the same location with the Juday Plankton Trap.

2. During the summer there was a progressive shift in the copepod population from predominantly carnivorous (Cyclopoida) to one of largely herbivorous (Calanoida) components.

3. Both copepod and cladoceran populations exhibited blooms in early July followed by low densities in late July.

4. Cladocera (other than *Leptodora*) showed the most daily variation in numbers during the period studied.

5. Quantitative data presented indicate the possible errors inherent in taking plankton samples at weekly intervals.

6. *Leptodora kindtii* was found to occur in very low densities in the open water of the Bass Island region of Lake Erie.

LITERATURE CITED

Andrews, T. F. 1949. The life history, distribution, growth, and abundance of *Leptodora kindtii* (Focke) in western Lake Erie. Abstract of doctoral dissertations, No. 57, The Ohio State University Press. pp. 5–11.

Birge, E. A. and **C. Juday.** 1912. A limnological study of the Finger Lakes of New York. Bull. Bureau Fisheries 32: 1–609.

Chandler, D. C. 1940. Limnological studies of western Lake Erie. I. Plankton and certain physical-chemical data of the Bass Island Region, from Sept. 1938-Nov. 1940. Ohio J. Sci. 40: 291–336.

Davis, C. C. 1959. Damage to fish fry by cyclopoid copepods. Ohio J. Sci. 59: 101.
Fabian, M. 1960. Mortality of fresh water and tropical fish fry by cyclopoid copepods. Ohio J. Sci. 60: 268–270.
Jahoda, W. J. 1949. Seasonal differences in the distribution of *Diaptomus* (Copepoda) in Western Lake Erie. Abstract of doctoral dissertations, No. 58. The Ohio State University Press. pp. 211–216.
Krecker, F. H. 1928. Periodic oscillations in Lake Erie. The Ohio State University Press, The Franz Theodore Stone Laboratory Contribution No. 1. pp. 1–21.
Marshall, S. M. and **A. P. Orr.** 1955. On the biology of *Calanus finmarchicus*. VIII. Food uptake, assimilation, and excretion in adult and stage V *Calanus*. J. Marine Bio. Assoc. U.K. 34: 495–529.
Needham, J. G. and **J. T. Lloyd.** 1916. The Life of Inland Waters. The Comstock Publishing Company, Ithaca, New York. 438 pp.
Welch, P. S. 1948. Limnological Methods. Blakiston Co., Philadelphia. 18, 381 pp.
Wright, S. and **W. M. Tidd.** 1933. Summary of limnological investigations in Western Lake Erie in 1929 and 1930. Trans. Am. Fisheries Soc. 63: 271–285.