DISTRIBUTION AND ABUNDANCE OF THE ZOOPLANKTON OF CANTON RESERVOIR, OKLAHOMA[1]

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The plankton of Canton Reservoir was sampled during 1967 and 1968. Spring pulses were noted both years. Plankton volumes also varied with horizontal location and depth. Entomostracans represented in the samples were cyclopoid copepoda, *Diaptomus*, *Daphnia*, *Bosmina*, *Diaphanosoma*, and *Ceriodaphnia*. Of these, only *Daphnia* and *Diaptomus* showed any vertical layering; the others occurred in about the same abundance at all depths. *Daphnia* and *Diaptomus* were the dominant spring-time zooplankters, while *Bosmina* was dominant in summer and fall.

It is the consensus of most fishery biologists that the larvae and fry of most fresh-water fish need a constant supply of zooplankton for survival and early growth.

For several years, the Oklahoma Fishery Research Laboratory has been interested in the survival factors of the fry and young-of-the-year fish of Canton Reservoir. The present study was started in 1965, with the purpose of obtaining data which would be helpful in understanding the zooplankton-fry relationship.

Results of the 1965 and 1966 investigations were reported by Bross (1, 2). Results of the 1967 and 1968 studies are covered in this paper. The main emphasis of this report is on the entomostracans, since this group contains the most important food organisms. Rough estimates of the abundance of the Rotatoria genera have also been made, but the highly mobile *Diptera* larvae, of which only two were caught, will not be considered. Algae contributed to the sample volumes, but treatment of the abundance of each phytoplankter is beyond the scope of this paper.

STUDY AREA AND METHODS

Canton Reservoir, as reported by Bross (1), is a shallow, hardwater impoundment in northwestern Oklahoma, having a mean depth of 15 ft. and an area of about 7,500 acres. The main axis of this somewhat crescent-shaped lake is in a northwest-southeast direction. The strong southwest winds, which prevail during the spring and summer, cause vigorous mixing of the water, which in turn prevents thermal stratification.

Samples were taken with a 62μ mesh plankton net towed for 5 min. at about 4 miles per hr. The 9 stations sampled in 1967 were so located that all the major sections of the lake would be represented. Only 3 stations, which were located near the center of the lake, were sampled in 1968. Tows for 1967 were made at the surface, and at 10 ft and 20 ft levels when the depth of the water permitted. Only surface and 10 ft levels were sampled in 1968.

The preserved samples were examined microscopically, and, except for the cyclopoid copepods, organisms were identified as to genus. The number of each plankter per low power field (40X; field diameter 3.75 mm) was recorded. Volumes for each sample were determined by measuring the liquid displaced by the organisms, which were removed by filtration through No. 3 filter paper. A suction device was used to hasten the filtration.

RESULTS AND DISCUSSION

Plankton volumes for 1967 showed a strong spring pulse, with no perceptible rise

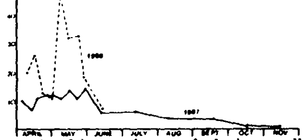

FIGURE 1. Mean volumes of plankton collected during 1967 and 1968.

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in autumn (Figure 1). Fall maxima are normal for temperate lakes and are, usually, associated with increases in nitrogen, phosphorus, and other nutrients (4). Nutrient concentrations are known to increase with water inflow, and since the surface level of Canton Reservoir rose steadily during the summer of 1967 (2), an increase in nutrients followed by an increase in plankton volumes would be expected. A fall peak, greater than the one shown, might have occurred during a time when no samples were taken.

Vertical movement of the plankton occurred during the spring of both years. Surface volumes in spring were greater than volumes at the 10 ft level. During June the reverse occurred with the 10 ft volumes being the larger. Water temperatures reached a peak about the middle of June in 1967 and, consequently, the plankton probably moved to the lower depths to avoid the temporarily warmer surface waters.

During the first half of 1967, volumes increased directly with the distance upstream from the dam (Figure 2). Bross (1) obtained a similar line with the 1965 data. Temperature also increased as one progressed upstream. A coefficient of correlation, R, as described by Townsend (5), was calculated and a value significant at the .01 level was obtained. The increase in volume with increased displacement upstream, therefore, is probably a result of temperature increase.

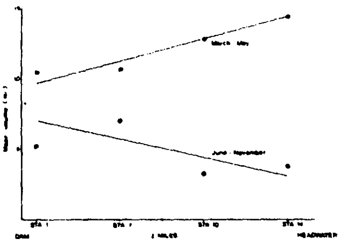

FIGURE 2. Change in sample volume with change in the distance upstream from the dam.

The line for the second half of 1967 is reversed, with the greater volumes, this time, being nearer the dam. Temperature difference for opposite ends of the lake for this period was only 1.1 F, with the headwaters being the warmest. It is unlikely that change in temperature alone brought about these volume differences, since the temperature range was so small.

Differences in volume of samples from stations located on a line drawn across the width of the lake were slight, as might be expected since most of the wave action is in that direction.

Entomostracans represented in samples for both years were cyclopoid Copepoda, *Diaptomus*, *Daphnia*, *Diaphanosoma*, and *Ceriodaphnia*. The various Rotatoria genera found both years are shown in Table 1.

Only *Daphnia* and *Diaptomus* showed vertical layering; both were more abundant at the surface than at the two lower depths. Avoidance of stagnant bottom water is probably not the cause of this migration to the surface, since Bross (1) found that the lake was well oxygenated at all depths. Irwin and Claffy (6) found greater volumes of zooplankton at the surface than at the bottom for both clear and turbid lakes in Oklahoma. Hutchinson (7) reported a similar reversed daytime distribution for large adult *Daphnia longispina* in Lough Derge, Ireland.

The number of copepod nauplii fluctuated greatly from week to week in both years (Tables 2 and 3), while numbers of adult entomostracans changed more gradually.

TABLE 1. Mean number per sample and percentage of occurrence of Rotatoria, 1967 and 1968.

	Mean Number	Percentage of Occurrence
Asplanchna	5.4	90.0
Brachionus	1.1	10.3
Filinia	2.1	17.9
Keratella	15.9	90.3
Platyias	0.1	0.3
Polyarthra	0.3	8.2

In June, 1967, both nauplii and *Bosmina* numbers rose sharply, but *Daphnia* was not found. This unusual happening might have

TABLE 2. *Mean number of organisms per sample, 1967.*

	Mar 28	Apr 6	Apr 12	Apr 18	Apr 25	May 2	May 9	May 16	May 23	May 31	Jun 12	Jul 10	Aug 8	Sep 19	Oct 17	Nov 11
Nauplii	27.6	31.9	15.6	21.9	19.2	20.7	17.6	11.1	9.3	15.2	23.6	8.3	19.9	15.0	7.9	1.5
Cyclopoida	4.9	2.3	1.8	1.4	1.6	1.8	1.2	1.6	1.3	1.1	0.4	0.6	1.7	1.4	1.3	0.7
Diaptomus	5.5	3.2	3.1	4.1	4.5	3.6	2.8	3.0	4.4	4.1	5.9	3.2	3.1	1.8	1.3	0.9
Bosmina	9.2	2.6	1.5	2.1	2.8	2.6	2.3	2.1	1.1	1.6	11.3	2.1	3.2	17.2	6.9	2.0
Daphnia	0.6	4.5	5.7	7.5	6.5	5.8	5.1	7.0	5.1	5.3	0.0	2.8	1.7	0.8	1.7	0.6
Diaphanosoma	0.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.4	1.4	0.4	0.0
Ceriodaphnia	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.8	1.6	0.5

TABLE 3. Mean number of organisms per sample, 1968.

	Apr 10	Apr 17	Apr 24	May 1	May 8	May 15	May 23	May 28	Jun 12	Jun 26
Nauplii	74.0	53.0	56.0	21.3	12.7	15.3	14.0	8.1	11.3	7.0
Cyclopoida	2.7	2.0	5.3	2.7	0.0	0.0	0.0	0.0	0.7	0.5
Diaptomus	2.3	6.0	3.3	2.7	0.0	7.3	0.0	4.2	2.7	1.5
Bosmina	0.0	0.7	0.3	0.0	0.0	2.0	0.0	0.0	0.0	2.0
Daphnia	6.0	12.5	10.0	6.0	0.0	15.3	10.7	12.7	4.7	0.0
Diaphanosoma	0.0	0.0	0.0	0.0	0.0	0.0	5.3	2.0	0.0	0.5

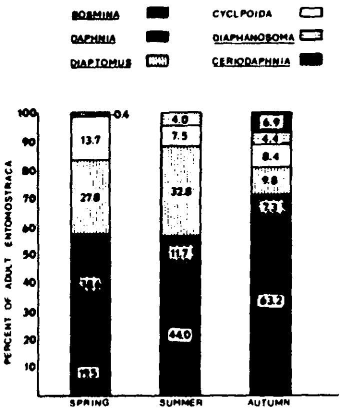

FIGURE 3. Relative abundance of adult entomostraca for 1967.

been the result of some factor or factors associated with the 7 inch rainfall on the area June 10.

Increases in Daphnia abundance were usually accompanied by decreases in *Bosmina* abundance and vice versa (Tables 2 and 3). On most sampling days, one cladoceran species was dominant, i.e., it comprised more than 50% of the cladocerans for that date. This suggests a possible competitive relationship, or a differential tolerance to a physical factor, such as temperature. Pennak (8) noticed similar dominance patterns in different species of Cladocera in various Colorado lakes.

Rotifers generally made up an insignificant part of the zooplankton. *Keratella* and *Asplanchna*, the dominant rotifers, were found in most samples (Table 1). *Filinia* occurred less frequently, but occasionally were the dominant zooplankter in a particular sample. Less numerous Rotatoria were *Platyias*, *Polyarthra*, and *Brachionus*.

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REFERENCES

1. M. G. BROSS, Limnology of Canton Reservoir, Okla. Fish. Res. Lab. Semi-Ann. Rept. Jan.-June, 1965, 1965, pp. 17-34.
2. __________, Net plankton investigations, Okla. Fish. Res. Lab. Ann. Rept. July, 1966-June, 1967, 1969, pp. 94-104.
3. __________, Physical and chemical limnology, Okla. Fish. Res. Lab. Ann. Rept. July, 1966 - June, 1967, 1969, pp. 1-21.
4. E. P. ODUM, Fundamentals of Ecology, 2nd ed., W. B. Saunders Co., Philadelphia, 1959.
5. J. C. TOWNSEND, Introduction to Experimental Method, McGraw-Hill, New York, 1953.
6. W. H. IRWIN and F. J. CLAFFEY, Proc. Okla. Acad. Sci. 47: 72-81 (1968).
7. G. E. HUTCHINSON, A Treatise on Limnology. Vol. II. Introduction to Lake Biology and Limno-plankton, John Wiley & Sons, New York, 1967.
8. R. W. PENNAK, Limnol. Oceanogr. 2: 222-232 (1957).