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ABSTRACT

Parvin Lake, Colorado, a 19 ha montane reservoir, was artificially destratified for 1 year. Abundance of cladocerans (collectively) and *Daphnia schødleri* was lower during destratification. Abundance of rotifers (collectively) was lower during winter months and higher during summer months of the destratification year. Abundance of copepods (mainly *Diaptomus* spp.) was not statistically different during destratification. Depth distribution of zooplankton was generally unaffected, but *Diaptomus* spp. tended to occur in deeper water during the destratification year.

INTRODUCTION

Lake destratification is becoming an increasingly common tool in attempts to solve certain water management problems. Water quality, particularly with regard to iron and manganese increases or oxygen depletion, can sometimes be improved by eliminating or reducing thermal stratification. The influence of destratification on physical and chemical parameters has been well studied (Bernhardt, 1967; Fast, 1968; Lackey, 1972a), but effects

TABLE 1.—*Abundance (number/liter weighted by lake volume) of Parvin Lake zooplankton during control (C) and treatment (T) years*

Group	Year	Abundance													Probability	
		Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Mean	Sign test	Run test
Cladocera[1]	C	18	1	6	14	3	4	2	10	12	25	16	14	10	0.01	0.26
	T	3	6	3	2	0	1	0	1	12	8	7	4	4		
Daphnia galeata mendotae	C	0	0	0	0	0	0	0	0	1	16	10	7	3	0.73	0.37
	T	2	3	2	1	0	0	0	0	11	6	5	4	3		
Daphnia schødleri	C	15	0	3	5	2	2	1	9	4	4	3	2	4	0.01	0.42
	T	0	1	0	0	0	0	0	0	0	0	0	0	0		
Daphnia juveniles	C	0	0	1	3	0	0	1	2	0	1	1	1	1	0.45	1.00
	T	0	0	0	0	0	1	0	0	0	2	1	0	0		
Copepoda[1]	C	14	6	6	36	36	42	26	14	16	33	20	22	22	0.39	0.07
	T	4	11	10	9	9	9	5	5	9	29	22	24	12		
Diaptomus	C	8	3	4	24	4	2	2	2	6	17	15	12	8	0.55	0.61
	T	3	7	7	4	4	3	1	1	4	15	14	13	6		
Nauplii	C	3	0	1	6	25	12	19	8	4	6	6	4	8	0.15	0.39
	T	0	2	0	0	1	2	1	2	2	14	4	8	3		
Rotifera[1]	C	0	19	110	110	110	60	12	9	5	0	0	1	36	0.55	0.04
	T	0	1	0	8	19	4	2	10	10	70	1	0	10		
Felinia	C	0	0	2	19	17	16	3	0	3	0	0	0	5	0.73	0.14
	T	0	1	0	3	8	1	1	10	8	0	0	0	3		
Keratella	C	0	12	35	46	86	40	8	9	0	0	0	0	20	0.07	0.11
	T	0	0	0	0	0	0	1	0	0	69	0	0	6		
Polyarthra	C	0	3	76	45	4	4	0	0	3	0	0	3	12	0.18	0.07
	T	0	0	0	0	1	2	0	0	2	1	1	0	1		

[1] Includes unidentified and rare members of this group.

on biological components are poorly defined. Several authors have studied effects on phytoplankton (Bernhardt, 1967; Robinson, Irwin, and Symons, 1968), but few quantitative data are available on zooplankton. Riddick (1957) suggested an increase in zooplankton abundance occurred following destratification, but his sample size was small. Fast (1971) showed that zooplankton increased their vertical range after artificial destratification. The purpose of this paper is to describe effects of destratification on zooplankton abundance and depth distribution in Parvin Lake, Colorado.

METHODS

Parvin Lake is a 19 ha montane reservoir located in northern Colorado. Maximum depth is 10 m and the mean depth is 4.4 m. This study consisted of a *control year* (November 1968–October 1969) and a *treatment year* (November 1969–October 1970). During the treatment year the destratification system was in continuous operation. Design, installation, and operation of the destratification system has been described by Lackey (1972b). Limnological conditions during the control year were typical of those for previous years (W. D. Klein, unpublished data).

Zooplankton was sampled at three stations: (1) the deepest part of the lake (10 m), (2) the 6-m contour, and (3) the 2-m contour. During each sampling, 12 liters of water were collected from each 2-m depth interval at each station (3 liters from each 0.5-m depth interval, combined over each 2-m stratum) and filtered through a 75-nm mesh net. Samples were preserved in a solution of 4% formaldehyde. Zooplankton abundance was extrapolated based on examination of at least 4 Sedgwick–Rafter cell samples.

Horizontal differences in abundance between stations were not detected by initial data analysis, so counts for a given stratum were averaged. From these average values, a lake mean for each taxon was calculated, weighed by lake volume for each 2-m stratum. Sign and run tests were calculated for each taxon (Sokal and Rohlf, 1969). A significant sign test indicates that an annual population change has probably taken place. A significant run test means that the data probably do not occur in a random pattern (e.g., winter abundance increased and summer abundance decreased).

RESULTS AND DISCUSSION

Cladocera were significantly less abundant ($P < 0.01$) during destratification (Table 1). Greatest abundance occurred during summer and autumn of the treatment year. *Daphnia galeata mendotae* was absent during the control year winter, but was present in low, but consistent numbers during the treatment winter. Depth distribution of *D. galeata mendotae* was similar in both years with individuals about evenly distributed in the water column. *D. schødleri* was significantly ($P < 0.01$) less abundant during the treatment year. In both years, *D. schødleri* was most abundant a few meters below the surface in summer and early fall, but in winter highest numbers occurred near the bottom. Juvenile *Daphnia* were not vertically stratified either year.

Copepod abundance was not significantly different during the treatment year, but spring and summer abundance decreased, while autumn and winter abundance increased (Table 1). *Diaptomus* spp. followed a nearly identical annual cycle of abundance during both years, but were usually found in deeper water during treatment. Nauplii abundance closely followed the abundance of *D.* spp. Although destratification had no apparent effect on copepod abundance in Parvin Lake, Riddick (1957) noted a four-fold increase in *Cyclops* and *Diaptomus* abundance during summer aeration of a New York lake.

Three genera of Rotifera were common in Parvin Lake during the study: *Felinia*, *Karatella*, and *Polyarthra* (Table 1). A run test indicated ($P < 0.04$) that rotifers were less abundant during the treatment year winter and higher in the treatment year summer (Table 1). During the control year vertical distribution did not follow a pattern for any genera, and this did not change during treatment.

Although the data presented here are not conclusive, there does appear to be a trend toward a decrease in zooplankton abundance during destratification. Several explanations might account for the decline other than random variation. During treatment, water temperatures were colder than normal in winter and warmer than normal in summer (Lackey, 1972a). Such a change in the typical annual temperature cycle may adversely affect zooplankton populations. Lack of water column stability is another factor that might likely cause a decrease in zooplankton abundance.

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