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COMPARISON OF ZOOPLANKTON FOUND IN THE EASTERN BASIN OF LAKE ERIE IN 1928 AND 1974[1]

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Abstract. Crustacean zooplankton from Eastern Lake Erie collected in 1974 were compared with those found in a 1928 survey. Calanoid copepods composed a higher percentage of the total zooplankton community in 1928, whereas cyclopoids were the more important component in 1974. Nine taxa of copepods and 9 taxa of cladocerans were observed in 1928. In 1974, 8 species of copepods and 11 species of cladocera were found. Oligotrophic indicator organisms (*e.g. Limnocalanus macrurus*) were more common in 1928, while eutrophic indicators (*e.g. Diaptomus siciloides*) were more common in 1974. The relative abundances of organisms occurring in both years were very different. *Leptodora kindtii* occurred in 55% of the samples in 1928 but only in 22% in 1974. *Daphnia retrocurva* occurred in 12% of the 1928 samples but in 90% of the 1974 samples. Changes in the occurrence and abundance of these and other organisms may indicate their association with different aquatic trophic conditions.

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Few historical comparisons of the zooplankton in the Great Lakes are available. Davis (1966) discussed the methods and some results of earlier studies on the Great Lakes and Bradshaw (1964) compared reports of zooplankton surveys from 1939, 1949, and 1959 on the Western Basin of Lake Erie. A major survey was carried out in the Eastern Basin of Lake Erie by Charles Fish (1929). His data were compared with Great Lakes Laboratory (1975) data from 1974 to determine if changes in species composition had occurred.

The zooplankton populations of Eastern Lake Erie were very different between 1928 and 1974. These differences probably reflect or were caused by changes in water quality and alterations in phytoplankton and fish populations. My investigation compared important, previously-neglected historical data to recent observations so that long-term changes in the zooplankton community and related water quality could be assessed, also providing data for future comparisons in the use of zooplankton as indicators of changes in water quality.

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MATERIALS AND METHODS

Sampling and laboratory methods used in 1928 and 1974 are summarized in table 1. Since the 1928 study reported only percent composition values, numbers of organisms per cubic meter from 1974 were converted to percent composition, and data from both years were converted to percent occurrence values. Percent composition is the percentage of the

TABLE 1

*A Comparison of Research Methods Used in Eastern Lake Erie in 1928 and 1974.**

Methods and Materials	1928	1974
Net pore size	1 m diameter 112 and 119 μm	0.5 m diameter 64 μm
Type of Tow	Horizontal	Vertical
Subsample Min. Vol.	1 ml	0.1 ml
Reported No. Organisms by	% composition	% composition % occurrence
Sampling Dates	26–30 July 7–10 August 15–17 August 22–25 August 28 August–3 September	18–22 June 26–30 July 6–9 August 6–9 September

*Maps of the stations sampled during 1928 and 1974 may be found in Slacer (1976).

community that a given taxa represents. Percent occurrence is the percentage of stations at which or samples in which a taxon is found.

The keys used in the 1974 analysis were Brooks (1957, 1959), Czaika and Robertson (1968), Deevey, E. S. Jr. and G. B. Deevey (1971), and Wilson and Yeatman (1959). Because Wilson did not report the keys that he used in his identification and since persons involved in the zooplankton research were not available, an attempt was made to relate the taxonomy of 1928 and 1974 by referring to the keys in use now, the ones probably used in 1928 (Birge 1918, Marsh 1918), and other references (Pennak 1953a and b, Davis 1966, 1968; Dussart 1969, C. B. Wilson's text as reported in Fish 1929, and Wilson 1960) (table 2).

TABLE 2

Presently Accepted Versions of Past Zooplankton Taxa.

Species Reported By C.B. Wilson (1928)	Presently Accepted Versions of C.B. Wilson's Taxa	References	Notes
Cyclops leuckarti	*Mesocyclops edax*	Marsh (1918)	*Cyclops leuckarti* was also called *Mesocyclops obsoletus* in 1928 (Fish 1929).
Cyclops robustus	*Cyclops vernalis*	Davis (1968)	*Cyclops robustus* was also called *Cyclops brevispinosus* in 1928 (Fish 1929). Davis (1968) suggested that *C. brevispinosus* be considered to be *Cyclops vernalis*.
Cyclops vulgaris	*Cyclops viridis*	Dussart (1969)	Also presently called *Acanthocyclops viridis*.
Leptocyclops agilis	*Eucyclops agilis*	Wilson and Yeatman (1959)	*Leptocyclops agilis* was also called *Cyclops serrulatus* in 1928 (Fish 1929).
Daphnia longispina typica	*Daphnia ambigua*, *Daphnia galeata mendotae*	Brooks (1957)	*Daphnia longispina* taxonomy is very ambiguous.
Daphnia longispina galeata	*Daphnia galeata mendotae*	Brooks (1957)	
Daphnia longispina mendotae	*Daphnia galeata mendotae*	Brooks (1957)	
Bosmina longirostris	*Mucronate bosminids*	Deevey and Deevey (1971)	
Bosmina coregoni	*Eubosmina* spp.	Deevey and Deevey (1971)	

RESULTS

Organisms reported in the 1928 survey but not in 1974 were the copepods, *Epischura lacustris*, *Limnocalanus macrurus*, *Cyclops robustus* (*C. vernalis*), *C. vulgaris* (*C. viridis*), *Leptocyclops agilis* (*Eucyclops agilis*), and the cladocerans, *Daphnia pulex* and *Sida crystallina* (table 3). Organisms found in 1974 but not in 1928 were the copepods, *Diaptomus oregonensis*, *D. siciloides*, *D. minutus*, *Tropocyclops prasinus mexicanus*, and the cladocerans, *Ceriodaphnia lacustris*, *Chydorus sphaericus*, *Daphnia longiremis*, *D. parvula*, *Diaphanosoma leuchtenbergianum*, and *Holopedium gibberum*.

In 1928, the most abundant organisms were *Daphnia pulex* and *Diaptomus ashlandi*. *Daphnia galeata mendotae* and *Cyclops bicuspidatus thomasi* were more numerous in 1974. Zooplankton that occurred in the majority of samples from 1928 were *Daphnia mendotae*, *D. pulex*, *Diaptomus ashlandi*, and *Epischura lacustris*. (All had percent occurrence values of 67%, which was the highest observed for the year.) In 1974, the mucronate bosminids, *Daphnia galeata mendotae*, *D. retrocurva*, *Diaptomus oregonensis*, *Cyclops bicuspidatus thomasi*, and *Mesocyclops edax* each occurred in over 90% of the samples.

Notable differences between the 2 years were shown by changes in the occurrence and numbers of certain organisms. *Cyclops bicuspidatus thomasi*, *Daphnia galeata mendotae*, *D. retrocurva*, and bosminids (all found in both years) were

more important in terms of occurrence and community composition in 1974 (table 3). In 1928, however, *Diaptomus ashlandi*, *D. sicilis*, and *Leptodora kindtii* (all found in both years) were more important.

the chemical and physical parameters for 1928 and 1974 may be found in Fish (1929) and Great Lakes Laboratory (1975), respectively.

Specific organisms have been associated with various trophic levels by many researchers. In 1928, the oligotrophic indicator organisms, *Limnocalanus macrurus* (Hakarri 1972) and *Diaptomus sicilis* (McNaught *et al* 1975) were common; in 1974, they were absent or occurred rarely. Eutrophic indicator organisms such as *Diaptomus siciloides* and *Chydorus sphaericus* (Gannon 1972) were found in 1974 but not in 1928, and *Daphnia retrocurva* (McNaught *et al* 1975) was much more prevalent in 1974 than in 1928.

TABLE 3

Percent Composition and Percent Occurrence Values for 1928 and 1974.*

Taxa	Compo. 1928	Compo. 1974	Occurr. 1928	Occurr. 1974
Cladocera				
Bosmina longirostris	T**	—	1	—
Bosminids, mucronate	—	3	—	93
Bosminids, nonmucronate	—	2	—	62
Ceriodaphnia lacustris	—	T	—	18
Chydorus sphaericus	—	T	—	2
Daphnia galeata mendotae	—	39	—	96
D. galeata	5	—	65	—
D. mendotae	4	—	67	—
D. longiremis	—	2	—	49
D. longispina typica	1	—	4	—
D. parvula	—	T	—	2
D. pulex	46	—	67	—
D. retrocurva	T	14	12	90
Diaphanosoma leuchtenbergianum	—	2	—	50
Holopedium gibberum	—	T	—	51
Latona setifera	T	—	2	—
Leptodora kindtii	1	T	55	22
Sida crystallina	2	—	61	—
Copepoda				
Diaptomus ashlandi	26	T	67	37
D. minutus	—	T	—	2
D. oregonensis	—	12	—	100
D. sicilis	2	T	64	6
D. siciloides	—	T	—	26
Epischura lacustris	2	—	67	—
Limnocalanus macrurus	1	—	21	—
Cyclops bicuspidatus thomasi	1	14	50	100
C. leuckarti	3	—	43	—
C. robustus	T	—	5	—
Leptocyclops agilis	T	—	1	—
Mesocyclops edax	—	11	—	98
M. obsoletus	1	—	20	—
Tropocyclops prasinus mexicanus	—	T	—	2

*Percent composition values for 1928 and 1974 were averaged for each year from data presented in Fish (1928) and Slacer (1976).

**T—less than 1%. All other data are expressed as % composition or % occurrence.

DISCUSSION

The occurrence and abundance of organisms may be associated with the quality of their environment. Since the quality of Eastern Lake Erie has changed from generally oligotrophic in 1928 (Fish 1929) to eutrophic (Beeton 1965) or mesotrophic (Hartman 1973, Vollenweider *et al* 1974), certain zooplankton species characteristic of the 2 years may reflect the different water quality. Values of

Vast differences in the numerical importance in the community (as expressed in percent composition values) and the distribution of an organism (expressed as percent occurrence values) were noted between certain taxa present in 1928 and 1974. The changes in abundance and occurrence of bosminids, *Daphnia galeata mendotae*, *Cyclops bicuspidatus thomasi*, *Mesocyclops edax* (all having higher values in 1974) and *Leptodora kindtii* and *Diaptomus ashlandi* (both having higher values in 1928) appear to associate them with the different water quality of the 2 years. Further investigation of the occurrence of these species is necessary before a definite link can be established between the organism and a specific water quality level.

Gliwicz (1969) noted that more cladocerans than calanoids occurred in Polish lakes with higher trophic levels. Patalas (1972) saw a similar trend (ratio of calanoids to cladocerans plus cyclopoids) in the Great Lakes. When adding the percent composition values (because actual counts from 1928 were not available) in each group for Eastern Lake Erie, a ratio of 31:64 (calanoids to cladocerans plus cyclopoids) was obtained for the 1928 data, while the 1974 data yielded a ratio of 12:88. This finding indicates that calanoids composed a higher percentage of the zooplankton population in 1928 than in 1974—again reinforcing the idea that the lake was more eutrophic in 1974 than in 1928.

The organisms found in 1974 seem to be very widespread in the Eastern Basin; whereas in 1928, the taxa appear to be more restricted in their occurrence. In 1974, 6 taxa were each found at over 90% of the stations sampled; in 1928, no organism was found at more than 67% of the stations sampled. These findings may indicate that water conditions have changed to provide a favorable environment for these organisms between 1928 and 1974. Individual taxa have also increased in their importance in the community from 1928 to 1974. In 1928, only 2 taxa each composed over 10% of the population; but in 1974, five species had a percent composition value of over 10%, demonstrating how the community structure of the zooplankton present in Eastern Lake Erie has changed from 1928 to 1974.

Concentrations (*i.e.* numbers per cubic meter) were not recorded in 1928, but other reports indicate that the number of zooplankton in Lake Erie have increased since 1928. Maximum numbers of organisms per cubic meter in the Western Basin increased from 87,000/m^3 in 1939 to 145,194/m^3 in 1949 and to 367,000/m^3 (excluding nauplii) in 1959 (Bradshaw 1964). Zooplankton numbers also have increased in the Central Basin (Rolan *et al* 1973) and in the Cleveland area of Lake Erie (Czaika 1978). The 1974 maximum in the Eastern Basin (270,000/m^3) is closer to the later values for the Western Basin and Cleveland area. It is reasonable to expect that zooplankton in the Eastern Basin also have increased accordingly.

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