

# ANALYSIS OF PLANKTON INGESTED BY *STIZOSTEDIDIUM VITREUM VITREUM* (MITCHILL) FRY AND CONCURRENT VERTICAL PLANKTON TOWS FROM SOUTHWESTERN LAKE ERIE, MAY 1961 AND MAY 1962<sup>1, 2</sup>

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## ABSTRACT

The analysis of plankton tows for May, 1961, and May, 1962, showed four species of diatoms, *Melosira binderana*, *M. ambigua*, *Fragilaria capucina* and *F. crotonensis* to be dominant. The analysis of the intestinal tract of the walleye fry showed these four species to be dominant in the fry up to 9 mm. Those fry above 9 mm contained zooplankton as well as species of these diatoms. This preliminary study indicates a change in food habits of the walleye fry at the 9-mm stage.

The objective of this study was threefold: 1. to determine the relative abundance of phytoplankton in southwestern Lake Erie, 2. to determine the nature of the

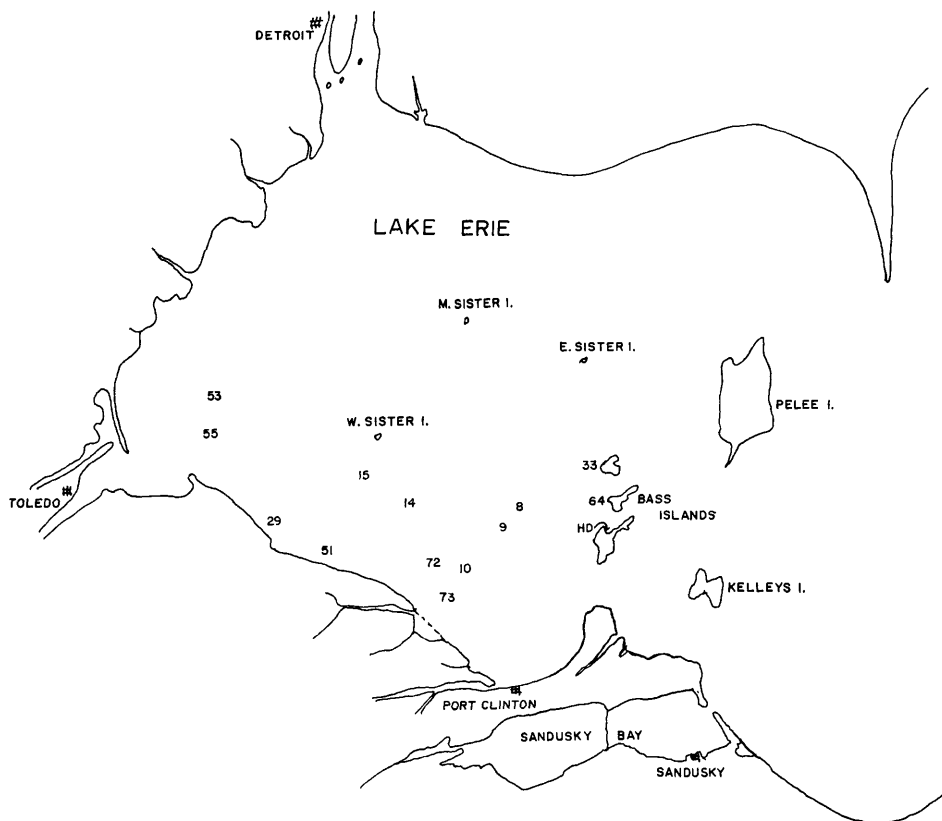


FIGURE 1. Walleye Fry and Concurrent Plankton Sampling Stations for May 1961-62.

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<sup>2</sup>Manuscript received March 14, 1964.

plankton consumed by the fry of the walleye, *Stizostedium vitreum vitreum* (Mitchill), and 3. to see if there was a relationship between size of fry, and type and/or size of plankton ingested. The fry samples and concurrent vertical plankton tows were secured in the general vicinity of the spawning grounds of southwestern Lake Erie (fig. 1).

I wish to express my appreciation to Mr. Jerry Manz, Fish Management Supervisor, Ohio Division of Wildlife, Sandusky, Ohio, who supervised the collection of the material, supplied the station number designations, and provided general information helpful in this study.

## METHODS

The plankton samples were obtained by pulling a plankton net of #20 mesh from the bottom of the station to the surface. The concentrated material was then transferred to vials. Enough formalin was added to make approximately a

TABLE 1

*Distribution of phytoplankton at Walleye fry sampling stations, May 1961 and May 1962\**

Diatoms	Stations											
	1961						1962					
	9	14	15	51	53	72	73	8	29	33	55	64
<i>Amphora ovalis</i> v. <i>pediculus</i> Kutz.	—	X	—	—	—	—	—	—	—	—	—	—
<i>Cocconeis placentula</i> Ehr.	X	—	—	—	—	—	—	—	—	—	—	X
<i>Coscinodiscus radiatus</i> Ehr.	—	—	—	—	—	—	—	—	—	—	—	X
<i>Cyclotella meneghiniana</i> Kutz.	—	—	—	—	—	—	—	X	—	—	—	X
<i>Cymatopleura solea</i> (Breb.) W. Sm.	—	—	—	—	—	—	—	—	—	—	—	X
<i>Diatoma elongatum</i> Ag.	X	X	—	X	13	X	—	X	—	—	—	X
<i>Fragilaria capucina</i> Desmez.	—	18	X	X	10	X	52	51	70	58	59	66
<i>Fragilaria crotonensis</i> Kitton	X	11	—	X	X	X	X	15	X	20	X	X
<i>Fragilaria vaucheriae</i> Grun.	—	X	—	—	—	—	—	—	—	—	—	—
<i>Fragilaria</i> sp. 1	X	X	—	—	—	—	X	—	—	—	—	X
<i>Melosira ambigua</i> (Grun.) O. Mull	37	15	50	87	37	35	20	X	X	X	X	X
<i>Melosira binderana</i> Kutz.	45	52	45	X	27	60	X	11	24	13	19	X
<i>Melosira granulata</i> (Ehr.) Ralfs.	—	X	—	X	X	X	—	—	—	—	—	—
<i>Nitzschia gracilis</i> Hantz.	—	—	—	—	—	—	—	X	—	—	—	X
<i>Nitzschia sigmoidea</i> (Ehr.) W. Sm.	—	—	—	—	—	—	—	—	—	—	—	X
<i>Stephanodiscus astraea</i> (Ehr.) Grun.	—	X	—	—	X	—	—	—	X	—	X	X
<i>Syneca acus</i> Kutz.	—	—	—	X	X	X	X	—	—	—	—	X
<i>Synedra ulna</i> (Nitz.) Ehr.	—	—	—	X	X	X	X	—	X	X	—	X
<i>Tabellaria fenestrata</i> (Lyngb.) Kutz.	11	X	X	X	X	X	11	13	X	X	X	X
Other Algae												
<i>Ceratium hirundinella</i> (O. Mull.) Dujardun	—	—	X	—	—	—	—	—	—	—	—	—
<i>Gomphosphaeria lacustris</i> Chodat.	—	—	—	—	—	—	—	—	X	X	X	—
<i>Pediastrum boryanum</i> (Trup.) Menegh.	—	—	—	—	X	—	—	—	—	—	—	—
<i>Pediastrum duplex</i> Mayen	—	—	—	—	X	—	—	—	X	X	X	X
<i>Pediastrum simplex</i> (Mayen) Lemmer.	—	X	—	—	—	X	—	—	—	—	—	X
<i>Scenedesmus acuminatus</i> (Lag.) Chodat.	—	X	—	—	—	—	—	—	—	—	—	—
<i>Staurastrum sebalzii</i> v. <i>ornatum</i> Nordst.	—	X	—	—	—	—	—	—	—	—	—	—

\*The numbers indicate the percent occurrence, while a check (X) indicates less than 10 percent occurrence.

10 per cent solution. Plankton nets of numbers 00 and 000 silk bolting cloth, mounted on a ½-m and 1-m ring, were used in the capture of walleye fry. Horizontal tows, 10 min in duration, were made at the surface, midwater, and bottom at each station sampled. All the fry secured were sorted and identified by personnel of the Ohio Division of Wildlife.

The diatoms were cleaned by the nitric acid-potassium dichromate method

and permanent slides secured by us of Hyrax, a mounting medium with an index of refraction of 1.65.

The diatoms were observed and counted by the use of a 93X oil immersion objective with a N.A. of 1.3. To secure a reliable sample, at least 1,000 specimens were observed for each collection. The percentage occurrence was then determined and tabulated (table 1).

Algae, other than diatoms, were observed by placing material on a slide and observing as a wet mount. The percentage composition of both algae and diatoms were calculated from a mount of this type, but identification and percentage

TABLE 2

*Organisms observed in the digestive tract of fry of Stizostedion vitreum vitreum (Mitchill) Collected in one-half meter fry net with a ten minute tow, May 1961*

Day of month:	10	10	10	12	13	13	22	22	22	24	24	25	25	25	25	25	25	25	25	25	25
Station Number:	10	10	14	14	9	9	73	14	14	72	72	53	15	51	51	51	51	51	51	51	51
Length in mm:	7	7	7	7	8	8	9	7	8.5	8	9	9	10	9	10	10.5	11	10	10.5	10.5	10.5
<i>Melosira binderana</i>			10		7	39		13	93			5	9	5	—	4	43	61	56	—	—
<i>Melosira ambigua</i>			—		—	6		4	—			—	—	—	—	—	—	—	—	—	7
<i>Fragilaria capucina</i>	egg	yolk	only				egg	yolk	only	101		—	35	6							—
<i>Stephanodiscus astraea</i>	egg	yolk	only				egg	yolk	only	1		—	—	—	—	—	—	—	—	—	—
<i>Gomphonema</i> sp.	—	—	—				—	—	—	—		—	1	—	—	—	—	—	—	—	—
<i>Pediastrum</i> sp.	—	—	—				—	—	—	—		—	1	—	—	—	—	—	—	—	—
<i>Ceratium hirundinella</i>	—	—	—				—	—	—	—		—	—	—	1	—	—	—	—	—	—
<i>Bosmina longirostris</i>	—	—	—				—	—	1	—	—	1	—	—	—	—	—	—	—	—	—
<i>Cyclops bicuspidatus</i>	—	—	—				—	—	2	—	—	—	—	6	—	1	2	3	2	4	—

composition of the diatoms had to be performed using an oil immersion lens. The relative abundance of algae other than diatoms is also recorded in table 1.

The walleye fry were carefully measured from the tip of the snout to the end of the caudal fin. To avoid contamination by phytoplankton or zooplankton that may have adhered to the outside of the fry, each specimen was carefully washed in several changes of distilled water. Each fry was then carefully opened and the digestive tract removed and placed in a drop of water on a slide. The dissection procedure was performed under low power of a dissecting scope. The entire digestive tract was teased apart and evenly distributed on the slide. This

TABLE 3

*Organisms observed in the digestive tract of fry of Stizostedion vitreum vitreum (Mitchill) collected in one-half meter fry net with a ten minute tow, May 1962*

Day of month:	8	8	10	10	10	10	10	10	10	10	10	10	10	10	21	21	25	
Station Number:	8	8	8	33	8	8	8	8	8	8	8	8	8	8	29	55	HD*	
Length in mm:	8	7	8	9	8	8	8	9	9	9	8	8	8	8	9	12	13	12
<i>Fragilaria capucina</i>	—	—	—	—	—	—	—	—	—	—	144	—	—	—	102	—	—	
<i>Melosira binderana</i>	egg	yolk	only	4	—	—	egg	yolk	only	—	2	—	—	—	—	—	—	
<i>Tabellaria fenestrata</i>	egg	yolk	only	—	—	—	egg	yolk	only	—	—	—	—	—	—	—	—	
<i>Surirella angusta</i>	—	—	—	—	—	—	egg	yolk	only	—	—	—	—	—	—	—	—	
<i>Spirogyra</i> sp.	—	—	—	4	—	—	egg	yolk	only	—	—	—	—	—	—	—	—	
<i>Cyclops bicuspidatus</i>	—	—	—	—	—	—	egg	yolk	only	—	—	—	—	—	—	—	—	
<i>Bosmina longirostris</i>	—	—	—	—	—	—	egg	yolk	only	—	—	—	—	—	—	—	—	

\*Hatchery dock, Put-in-Bay, Ohio.

material then was permanently mounted in very thin hyrax. Using this method, not only diatoms, but other algae such as desmids, as well as protozoans, were preserved for identification.

The organisms present were identified, counted, and recorded for each fry (tables 2 and 3).

All permanent slides are now in the private herbarium of the author, where they are available to interested persons.

#### RESULTS AND DISCUSSION

The general pattern of the phytoplankton observed for the Spring of 1961 and 1962 (table 1) was one that exhibited a predominance of diatoms. In all the collections that contained sufficient material for an accurate analysis, diatoms occupied between 95 and 99 per cent of the total phytoplankton. These same conditions were observed by Chandler (1940, 1942, 1944). In total per cent composition, the phytoplankton was very similar to that observed by Chandler, but the species composition of the 1961-62 samples was quite different.

In April and May of 1940, *Asterionella* sp. occupied 95 per cent or more of the total diatom population, with *Melosira* sp. and *Stephanodiscus* sp. occupying a combined total of less than 5 per cent. In the present study, no species of diatoms occupied as much as 95 per cent of the total phytoplankton. In 1961, three species, *Melosira binderana*, *M. ambigua* and *Fragilaria capucina*, occupied a combined total of approximately 95 per cent. The highest occurrence of one species occurred at station 51 when *M. ambigua* represented 87 per cent of the total. In 1962, *M. binderana*, *F. capucina*, and *F. crotonensis* constituted up to 95 per cent of the total phytoplankton. *F. capucina* appeared to be more abundant, on the average, than *M. binderana*. *M. ambigua*, a very abundant species in 1961, never exceeded 5 per cent in the 1962 samples. It had evidently been replaced by *F. crotonensis*, a species present in moderate amounts in 1961.

Chandler (1940) states that species of diatoms belonging to the order Centrales (*Melosira*, *Cyclotella*, *Stephanodiscus*) were most numerous in the fall, and those belonging to the order Pennales (*Tabellaria*, *Diatoma*, *Fragilaria*, *Synedra* and *Asterionella*) were most abundant in the spring. *M. binderana*, a centric form, was very abundant in the spring of both 1961 and 1962. Concurrent studies being undertaken by the author indicate that the seasonal occurrence of species of diatoms in Lake Erie is quite variable.

Species of algae other than diatoms were few in numbers and per cent occurrence. Species of the genus *Pediastrum* were present in more samples than all other algae combined. This occurrence in most of the samples with relatively few representatives agrees well with the findings of Chandler (1940).

The analysis of 180 additional plankton samples for this period is given in Hohn (1963).

The contents of the intestinal tract of the fry of *Stizostedion vitreum vitreum* were quite variable in the 1961 collections (table 2). Smaller specimens, 7 to 8 mm, generally contained fewer algae, with the exception of one 7-mm specimen from Station 14 on May 22 that had a total of 119 specimens of diatoms. There were 101 individuals of *F. capucina*, 13 individuals of *M. binderana*, 4 individuals of *M. ambigua*, and 1 individual of *Stephanodiscus astraea*. A variable number of diatoms were observed in specimens 8.5 to 11 mm in length. Also present in these larger specimens was the cladoceran, *Bosmina longirostris*, and the copepod, *Cyclops bicuspidatus*. These two species were more abundant in the 10- to 11-mm individuals. Diatoms were also found in these larger specimens. One specimen of 10 mm from Station 15 on May 25 contained 6 individuals of *C. bicuspidatus*, as well as specimens of the diatoms, *M. binderana* and *F. capucina*. At least one copepod was found in the intestinal tract of all specimens 10 mm and larger.

*M. binderana*, the dominant plankton diatom, was also the most abundant phytoplankton in the fry.

The analysis of the 1962 fry (table 3) were quite similar to those observed in 1961. In general, the smaller fry of 7 to 8 mm contained only the remains of the yolk sac. The larger specimens contained plankton and the 12- and 13-mm specimens contained *C. bicuspidatus* and *B. longirostris*. *F. capucina*, the dominant plankton diatom, was also the most abundant phytoplankton in the fry.

## SUMMARY

The results obtained in this survey indicate the following:

1. The total phytoplankton population in the southwestern region of Lake Erie investigated in this study was composed of 95 to 99 per cent diatoms during the survey of 1961 and 1962, the same ratios as reported by other investigators.

2. Four species of diatoms: *Melosira binderana*, *M. ambigua*, *Fragilaria capucina*, *F. crotonensis*, were dominant forms in 1961 and 1962, with a shift in rank of the dominants from one year to the next.

3. Representatives of the genus *Pediastrum* were present in most samples, but never constituted a major dominant.

4. The smaller walleye fry, 7 to 8 mm in length, had only diatoms in their intestinal tracts. The larger specimens (up to 13 mm) had diatoms, other algae, and specimens of *Cyclops bicuspidatus* and *Bosmina longirostris*. This seems to indicate that an occasional fry of 7 mm may begin feeding on diatoms and continue to utilize this type of plankton until they reach 8½ to 9 mm. Specimens of 10 to 13 mm were able to utilize not only diatoms but also several specimens of zooplankton. All fry of 10 mm or more in length contained specimens of either *C. bicuspidatus* or *B. longirostris* or both.

5. It is of interest that the diatom *Melosira binderana* was not reported from the United States until 1961. The author has since found it to occupy as much as 99 per cent of the total phytoplankton population of the Bass Island region during the month of January.

## LITERATURE CITED

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