FOOD OF YOUNG-OF-THE-YEAR WALLEYES IN LAKE ERIE

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ABSTRACT

Stomach contents were examined for 794 young-of-the-year (O-group) walleyes (*Stizostedion vitreum vitreum*) captured by trawls at 17 locations in western Lake Erie in June-November 1962. Food organisms were found in 92.5 percent of the stomachs. Food varied with geographic location and season of capture, but within areas and seasons, selection for certain species and sizes of prey was strong. Walleyes from the extreme western end of Lake Erie fed primarily on gizzard shad and alewives during the summer and shifted to emerald shiners during the fall. The stomach contents of walleyes from the Island region changed from mainly yellow perch during the summer to emerald shiners by the end of the year. Walleyes collected east of the Islands had consumed only smelt and yellow perch. The numbers of forage species caught with walleyes in trawls showed little correlation with the representation of these species in walleye stomachs. Walleyes fed on the smallest individuals of each species regardless of species preferences.

Among the fishes of primary economic importance in Lake Erie, the cisco or lake herring (*Coregonus artedi*), the whitefish (*C. clupeaformis*), the sauger (*Stizostedion canadense*), and the blue pike (*S. vitreum glaucum*) have become commercially unimportant, mostly in recent years. The last remaining "high-priced" fish left to the industry—the walleye (*S. vitreum vitreum*)—has also declined to a remnant population which fluctuates widely in abundance. The commercial catch (United States and Canadian) of walleyes has declined from a peak of 15,405,000 pounds in 1956 to a low of 717,000 pounds in 1962. The decline has been accompanied by demands for management of the fishery to restore and maintain abundance. Recent studies of the life history of the walleye were begun in 1957 to provide information essential to management. This report on feeding of young-of-the-year (O-group) walleyes at various seasons of the year and at different locations in western Lake Erie is a contribution to these studies.

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MATERIALS AND METHODS

The contents were examined of 794 stomachs from O-group walleyes of the 1962 year class collected in western Lake Erie at 17 locations in June–November 1962 (fig. 1). All collections were from U.S. waters and were made during routine trawling to ascertain the relative success of the hatching and survival of commercial and other species. The fish were caught in semi-balloon bottom trawls by Bureau of Commercial Fisheries vessels, *Musky II* (523 fish), *Kaho* (35), and an outboard-motor boat (233), and the Ohio Division of Wildlife vessel *Explorer* (3). The walleyes were preserved whole in 20 percent formalin after their abdomens had been slit; examinations and measurements were made in the laboratory. Food organisms were identified to the lowest taxonomic level possible. Stomach contents

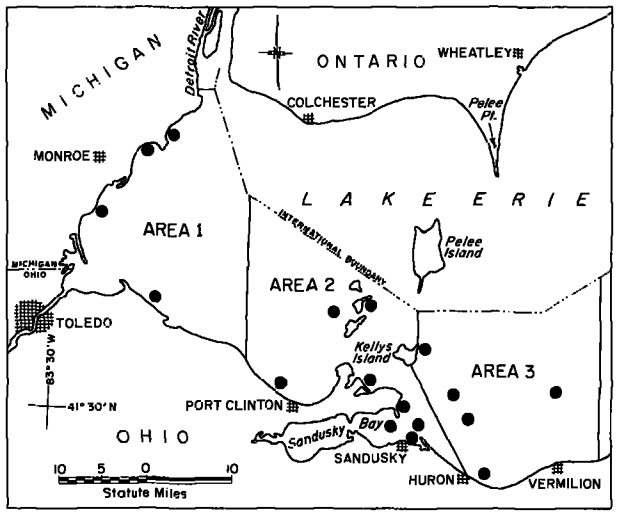

FIGURE 1.—Map of western Lake Erie showing locations where young-of-the-year walleyes were collected and areas by which data were analyzed. Dots represent collection locations.

were measured volumetrically by water displacement in a cylinder graduated to 0.1 ml. Items with a volume less than 0.1 ml. were listed as "trace". The entire stomach contents of 176 walleyes (41–74 mm. long) caught in June were examined with a dissecting microscope. No volumetric measurements were made of the food of these fish.

Counts were made of the O-group fish of the following species that were caught in the trawl hauls with the walleyes: Gizzard shad (*Dorosoma cepedianum*), alewife (*Alosa pseudoharengus*), American smelt (*Osmerus mordax*), emerald shiner (*Notropis atherinoides*), spottail shiner (*N. hudsonius*), trout-perch (*Percopsis omiscomaycus*), white bass (*Roccus chrysops*), yellow perch (*Perca flavescens*), and sheepshead or freshwater drum (*Aplodinotus grunniens*).

Data on food are presented separately for each of three areas in which walleyes were collected (fig. 1). Although the boundaries are somewhat arbitrary, each area differs ecologically from the others and each has its own characteristic fish fauna.

FOOD OF YOUNG WALLEYES IN DIFFERENT AREAS

The food of young-of-the-year walleyes in Lake Erie varied with geographic location and season of capture, but, within an area and season, selection for certain species and sizes of prey was strong. In general, little correlation existed between the numbers of various forage species present in the same catches with walleyes and the representation of these species in walleye stomachs.

Extreme Western Lake Erie (Area 1)

Food organisms were found in 94.7 percent of the 189 walleye stomachs (table 1). Gizzard shad and alewives were the principal food in July. Together they made up 72.7 percent of the total volume; gizzard shad occurred in 30.6 percent and alewives in 20.7 percent of the stomachs containing food. These species represented only 4.1 per-

TABLE 1.—*Food of young-of-the-year walleyes in extreme western Lake Erie in July, August, and October, 1962*

[Expressed in percentage of total volume (PV) and percentage frequency of occurrence (PO). Percentage frequencies based on numbers of stomachs containing food]

Food item	Dates of capture					
	July 17–24		August 14–16		October 15–18	
	PV	PO	PV	PO	PV	PO
Insects:						
Tendipes pupae	<0.1	0.1	<0.1	13.9		
Tendipes larvae			<.1	2.8		
Fish:						
Alewife	32.7	20.7	16.7	8.3		
Emerald shiner			47.0	47.2	99.7	100.0
Gizzard shad	40.0	30.6	23.7	13.9		
Smelt	1.6	.9				
Spottail shiner	.3	.9				
Yellow perch	10.0	9.0	6.7	5.2		
Unidentifiable remains	15.4	53.2	5.9	33.3	.3	7.1
Number of stomachs	120		37		32	
Number of stomachs empty	9		1		4	
Average total length (mm.)	108		157		226	

TABLE 2.—*Young-of-the-year fishes taken in the same trawl hauls as walleyes (1962)*

[Expressed as percentage of total trawl catches in each indicated period [1]; no data for Area 3 because walleyes east of the Islands were taken in large-mesh trawls]

Dates of capture	Yellow perch	Emerald shiner	Gizzard shad	Alewife	Spottail shiner	White bass	Sheeps-head	Trout-perch	Smelt
	Extreme western Lake Erie (Area 1)								
July 17–24	39.2		1.2	2.9	13.0	43.4	0.1		0.2
Aug. 14–16	16.9	0.4	5.4	5.5	9.3	58.5	3.6	0.3	.1
Oct. 15–18	66.3	12.4	<.1	4.2	14.7	.9	.2	.6	.7
	Island region (Area 2)								
June 25–27	97.1					2.5		0.2	0.2
July 2–18	99.0		0.7	<0.1	0.1	.2			
July 25–Aug. 1	38.8		11.9	.8	30.8	16.6	1.1		<.1
Aug. 20–30	79.6		1.2	.8	12.7	4.1	<.1	.4	1.2
Sept. 18–19	17.9	4.1	7.4	1.4	47.2	13.6	5.9	1.0	1.5
Oct. 29–Nov. 1	73.0	2.2	.1	.6	19.3	.4	1.9	1.9	.6

[1] Numbers of young-of-the-year walleyes caught are given in table 1 and table 4.

cent of the total number of fish taken in the trawl (table 2). In contrast, white bass made up 43.4 percent of the total number of O-group fish in the trawl catches from which the walleyes were obtained but none were found in walleye stomachs. Yellow perch composed 39.2 percent of the trawl catches but were in only 9.0 percent of the stomachs. The consumption of smelt and spottail shiners was negligible. No emerald shiners had been eaten.

Gizzard shad and alewives were being supplanted by other prey in stomachs of walleyes captured August 14–16. The volume of the two species in stomachs had dropped to 40.4 percent and the frequency of occurrence was only 13.9 percent for the gizzard shad and 8.3 percent for the alewife. Emerald shiners had entered strongly into the diet; they made up 47.0 percent of the volume and occurred in 47.2 percent of the stomachs. Emerald shiners were scarce, nevertheless, in trawl catches (0.4 percent of the total catches). The number of gizzard shad and alewives combined had increased to 10.9 percent of all fish caught, even though they had decreased in importance as food for walleyes. White bass, still the most abundant forage species available, had not been eaten.

The shift in food from gizzard shad and alewives to emerald shiners was complete in October when the identifiable stomach contents of 32 walleyes contained only emerald shiners. Emerald shiners had increased to 12.4 percent of the total catch of trawls in mid-October. Young-of-the-year yellow perch, although now the most available forage fish (66.3 percent of the total trawl catches), had not been eaten. Walleyes apparently sought more emerald shiners as the gizzard shad and alewives grew to a size that made them unsuitable prey (table 3).

Insects were eaten most commonly in August when the percentage frequencies of occurrence of pupae and larvae of the midge *Tendipes* were 13.9 and 2.8 percent, respectively. *Tendipes*, however, constituted a negligible amount of the total volume

TABLE 3.—*Comparison of total lengths (mm.) of young-of-the-year fish caught in trawls in extreme western Lake Erie and those taken from walleye stomachs (1962)*

Species and item	July 17–24		Aug. 14–16		Oct. 15–18	
	Trawls	Stomachs	Trawls	Stomachs	Trawls	Stomachs
Alewife:						
Average length	48	42	89	56	117	
Range of length	33–69	36–47	64–102	52–60	76–147	
Number	256	8	91	3	141	0
Emerald shiner:						
Average length			51	49	69	55
Range of length			38–61	45–54	51–86	48–65
Number	0	0	100	4	339	42
Gizzard shad:						
Average length	56	46	102	55	157	
Range of length	48–76	35–50	79–130	49–64	135–193	
Number	13	5	40	4	141	0
Sheepshead:						
Average length			64		109	
Range of length			33–89		61–142	
Number	0	0	98	0	49	0
Smelt:						
Average length	45		53		69	
Range of length	43–46		51–58		53–94	
Number	2	0	6	0	41	0
Spottail shiner:						
Average length	43		51		74	
Range of length	20–69		38–64		58–91	
Number	311	0	130	0	166	0
White bass:						
Average length	36		69		104	
Range of length	20–84		43–86		69–157	
Number	308	0	97	0	44	0
Yellow perch:						
Average length	53	36	66	53	81	
Range of length	41–74	33–42	58–76	53	66–97	
Number	482	6	142	1	219	0

of food. No other insects were present in the stomachs of walleyes from this area.

Island Region (Area 2)

Of the 562 walleyes collected from Area 2 (table 4) the late June sample of 176 individuals (mean length 55 mm.) required special treatment. All stomach contents of these small fish were examined with a dissecting microscope. The major food at this time was unidentifiable fish fry (frequency of occurrence—65.5 percent). Many of the fry probaby were yellow perch but positive identification was impossible, because of their small size. *Leptodora kindtii* appeared in 16.5 percent of the stomachs. Consumption of *Diaptomus*, *Cyclops*, and *Daphnia* was limited as was also that of unidentifible midge larvae and pupae. Ewers (1933) found *Leptodora* the most common of the Entomostraca in the diet of young walleyes and blue pike in western Lake Erie. The stomachs of 23 walleyes caught in the latter part of July 1929, and examined by Boesel [1] contained 82.9 percent Entomostraca and 17.1 percent fish by volume.

The 61 walleyes captured July 2–18 had been feeding entirely on fish fry. Yellow perch comprised 92.3 percent of the total volume. Seemingly little other food was available to small walleyes in this area at this season. Trawl catches in which the walleyes were taken consisted of 99.0 percent O-group yellow perch.

Young-of-the-year walleyes in other lakes of the Midwest consume large quantities of yellow perch. Eschmeyer (1950) found yellow perch in 42.1 percent of the stomachs of O-group walleyes of Gogebic Lake, Mich., during June 24 to July 10, 1941. Yellow perch also made up 68 percent of the total volume of food. Yellow perch constituted 77 percent by volume of the stomach contents of O-group walleyes in Mille Lacs Lake, Minn., in June–September (Maloney and Johnson, 1957).

The 219 walleyes taken July 25 to August 7 had eaten a diversity of organisms. Yellow perch continued to be the major food (total volume—64.3 percent; frequency of occurrence—72.3 percent). They were also the most available prey

[1] Boesel, M. W. 1929. A preliminary report on the food of certain insect feeding fishes of Lake Erie. MS., Department of Zoology, Ohio State University, 30 pp.

TABLE 4.—*Food of young-of-the-year walleyes in the Island region in June–November 1962*

[Expressed in percentage of total volume (PV) and percentage frequency of occurrence (PO). Percentage frequencies based on numbers of stomachs containing food]

Food item	Dates of capture									
	June 25–27	July 2–18		July 25–Aug. 7		Aug. 20–30		Sept. 18–19		Oct. 29–Nov. 1	
	PO [1]	PV	PO	PV	PO	PV	PO	PV	PO	PV	PO
Algae	0.5										
Copepods:											
Diaptomus oregonensis	.5										
Diaptomus spp.	.5										
Cyclops vernalis	1.9										
Cyclops spp.	2.9										
Cladocerans:											
Daphnia retrocurva	1.9										
Daphnia galeata	.5										
Daphnia spp.	1.5										
Leptodora kindtii	16.5										
Unidentifiable remains	.5										
Insects:											
Tendipes pupae				<0.1	7.0	<0.1	1.8				
Tendipes larvae				<.1	.5						
Unidentified midge pupae	2.4										
Unidentified midge larvae	3.4										
Ichneumonidae				<.1	.5						
Fish:											
Alewife				12.1	6.1						
Emerald shiner				4.5	3.3	3.0	3.5	9.3	22.9	93.0	88.8
Gizzard shad				12.1	4.2	.8	1.8	28.0	17.1		
Percina spp.				.1	.5						
Smelt				.6	.9			1.5	8.6		
Spottail shiner				1.5	1.4						
Yellow perch	1.5	92.3	58.6	64.3	72.3	91.5	84.2	60.4	65.7	7.0	11.1
Unidentifiable fry	65.6	7.7	55.2								
Unidentifiable remains				4.8	31.0	4.7	19.3	.8	8.6	<.1	11.1
Number of stomachs	176	61		219		60		36		10	
Number of stomachs empty	27	3		6		3		1		1	
Average total length (mm.)	55	79		132		183		214		239	

[1] Volumes not measured in this collection.

(38.8 percent of all fish taken by trawl). Although gizzard shad and alewives made up 24.2 percent of the total volume of food, they were present in relatively few stomachs. Similarly, few spottail shiners had been eaten (frequency of occurrence—1.4 percent) even though they were readily available (30.8 percent of the trawl catches). Emerald shiners were not taken by the trawl but were in 3.3 percent of the stomachs. *Tendipes* pupae were more prominent at this time than in any other period (frequency of occurrence—7.1 percent). Maloney and Johnson (1957) reported that dipterous larvae occurred in the stomachs of walleyes taken in August in Lake Winnibigoshish, Minn.

Yellow perch made up the bulk of the food of the walleyes captured in the Island area, August 20–30 (total volume—91.5 percent; frequency of occurrence—84.2 percent). Gizzard shad had almost disappeared from the stomachs (total volume—0.8 percent). Again, emerald shiners had been eaten but were not in the trawl catches. Walleyes may have been seeking out this minnow. On the other hand, trawl catches may not provide an exact index of relative abundance of emerald shiners because this fish occasionally frequents the surface waters and hence becomes unavailable to bottom trawls.

The importance of yellow perch had begun to decline by September 18–19 (total volume—60.4 percent; frequency of occurrence—65.7 percent); perch were being supplanted by emerald shiners (total volume—9.3 percent; frequency of occurrence—22.9 percent). Trawl catches indicated that the availability of yellow perch had decreased while that of the emerald shiners had increased (table 2).

The few walleyes caught between October 29 and November 1 showed a further shift from yellow perch (total volume—7.0 percent; frequency of occurrence—11.1 percent) to emerald shiners (total volume—93.0 percent; frequency of occurrence—88.8 percent). Doan (1941) stated that emerald shiners constituted 82 percent of the volume of food eaten by 62 walleyes, 10–17 inches long, caught at Put-In-Bay, Ohio, in November and December 1940.

Evidence from extreme western Lake Erie (Area 1) suggests that the walleye prefers gizzard shad or alewives during its early months of life, even though ample numbers of young yellow perch (and other species) of suitable size are available. It is apparent from the fish taken in the Islands region (Area 2), however, that where yellow perch almost completely dominate the food supply, the walleye can and does feed heavily upon them. The shift to emerald shiners that occurred in the late summer and autumn in both Areas 1 and 2 may be traceable to different causes. In Area 1, the emerald shiners became prominent in the food of walleyes when the gizzard shad and alewives became too large to eat. In Area 2, the change probably reflects species rather than size preference since both the emerald shiners and the yellow perch captured in October were about the same size (table 5).

East of the Island Region (Area 3)

Forty-three O-group walleyes were collected off Huron and Vermilion, Ohio, and east of Kelleys Island in July, August, September, and October. The 38 fish that had food in their stomachs had eaten almost exclusively smelt and yellow perch (table 6). Yellow perch were the only food of walleyes in the small July collection. Some smelt were eaten in August, and by September this species had become the only food in almost all stomachs. No suitable records are available of the relative numbers of O-group fish living with the walleyes because most were taken in trawls with large-mesh cod ends that permitted the escape of most small fish. A cursory examination of the catches did reveal, however, that the bulk of forage available to the walleyes east of the Islands consisted of smelt and yellow perch in all seasons.

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TABLE 5.—*Comparison of total lengths (mm.) of young-of-the-year fish caught in trawls in the Island region and those taken from walleye stomachs (1962)*

Species and item	July 2–18		July 25–August 7		August 20–30		September 18–19		Oct. 29–Nov. 1	
	Trawls	Stomachs	Trawls	Stomachs	Trawls	Stomachs	Trawls	Stomachs	Trawls	Stomachs
Alewife:										
Average length	51		79	50			97			
Range of length	28–61		64–89	46–59			61–117			
Number	111	0	54	8	0	0	15	0	0	0
Emerald shiner:										
Average length				42		44		49	66	62
Range of length				37–45		44		43–55	56–76	55–65
Number	0	0	0	3	0	1	0	8	100	9
Gizzard shad:										
Average length			84	54			102	65		
Range of length			58–117	44–64			61–147	57–75		
Number	0	0	174	6	0	0	253	6	0	0
Sheepshead:										
Average length			69							
Range of length			30–99							
Number	0	0	193	0	0	0	0	0	0	0
Smelt:										
Average length				35	53			48		
Range of length				30–40	46–58			45–53		
Number	0	0	0	2	4	0	0	3	0	0
Spottail shiner:										
Average length	38		43	35	53		58		76	
Range of length	25–56		28–58	27–40	38–74		51–71		51–91	
Number	87	0	209	4	158	0	104	0	86	0
White bass:										
Average length	38		56		53		109		84	
Range of length	25–56		28–81		41–79		51–147		53–124	
Number	126	0	298	0	152	0	209	0	78	0
Yellow perch:										
Average length	41	25	48	37	58	49	71	51	71	50
Range of length	30–51	23–28	30–76	26–46	48–76	42–61	56–91	43–64	53–94	50
Number	121	6	573	79	171	48	75	45	186	1

TABLE 6.—*Food of young-of-the-year walleyes captured in Area 3 in July, August, September, and October, 1962*

[Expressed in percentage of total volume (PV) and percentage frequency of occurrence (PO). Percentage frequencies based on numbers of stomachs containing food]

Food item	Dates of capture							
	July 19		Aug. 23–30		Sept. 6–26		Oct. 10	
	PV	PO	PV	PO	PV	PO	PV	PO
Smelt			16.1	50.0	93.3	63.6	95.7	90.9
Yellow perch	100.0	100.0	83.9	100.0			4.3	4.5
Unidentifiable fish remains					.7	36.4	<.1	4.5
Number of stomachs	4		2		15		22	
Number of stomachs empty	1		0		4		0	
Average total length (mm.)	82		174		218		236	

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