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# LIMNETIC MICROCRUSTACEA OF SOME FLOOD CONTROL RESERVOIRS IN SOUTHEASTERN NEBRASKA

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ABSTRACT: Limnetic microcrustacean communities of 5 flood control reservoirs in the Salt Valley Watershed of Southeastern Nebraska were studied from June 1968 to January 1970. The average community during summer was comprised of 3.2 cladoceran and 2.4 copepod species. Cladoceran densities usually exceeded those of the copepods. *Bosmina longirostris* was found in the more productive reservoirs while *Bosmina coregoni* inhabited the light-limited, nonproductive reservoirs. Congeneric occurrences of *Diaptomus* species were common in three of the five reservoirs. Congeneric *Daphnia* occurrences were found on 61 percent of the sampling dates, excluding one reservoir in which only one species of *Daphnia* was found. The most abundant species of *Daphnia* seldom outnumbered the less abundant species by more than 10 times and it was not uncommon to find ratios lower than 5:1.

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## INTRODUCTION

The species composition of limnetic zooplankton communities is one parameter of limnological importance that has received little study in Midwestern reservoirs. Pearse (1905) and Fordyce (1901) surveyed crustacean fauna in natural lakes of Nebraska but nothing is reported on the structure of zooplankton communities. It has been shown that open water plankton communities are quite simple in terms of the number of species found on any given sampling date (Anderson, 1971; Armitage, 1961; Pennak, 1957; Timms, 1968). This paper considers species composition in some reservoirs in a midwestern agricultural area where surface runoff provides an abundance of chemical factors necessary to sustain high levels of organic production.

## THE STUDY RESERVOIRS

Branched Oak, Holmes, Pawnee, Stagecoach and Wagontrain reservoirs, built as flood control and soil conservation projects in the Salt Valley Watershed of eastern Nebraska, were studied from June 1968-December 1970. Drainage areas consist primarily of agricultural and pasture lands. About three-quarters of the 28 inches of annual precipitation occurs in spring and summer. The reservoirs are all shallow with mean depths varying between 2.0 and 4.5 m and ranging in area from 112 to 1800 acres. Quite strong southerly winds that prevail in summer coupled with the shallowness of the reservoirs prevents stable thermal stratification. Holmes and Wagontrain are turbid, light-limited reservoirs that have low organic production. Pawnee,

Stagecoach and Branched Oak reservoirs are clearer with abundant growths of rooted aquatics and algae in midsummer and showing rapid eutrophication (Hergenrader and Hammer, 1973).

## METHODS

Six hundred and forty zooplankton samples were examined. Three stations were sampled weekly during June, July, and August 1968-1970 in Wagontrain and Branched Oak reservoirs. Stagecoach was sampled at two stations in the summers of 1969 and 1970. Holmes was sampled at 3 stations during the summers of 1968 and 1969. Year-round samples were taken weekly at three stations in Pawnee except during periods of ice cover when the sampling interval was extended to once monthly. Collecting procedure consisted of making oblique tows, from bottom to surface, at each station, with a Clarke-Bumpus plankton sampler using a nylon net equivalent

**Table 1**: Mean number of copepod and cladoceran species collected from the study reservoirs during various seasons.

| Taxonomic category within each reservoir | June-Aug Collections | Sept-Nov Collections | Dec-Feb Collections | Mar-May Collections |
|---|---|---|---|---|
| Branched Oak | | | | |
| Copepods | 2.4 | – | – | – |
| Cladocerans | 3.6 | – | – | – |
| Holmes | | | | |
| Copepods | 2.8 | – | – | – |
| Cladocerans | 2.3 | – | – | – |
| Pawnee | | | | |
| Copepods | 2.6 | 2.1 | 2.0 | 2.2 |
| Cladocerans | 4.0 | 4.2 | 3.6 | 2.6 |
| Stagecoach | | | | |
| Copepods | 1.6 | – | – | – |
| Cladocerans | 2.5 | – | – | – |
| Wagontrain | | | | |
| Copepods | 2.6 | – | – | – |
| Cladocerans | 3.5 | – | – | – |
| Copepod mean, all reservoirs | 2.4 | | | |
| Cladocera mean, all reservoirs | 3.2 | | | |

to No. 2 silk bolting cloth. During ice cover composit samples were taken from surface to bottom at each meter in depth with a Van Dorn water bottle. Samples were concentrated by pouring through a No. 35 Nitex net. Collections were preserved in 5 percent formalin solution. Analyses were made with a 30X binocular dissecting microscope. Aliquots were taken with a 1-ml capacity Hensen-Stempel pipet and the contents placed in a Sedgwick-Rafter cell, the entire contents of which were counted for each aliquot. During periods in which plankton were scarce, the entire sample was concentrated and counted. Rare species were noted by scanning a milliliter or so of concentrated sample.

Identification of plankters follows that of Brooks, Wilson and Yeatman (Edmondson, 1969). During 1968 in Wagontrain and Holmes reservoirs, copepods were keyed only to genus, as were *Daphnia* species in Wagontrain for this period. In all other samples identification was made to species.

## SPECIES COMPOSITION

Seventeen species occurred in limnetic zone samples throughout the study period. Six copepods and 11 cladocerans were found. Table 1 shows the typical summer mean number of species present to be 5.6 per community, comprised of 2.4 copepods and 3.2 cladocerans. The mean number of cladoceran species exceeded the mean number of copepods in all but Holmes reservoir. Pennak (1957) reported the momentary structure of limnetic zooplankton communities of 27 Colorado lakes to be 1.6 cladocerans and 1.3 copepods. Timms (1968) found Australian reservoirs to have 2.0 cladoceran and 2.3 copepod species. Our study reservoirs were quite similar in composition to those Kansas lakes studied by Armitage (1961) in which he found an average of 3.0 cladocerans and 2.3 copepods. The number of species found during seasons other than summer in Pawnee reservoir was quite similar to that of summer. March-May collections are somewhat lower in cladeceran species because *Diaphanosoma* and *Ceriodaphnia* tended to be rare or absent at this time.

The species found in each reservoir are shown in Table 2 in terms of frequency of occurrence. Typically there is a cyclopoid copepod, usually *Mesocyclops edax* (S. A. Forbes) 1891 and a calanoid copepod, usually *Diaptomus pallidus* Herrick 1879 in Pawnee, Stagecoach and Branched Oak and *Diaptomus siciloides* Lilljeborg 1889 in Holmes and Wagontrain Reservoirs. Of the cladocerans, one typically finds one or two *Daphnia* species, usually *Daphnia galeata* Sars 1864 *mendotae* Birge 1918 and a smaller species, either *Daphnia ambigua* Scourfield, 1947 or *Daphnia parvula* Fordyce, 1901. *Daphnia pulex* Leydig, 1860 emend. Richard, 1896 was the numerically dominant cladoceran in 1968 and in early summer of 1969 after

**Table 2**: Percentage of sampling dates upon which each species of zooplankter occured.

| | Branched Oak | Holmes | Pawnee | Stage-coach | Wagon-train |
|---|---|---|---|---|---|
| Total sampling dates | 34 | 14 | 99 | 28 | 28 |
| *Mesocyclops edax* | 76 | 79 | 81 | 75 | 82 |
| *Cyclops vernalis* | 15 | 0 | 35 | 14 | 32 |
| *Eucyclops agilis* | 0 | 0 | 4 | 0 | 0 |
| *Diaptomus pallidus* | 100 | 0 | 99 | 71 | 0 |
| *Diaptomus siciloides* | 9 | 86 | 0 | 0 | 100 |
| *Diaptomus clavipes* | 21 | 100 | 2 | 7 | 43 |
| *Daphnia galeata mendotae* | 47 | 0 | 80 | 96 | 50 |
| *Daphnia pulex* | 50 | 0 | 8 | 0 | 4 |
| *Daphnia ambigua* | 41 | 0 | 21 | 25 | 43 |
| *Daphnia parvula* | 35 | 0 | 64 | 25 | 100 |
| *Daphnia retrocurva* | 0 | 100 | 0 | 0 | 0 |
| *Ceriodaphnia lacustris* | 65 | 0 | 68 | 68 | 0 |
| *Ceriodaphnia quadrangula* | 6 | 14 | 0 | 0 | 54 |
| *Diaphanosoma leuchtenbergianum* | 44 | 100 | 60 | 22 | 82 |
| *Bosmina longirostris* | 23 | 0 | 49 | 25 | 0 |
| *Bosmina coregoni* | 0 | 14 | 0 | 0 | 32 |
| *Chydorus sphaericus* | 0 | 0 | 4 | 0 | 0 |

which time it was replaced by *D. g. mendotae.* A similar situation existed in Pawnee. After June of 1968 *Daphnia pulex* was replaced by *D. g. mendotae.* Such a shift in dominance from larger to smaller bodied plankters was reported by Beeton (1965) as eutrophication increased in Lake Erie. Brooks (1970) points out that such a shift occurs with increased predation and selection for larger-bodied plankters by planktivorous fishes.

The remaining cladoceran species usually found were *Ceriodaphnia lacustris* Birge 1893 or *Ceriodaphnia quadrangula* (O. F. Muller) 1785 and *Diaphanosoma leuchtenbergianum* Fischer 1850. *Bosmina longirostris* (O. F. Fuller) 1785 was found in 49 percent of the samples from Pawnee reservoir. The more frequent occurrence here results from the fact that it becomes abundant in fall and winter, periods when the other reservoirs were not being sampled. *Bosmina longirostris* was occasionally found in Branched Oak and Stagecoach reservoirs also, while *Bosmina coregoni* Baird 1857 occurred in Wagontrain and Holmes. Brooks (1970) reports that *Bosmina longirostris* replaced *B. coregoni* in the plankton of an enriched lake and, with caution, may be considered an indicator species of polluted or eutrophic conditions.

**Table 3**: Congeneric occurrences of *Diaptomus* and *Daphnia* species. Percentages of samples in which the associations were found and relative abundance ratios are shown. Missing ratios occur when one species was not found during routine sub-sampling.

| Congeneric occurrences | Branched Oak | | Holmes | | Pawnee | | Stagecoach | | Wagontrain | |
|---|---|---|---|---|---|---|---|---|---|---|
| | % | ratio | % | ratio | % | ratio | % | ratio | % | ratio |
| *Diaptomus clavipes: D. siciloides* | – | – | 86 | 3.3:1* | – | – | – | – | 80 | 2.8:1** |
| *Diaptomus pallidus: D. siciloides* | 11 | – | – | – | – | – | – | – | – | – |
| *Diaptomus pallidus: D. clavipes* | 54 | 1:14.5 | – | – | 2 | – | 10 | 9.6:1 | – | – |
| *Daphnia galeata: D. parvula* | 20 | 15.5:1 | – | – | 55 | 1.2:1 | 21 | 2.6:1 | 46 | 1:7.0 |
| *Daphnia galeata: D. ambigua* | 15 | 1:8.6 | – | – | 21 | 16.5:1 | 25 | 1.5:1 | 25 | 1:9.4 |
| *Daphnia parvula: D. ambigua* | 26 | 1:3.4 | – | – | 11 | 1:2.5 | 14 | 1:4.5 | 46 | 1:9.1 |
| *Daphnia galeata: D. parvula: D. ambigua:* | 15 | 3.0:8.6:1 | – | – | 11 | 13.7:2.4:1 | 14 | 1:2.2:4.5 | 25 | 1:9.1:9.2 |
| *Daphnia galeata: D. pulex* | 6 | 1:57.0 | – | – | 1 | – | – | – | – | – |
| *Daphnia ambigua: D. pulex* | 23 | 1:8.9 | – | – | – | – | – | – | 4 | 2.3:1 |
| *Daphnia parvula: D. pulex* | 8 | – | – | – | – | – | – | – | 4 | 27.7:1 |
| *Daphnia galeata: D. parvula: D. ambigua: D. pulex:* | 3 | – | – | – | – | – | – | – | – | – |
| *Daphnia ambigua: D. parvula: D. pulex:* | 8 | – | – | – | – | – | – | – | 4 | 2.3:27.7:1 |

* 1969 data only.

**1969 and 1970 data only.

## CONGENERIC OCCURRENCES

Two species of plankters within the same genus were frequently found. Species of *Diaptomus* and *Daphnia* seem to be able to coexist despite the hypothesis of Gause which implies that competition for nearly identical niches would prevent their living together. Table 3 shows that two species of *Diaptomus* are found in the same sample regularly in Holmes, Wagontrain and Branched Oak reservoirs. In Holmes and Wagontrain *Diaptomus clavipes* Schacht 1897 is numerically dominant over *Diaptomus siciloides* but far less so than is suggested by Pennak (1957). Pennak states that one species will usually be 20 or more times as abundant as the other. Other workers have also found the extent of dominance to be less than that found by Pennak in Colorado reservoirs (Anderson; Armitage, 1961; Cole, 1961; Hammer and Sawchyn, 1968).

Our measurements indicate that *Diaptomus clavipes* is often nearly twice as long as *D. siciloides*. Hutchinson (1951) reported that closely allied copepods are frequently of different sizes when they occur together. Food habits of different sizes of Diaptomids may be quite different (Fryer, 1954), thus interspecific competition for food was probably slight between these species in the Salt Valley reservoirs, allowing them to coexist. In Table 3 one can see that congeneric *Daphnia* occurrences were common. With the exception of Holmes reservoir, in which only one species of *Daphnia* was found, there were at least two species in 61 percent of the collections and three or more species in 18.6 percent of the samples. The relative abundance of co-occurring species of *Daphnia* did not usually exceed a 20:1 ratio and it was not uncommon to find ratios lower than 5:1. Although these species occur in the same collections, it is probable that different vertical strata of water were occupied by the different species (Woltereck, 1932).

*Ceriodaphnia lacustris* and *C. quadrangula* were the only other species within the same genus to be found in the same sample. On two occasions in late July, 1969 in Branched Oak reservoir, *C. quadrangula* was noted but was too rare to occur during routine sub-sampling. At this time *C. lacustris* was found to be at a density of 2.3 and 0.8 organisms per liter, respectively.

## DISCUSSION

In considering the species composition of limnetic zooplankton communities in Nebraska one sees striking similarities to those found in other areas of the world. The data collected certainly lend themselves to further analyses. Knowledge of the population dynamics, production and trophic relations within these reservoirs will lend further insight into such basic ecological concepts as competition and predation.

The literature often contains information which is difficult to relate from one body of water to another and it is a problem to decide which parameters are most useful to study at the community level. These similarities in species composition are valuable in that we have a further common ground of familiarity upon which future work can be based and compared.

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