ZOOPLANKTON OF WESTERN LAKE ERIE AT PUT-IN-BAY: A QUANTITATIVE STUDY, APRIL 1973–MARCH 1974[1]

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ABSTRACT

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From 2 April 1973 to 29 March 1974, 1974, 117 zooplankton samples were collected from Put-in-Bay Harbor. Rotifer, copepod, and cladoceran populations all reached peaks in June. Cladocerans also peaked in October. Monthly mean rotifer populations were always the largest, while cladoceran populations were always the smallest. In general, rotifer and nauplii populations showed increases, cyclopoid copepod populations were relatively unchanged, and calanoid copepod and cladoceran populations were decreasing when compared with reports of Chandler (1940), Hubschman (1960), Bradshaw (1964), Britt *et al.* (1973), and Stromberg and Crites (1974).

INTRODUCTION

Zooplankton serves as the primary food source during sometime in the life cycle of almost every fish in Lake Erie. Without zooplankton the fishery resource of any lake would be eliminated. Yet, a complete year-round study of the zooplankton of western Lake Erie has not been performed since 1948–49 (Bradshaw, 1964). In the time since, the lake has changed drastically due to the many pollutants that have been dumped into it. This study was conducted to qualitatively and quantitatively observe the zooplankton of western Lake Erie and compare current populations to those of previous studies.

METHODS

From 2 April 1973 to 29 March 1974, 117 plankton samples were collected with a Wisconsin plankton net (12 cm diameter, no. 25 mesh) in Fisheries Bay from the research building dock of the Franz Theodore Stone Laboratory on South Bass Island, western Lake Erie. Exact collection dates can be read from figure 1. A vertical tow, bottom to surface, was made through the water column in a manner by which the plankton bucket did not touch the lake bottom. The volume of each sample was computed from the depth of the tow (0.8–2.4 m) and the area of the net mouth. Each sample was concentrated to 50 ml, preserved in 5% formalin, and stored in 75 ml glass bottles prior to identification and enumeration. After gently mixing the sample by shaking and bubbling air through it, three 1-ml aliquots were transferred to Sedgewick Rafter counting cells. Each counting cell was scanned with a binocular microscope (60–100×), and all zooplankters (Protozoa excluded) were identified and enumerated. The total from 3 cells was then used to calculate the number of zooplankters per liter (fig. 1). The works of Jahoda (1948), Pennak (1953), Ward and Whipple (1959), Eddy and Hodson (1964), and Chengalath *et al.* (1971) were used in plankton identification.

RESULTS

Zooplankton collected during this study were assigned to 46 taxa (table 1). Overall, *Polyarthra* sp. was the most abundant rotifer, nauplii were the most populous Copepoda, and *Bosmina* sp. was the most populous cladoceran.

The total zooplankton population reached a peak in June 1973 when the mean value reached 588 individuals per liter and then decreased steadily to the monthly low of 54 per liter in January 1974 (fig. 1). The mean values for December 1973 through March 1974 were relatively constant at 50–75 individuals per liter. Individual values from the 117 sampling dates ranged from a high of 962/*l* on 11 June 1973 to a low of 16/*l* on 21 December 1973. Values from early April 1973 correlated well with values from late March 1974.

The total rotifer population followed the same pattern as the total zooplankton population (fig. 2). It reached a peak in June 1973 with a mean of approximately 300 rotifers/*l* and then steadily

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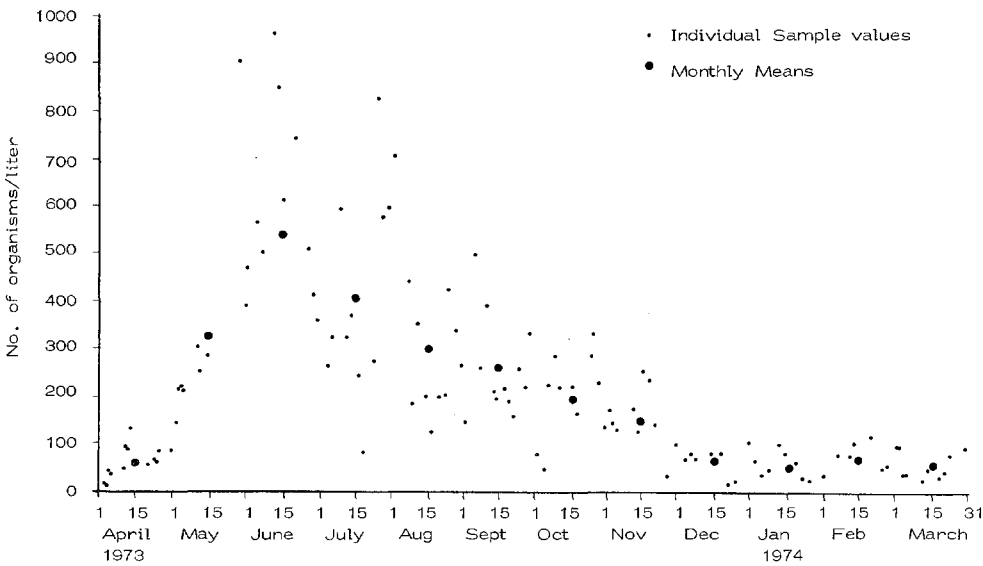

FIGURE 1. Total zooplankton populations at Put-in-Bay: 2 April 1973–29 March 1974.

TABLE 1

Mean number of individuals per month per liter.

Taxa	1973									1974		
	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar
ROTIFERA												
Asplanchna giroidi	7.4	27.1	1.0							0.5	3.6	
A. priodonta		11.9	7.0	0.9	11.8	1.1	2.7	1.3	0.3	0.2		
Brachionus angularis		0.1	0.2		0.5	3.7	0.8	0.2	0.6			
B. calyciflorus		0.2			0.2		2.3	9.7	6.7	0.1		
B. havanaensis					0.3	0.1	0.3					0.4
B. (Platylas) patulus										0.1	0.3	
B. quadridentatus					0.1							
B. urceolaris	0.1	0.2			0.1							2.6
Chromogaster ovalis					0.8	0.1		0.4	1.1	7.0	0.7	0.2
Conochiloides sp.		0.3	62.4	1.1	4.5	4.2	0.2			0.1		
Euchlanis sp.					0.1					0.2	1.0	
Filinia terminalis	0.3	0.8	0.1		0.2	0.7	0.1					
Hexarthra mira						0.1						
Kellicottia longispina	0.5	12.6	14.0	0.4	0.1			0.4	2.3	0.7	0.6	0 7
Keratella cochlearis	1.4	46.6	85.9	31.9	14.5	29.1	40.9	46.5	21.2	17.6	13.6	4.9
K. quadrata	1.2	27.4	35.8	0.4	0.1			2.4	0.9	0.9	0.4	0.9
Lecane (Lecane) luna			0.2	0.3	0.1	0.6						
L. (Monostyla) lunaris			0.2	0.1	0.2	0.1						
Lepadella patella			0.3		0.1							
Mytilina sp.					3.2	0.6	0.1					
Notholca acuminata												0.2
N. squamula	26.0	38.5	1.5									14.2
Pleosoma sp.				0.3		0.2	2.8	1.9				
Polyarthra sp.	3.0	37.2	83.7	234.0	140.2	105.6	62.5	47.5	21.7	16.3	29.2	4.5
Pompholyx sulcata											13.7	17.8
Synchaeta sp.	0.7				0.3				0.4			0.3
Trichocerca clyindrica		0.3	0.1		0.6	1.6	1.2					
T. multicrinis			0.1	0.1	6.8	3.5	1.2	0.1				
Rotifer (Unidentified)				0.1	49.9	58.2	7.5	3.0	0.6	1.7	7.9	

TABLE 1. *Continued.*

Taxa	1973									1974		
	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar
COPEPODA												
Calanoid copepods												
Diaptomus sp.	0.5	0.9	0.3	0.9	0.2	0.2	0.1	0.2	0.3	0.6	0.5	1.6
Eurytemora sp.		0.1										
Immatures	0.5	4.4	0.8	0.3	0.4		0.9	0.1		0.3		
Cyclopoid copepods												
Cyclops sp.	1.0	3.6	18.5	9.9	0.6	1.0	3.5	1.8	0.8	2.6	4.6	5.0
Mesocyclops sp.					0.1	0.2	0.3					
Immatures	0.8	23.8	53.6	13.7	7.4	6.1	4.7	2.3	0.3	2.4	1.4	0.1
Nauplii	22.7	86.7	192.6	106.8	51.5	28.7	28.7	15.8	6.1	2.7	2.9	4.5
CLADOCERA												
Alona sp.		0.1	0.2	0.7								
Bosmina sp.	0.4	2.4	27.0	2.1	3.2	14.8	26.5	17.3	1.4	0.2	0.1	
Camptocercus sp.				0.1								
Ceriodaphnia sp.					0.1	1.1						
Chydorus sp.			0.3	0.1	0.6	0.2	2.3	2.8	0.3			
Daphnia galeata				0.2	0.1			0.1				
D. retrocurva		0.3	1.3	2.1	0.8	1.3	1.0	0.6				
Diaphanosoma sp.					0.1	0.2						
Holopedium gibberium						0.7	0.2					
Leptodora kindtii			0.1				0.1					
TOTAL	66.5	325.5	587.5	406.2	300.0	266.6	190.0	152.5	65.1	54.2	80.5	57.9

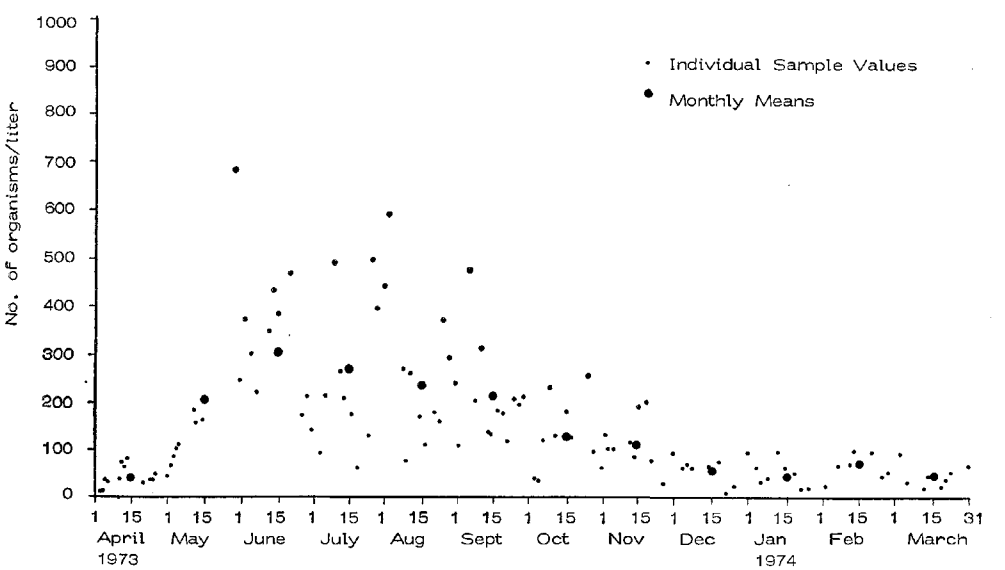

FIGURE 2. Rotifer populations at Put-in-Bay: 2 April 1973–29 March 1974.

decreased through December. Again, the means for December 1973 through March 1974 were relatively constant, 40–70/*l*. Individual values ranged from 680/*l* on 28 May 1973 to 9/*l* on 21 December 1973 (the same day the total zooplankton population reached its minimum). The mean values for all months were higher than those of the Copepoda and Cladocera.

The monthly mean copepod population, including nauplii, also reached its peak in June 1973 at 266/*l* (fig. 3). The

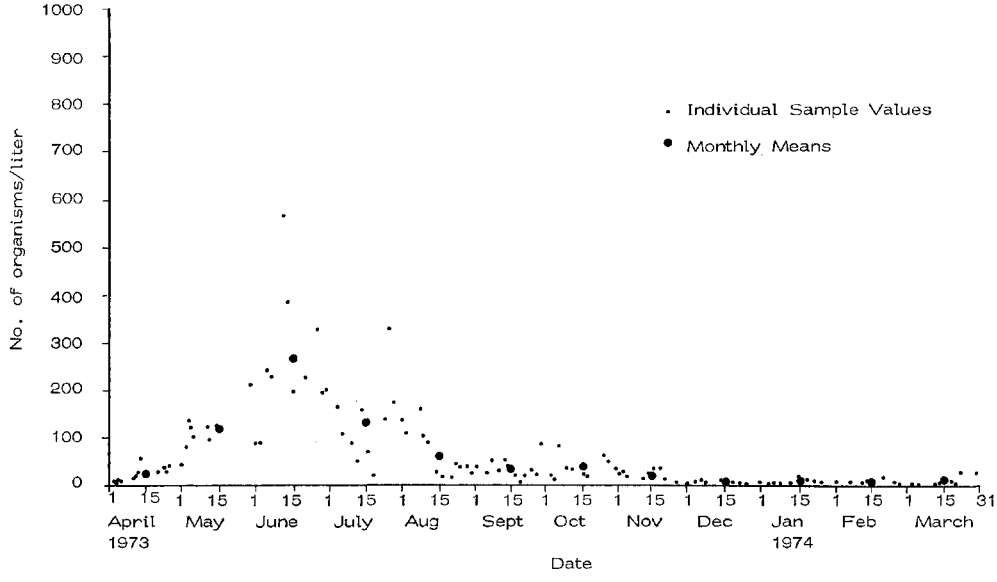

FIGURE 3. Total copepod populations at Put-in-Bay: 2 April 1973–29 March 1974.

population, however, decreased much faster than either the total zooplankton population or the total rotifer population. Mean populations for the months December 1973 through March 1974 were below 12/*l*. Individual values ranged from 569/*l* on 11 June to 3.2/*l* on 30 November and 24 December 1973.

We separated the total copepod population into 3 components, calanoid copepods, cyclopoid copepods, and nauplii (fig. 4). This accented the differences between calanoid and cylcopoid populations and made the results more comparable to prior studies. Copepods of the suborder Calanoida are filter feeders which graze on small phytoplankters and debris (Marshall and Orr, 1955). Copepods of the suborder Cyclopoida are omnivorous particulate feeders, important as vectors for various aquatic parasites, and known to attack fish fry (Davis, 1959). April through December 1973 the copepod populations were dominated by nauplii. January through March 1974 cyclopoids were slightly more abundant. Monthly mean nauplii and cyclopoid populations peaked in June 1973 at 193 and 72 individuals/*l*, respectively, and distributions approached bell-shaped curves. The population of calanoid copepods peaked in May 1973 at 5.4/*l*. During no other month did the mean calanoid population surpass 1.6/*l*, and at no time did it exceed the cyclopoid or nauplii populations.

Of the rotifers, copepods, and cladocerans, the caldocerans had by far the lowest populations (fig. 5). Figure 5 is on an expanded scale due to the low values, therefore, is not directly comparable to figures 1 to 4. The monthly mean cladoceran population had 2 peaks, one in June 1973 at 29/*l* and one in October 1973 at 31/*l*. The peak in June was quite sudden and then terminated rapidly (populations in May and July were low). There appeared to be a general fall pulse from September through

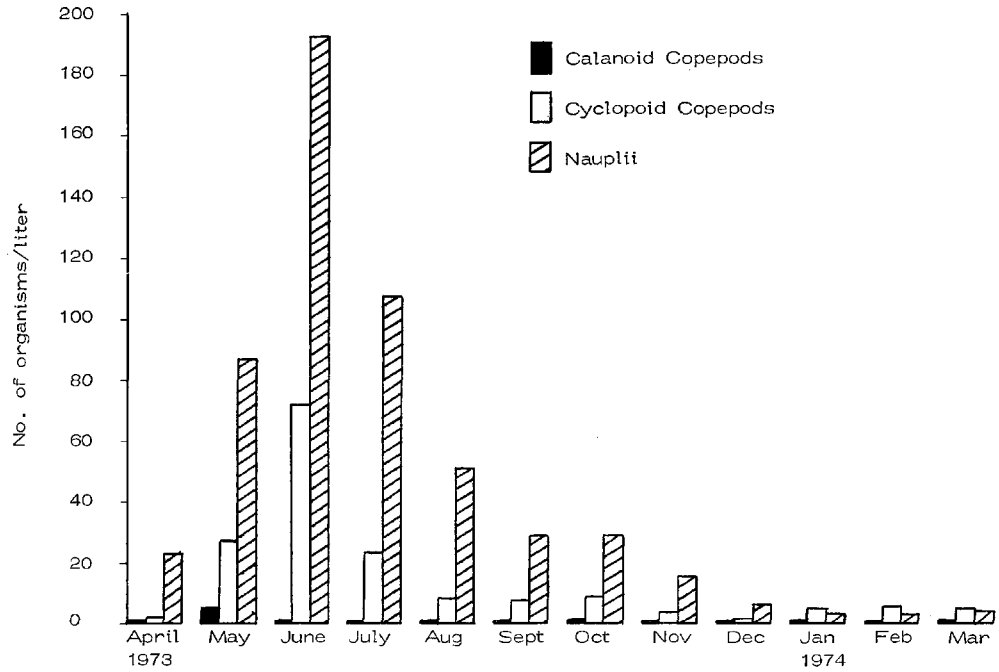

FIGURE 4. Monthly mean calanoid copepod, cyclopoid copepod, and nauplii populations at Put-in-Bay: April 1973–March 1974.

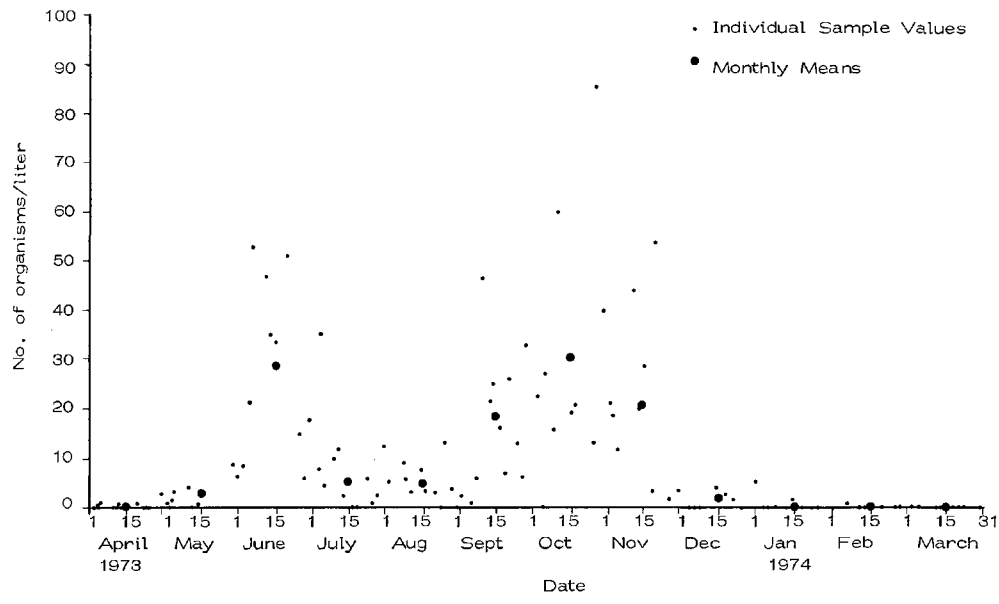

FIGURE 5. Total cladoceran populations at Put-in-Bay: 2 April 1973–29 March 1974.

November. Individual values ranged from 86/*l* on 26 October 1973 to 0 during most of January, February, and March 1974. In fact, of the 23 samples collected during January, February, and March, only 2 contained cladocerans.

DISCUSSION

Previous studies in the Bass Island Region were conducted from 2 September 1938 to 25 September 1939 (Chandler, 1940), 26 October 1948 to 3 October 1949 (Bradshaw, 1964), 30 June to 21 August 1959 (Hubschman, 1960), 13 June to 21 September 1961 (Britt, *et al.*, 1973), and June through August of 1971, 1972 and 1973 (Stromberg and Crites, 1974). Comparison of these investigations with the results of our study depends on an understanding of the differences in sampling methods, and location of sampling stations. Our results may be typical only of the near-shore sections of Put-in-Bay Harbor, and may not be comparable with results from the open lake. Our samples were collected by vertical tow with a plankton net but most of the previous studies combined the results of Juday Plankton Trap samples taken from various depths throughout the water column.

Our total zooplankton curve peaked in June while Chandler (1940) noted 2 peaks, one in May which was lower than ours and one in September which was higher. Britt and coworkers (1974) observed only a September peak approximately half as large as our June peak. Peaks in the work of Carpenter (1934) were difficult to discern, but it appears that his values were all greater than those which we obtained. The major differences between the total zooplankton curves of our study and those of Chandler (1940) and Britt *et al.* (1973) were apparently caused by a trend of increasing rotifer populations. Both of these previous studies showed greater variation in the rotifer populations than we observed, and often noted that crustacean populations surpassed the rotifer populations. We never observed this.

Copepod populations have also changed considerably. The copepod peak we observed in June 1973 was only slightly lower than that observed by Chandler (1940) and Hubschman (1960) in late June and early July. The calanoid portion of the populations, however, decreased significantly. The previous studies often showed them to surpass the cyclopoid populations. We never observed this. The peak we observed in the cyclopoid population in June 1973 corresponded in time well with the previous investigations, but it was larger than that observed by Chandler or Britt, Addis, and Engel, slightly lower than that observed by Hubschman, and similar to that observed by Stromberg and Crites (1974). This similarity is significant since Stromberg and Crites collected during the same months we did but in the center of Fisheries Bay. We believe our results are at least characteristic of the harbor area. Our June 1973 peak of the nauplii population was similar to that observed by Chandler (1940). The nauplii populations we observed were larger than those of the previous studies except for September 1939 when over 700/*l* were noted. Chandler, in the same study, reported a value of approximately 30/*l* for September 1938.

Cladoceran populations observed here corresponded well with those observed by Chandler (1940). However, the populations were much lower than those observed by later investigators.

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