Proceedings of the Iowa Academy of Science

Volume 78 | Number 3-4 Article 13

1972

Copepoda and Cladocera Populations of Red Rock Reservoir, Iowa from April to November, 1970

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Copepoda and Cladocera Populations of Red Rock Reservoir, Iowa from April to November, 1970[1]

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RONALD L. ASCH and PHYLLIS J. KINGSBURY. Copepoda and Cladocera Populations of Red Rock Reservoir, Iowa from April to November, 1970. *Proc. Iowa Acad. Sci.*, 78(3-4):73-75, 1972.
SYNOPSIS. The effects of nutrient renewal, conservation pool water level, and the average weekly discharge rate on the species composition, relative abundance, and population fluctuations of the Copepoda and Cladocera of Red Rock Reservoir were determined. The average retention time (flushing rate) was 11.2 days. Twenty-one species were identified with the dominants being *Cyclops* spp., *Diaptomus* spp., *Daphnia* spp., *Bosmina longirostris, Moina micrura, Ceriodaphnia quadrangula,* and *Diaphanosoma* spp. Three distinct seasonal peaks in population growth were noted. Population fluctuations showed slight correlation with temperature, transparency, discharge rate, nutrient levels and no relationship was seen with water level. A time interval of 18 to 32 days occurred between high nitrate and phosphate levels and population abundance peaks. Species composition showed distinct seasonal changes. Population numbers began increasing at the dam area and continued upstream with declines following the reverse pattern.
INDEX DESCRIPTORS: Zooplankton, Species Composition, Reservoir Flushing.

Within the last two decades the U.S. Army Corps of Engineers has created some vast changes in the landscape of midwest America. These man-made changes have not only changed the landscape, but have had a definite effect on the ecosystems of several streams and major river systems. These changes have included with the State of Iowa, three reservoirs (Coralville, Red Rock, and Rathbun) completed and Saylorville Reservoir currently under construction. The main functions of these structures as stated by the U.S. Army Corps of Engineers are flood control and maintenance of downstream flow during periods of low water.

Each lake or reservoir is an individual problem with its own peculiar chemical, physical, and planktonic characteristics (Schmidt, 1968). By selecting stations within a reservoir along the line of water movement it should be possible to show population development. Changes in numbers of individuals of various species should indicate changes in population density. Analysis of the reservoir water level and outlet discharge rate should provide the information to determine flushing rate. Chemical analysis of the water should determine whether nutrient renewal was taking place.

It was the intent of this current study to explain: the species composition, the relative abundance, and some reasons for fluctuations in population abundance of the Copepoda and Cladocera of Red Rock Reservoir. Effects of nutrient renewal, conservation pool water level, and the average weekly discharge rate on these zooplankton populations were determined.

THE STUDY AREA

Red Rock Reservoir, located in south central Iowa, 8 km north of Knoxville, is a U.S. Army Corps of Engineers flood control project on the Des Moines River. Under normal river conditions the conservation pool extends 18.2 km upstream from the dam. The surface of the conservation pool is 221.0 m above mean sea level. At conservation level the reservoir has a surface of 3,623 ha and an average depth of 3.1 m. During flood control operations the surface area may increase to 26,500 ha with an average depth of 8.1 m and a length of 53.9 km.

COLLECTING SITES

Three transects were selected to divide the conservation pool into approximately three equal parts. Transect one was located through the deep water area near the dam. Transect two was located near the middle of the reservoir. Transect three was located in the upper end of the reservoir to represent the effects of the entering river. Ten sampling sites were positioned on these transects (Fig. 1). Stations one and two were located on either side of the dam outlet. Stations three, six, and eight were in the old river channel. Station four was positioned in White Breast Bay on the old creek channel.

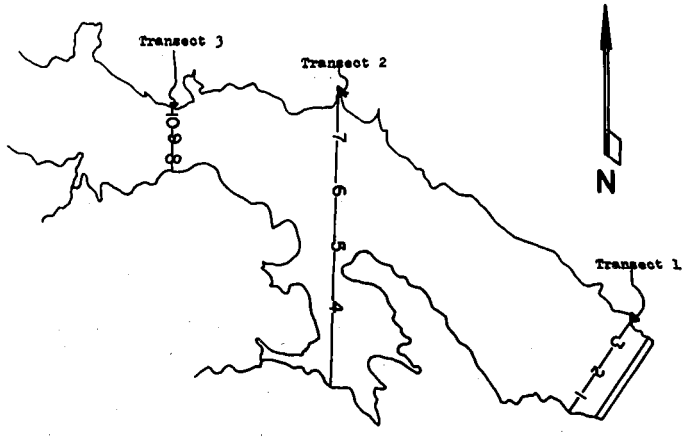

Fig. 1. A map showing the location of the stations and transects on Red Rock Reservoir.

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MATERIALS AND METHODS

From April 17 to November 6, 1970, volumetric samples of free swimming zooplankton were collected at weekly intervals. Organisms were collected with a three liter Kemmerer water bottle. Samples from each depth were concentrated by emptying the contents into a conical No. 20 mesh plankton net with attached vial, preserved in ten percent formalin and returned to the laboratory for examination.

Physical measurements taken at each station included the temperature and a Secchi disc reading.

The water samples for chemical analysis were collected biweekly by the Iowa State Conservation Department personnel and analyzed by the Iowa State Hygenic Laboratory, Des Moines, Iowa. Water level and discharge rate data were obtained from the Corps of Engineers records.

In the laboratory the contents of each plankton sample were placed in a gridded plastic petri dish for enumeration and genus identification using a dissecting microscope. Species determinations were made on representative numbers of each genus (Brooks, 1957, 1959; Pennak, 1963; Wilson, 1959; and Yeatman, 1959).

PHYSICAL AND CHEMICAL CHARACTERISTICS

Water temperatures followed the seasonal pattern with only weak stratification. The maximum temperature difference within the reservoir was 5.5°C. between the surface and the bottom; this occurred on July 10.

Secchi disc reading ranged from 5 to 100 cm. The lowest readings occurred at transect three and at station 4 following a heavy rainstorm.

The mean discharge rate calculated for the entire 30 week period was 114.4 m^3/sec (Asch, 1971). The calculated retention time varied from 2.58 to 109 days. The average retention time for the 30 week study based on the average discharge rate was 11.2 days.

The pH values ranged from 7.1 to 8.2 with low values occurring during the influx of runoff into the reservoir. Nitrate nitrogen values ranged from 0.2 to 5.6 mg/1 and the orthophosphate values from 0.1 to 0.9 mg/1.

ZOOPLANKTON

Since the stations on each transect had similar populations, physical and chemical properties, they were considered as a single unit. Population fluctuations at station 4, located in White Breast Bay, varied from those in the main reservoir.

A gradual increase in zooplankton abundance was noted prior to June 5 (Table 1). The late spring maximum in population growth occurred on June 19. A smaller summer peak occurred on transects 2 and 3 on July 17 and transect 1 on July 24. Another minimum was reached on August 14 which was followed by an increase to an early fall peak on September 4 (transect 1) and September 11 (transects 2 and 3). A gradual decrease in abundance was noted from September 18 to the end of the sampling period.

Population abundance at station 4 appeared to peak about the same time as the other stations, but the populations remained at high levels for a longer period of time.

Twenty-one species were identified. The most abundant forms were *Cyclops bicuspidatus thomasi, Diaptomus siciloides, Daphnia ambigua, Daphnia pulex, Bosmina longirostris, Moina micrura, Ceriodaphnia quadrangula,* and *Diaphanosoma brachyurum.* The remaining species occurred in small numbers, except *Cyclops varicans rubellus* which was quite common during August and September.

TABLE 1

The Average Number of Copepoda and Cladocera Collected per Liter at Each Transect and Station Four.

Date	Trans. 1	Trans. 2	Trans. 3	Sta. 4
4/17	1.7	1.3	1.3	4.7
4/24	3.8	0.6	0.5	3.0
5/1	7.5	1.3	0.7	4.9
5/8	2.1	0.6	1.3	2.2
5/15	4.2	0.4	0.2	1.3
5/22	7.3	1.7	1.2	9.1
5/28	6.2	4.8	1.8	39.1
6/5	16.0	6.8	0.7	36.1
6/12	43.5	18.7	6.5	22.4
6/19	79.9	22.3	44.9	50.5
6/26	33.6	10.7	5.4	17.6
7/2	7.1	17.7	11.9	40.9
7/10	12.4	20.1	9.8	23.2
7/17	19.2	24.9	18.7	19.1
7/24	56.7	8.0	5.1	28.5
7/31	19.1	15.5	7.2	27.9
8/7	18.1	17.6	14.1	21.2
8/14	11.4	3.2	2.8	5.5
8/21	21.0	15.2	4.7	11.4
8/28	27.6	19.2	10.5	13.6
9/4	42.6	25.3	14.7	27.2
9/11	33.2	39.1	15.2	31.6
9/18	28.3	10.8	4.8	21.0
9/25	28.9	10.3	4.6	14.1
10/2	19.2	7.4	2.6	16.3
10/9	18.1	9.4	2.9	4.8
10/16	6.1	2.8	0.9	8.2
10/23	7.2	2.4	1.1	5.9
10/30	2.4	1.9	0.7	2.7
11/6	1.3	0.7	0.2	0.8

DISCUSSION

Multiple Regression Analysis

Correlation for temperature and the seven most abundant genera indicated that there might be a general, direct relationship between temperature and *Cyclops* and *Moina,* while *Diaptomus, Bosmina* and *Diaphanosoma* showed a slight relationship.

Secchi disc readings and genera populations showed a general relationship with *Cyclops, Moina* and *Daphnia* populations. A general inverse correlation was found between turbidity and *Cyclops* and *Bosmina.*

The correlation values between nitrate nitrogen and populations showed an inverse correlation with *Diaptomus, Ceriodaphnia* and *Diaphanosoma.* Phosphate levels showed an inverse correlation with *Moina.*

Diaptomus and *Diaphanosoma* showed the greatest inverse relationship to water discharge, while *Daphnia, Moina* and *Ceriodaphnia* showed a slight inverse relationship. Water level showed no correlation with population number at any transect or station (Asch, 1971).

A time interval occurred between the nutrient (nitrate and phosphate) levels and the population abundance peaks. The highest levels of nutrients occurred on June 1 and were followed 18 days later by the late spring population maximum. The summer population peak was not preceded by a nutrient

increase, but the nitrate and phosphate levels were high. The fall population pulse was preceded by an increase in nitrate levels (August 24) and phosphate levels (August 11). The populations peaks on transect 3 varied from those on transect 1 and 2 by the number of days elapsing since the nutrient increases. There was a lag of 19 to 32 days between nutrient level increases and the population peaks.

Species Composition

There was a seasonal change in the species composition at all stations. In April, *C. bicuspidatus thomasi, Diaptomus clavipes, D. siciloides, Daphnia ambigua, D. pulex,* and *Bosmina longirostris* were present. *D. clavipes* disappeared in late April. During June, two new species, *Moina micrura* and *Diaphanosoma brachyurum* appeared. In July, *D. ambigua* disappeared. In August, *Cyclops varicans rubellus* and *Paracyclops fimbriatus poppei* were present. During September, the predominant species were *D. siciloides* and *D. brachyurum.* In September, *M. micrura* disappeared and *Ceriodaphnia quadrangula* appeared. In October, *D. pulex* and *D. brachyurum* were the abundant species. During the first week in November, five species were present: *C. bicuspidatus thomasi, D. siciloides, D. pulex, B. longirostris,* and *Diaphanosoma leuchtenbergianum.*

Population numbers of a species began to increase first at transect 1, then succeeding increases were shown at transects 2 and 3. The population numbers of a given species declined first in the upper end of the reservoir (transect 3), while persisting for a longer period of time at the dam area (transect 1). Similar patterns of zooplankton distribution were noted in Lewis and Clark Lake, South Dakota (Cowell, 1970, Tash, Swanson, and Siefert, 1966).

ACKNOWLEDGMENT

The authors wish to express their gratitude to James Mayhew, of the Iowa State Conservation Commission, who was kind enough to cooperate in gathering the data for this study.

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