

Prepared for

U. S. Fish and Wildlife Service Ohio Department of Natural Resources Division of Wildlife

Prepared by

Loren S. Putnam and Richard A. Tubb

THE OHIO STATE UNIVERSITY CENTER FOR LAKE ERIE AREA RESEARCH COLUMBUS, OHIO

> October 1979 (Originally prepared in May 1972)

JOB COMPLETION REPORT

RESEARCH COMPLETION SEGMENT

State of:

Ohio

Date:

May 31, 1972

Project No.

F-41-R-3

Name:

Environmental Evaluation of

a Nuclear Power Plant

Job No.:

1-A

Title:

Fish Population Prior to

Period Covered:

June 1, 1969-May 31, 1972

Discharge

ABSTRACT

Fish populations were sampled during ice-free months from June, 1969 through May, 1971 using a 150-ft. bag seine, 2750-ft. commercial seine, and three 150-ft. experimental gill nets.

Carp*, gizzard shad, freshwater drum and white bass were found during every sampling period. Carp were the most abundant over-all, normally comprising more than 80% of the sample. Drum and gizzard shad were next in abundance.

In general, the spring and early summer samples contained a greater percentage of adult fish, while the late summer and fall samples reflected the recruitment of young-of-the-year fish.

Chironomid larvae were the most frequently-found food items for most species in all months. There was little evidence of a seasonal change in food habits.

Some species (drum, white bass) showed size-related changes in food habits.

^{*} In this report, carp refers to carp, goldfish and/or carp-goldfish hybrids.

RECOMMENDATIONS

Sampling of fish populations should be repeated after the nuclear power plant is in operation. Seasonal samples between now and then (1974) would be desirable in order to detect any major changes in the populations before discharge.

OBJECTIVES

The objective of this job was to determine the composition and character of the fish populations in the area prior to discharge.

TECHNIQUES USED

Sampling: Three transects in the Locust Point area were established in 1969 for sampling fish populations. The same three transects were used in 1970 and 1971 (Fig. I). Transect I begins 1,000 ft. west of the Toussaint River and runs toward West Sister Island. Transect 2 runs from the mouth of the Toussaint River to Niagara Reef and Transect 3 starts 1,000 ft. east of the river and runs toward South Bass Island.

Mr. Virgil St. Clair, a commercial fisherman, operated his 2750-ft. seine east of the Toussaint River in the area of Transect 3. This net was from 12 to 16 ft. deep with 5" mesh at the outsides. The mesh gradually decreased in size toward the bat, which was 2-1/4" mesh. Fish were sampled with this gear once a month from June through October, 1969, May through October, 1970, and April and May, 1971.

The 150-ft. bag seine was fished at five locations; one haul was made at the base of each transect, one haul between Transects 1 and 2 and one haul between Transects 2 and 3. The net was 6 ft. deep with 3/4" mesh in the wings and 1/4" mesh in the bag. Fish were sampled by this method in July, August and October, 1969, May through October, 1970 and May, 1971.

Three experimental gill nets were set, one along each transect. They were fished overnight perpendicular to shore with the small mesh set closest to shore in about 8 feet of water. The nets were 6 ft. deep and 150 ft. long, consisting of contiguous 30-ft. panels of stretch mesh from 1/4" to 3". Gill nets were set once a month from August through October, 1969 and in May and August, 1970.

Species Composition: The catch of each species by each method was determined after every sampling period, as was the total catch for each gear. Except for carp all fish were weighed and measured and scales taken from representatives of each size group. When the commercial seine catch contained too many carp to process feasibly, Mr. St. Clair estimated the total catch. Catch per unit effort (CPE) was determined for each gear and a comparison was made between the relative numbers of individuals and species for each gill net and 150-ft. seine haul.

Age-Growth: Scales were read using a Bausch & Lomb microprojector and annular measurements made to enable back calculation of growth rate. Length-frequently plots were used for determining ages of shiners. Age data was compared with and supplemented by data from the Lake Erie Research Unit, Ohio Division of Wildlife, and Carlander's (1969) data for Lake Erie fishes.

Food Habits: Representatives of different size groups and species were weighed, measured and their stomachs preserved in 5% formalin as soon as possible after capture. Only live, seined fish were used for this study. Stomach contents were identified as far as possible and enumerated. Because of the small stomach volumes and diversity of food items, the numerical approach was used rather than the volumetric method.

Frequency of occurrence was calculated for each food item for each fish species. Differences from month to month were examined and food habits of different sized individuals of the same species were compared.

FINDINGS

Species Composition: Appendix I is a list of scientific and common names of all fish taken. Table I shows the species present in each month of sampling. Altogether 33 species were found, although the greatest number for any one month was 21 (May, 1970). Fewest species (12) were taken in July and September, 1970.

Freshwater drum, carp (including goldfish and/or hybrids), gizzard shad and white bass were taken during every month sampled, while several species (spotted and white suckers, stonecat, rockbass, smallmouth and largemouth bass, green sunfish and logperch) occurred only once or twice. The number of species in part reflected the methods used, since not all sampling methods were used every month.

In every month except October, 1969 and August, 1970, carp and goldfish made up at least 60% by weight of the total sample. Next in abundance were gizzard shad and drum. In the two other months freshwater drum were most abundant. Total catches were greatest in the late spring and early fall samples and lowest in the summer months.

Tables 2, 3, and 4 show catch per unit effort (CPE) for the three sampling methods for each month. Data for the 2750-ft. seine is expressed as pounds per haul, for the 150-ft. seine as individuals per haul and for the gill nets as individuals per net. Since the 2750-ft. seine captured the large individuals of each species and too many individuals to count feasibly, the catch was expressed as pounds rather than numbers of individuals. The 150-ft. seine, on the other hand, took mostly young-of-the-year fish and shiners; thus it was more practical to express these catches as numbers of individuals.

Tables 5 and 6 are comparisons of the numbers of individuals each month at each sampling location for the gill net and 150-ft. seine catches. Since the 2750-ft. seine was pulled at only one location each month, there is no similar data for it.

The greatest numbers of individuals were taken most often West of the Touissaint River and the fewest individuals were most often taken East of the river. No seasonal trend in numbers of species or individuals at a given location was detected, but numbers seemed lower in August and September, 1970 than the same months of 1969.

Age-Growth: Data from several sources was combined to give a view of the age structure of fishes in the Locust Point area. Table 7 shows the mean length for each age class of most species collected. The figures are from work done in this study, from the Lake Erie Research Unit of the Ohio Division of Wildlife and from Carlander's (1969) information on Lake Erie fishes.

Samples in early spring were comprised mostly of adult individuals. As the summer progressed, young-of-the-year individuals, as well as yearlings, became more abundant. Young-of-the-year white bass, shiners, drum, gizzard shad and alewife were taken only in the 150-ft. bag seine. Young-of-the-year carp and goldfish were never taken and only a few young-of-the-year channel catfish were captured.

Table 8 shows the size composition of the species frequently captured, using all three methods. This table reflects type of gear used as well as population changes, since not all sizes of fish were equally susceptible to all types of gear.

Food Habits: From June, 1969 through May, 1971, 1919 stomachs were examined, 71.8% of which contained food. The number of stomachs examined each month and the number containing food is shown in Table 9. A seasonal pattern

was evident, with a greater percentage of stomachs containing food in the summer months than in the spring and fall (Fig. 2). All the percentages may be lower than in actuality since it is common for fish to regurgitate when they are caught and handled.

Table 10 shows the frequency of occurrence of various food items in Locust Point fish stomachs from June, 1969 through May, 1971. The percent frequency of occurrence is based on the number of stomachs containing food. "Unidentifiable debris" included material too digested to be identified as well as sand, silt and gravel. Results are probably biased toward hard-to-digest organisms, since they would remain in the stomach longer.

Stomach contents of carp and goldfish were the most difficult to identify, but almost always included copepods and cladocerans. In addition, insects and amphipod remains were frequently found, as was plant material.

Gizzard shad stomach contents were predominantly zooplankton and phytoplankton, but most contained significant amounts of silt or sand grains.

Freshwater drum under 6 inches long ate no fish; their major food items were chironomid larvae (mostly <u>Chironomus</u> (<u>Chironomus</u>), <u>C. (Cryptochironomus</u>) and <u>Glyptotendipes</u>. Other insects and cladocerans occurred occasionally. The three species of chironomids found were the most abundant ones found in benthos samples from the area. The species were plentiful in all open-lake samples, from all substrate types and seldom occur in emergent vegetation along the shore.

Drum between 6 and 12 inches long ate primarily Chironomidae, but contained a wider variety of other insects, including Hemiptera and Odonata, than those shorter than six inches. Drum larger than 12-inches contained fish

almost exclusively. The apparent seasonal trend toward a greater occurrence of Chironomidae in late summer and fall is probably due to recruitment of young-of-the-year drum into the population rather than an actual change in food habits.

The San San American Control of the

white bass showed a similar size-related pattern, the small individuals utilizing zooplankton and Chironomidae and the larger ones feeding almost entirely on fish. No such pattern was evident for yellow perch. All sizes fed about equally on Chironomidae and fish.

Emerald and spottail shiners fed mainly on insects. The large individuals utilized Cladocera and Copepoda extensively, but diets of young-of-the-year individuals (less than 2.8 inches) were not so restricted. The diversity of insects eaten (Chironomidae and other Diptera, Odonata, Trichoptera, Hemiptera and Coleoptera) indicated the shiners were feeding on the surface and in emergent vegetation, perhaps into the Toussaint River, as well as in the open lake.

Both bullheads and channel catfish were omnivorous, feeding on everything from cladocerans to fish. The occurrence of the midge <u>Cricotopus</u>, dipterans other than Chironomidae, and Coleoptera indicates considerable shallow-water or upstream feeding as well as open-water feeding suggested by the presence of <u>C. (Cryptochironomus</u>), amphipods, and Gastropoda.

Amphipods were utilized by all species of fish except gizzard shad.

They occurred especially frequently in the spring, perhaps before many small fish were available as food.

All species of fish utilized food organisms found in the Locust Point area, both in the open lake and along the shore or in the river. Food items found included benthic invertebrates from all substitutes in the area (silt and sand bottom, gravel and clay bottom and the reefs). The plankters utilized corresponded with those predominant in most of the plankton samples (Daphnia retrocurva, Bosmina sp., Chydorus sp. and cyclopold copepods).

îrêm eledocerale la riem el riel etaur elacă ci filă alter <u>un ecrelus. Perspesses</u> 7 chronid Manten Panicale 1860 - Tana Cold Corrin final Letra, constae pers î în brok-bă foi

LITERATURE CITED

- Baker, Carl. 1969. Lake Erie Fish Population Trawling Survey.

 Dingell-Johnson Project F-35-R-7, Job #3. 32 pp.
- Carlander, K. D. 1969. Handbook of Freshwater Fishery Biology. Vol. I. lowa State Univ. Press, Ames, 1owa. 752 pp.

Table 1. Species compositon of Locust Point fish populations in the months sampled from 1969 to 1971. The presence of a species during a given month is indicated by an X.

1971 1970 1969 ja jac Aabc Sab Oabc Mapc lac lac Vapc Sac Oac Aa Mac X longnose gar Х Х X X bowfin X X X X X Х alewife X X Х X X X Х X Х X X X X gizzard shad X X X coho salmon X Х X X X American smelt X X X northern pike X X X X X X X X X X Х carp X Х X X X X Х X X X Х goldfish Х X X X Х χ X X X X X Χ X carp X goldfish X X silver chub X X X X X X X Х Х X X emerald shiner X X X X Х Х X X X X X spottail shiner X X spotfin shiner Х X X X X X X Х Х quill back X X X X X X golden redhorse X X white sucker X spotted sucker X Х X X Χ Х X X X X X channel catfish X X Х X X X X X X X Х brown bullhead X X stonecat X XXX X X X X X X X X XXX XXX X white bass X X X X white crapple black crapple X X X rock bass X smallmouth bass X X largemouth bass X green sunfish X X X orange spotted sunfish X Χ X X walleye X X X X X X X X X X Ϋ́ X yellow perch Х X log perch Х X X X X X X X X X X X. X freshwater drum 14 13 12 14 17 12 15 21 11 16 18 13 20 TOTAL SPECIES

^{*} a=commercial seine

^{*} b=gill nets

^{*} c=150-ft. bag seine

Table 2. Catch per unit effort (lbs/haul), using the 2750-ft. shore seine.

ומום כל ויסומים ליסומים	5		· ·)							
			1969					1970	70			1761	- -1
	June	July	Aug.	Sept.	0ct.	May	June	July	Aug.	Sept.	Oct.	Apr.	Мау
Alewife	C	1	1	0	0	0	0.3	0	0	0	0	0	9.0
Gizzard shad	ınknı	MC	unknown	WN	58	17	23	8.	0	7.2	207	0.9	10.1
Carp	unkn	. L. M.	unknown	526	55	2055	1405	270	6.1	502	1026	14,000	0001
Ouillback	21	2.8	2.8 unknown	6.	0	8	0	0	0	8.	2.8	28	68
Channel catfish	21	9.6	9.6 unknown	<u>5</u>	0	1.2	8,2	6.5	3.0	<u>-</u>	1.4	7.9	0
Brown bullheads	6.6	0.8	unknown	1.3	0	2.3	2.3	8,3	0.9	3.4	0.5	ς. Θ	7.4
Golden redhorse	0.4	0	0	0	0	1.7	0	0	0	0	6.0	5,7	0.4
White sucker	C	0	0	0	0	7.8	0	0	0	0	0	76	0
White bass	4.1	3,3	4.0	30	0	0	=	7.0	0.4	<u>.</u>	0	9	17
Crappie	0.4	0	unknown	0.3	0	2	0.5	8	0.8	0.2	0		0.4
Walleye	0	0	0	0	0	9.4	0	0	0	0	0	2.5	0,
Yellow perch	0.8	0.3	unknown	2.3	0.2	3.3	2.1	0.5	0.8	0.2	0	5	7
Freshwater drum	44	6	unknown	8.2	0	42	9	114	7.5	16.0	0	75	64
Coho salmon	0	0	0	9.	0	0	0	0	1.2	0	0	6.8	0

total 35.8 unknown 586.6 113.2 2159.8 1468.4 416.2 16.5 543.3 1238.6 14,188.8 1169.9 9.101 TOTAL LBS.

*excluding gizzard shad and carp

Table 3. Catch per unit effort (numbers per haul), using the 150-ft. bag seine.

										.~							G)	
=1	May	0	0	0	264.3	11.3	0	0	0	0.3	0	0	0	0	-	0	276.9	
1761	Apr.	No Sample	- S	Ħ	12	ge ten	*-	101	5++ g++	<u></u>	ta- fin	en Pr-	=	fom gre	gos Ços	=		
	0ct.	0		0.2	0.2	0.8	0	0	0	0.8	0	0.2	0.2	0	0	0	121.0	
	Sept.	0	13.4	0.2	9.01	2.8	0	0	О	0	0	0.4	0.2	0	0	0	56.6)
o i	Aug.	0	33	0	3.3	٠, د.	0	0	w.	ņ	0	0,	0	0	7.	0	40.9) }
1970	July	0	2519	0	34.8	5.2	÷0	0	86	0.4	0	0.2	0	0	0	0,2	2698.8	,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,
	June	0.4	0		53.6	22.4	0.2	0	0	0	ာ	0	0	0	0	0	75.6)
	Мау	0	0	4.6	8.	136.2	0.2	0	2.6	0.8	0.4	0.2	0	0	0	0	7. 8)
	0ct.	0	237	0.2	2	9.9	0	0	2.6	0.2	0.2	0	0	0.2	0	0	249.0	7.647
	Sept.	No Samo le) - di	=	⊕	<u> </u>	=	-	: '	=	рч б и	Orr Bro	E	Dan Bar	t	20- 0-		
1969	Aug.	7.6	71.3		24	3,3		5.0	7.6	0.3	0.3	0	0	0	0	0	0	7.7
	June July	50	141	4.2	33.4	9	0.2	9.0	32.2	8	9.0	0.2	0.8	0	0.0	Ö		749.9 119.9
	June	No S	Salinp i e	=	рь. u-	e:: -	<u>۔</u>	=	=	=	<u> </u>	=	± &	=	E	5		
		Alewife	Gizzard shad	Carn & Goldfish	Fmerald shiner	Spottail shiner	Channel caffish	Brown bullhead	White bass	Cranole	Yellow nerch	min.	Sunfish	Black bass	Sme I +	Walleye	of definition of the second	TOTAL NOWBER

Table 4. Catch per unit effort (numbers per net), using experimental gill nets.

			0901				٠	1970				1971	
	-	<u> </u>	A Signature	Sept.	0ct.	May	May June	July	Aug.	Sept. Oct.	0c+.	Apr.	May
	Pino 4	, S		-	6	, ,	No	2		8	o N	ON O	No
Alewite	Sample	Sample	102	286	67	2.0	Sample	Sample	, f	Samp le	Sample	Sample	Sample
Gizzard shad		" 64.3	64.3	7.3	36	1.3	2=	- -	1.46	z	<u>.</u> :	: :	E.
U1	E	er.	19.3	8.7	0.3	8.7	Bon Type	# - *	25	:	o. L.	:	=
Calp a chinore	:	=	12.3	62	0	0.7	(• #=	2	10.3	i- u-	(2844 53)+	=	3
Emerald sittlets		¥-			0	227.7	=	=	0	=	ne ev-	Ħ	=
Sportal silliers		;) t	, (ų	=	=	6.7	-	<u> -</u>	=	=
Channel caffish	E	-	v	0.5	>	4.		. ;	. 1	=	=	e. Cim	=
Brown bullheads	9×-	gen S-1	0	0	0	0	=		7.7		:		:
White bass	ŧ	#	4.7	2.3	. —	6.7	ga. gan	BAN	12.7	der (in	tire Ses	gian Agas	خنین ۵ د
HOTO WOLLOW	E	=	7.702	85	29.3	3.7	=	=	50	=	5344 6-74	fu fu	=
io lad woller					, ,	0	=	8	9	=	=	=	67+ 0-
Freshwater drum	=	-	•	C*7	1.7	•		:		e.	4-	ŧ.	2
Crappie	Ξ.	=	1.3	0	0.7	0	=	5 L		·····	;		
Golden redhorse	=	t-	0	0.7	0	0	5 <u>.</u>	=	0	=	Q aa € ~	Ë	=
	=	\$ 53	0	0	0.3	0.3	=	* -	0	ge-	=	Bon Effer	ò
evel lew	E	***	0	0	0	2	=	gr	2	-	8	: -	ţ <u>.</u>
TOTAL NUMBER			417.6	564.6	300.3	256.4			311.				

Table 5. Numbers of individuals and species taken at each gill net location.

	Transport		Transect 2	;	Transect 5 (Fact of river)	5 Iver)
	(West of rive	river)	(at river mouth) No. indiv. No.	No. Spp.	No. indiv.	No. SDD.
	NO. HILLIY					-
1	098	α	197	7	488	
8/22/69	200	,			1	2
00,40,0	A. P.	Ø	561	ထ	CII.	2
60/47/6				ı	200	ī.
10 100 160	452	œ	251	v		
60/07/01			ŗ	-	225	7
5/6/70	368	7	0/1	^		:
	!\ - -	4	346	6	437	gorium gorium
8/12/70	2	r			أفاهو فالمراسبة فيترخ وبالماسة ومستداراتها ويستان والمشارد فيداراها	

Table 6. Numbers of individuals and species taken at each 150-ft. bag seine haul location.

	Transact 1	- +: 	Transect 1-2 (West of river)	t 1-2 river)	Transect 2 (river mouth)	. 2 outh)	Transect 2-3 (East of river)	2-3 river)	ш	t 3 river)
	No. indiv.	indiv. No. spp.	No. indiv.	No. spp.	No. indiv. No.	No. Spp.	No. indiv.	No. Spp.	No. indiv.	No, Sr
						•				
69/05/1	236	ю	412	01	ı	i	1		230	7
8/29/69	691	6	3 .	1	122	9	ı	ŧ	71	ťΩ
69/62/01	365	-	349	W	295	W	63	ıv	265	īU
5/6/70	00	'n	287	7	335	. w	43	9	21	М
6/12/70	991	īV	27	2	06	ю	9	ঝ	1 16	6 0
7/18/70	R	in.	208	ĸ	275	परं	4 5	M	3518	7
8/22/70	58	. 2	14	4	25	រក	t t	1	ı	1
9/21/70	2	4	3	īU	986	4	61	ø	11	4
10/24/70	242	ĸv	219	n	117	2	8	7	61	4
5/15/71	657	4	1	•	123	20	ŧ		ī	4

Mean total length and range (in inches), where available, of indicated age class for some species captured in the Locust Point area.

	0	. 1	11	111	17	V	VI
Alewife b	1.5-5.9 \$=4.4				·		www.alfacku.no.com.com.com.com.com.com.com.com.com.co
Gizzard shad b	x =6.4	x=10.9	x=12.8	- x=13.6	x=14.3	و منابع المار	
Carp c	0.7-8.0 x=6.0	≅=6.5	≅=8.7	≅=9. 6	≅=13.9	x=13.9	x=15.7
Goldfish ^C		x=3.5	5.0-6.0			,	
Quiliback C	1.5-2.2	9.5-9.7	10.9-15.4	14.9-16.5			
Emerald shiner ^{ab}	1.7-3.1b ¤=2.6b		3.0-3.8ª				
Spottail shiner ^{ab}	1075	3.4-4.6 ⁸	4.5-5.1a	4.9-5.5 ^a		The state of the s	
Channel catfish ^b	≅=4.8	₹=7.9	≅=10.1	X=12.2	x=13.2	≅=15.3	X=15.9
Brown builhead ^C	2.0-4.9	2.7-6.0					
White bass ^b	2.0-6.0 x=4.1	≅=10.i	≅=11.8	x=12.6	<u>⊽=13.4</u>	x=14.6	
Yellow perch ^b	2.2-4.7 \$\bar{x}=2.6	5.1-6.9 x=6.5	6.2-7.9 x=7.2	6.5-9.8 x=8.3	7.9-10.1 \$\bar{x}=9.0	8.6-10.6 x=9.6	
Walleye ^b	₹=9.6	₹=15.2	x=16.8	x=18.4	x=19.5	≅=19.9	
Freshwater drum ^a	1.5-5.6 x=3.9	5.1-7.5 x=6,4	6.4-9.4 x=8.5	8.9-14.0 x=11.7	10.2-15.4 x=12.3	12.2-16.5 x=14.6	12.3-16.9 x=15.1
American smelt ^{bc}	1.6-3.6b x=2.4b	5.6-6.2 ^c	⊼=9.5 ^C				,,,

a=age determined in the present study
b= age determined by Lake Erie Research Unit, Ohio Division of Wildlife
c=data from Carlander, Freshwater Fishery Biology, for Lake Erie fish

Size range (inches) of fish captured in the Locust Point area by all three methods of capture. Table 8.

				•																
4	Oct. and	2,4-16.6	3.6- 5.4	4.3-24.6	14.9	2.4- 3.7	2.6- 5.5	o o	0	0	0	2.7- 6.0	5.2-11.5	3.2	0	2.8- 3.5	0	3.3-15.0	o	7.6
ا.	Sept. an	4.9-14.6	4.1-5.1	4.1-19.8	9.3-13.0	M W 	1.	13.6-19.7	6.1-9.4	13.2-13.9	0	3.6-12.4	5.6- 9.4	13.0	0	7.5	0	2.6-16.1	16.3	0
6.		1.2-12.0	1.4-4.1	5.9-19.7	9.3-13.0	1.9- 4.8	1.9- 4.7	5.5-18.0	6.7	0	0	1.8-10.6	5.8-11.5	0	0	6.0-10.3	0	5.5-18.5	0	0
6961	Julyac	1.5-15.8	1.3- 2.2	9.5-23.2	12.4-13.3	2.4- 4.4	1.8- 5.4	2.9-16.1	4.1-10.4	0	0	1.5- 7.9	5.0-8.9	0	2.6- 3.0	4.1-8.9	0	6.3-20.9	0	3,3
	Junea	7.0-16.5	0	6.2-29.4	9.6-16.3	0	0	7.2-16.3	7.3-11.6	9.5	0	5.4-9.9	6.5-8.3	0	0	8.3	0	9.3-21.3	0	•
		Gizzard shad	Alewife	Carp & Goldfish	Quillback	Emerald shiners	Spottail shiners	Channel catfish	Brown bullheads	Golden redhorse	White sucker	White bass	Yellow perch	Black bass	Sunfish	Crappie	Walleye	Freshwater drum	Coho salmon	Sme1+

=commercial seine
=gill net
=150-ft. bag seine

Size range (inches) of fish captured in the Locust Point area by all three methods of capture. Table 8.

											•			,							
1	Oct. ac	2.1-15.4	0	6.9-16.3	13.1-13.3	چ ف	3.4- 4.4	16.2	8.3-8.4	14.7	0	2.4-10.6	0	o !	3.7	2.9- 4.1	0	O	o · ,	0	
	Sept.ac	1.4-13.1	0	6.7-8.6	5.6-13.9	1.4- 4.3	2.6- 4.9	14.0-17.7	6.7-10.7	•	0	2.0-11.7						1.1-15.8	0	0	
	Aug. abc	1.0-15.1	0	7.4-18.1	0	3.0- 5.1	1.0- 4.6	4.8-17.9	6.1-11.4	0	0	1.6-11.1	5.6- 9.2	0	0	3.3- 7.8	6.2-12.8	3.9-17.4	14.1	1.9- 2.3	
2/5/	Julyac	1.2-11.0	0	6.2-23.1	0	2.0- 5.2	1.3- 3.7	13.4-17.4	5.1-10.9	0	0	1.5- 7.5	6.8- 7.3	0	0	1.3-7.6	4	3.7-14.0	0	0	
	Juneac	6.9-15.5	6.6- 7.4	8.8-16.3	0	1.8- 4.2	3.0- 4.8	2,3-16,5	7.5-10.6	0	0	5.1-11.6	6.8-9.0	O	0	6.3- 7.9	0	6.6-15.9	0	0.	
	Mayabc	6.7-14.9	6.7	6.5-27.3	9.8-16.6	1.8- 4.7	3.2- 5.3	2.9-18.9	8.5-11.5	9*91	9.2-17.0	4.4-15.6	6.2- 9.3	10.4	0	3.3-14.2	9.4-12.5	6,1-17,9	0	6.6-7.3	
		Gizzard	Alewife	Carp &	Quillback	Emerald shiners	Spottail	Channel catfish	Brown bullheads	Golden redhorse	White sucker	White bass	Yellow perch	Black bass	Sunfish	Crappie	Walleye	Freshwater	Coho salmon	Snelt	

=commercial seine
=gill net
=150-ft. bag seine

Size range (inches) of fish captured in the Locust Point area by all three methods of capture. Table 3.

Mayac	8.1-16.1	6.7-7.3	8.3-12.3	5.2-18.3	1.9- 4.3	3.1-4.8	0	7.5-11.4	7.8-8.1	0	5.6-14.6	7.1-9.3	0	0	7,5-8.1	0	5.3-20.7	0	5.0- 5.9
Apr. 3	13.0-13.2	0	8.0-19.1	16.0-20.6	0	0	11.7-19.1	8.7-11.7	13.8-16.2	13.3-18.9	6.5-12.2	6.6-12.4	0	0	9.0- 9.3	9.1-14.6	7.5-17.6	18.3-20.4	. 0
	Gizzard shad	Alewife	Carp & Goldfish	Qui I I back	Emerald shiners	Spottail shinars	Channel caffish	Brown bullneads	Golden redhorse	White sucker	White bass	Yellow perch	Black bass	Sunfish	Crapo	Walleye	Freshwater drum	Coho	Sme1+

=commercial seine,
=gill net
=150-ft, bag seine

Table 9. Number of fish stomachs examined each month and number containing food, June, 1969 - May, 1971.

Sample Date	Stomachs examined	Stomachs containing food	Percent containing food
1969			
June 26	140	120	85.7
July 4	149	127	85.0
July 26	92	72	78.0
July 30	130	107	82.0
Aug. 24	0	-	
Sept.24	80	51	63.8
Oct. 29	140	88	62.9
1970			
May 8	298	172	57.7
June 22	255	181	71.0
July 18	208	178	85.6
Aug. 22	72	60	83.3
Sept.12	89	71	79. 8
Oct. 10	33	23	69.7
1971			
April 17	83	51	61.4
May 15	150	76	50.7
TOTAL	1919	1377	71.8

						•		٠			*.	
y, 157	⊖ldcilitnəbinU ≳i⊐dəO	888	88	82 26 26 26 26 26 26 26 26 26 26 26 26 26	3		00	00	25 8	<u>88</u>		
- N	Fish											
Dno.	Pelecypoda											
=	Gastropods								•			
1969 through May,	Decebogs		0	11			4					
	sboq14qmA		<u>8</u>	<u>Las</u>			-					
s, June,	insecta (unidentifiable)	67					20		33			
545	Psectrocladius					-						
± 1	Tanytars											
Poil	Pseudoch i ronomus											
tsit:	Cricotopus					_						
some Locust Point fishes,	Coelotanyeus					001	•					
SOM	Procledius	•					1					
i.	Polypedilum											
Tons	elyptotondipes											
focd items in	C. (Cryptochir-	·			_							
of of	C. (Chironomus)				001							
, 6 , 6	€hironamidae*										•	
Frequency of occurrence (5)	Diptera(not Chironomidae)				100							
SSS	Coleoptera											
of of	Trichoptera										00	
enc	copepoda	22	001				48	7	133			
redn	enecera 	22	8	1	3	nama	67	i T	007	•	8	
	Chs	<u> </u>	4	7921	n m –	0-00	- ² ²	4 2	- n a	040	00-0	0
<u>0</u>	as ad & stom) 1	1 1 1	1 1 1	1 1 1 1	1	1 1 1	1 1.	1 1 5	11:1	1 1
Teble	species sampled er of sto	6	⊕ ⊕	თ დ თ	000	0 K	4S 6	<u> </u>	69	, 22 2	5 5 <u>5</u> 5	
	Fish sp Date sa	9/	7/26/69	19/73 1/81/ 07/2	6/12/70 5/13/70 5/75/8	07/21 7/01/ 17/71	6/28/69	7/26/69 7/26/69	9/27/69	5/3/70 5/12/70 7/18/70	2225	15/1
	Fish Date numbé	Carp 6/28	1/2	25%	1012	9/12/	16 8	: <u> </u>	:2:2:	166	395	3 10

	i				•	
May, 15	eldsiłitnebi∩U Debris	000 833 000 000 000 000 000 000 000 000	00		•	4
다.	Fish		33	<u>4</u> <u>0</u>	2222	
through	Pelecypoda			•		
tir	Gastropoda					
1969	Decapoda		00 001		- 80 8	20 8
- 1	sboqidqmA		2			
ss, June,	lnsecta (eldsilitable)		9	28	0	
15.1	Psectrocladius				•	
4 + 4	<u>Ianytarsus</u>				33	
Foi	Pseudoch i ronomus					
+SP:	Cricotopus				=	
Loc	Coelotanypus				anun 	
SOM	Procladius				<u>-</u> ع	
Ë	Polypedilum				5 = = 0	
rems	<u>Glyptotendipes</u>				22	
of food items in some Locust Foint fishes,	C. (Cryptochir-				33.40	50
_	C. (Chironomus)				21 26 26 26 27 20	19
7,2 . D	Chironomidae*		0	86	. •	
Frequency of occurrence (శ)	Diptera(not Chironomidae)				33 - 2	
ö	Coleoptera					_
9	Trichoptera				īU	
ency	Copepoda	56 50 50 100 100	00			
recu	enecobal J	89 94 90 90 64 100	38	4	= 20	
	1 · — — — — — — — — — — — — — — — — — —					
10.	ecies mpled & of stomachs	0692020000	를으- <u>2</u> .0	0 - 0 -	4006-	~ 6
1 4cl	ies led st	bed o	- H	1 1 1 1		1 1
1-	α ()		Freshwater 6/23/69 7/4/69	69 69 69 69	5555	77
	Fish s Cate S	6122ard s 6/25/69 7/4/69 7/26/69 9/27/69 10/18/69 5/8/70 7/18/70 5/22/70 9/12/70 10/10/70	Freshwat 6/22/69 7/4/69	7/30/69 9/27/69 10/18/69	. Aim Ai Ai Z	-
	Fish Cate numbe	12/05/20/05/20/20/20/20/20/20/20/20/20/20/20/20/20/	12/25/27	0/2/6/2/2/2/2/2/2/2/2/2/2/2/2/2/2/2/2/2/	25.25.5	3 6
4		•	•			

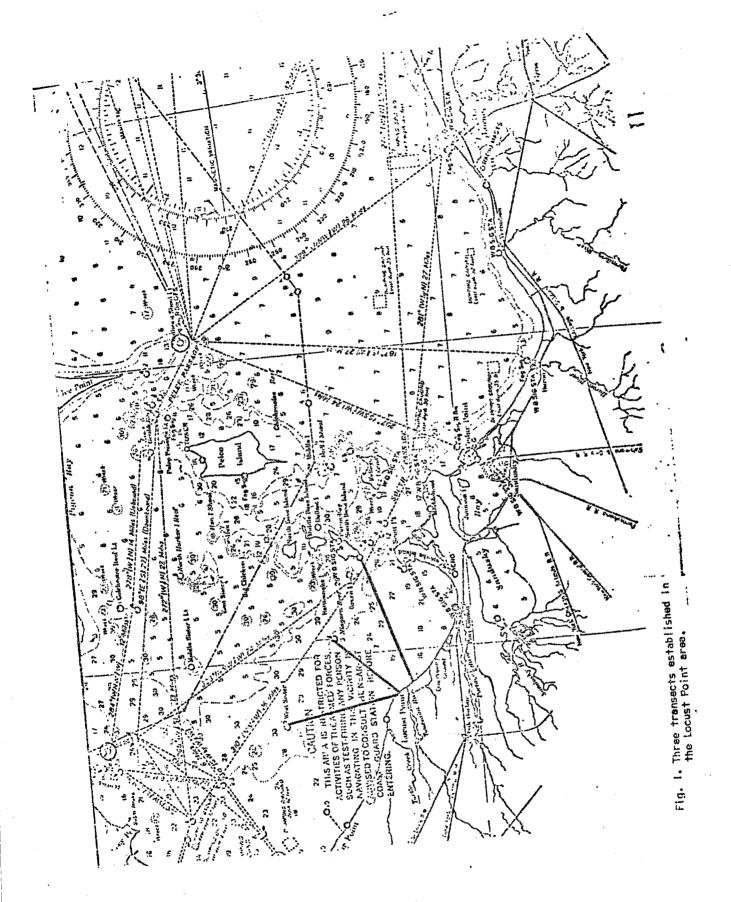
hrough May, 19	rish 9 dsilitnabinU 2 rdaQ	94 63 6 58 10 100 70 25 25 92 5 21 6 6 6 50 6 50 8 100 100 100 100 13 33 33 67 13 67
Sinori	Pelecypoda	ĸ K
	6astropoda	·
19.5	Decapoda	31 31 31 31 31 31 31 31 31 31 31 31 31 3
	sboqi dqmA	rv — 60
is, June,	Insecta (aldaititable)	12 20 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8
fishes,	Psectrocladius	8)
	Tanytarsus	
<u>اة</u>	Pseudochironomus	
some Locust Point	Cricotopus	12
5	Coelotanypus	vo
SOID	Procladius	
c.	Polypedilum	
food items	eagibnatotqy10	6 12 25
758	C. (Cryptochir- onomus)	14 14 100
10		ν ν4 δο <i>Ϋ</i>
	(Chironomus) .0	
9	^X ⊖ohimono⊓idO	δ 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2
renc	(Gebimononidae)	23 23 25 25 25 25 25 25 25 25 25 25 25 25 25
cur) iptera(not	S
φ. Ος	Coleoptera	. is
ە ت	richoptera	
nenc	obebogs	i de la companya de
Frequency of occurrence (\$)	ladocera	
	ļ	820040528857470 0w-0w44ew4-08w
	nue d &	
<u></u>	continued continued spacies sampled &	8 9 9 9 00 8 100 8 -
11.7	S C C	#hite bass 6/28/69
	Fish signature	white bas 6/28/69 7/26/69 7/26/69 7/26/69 10/18/69 5/3/70 6/12/70 6/12/70 10/18/69 9/12/70 10/18/69 10/18/69 9/27/69 10/18/69 10/18/69 10/18/70 6/12/70 6/12/70 10/18/69 9/27/70 10/18/70 10/18/70 10/18/70 10/18/70 10/18/70 10/18/70
۳		

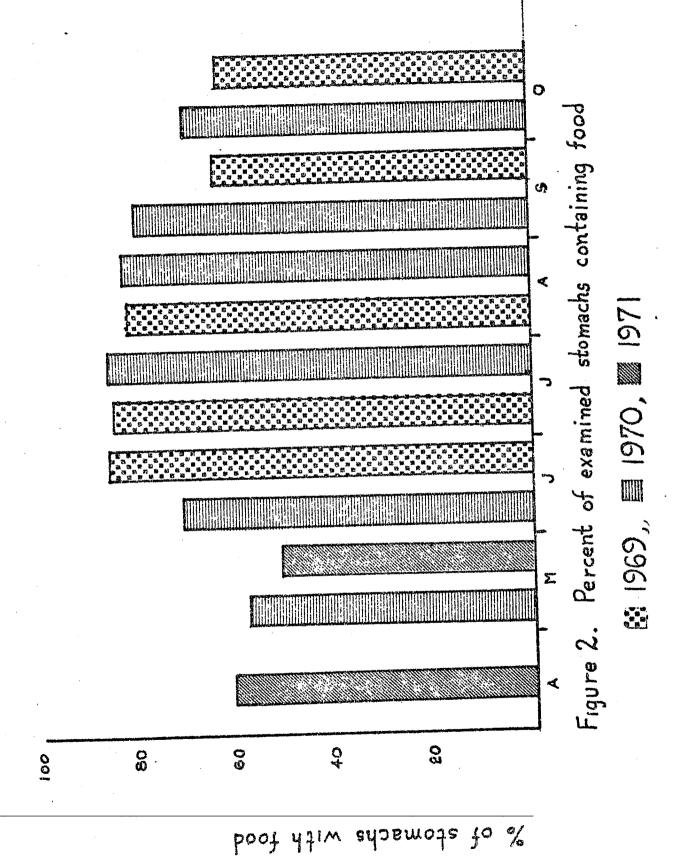
	·		A taus	•		a e e i	\$ 18 mm #6
197	Debris	50 50		001		•	5 6
Š	eldeilitnabinU	Į.	8	= = ₹	50	20	33
-ig	Fish	46	50 50 50 50 50	22	50	~	8
through May,	Pelecypoda						
=	Gastropoda					33	
969	Decapoda						<u> </u>
	sboqidqmA	4	00_	1.1	20	78 m	88
June,	stoean! (e dsi}itnebinu)	1200 100	25 100 17	33	20	8 8	3
fishes,	Psectrocladius						
1						S	₹ '
Point	Tanytarsus					2	•
	Pseudoch i ronomus		·				
†sn.	Cricctopus		100				3
some Locust	Coelotanypus		333			100	100
SO	Procladius		9			200	69
is in	Polyped! lun	,	0				α
1100	secibnetotav10		100			2	<u>.</u>
food frams	C. (Cryptochir-		11 120 200 200			67	69
of			11 25 100 67 100 50			100 67	2 2 3 8
- 1	C. (Chironomus)		-4-0-5			- 6 -	00
. 9	Chironomidae*	25		4			8 %
occurrence (%)	Diptera(not Chironomidae)	17 10 10 43	83 83			333	67
8	Coleoptera	53	•	8		8 8	3
Ö	Trichoptera	0_	25				-
Frequency	epodedog					20 62 7	
nbeu	Cladocera	20	25 25			20 100	
}				*	- 		i
2	tinued es ed & estomachs	181 22 10 10	0 4 <u>-</u> 6 - 4 c		70	- 322	-n-on
iab le	continued ecies mpled & of stomac	(a) (a) (b) (c) (c) (c) (c) (c) (c) (c) (c) (c) (c		lhead	1 1	111	1111
de l	conting spacies sampled r of ste	1 '	00000	= =	ο S	000	202:
	11	728/69 726/69 726/69 730/69 730/69	5/2/10 5/2/10 5/12/70 5/12/70 7/16/70 9/12/70 10/10/77	3rown bi 6/23/69 7/4/69	9/27/69 10/18/69	5/6/70 6/12/70 6/18/70	2/23 07/21 07/71 17/71
	Fish sg Cale sann number	Channel 6/28/69 7/4/69 7/26/69 9/77/69 9/77/69	5/8/70 5/8/70 05/8/70 5/12/70 2/22/70 2/12/70 10/10/77	6/23/69 7/4/69 7/26/69	7/5	5/6/70 6/12/70 7/18/71	25.2%
			21				

g ...

	: •			1					•	÷ ; 6 .	
۷, 197	eldsilitnabinU Debris	78	47	50 50 67 90	22 20	17	95	33	57	5	80
*	Fish									-	
Dro Ordi	Pelecypoda										
취	Gastropoda										
906	Deceboqs		ı							10	_
- 1	&boq1dqmA			4					04	25	2
sens Locust Point fishes, June, 1969 through May,	insecta (unidentifiable)		<u>r</u> .	33	71				23	25	
21.0	Psectrocladius			9							•
11	Tanytarsus				•				8		
Poir	Pseudoch i ronomus								8		
ust	Cricotopus									N	
Loo	Coelotanypus				·					2	
çiliç	Shavaeto (00)			9					-		
in s				-					•		
	Polypedilum				001				2	25	
1-	sagibnatotqy10										
icod i fams	C. (Cryptochir-				× ~				1 21	75 13 56 22 50 25	33
) of	C. (Chironomus)				27				. 2	~ ~ ~ ~ ~ ~	נית
Fraquancy of occurrence (%)	Chironomidae*		53	6	25	33	M	67	3 22	,	
, Jonet	Chironomidae)			ī.	75				4	100 67 50	
Curi	101pteral not				100	11			<u>n</u>	25 20 50	
٠ 0	Coleoptera				.,						
;; ;;	Trichoptera								0.0	25	
ien Canci	Copepoda	=	7	6					4		
1001	в терорь 10	63	2	6 33		20	26		8 26	25	
	1		O 10	0 10 m b :	- a v -	09 !	္ပုဝ ဆ္က ဇ	o M (0 64 52	- x 0 4	0 0
	ecies mpled & of stomachs	shiner 0 - 27	- = -	1111	N		38 - 38	1 1	1111	-	1 1
ر بر در	species sampled ir of sta	1 1.		, o	000		_l	מאַ פּט	ရက် ရှင်္က (၂)	555 657 67	
1.	8 8 8 8	erald 23/69	69/0	9/27/59 10/18/69 5/8/70 6/12/70	8/22/70 9/12/70 9/12/70		6/23/69 7/4/59	26/6 30/6	9/27/69 10/18/69 5/8/70 6/12/70		17/7 15/7
	Cate si	Emerald c/23/c9	7/26/69	9/27/59 10/18/69 5/8/70 6/12/70	7/18/7 7/22/2 7/21/9	45	3/2/2	1/2	50.00	7/18/ 8/22/ 9/12/ 10/10	400
	a control section of the section of			Commence of the Commence of th	22				grand of the state	and the second second second	

1971									
- 1	eldsiłitnebinU Debris	29	2		25				
through May,		100 7 100 252 100 100		92					
ugh	Fish	7 7 7 7	6 0 -	- 01	, stands, elimina				
re or	Pelecypoda				*				
	6astropoda	·							
1969	Decapoda	80							
1e,	sboqidqmA	, rc		œ					
ishes, June,	stoern! (aldsilitnablnu)	rv.	2	ထ	25				
	Psectrocladius			•					
int	Tanytarsus								
Po P	Pseudoch i ronomus								•
.sno	Cricotopus								
e Loc	Coelotanypus			8					
Som	Procladius								
of food items in some Locust Point fishes,	Polypedilum								
	Sedibnatotqyla		0	20					•
	C. (Cryptochir-								
	(Sumogenida)		2	25 100	25				
0	Chironomidae*		3						
, renen	Diptera(not Chironomidae)		1	823			•		
(Coleoptera		2		•				
Frequency of occurrence (%)	Trichoptera								
	Copepoda	8 8		42	75				
(()	Cladocera .	90		67	75			د د د د د د د د د د د د د د د د د د د 	:
	chs					•			
5	es ed & stomachs	02-2-00222-4-9							
(-	Decies ampled of st	111	1 1 1	; ; ;					
ł		1e 69 9 69 69	69 769 70	555	57.00 57.70 1.17				
	Fish son number	Crapple 6/23/69 7/4/69 7/26/69	9/27/69 10/18/69 5/8/70	727/13/	9/12/ 10/10 4/17/ 5/15/	· ·		•	
13	U Da	1995-	oʻ <u>~</u> w	10 m 0	01-40				n





Appendix 1. Scientific names of fishes found in the Locust Point area, June, 1969 - May, 1971.

Alewife

American smelt

Black crappie

Bowfin

Brown bullhead

Carp

Channel catfish

Coho salmon

Common emerald shiner

Common white sucker

Freshwater drum

Gizzard shad

Golden redhorse

Goldfish

Green sunfish

Largemouth bass

Logperch

Longnose gar

Northern pike

Orangespotted sunfish

Quiliback

Rock bass

Silver chub

Smallmouth bass

Alosa pseudoharengus

Osmerus eperlanus mordax

Pomoxis nigromaculatus

Amia calva

Ictalurus nebulosus

Cyprinus carpio

<u>lctalurus</u> <u>punctatus</u>

Oncorhynchus kisutch

Notropis atherinoides

Catostomus commersoni

Aplodinotus grunniens

Dorosoma cepedianum

Moxostoma erythrurum

<u>Carassius</u> <u>auratus</u>

Lepomis cyanellus

Micropterus s. salmoides

Percina caprodes

Legisosteus osseus

Esox lucius

Lepomis humilis

Carpiodes cyprinus

Ambioplites rupestris

Hybopsis storeriana

Micropterus d. dolomieui

Appendix 1. (cont'd)

Spotted sucker

Spotfin shiner

Spottail shiner

Stonecat

Walleye

White bass

White crappie

Yellow perch

Minytrema melanops

Notropis spilopterus

Notropis hudsonius

Noturus flavus

Stizostedion v. vitreum

Morone chrysops

Pomoxis annularis

Perca flavescens

JOB COMPLETION REPORT

RESEARCH PROGRESS SEGMENT

State of:

Ohio

Date:

May 31, 1972

Project No.:

Period Covered:

F-41-R-3

Name:

Environmental Evaluation of

a Nuclear Power Plant

Job No.:

2-A

Title:

Temperature Preferences of

Locust Point Fishes

June I, 1971-May 31, 1972

ABSTRACT

Temperature preferences were determined for adult and young-of-the-year white bass, smallmouth bass, yellow perch and emerald shiners during four seasons from July, 1971 through May, 1972.

Fish specimens for experiments were collected from local areas by shore seining, trap netting, hook-and-line fishing and from commercial fishermen.

Most fish were held in the laboratory at or near ambient lake temperatures for only short periods prior to testing. Fish tested in winter were caught during late fall and held at ambient temperatures until they were tested.

Seasonal differences in temperature selection existed for all four species within the 2-3 day testing periods. With the exception of emerald shiners in summer, all species preferred above ambient lake temperatures each season. In general, white bass and smallmouth bass selected similar high temperatures, yellow perch preferred intermediate temperatures while emerald shiners selected low water temperatures. Fish were distributed about a narrow range of temperatures in the summer and were widely distributed over a large range of temperatures during fall. A relatively constant temperature preference was reached within several hours in summer, but required 2-3 days of progressive acclimation in the temperature gradient during winter. Young

yellow perch and emerald shiners selected temperatures differing from those selected by the adults during the same season, while the young and adults of white bass and smallmouth bass preferred very similar temperatures.

RECOMMENDATIONS

The study of the seasonal temperature preferences of fishes should continue with emphasis on species from the bottom habitat of the Locust Point area. Effort should be expended to obtain healthy test specimens and any differences in temperature selection between healthy and unhealthy individuals should be clearly defined.

OBJECTIVE

The objective of this job is to determine the temperature preferences of Locust Point fishes.

TECHNIQUES USED

A horizontal temperature gradient approximately 24 m in length and 25 cm in depth was established for testing the temperature preferences of fish during four seasons of the year. Within a wooden tank 8.72 m long, 79.0 cm wide and 50 cm high, a system of alternating transverse baffles formed a series of 28 compartments without greatly restricting the movements of fish. Filtered lake water (1-2 l/min) passed through l/4" Tygon tubing within a cooling reservoir and into the low temperature end of the gradient; the water was then heated progressively higher by immersion heaters as it flowed to a standpipe at the opposite end of the trough.

A Vicore 500 watt heater, ARC static switch relay and corresponding Juno thermoregulator maintained a constant water temperature $\frac{1}{2}$ 0.15C in the center

of each compartment. Each season a different gradient was established by controlling the temperature at the thermoregulator of each compartment 0.5-1.0C above that of the previous compartment. The gradient ranged from a low of several degrees below ambient lake temperature (summer, fall and spring), or slightly above ambient (winter), to high of 15-26C above ambient.

Aeration from three air stones in each compartment greatly reduced vertical temperature stratification of the water column (Table I) and created saturated, or nearly saturated, 0_2 levels during all seasons (Table 2). Oxygen measurements were made each season using a model 54 YSI oxygen meter and probe.

Most fish were caught by trapping, shore seining and hook-and-line fishing near the F. T. Stone Laboratory on South Bass Island. Adult fish were sexually mature. Young fish were primarily young-of-the-year, although some immature (I+ year oid) perch and smallmouth were tested in spring. Fish for winter experiments were caught during November and held at ambient lake temperatures until they were tested. During other seasons fish were held only for short periods of time at lake temperatures. Fish were maintained and tested under normal seasonal photoperiods. Natural lighting from windows in north and west walls was adequate for almost all observations.

Prior, to testing, each fish or group of fish was held in an acclimation tank similar to the gradient apparatus for 24-48 hrs. The acclimation tank was half the length of the gradient tank, identical to it in compartmentation (without heaters and thermoregulators) and maintained at ambient lake temperatures. In the acclimation tank fish were observed for visible signs of poor condition, aggressive behavior and randomness of distribution.

Fish were then transferred from the behavioral acclimation tank to the compartment of the gradient with a temperature nearest the ambient lake temperature. The number of fish tested at one time varied with the species and size of individual fish. Large smallmouth bass were tested singly, while

young-of-the-year emerald shiners were run in groups of 20-25 fish. After the transfer, fish moved freely about the thermal gradient for 4-6 hours before the first observation period. In summer, the gradient ranged from below ambient to 36C. During fall and winter, the testing procedure was modified because many fish moved into temperatures beyond their upper lethal limits while exploring the gradient trough. Fish were screened within a limited gradient with a maximum temperature below the suspected upper lethal temperature of each species, and were allowed into progressively higher temperatures as their selected temperatures increased.

Observations of fish distribution within the test apparatus were initiated approximately 4-6 hours after fish had been introduced into the temperature gradient. Fish were observed from behind a blind during three periods each day. The number of fish in each compartment was recorded every 10 min. for 80-100 min. in the morning, at mid-day and just before sunset. The water temperatures at the center of every other compartment were measured with a YSI multi-channel telothermometer (with fixed probes) and were recorded before and after each observation period. The water temperatures in compartments without temperature probes were interpolated from adjacent water temperatures and periodically confirmed by actual measurement.

During the summer and fall most preference tests lasted 48-hours (6 observation periods). Spring tests for each species group consisted of one 72 hr. test followed by one or more test of 48 hrs. Winter tests were 72 hours long. Five day (120 hr.) tests were conducted for three of the four species in summer and occasionally during the remaining seasons.

FINDINGS

Temperatures selected by each species during the 2-3 day tests changed progressively through the four seasons. Seasonal thermal preferences are represented by the modes in the distributions of each species about temperatures in the laboratory gradient (Figures 1,2,3,4). Although white bass, smallmouth bass and yellow perch preferred temperatures above ambient lake temperatures during the four seasons, the interval between the selected temperature and ambient varied from season to season. The smallest difference between the seasonal preferred temperatures and ambient temperatures occurred in summer. The targest difference was during winter when the preference was not considered stable until fish had been in the gradient for 2 to 3 days. The difference between temperatures selected during summer and winter was greatest (11-17C) for emerald shiner, about 10C for white bass and yellow perch and least (5C) for smallmouth bass. Temperatures selected by most fish during the fail : (falling field temperatures) were similar to those preferred in summer. However, temperatures selected in spring (rising field temperatures) were nearest winter preference values. Emerald shiners, the exception, selected very similar temperatures during fall and spring.

Although variation existed between temperatures selected during a given test and those selected in replicate tests, each species appeared to prefer a relatively precise zone of temperatures in the thermal gradient. Figures 2,3,4 and 5 show the variability of modal temperatures selected within given tests, between replicate tests and between species. Temperature selection appeared most consistent during summer and least definite in fall when wide differences existed within tests and between replicate tests. During all seasons, most emerald shiners selected a narrow range of temperatures ($^{\pm}$ 2C about their preference temperatures) with little differences between

smallmouth bass, also, were fairly precise in thermal selection, although preferences of these species changed over successive observation periods, especially during winter. Yellow perch were the least precise species in selecting a temperature. Yellow perch formed tight schools at ambient temperatures in the behavioral acclimation tank, but were widely spaced in the temperature gradient and moved as a group back and forth between high and low temperature areas. This behavior usually resulted in fairly reliable modal temperature values (with a wide range in observed distribution), but periodically produced erratic modal values.

The time required for fish to select a relatively constant zone of temperatures varied seasonally. Although most groups of fish demonstrated a precise temperature preference within several hours during summer months, a few groups (especially yellow perch) remained inactive at ambient or nearambient temperatures for almost a day before initiating exploratory behavior in the gradient and then making a temperature selection. Temperature frequency distribution of fish within the gradient of temperatures were pooled at 2C temperature intervals. The data were analyzed by Spearman's rank correlation coeficients to determine differences between temperatures selected during successive days from the initiation of each test. Results indicated that no significant difference existed for any species between temperatures selected the first day and those selected the second day during the summer. A standard 2-day test period was established during summer to insure adequate time for selection of temperatures and to allow time for changes in temperature preference. Tests of 5-days duration were conducted once during summer on most species age groups. Only slight fluctuations (1-4C) occurred in thermal preferences made by fish through the 5th or 6th day in the gradient (where data was available).

During fall, selected temperatures fluctuated widely with successive observations but definite upper and lower preference limits were evident for each species within the 2-day test period. Preferendum temperatures were below those of the same species during the summer period. During winter, higher temperatures were preferred during the first day and, generally, the fish moved toward a temperature below the summer selected temperatures, with the exception of young white bass and smallmouth bass. Young-of-the-year white bass appeared to select decreasing temperatures after the 2nd day. Young and adult smallmouth bass (small sample sizes) selected temperatures after 3-days near temperatures preferred in summer. In spring, smallmouth bass, young yellow perch and adult white bass preferred increasing temperatures during the first day, as in winter. However, other species and age groups made relatively stable selections shortly after their introduction.

Differences between temperatures selected by young and adults were largest in yellow perch and emerald shiners. During all seasons young perch selected temperatures 4C or more above temperatures preferred by adults.

Adult emerald shiners chose temperatures higher than young in summer, fall and spring, but preferred waters about 5C lower than young in winter. Very similar temperatures were selected by the young and adults of both white bass and smallmouth bass.

Table 1. Seasonal temperatures (°C) of surface (S) and bottom (B) waters of the temperature gradient apparatus.

a Ma	SUMM	1ED	FAL	L	WINT	<u>ER</u>	SPRI	NG
Compartment No.	S	В	S	В	S	В	S	В
1	20.8	20.5	11.0	10.7	2.0	2.0	9.9	9.8
2	21.0	20.8	13.5	13.3	5.0	5.0	12.2	12.0
3	21.2	21.0	14.0	14.0	6.0	6.0	12.5	12.5
4	21.8	21.6	15.5	15.5	6.8	6,8	13.1	3.0
5	22.2	22.0	16.2	16.0	7.5	7.5	14.1	14.1
6	22.5	22.3	17.0	17.0	8.4	8.4	15.0	15.0
7	22.7	22.6	17.2	17.2	9.8	9.8	15.3	15.2
8	23.0	23.0	18.0	18.0	10.2	10.2	16.1	16.0
9	23.8	23.6	18.5	18.5	11.2	11.2	17.2	17.2
10	24.0	24.0	19.3	19.2	12.2	12.2	18.0	18.0
11	24.7	24.6	20.0	20.0	13.5	13.2	19.0	19.0
12	25.5	25.2	20.5	20.5	14.2	14.2	20.2	20.0
13	25.5	25.4	21.6	21.5	15.2	15.2	20.5	20.5
14	25.9	25.6	22.3	22.1	16.0	16.0	22.1	22.1
15	26.6	26.5	23.0	23.0	17.0	17.0	23.6	23.5
16	27.2	27.2	24.2	24.2	18.0	18.0	24.2	24.2
17	28.0	28.0	25.0	25.0	18.9	18.8	25.7	25.5
18	28.8	28.8	26.0	26.0	19.8	19.8	26.0	26.0
19	2918	29.8	27.7	27.5	21.0	21.0	27.1	27.0
20	30.8	30.6	29.0	29.0	22.1	22.1	28.3	28.0
21	31.6	3.15	30.0	30.0	23.0	23,0	29.2	29.0
22	32.5			32.2	23.9	23.9	30.2	30.2
23	33.3		33.0	33.0	25.0	25.0	31.2	31.1
24	34.5		34,1	34.0	26.1	26.0	32.7	32.5
25	35.6		35.4	35.3	27.5	27.4	33.7	
26	36.1		35.9	35.8	28.1	28.1	34.1	34.0
27	36.0		36.0	36.0	29.1	29.1	34.3	34.2
28	-35.9		35.8	35.8	29.5	29.5	35.0	34.8

Table 2. Seasonal oxygen concentrations (mg/l) in surface (S) and bottom (B) waters of the temperature gradient apparatus.

		¥						
Compartment No.	SUMM	IER	FAL S	L B	WIN	TER B	SPR S	ING
	S 8.1	B 8.1	5	D	11.2	11.2	10.4	10.4
2	8.2	8.2	10.0	9.9	11.0	11.0	10.4	10.4
3	8.2	8.2	10.0	9.8	10.9	10.9	10.4	10.4
4	8.2	8.2	9.8	9.7	10.8	10.8	10.4	10.4
	8.1	8.1	9.8	9,6	10.6	10.6	10.2	10.2
. 5	8.1	8,1	9.8	9.6	10.4	10.4	10.2	10.2
6 7	8.1	8.1	10.0	9.6	10.2	10.2	10.1	10.0
7	8.0	8.0	10.0	9.4	10.0	10.0	10.0	10.0
8	8.0	8.0	9.6	9.4	9.8	9.7	9.9	9.9
9	0.0						. 0 7	9.7
10	8.0	8.0	9.6	9.2	9.6	9.6	9.7	9.7
11	7.9	7.9	9.7	9.2	9.5	9.5	9.7	
12	7.9	7.9	9.8	8.9	9.2	9.2	9.6	9.5
13	7.8	7.8	9.4	8.9	8.8	8.8	9.5	9.5
14	7.7	7.7	9.3	8.7	8.6	8,6	9.1	9.1
15	7.7	7.6	9.1	8.6	8.5	8.5	8.8	8.8
16	7.6	7.5	9.6	8.4	8.4	8.4	8.7	8.7
17	7.4	7.3	9.0	8.3	8.2	8.2	8.6	8.6
18	7.3	7.3	9.5	8.2	8.0	8.0	8.6	8.5
19	7.2	7.1	9.0	8.0	7.9	7.9	8.4	8.4
20	7.0	7.0	9.5	7.8	7.8	7.7	8.3	8.3
21	7.0	6.9	9.5	7.6	7.6	7.6	8.2	8.1
22	6.8	6.8	9.9	7.5	7.5	7.5	8.0	8.0
23	6.7	6.7	9.3	7.4	7.4	7.4	7.8	7.8
24	6.6	6.6	9.4	7.2	7.3	7.3	7.5	7.5
25	6.6	6.5	9.4	7.2	7.2	7.2	7.4	7.4
26	6.6	6,6	9,4	7.2	7.0	7.0	7.4	7.4
27	6.6	6.6	9.5	7.1	7.0	7.0	7.5	7.5
28	6.6	6,6	9.1	7.1	6.9	6.9	7.4	7.5

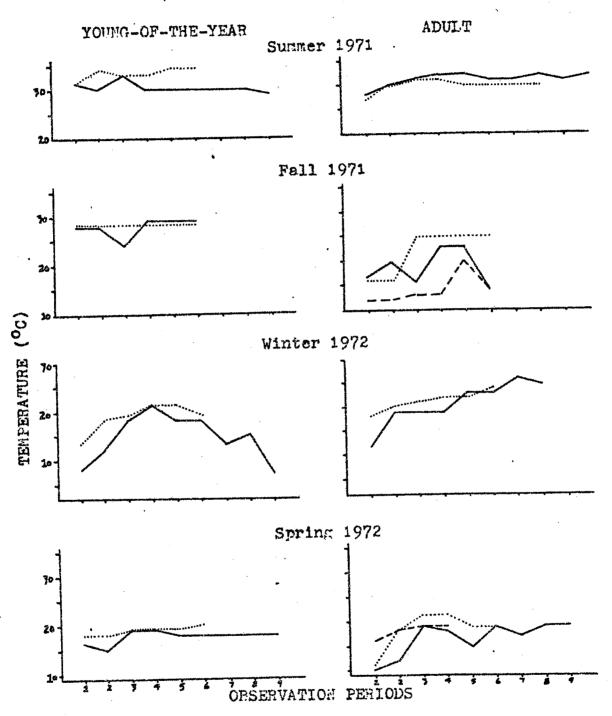


Fig. 1. Modal temperatures of white bass distribution in the thermal gradeint during successive observation periods from initiation of each test (3 observation periods equal one day).

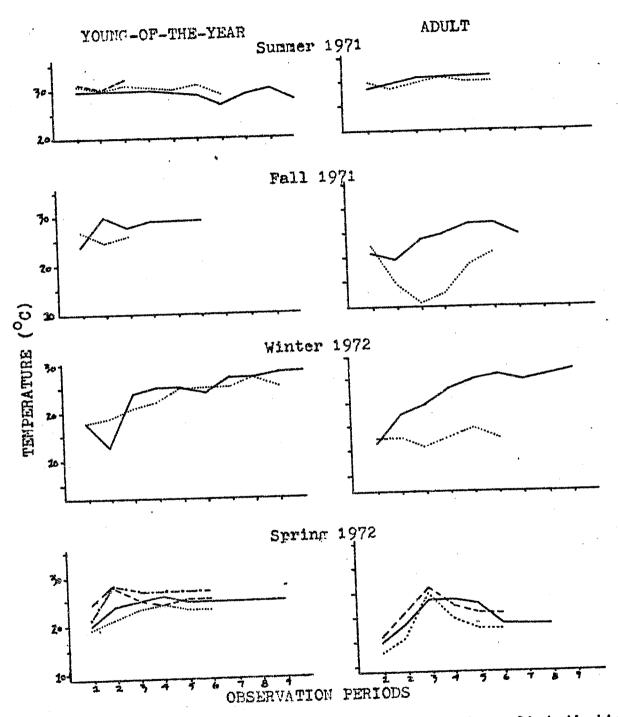


Fig. 2. Model temperatures of smallmouth bass distribution in the thermal gradient during successive observation periods from initiation of each test (3 observation periods equal one day).

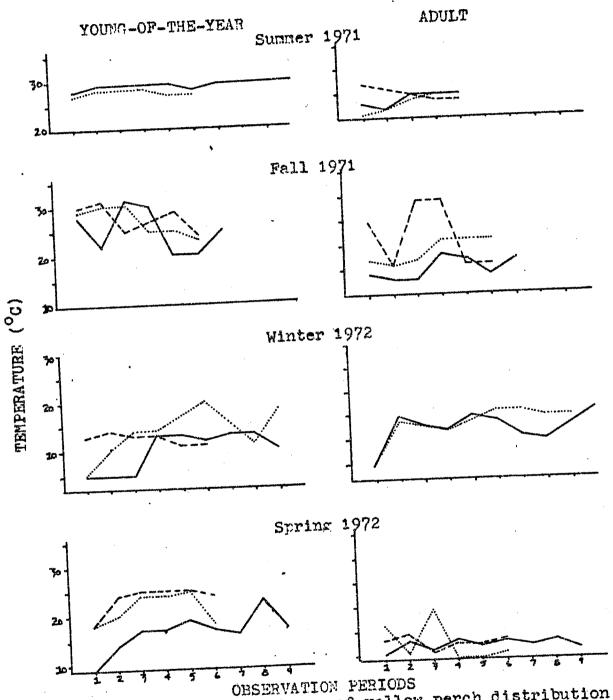


Fig. 3. Modal temperatures of yellow perch distribution in the thermal gradient during successive observation periods from initiation of each test (3 observation periods equal one day).

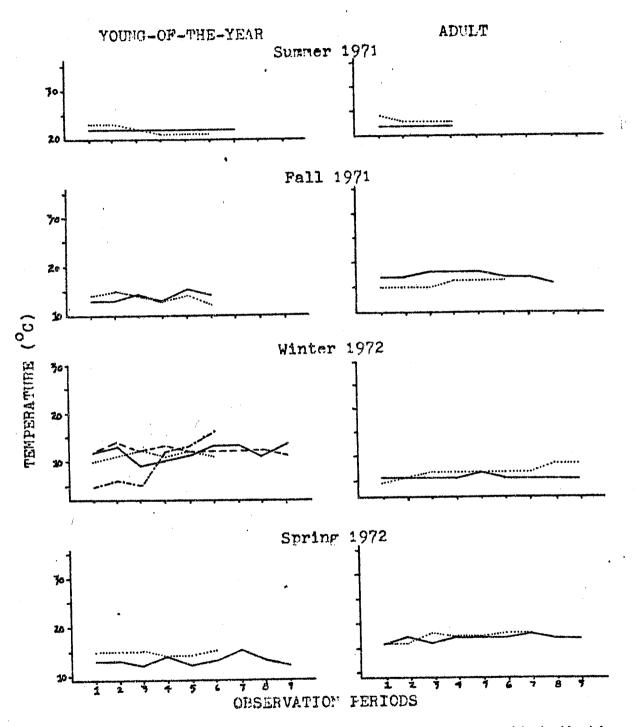


Fig. 4. Modal temperatures of emerald shiner distribution in the thermal gradient during successive observation periods from initiation of each test (3 observation periods equal one day).

JOB PROGRESS REPORT

RESEARCH PROGRESS SEGMENT

State of:

Ohio

Date:

May 31, 1972

Project No.:

F-41-R-3

Name:

Environmental Evaluation of

a Nuclear Power Plant

Job No .:

2**-**B

Title:

Effects of Sudden Temperature

Period Covered: June 1, 1971-May 31, 1972

Change

ABSTRACT

Adult and young-of-the-year white bass, smallmouth bass, yellow perch and emerald shiners were tested to determine temperatures actively avoided by fish in a thermal gradient and to describe rapid temperature changes resulting in stress symptoms. Upper avoidance temperatures indicated temperatures above which a species would not be found in the lake habitat. Stress temperatures indicated lethal temperatures. The same facilities and fish specimens were used in both preference and temperature change experiments.

Most species avoided different temperatures each season. Higher temperatures were avoided by fishes in summer and the lower temperatures avoided in winter or spring. Similar temperatures were avoided by adults and young of each species.

The upper stress temperature varied seasonally but appeared to be similar for all species in a given season. Rapid decreases in temperature of greater than IOC during winter usually caused stress to the species studied.

RECOMMENDATIONS

The study of temperature avoidance behavior of fish and the affects of sudden temperature changes on fish species from the Locust Point area should continue. Tests to determine avoidance temperatures should be completed prior to temperature selection tests because avoidance tests may provide information on the upper lethal temperatures of each species. This information would be helpful in designing the upper limits of the gradient in temperature preference experiments.

OBJECTIVE

The objective of this job is to determine the effects of sudden temperature changes on aquatic animals in the Locust Point region.

TECHNIQUES USED

Information on the affects of sudden temperature changes on white bass, smallmouth bass, yellow perch and emerald shiners was obtained by behavioral observations before and after each thermal preference test. All equipment and facilities were those used in the preference experiments, and test temperatures were those available in the thermal gradient or holding tanks. The same fish species were used in both preference and temperature change experiments.

The temperature avoidance behavior of fish (acclimated to lake temperatures) was recorded during their initial period of exploration in the temperature gradient. This period usually extended from I to 4 hours after fish were placed into the gradient at ambient water temperatures. Higher temperatures consistently avoided by small groups of fish were schooling species, although individual fish sometimes penetrated warmer waters.

After a temperature preference test was terminated, fish were subjected to thermal changes by chasing them or transferring them from the compartment of their selected temperature to another of higher or lower temperature. Experimental fish were held in the compartment of a given test temperature for 5 to 10 minutes in tests of increased temperatures and one to several days in tests of decreased temperatures. The loss of swimming control and equilibrium which occurred at elevated temperatures were used as signs of "acute thermal stress" or "shock". The temperatures at which shock and death occurred were recorded. Fish were removed and measured immediately after a test.

FINDINGS

With the exception of smallmouth bass, fish avoided different temperatures each season during their initial exposure to the thermal gradient.

Avoidance temperatures at the upper limit of the experimental gradient were of questionable validity; gradient restrictions were necessary in some cases to insure survival of fish for preference tests. Smallmouth bass avoided similar temperatures (32-34C) during summer, fall and spring (winter tests were inconclusive) although they preferred different temperatures each season. Emerald shiners exhibited seasonal changes in upper avoidance temperatures, with a summer high (27-30C), intermediate fall and spring values and a winter low. White bass avoided high temperatures of 33-34C in summer and low temperature of about 20C during winter, while yellow perch avoided 29-32C in summer and 17-18C in winter.

Adult and young-of-the-year fish of each species appeared to avoid very similar temperatures each season. Although young, generally, avoided temperatures I-2C higher than adults in summer and fall, the differences were small and this pattern did not continue through spring.

The loss of equilibrium and swimming control by fish at elevated temperatures were used as signs of "thermal stress". The temperature at which the above responses occur was considered to be lethal. Ecologically, the thermal stress temperature is as important as a temperature resulting in the physiological death of a fish.

The results of tests on the effects of rapid changes in temperature on white bass, smallmouth bass, yellow perch and emerald shiners indicated the immediate effects after short term exposure, and did not preclude the possibility that fish were affected in a way that did not become evident until beyond the observation period. Little information was available on stress temperatures during fall or winter, when most tests were eliminated to conserve healthy specimens for possible reuse in later preference tests. Although fish were not retested in later preference tests, the uncertainty of obtaining healthy individuals of various species and age groups justified the omission of many thermal stress tests which may have resulted in death or fish of questionable physiological state.

Although seasonal differences existed in the upper stress temperatures of each of the four species, these differences did not exceed IOC for the limited data available (perch and emerald shiners in winter). All species were stressed at similar upper temperatures (within 5C or less) in a given season. Smallmouth bass did not appear affected by temperatures that stressed other species in summer and spring (26 and 32C respectively). In summer emerald shiners were stressed at temperatures about 2C lower than white bass and yellow perch (both 35C), while during spring all three species were stressed at similar temperatures (28–30C).

During any season, only slight differences existed in the upper stress temperatures between young and adults of the same species.

Tests indicated a correlation between the stress response and one given upper temperature to which a species was exposed. This suggests that the rate of change of temperature (between 5-15C) over a very short period was less important, over the range tested, than a species specific upper stress temperature.

Tests to determine the effects of sudden decreases in water temperature on the four species were conducted primarily in spring and in winter when the difference between selected temperatures and ambient lake temperatures were greatest. In winter young fish of all species appeared slightly more sensitive to rapid temperature decreases than did adults. Temperature drops of greater than IOC usually caused fish to exhibit stress while temperature changes between -15 and -20C caused death. In spring most temperature decreases from preferred to ambient temperatures were of less than IIC. Fish exposed to an IIC temperature drop (or less) showed no visible stress during this season.

JOB COMPLETION REPORT

RESEARCH COMPLETION SEGMENT

State of:

Ohio

Date: May 31, 1972

Project No.:

F-41-R-3

Name: Environmental Evaluation of a

Nuclear Power Plant

Job No.:

1-B

Title:

Benthos Populations Prior to

Discharge

Period Covered: June 1, 1969-May 31, 1972

ABSTRACT

Benthos was sampled monthly in the Locust Point area during the ice-free months from June, 1969 through May, 1971. In 1969 and 1970, 21 stations along three transects were sampled; in 1971, the far-offshore stations were deleted and additional near-shore stations were added. In 1969 all samples were taken with a Petersen dredge; after that, the rocky substrates were sampled with a pump sampler, (Baker and Scholl, 1971).

Samples were taken in the reefs in April and May, 1967 through 1970 by the Lake Erie Research Unit, Ohio Division of Wildlife. Reef samples were analysed to provide supplemental information.

The most abundant organisms collected were Chironomidae larvae, Tubificidae and Gastropoda. The greatest diversity occurred on the gravel-small rock substrate. Diversity was least on silt-detritus substrate, where density was greatest. Clay supported only a few species and at low population densities.

RECOMMENDATIONS

Sampling should be repeated after the power plant is in operation and results compared with this survey. Seasonal samples between 1972 and 1974 are desirable in order to detect any major changes that occur before the plant becomes operational.

OBJECTIVES

The objective of this job was to determine the species distribution and density of benthic populations prior to discharge.

TECHNIQUES USED

Twenty one stations in the Locust Point area were established in 1969 (Fig. 1). These varied in depth from 6 to 22 feet and included substrates of silt, sand, detritus, gravel, clay, small rocks, boulders and bedrock. The same 21 stations were sampled monthly from June through October, 1969, and from May through October, 1970.

Late in 1970, Toledo-Edison announced plans to build a cooling tower substantially reducing the area affected by the heated effluent. The sampling program for the spring of 1971 was modified accordingly by deleting the deeper, offshore stations and adding stations at the 6 and 10-foot contours (Fig. 2).

Samples were collected in 1969 with a Petersen dredge (A=0.0833 m^2). In 1970, a pump-type sampler was used on the boulder and bedrock reef areas. This sampler consisted of a gasoline-powered centrifugal pump, 25 feet of 2-inch pressure hose and a 12-inch diameter head (A=0.073 m^2). Mr. Russell Scholl and Mr. Ed Driscoll of the Ohio Division of Wildlife helped design the sampler and locate parts for it.

During 1969, each sample consisted of three dredge hauls which were analysed separately. However, the replicates proved to be very similar, and in 1970 and 1971 only one dredge haul was taken at each station.

All samples were sieved through a Number 35 U.S. Scil Series screen (0.5 mm mesh) and preserved in 10% formalin. Samples taken in 1970 and 1971 were stained with Rose Bengal. Samples were rough-sorted using a 10X dissecting microscope and the organisms identified to genus (species when possible) and counted.

Samples taken by the Ohio Division of Wildlife on the reefs in the Locust Point area were also examined. These were samples collected in April and May, 1967 through 1970 with the egg pump described by Manz (1964). The pump was towed over 0.024 hectares and the organisms sieved through standard brass screen (opening of 0.420mm) and preserved in 10% formalin.

FINDINGS

Forty-five species were found in the benthos samples between June, 1969 and May, 1971 (Table I). Thirteen species were oligochaetes and nine were chironomids. The greatest number of species collected in any month was 30 (September, 1969) and the fewest species (16) were taken in April and May, 1971.

meter and the number of species collected each month is shown in Table 2. In this figure, all substrate types and water depths were pooled to show differences due only to season. The 1969 data does not show a seasonal pattern, but this was probably caused by inexperience on the part of the field crews. For example, the average number of organisms/m² in August was much lower than in July or September. However, in August, 1969 Transect 3 was not sampled because of the firing schedule at Camp Perry. Since the stations on Transect three were usually the most densely populated, the omission of the transect probably resulted in the lower average numbers.

A second factor probably affecting the 1969 samples was the method of sorting and counting, especially samples containing high amounts of detritus and silt. In 1969, samples were preserved in 10% formalin and sorted in white enamel pans. After 1969, samples were stained with Rose Bengal (100 mg/l) before sorting. Rose Bengal is a red dye with an affinity for lipids.

Organisms were stained bright red and were much more easily seen. No doubt many small oligochaetes and chironomids in the 1969 samples were unnoticed.

The 1970 samples show a four-fold increase in numbers of organisms between May and September. This increase is due primarily to an increase in oligochaetes in late summer. There was little change in the numbers of species present over the summer. Apparently the total numbers of species in 1970 was less than in 1969, but this is probably because the reef samples were included in the 1969 figures. Several species were only found on the reefs.

In 1971, samples were taken in April and May. Samples were restricted to the six and 10-foot contours. The number of organsims per square meter was greater than in May, 1970, but the number of species was lower. At the six-foot contour stations the number of organisms was greater in April 1971 than in May 1971. Lower populations were probably caused by shifting sand bars in the area after heavy winds (Fig. 2).

The affect of water depth on species distribution and population density in 1970 is shown in figure 3. The 1970 data was chosen because 1970 was consistently sampled during all seasons. The distribution of organisms over the seasons did not appear to be dependent on depth. At the 6-foot stations there was considerable variation both in numbers of species and in percentage of the total organisms present. These fluctuations were probably caused by shifting sand bars and wave action. The greatest percentage of organisms was usually found between 10 and 15 feet where wave action was diminished but bottom conditions were suitable for high populations. The fewest organisms were usually taken at the 6-foot stations. The greatest numbers of species occurred at the 10 and 12-foot stations. The lowest species diversity was found at stations deeper than 15 feet.

Figure 4 and Tables 3-6 indicate how the distribution of species was related to substrate composition. The greatest diversity of species occurred

in gravel-small rock substrate and the greatest percentage of organisms was found in silt-detritus. Clay-gravel substrate supported the fewest organisms and the least diversity. The increase in percentage of organisms is silt-detritus in late summer corresponded with the increase in oligochaetes.

The most abundant taxa overall were Oligochaeta and Chironomidae.

Gastropoda were fairly abundant at stations deeper than 10 feet. Aquatic insects other than chironomids were very scarce; <u>Caenis</u> was the only Ephemeropteran found and three genera of Trichoptera (<u>Athripsodes</u>, <u>Oecetis</u> and <u>Polycentropus</u>) occurred occasionally.

The four reef stations (D6-II, Niagara Reef; D6-IO, Crib Reef; D6-9, Toussaint Reef; D6-8) have been treated separately because different sampling methods were used. In 1969, the Petersen dredge was used and gave very poor results, certainly underestimating the population. The pump sampler used in 1970 probably overestimated the population, though the samples are more representative of the reef environment. The pump head did not remain in one spot during sampling and the exact area sampled cannot be determined. The estimates showed the composition and relative abundance of species in the reef community. Table 7 shows the relative abundance of various species during the months sampled.

The reef data was supplemented by analyses of samples taken on the three reefs by the Ohio Division of Wildlife (Table 8). The additional pumped samples were sleved through a coarser screen than was used in our sampling and showed a different species composition. Very few chironomids or oligochaetes were retained by the screen, but some organisms not captured by the smaller pump (Orconectes, Asellus and some gastropods) were taken with the larger pump. The pump was towed over a known area and the results are expressed as mean number per hectare for the season (April and May).

LITERATURE CITED

- Baker, Carl T. and Russel L. Scholl. 1971. Walleye spawning area study in western Lake Erie, Ohio Division of Wildlife Dingell-Johnson Rept. F35 R-10 Job I. Mimeographed 24 p.
- Manz, J. V. 1964. A pumping device used to collect walleye eggs from offshore spawning areas in western Lake Erie. Trans. Am. Fish Soc. 93(2):204-205.

Table I. Benthic macroinvertebrates found in the Locust Point area June, 1969 through May, 1971.

Hydra

Planariidae

Hirudinea

Oligochaeta

Limnodrilus hoffmeisteri
Limnodrilus maumeensis

Limnodrilus madmoons

Limnodrilus cervix

Limnodrilus claparedeanus

Limnodrilus claparedeanus-cervix

Limnodrilus uderemianus

Awlodrilus sp.

Peloscolex ferox

Potamothrix maidaviensis

Potamothrix vejdovskyi

Branchyura sowerbyi

Nais sp.

Stylaria sp.

Bryozoa

Isopoda

Ascellus sp.

Amphipoda

Gammarus sp.

Hyalella azteca

Decapoda

Orconectes virilis

Ephemeroptera

Caenis sp.

Trichoptera

Oecetis sp.

Athripsodes sp.

Polycentropus sp.

Chironomidae

Chironomus (Chironomus) sp.

C. (Cryptochironomus) sp.

Polypedilum sp.

Pseudochironomus sp.

Tariytarus sp.

Procladius sp.

Ccelotanypus sp.

Cricotopus sp.

Psectrocladius sp.

Gastropoda

Amnicola sp.

Bythinia sp.

Physa sp.

Pleurocera - Goniobasis

Gyraulus sp.

Volvata

Pelycepoda

Sphaerium sp.

Pisidium sp.

Lampsilis sp.

Proptera elata

Numbers of organisms/ m^2 and species at various depths. Table 2.

6961	1969 - Includes reef stations	reef stat		by Peters	sampled by Petersen dreage.					
	<u>_</u>	nne	July	<u>^1</u>	Aug	•	Se	Sept.	0ct.	
	No. Indiv	No. Indiv. No. spp.	No. Indi	No. spp.	No. indiv. No.	No. spp.	No. indiv.	No. spp.	No. indiv. No.	٠ 9
5	138	=		12	137	12	76	2	340	_
5	167	4	469	17	159	δ	208	18	192	
4)	901	22	521	15	78	81	928	28	135	
15 ft. (4 sta)	933	20	1272	25	149	12	625	23	128	_
>15 ft. (2 sta)	748	9]	1048	9	40	4	464	9	12	,
Total species Total/m ²	2092+5	27 2092 , 5=418.4	3549÷5=709	27 09.8	563+5=112.6	23	2301+5=460	30	1376+5=295	95.3

1970 - Does not include reef stations.

May	>	June	Jе	אוחר	>	Ang	•	Sept	÷.	0ct	.
164	6	1055	17	645	ω	572	ο,	. 4552	9	3341	9
9/91	17	1761	17	2338	7	4000	11	8175	91	5882	5
1320	7	2678	17	1670	9	2361	8	4220	22	6511	<u>&</u>
854	12	2119	<u>2</u>	9061	12	2944	3	5342	4	1992	11
1845	9	528	ωĺ	1703	의	2979	8	6044	∞	5664	8
	20		24		23		23		24		22
5909+5	5909+5=1181.8	8141+5=	1628,2	8262+5=1652.	:1652.4	12856+5	2856+5=2571.2	2833345=	5=5666.6	2505945=	5=5011.8

1971 - Ten nearshore stations.

186 May 8	16
5327 16	5513 <u>~</u> 2=7756
427 April 10	16
5045 16	5477 ~ 27
6 ft. (5 sta)	Total species
10 ft. (5 sta)	Total/m²

TABLE 3

Benthic macroinvertebrates from stations with a silt, sand and detrital substrate (D6-I2,C6-I,D6-I6,D6-I7, D6-I8,D6-I9), May through October, 1969 & 1970, expressed as the mean number of organisms per square meter.

	,		1969					1970			
	6/17	7/17	8/15	9/23	10/29	5/8	6/8	7/7	8/6	9/16	10/7
Hydra	7	0	No Sample	0	0	0	4	0	0	0	0
Hirudinea	0	0	Taken	0	. 0	0	2	2	0	0	0
Oligochaeta (Immature)	329	778		25	2212	635	1307	1012	2836	6737	6489
Limnodrilus Hoffmeisteri	21	82		0	12	5 6	34	42	52	132	172
L. maumeensis	45	72		ŀ	9	8	102	156	100	160	70
L. claparedeanus- cervix	17	23		0	18	82	118	114	78	345	306
Potamothrix Moldaviensis	43	77	,	0	10	12	50	108	190	26	108
Branchyura sowerby!	10	3			138	154	244	248	259	569	1192
Chironomus (Chironomus)	86	24		10	126	345	126	291	49 9	1273	1124
C.(Cryptochironom	us)15	7		3	63	. 12	2	. 8	4	4	52
Polypedilum	23	ļ		0	15	0	2	2 6	4	. 8	2
Tanytarsus	3	92		0	9	2) () 4	14	4
Procladius	45	10		0	15	155	54	t () 16	12	16
Coelotanypus	19) 0		9	9	8	3 6	5 1:	2 14	108	86
Caenis	1	3		0	0	c) () (0	0	0
Sphaerium	0	4		0	0	C) :	2	0 0	0	0
Gammarus	0	5		0	6	2	2	D	8 6	24	4

TABLE 4

Benthic macroinvertebrates from stations with a clay-gravel substrate (D6-13,D6-14,D6-15,D5-2), May through October, 1969 & 1970, expressed as the mean number of organisms per square meter.

			1969			1970						
	6/17	7/17	8/15	9/23	10/29	5/8	6/8	7/7	8/6	9/16	10/7	
Hydra	0	4	0	0	0	0	108	0	0	0	0	
Hirudinea	0	0	0	0	0	0	6	0	0	3	0	
Oligochaeta (immature)	1	95	46	116	28	249 3	396 -	810	3 96	465	198	
Limnodrilus hoffmeisteri	0	2 .	2	0	0	0	0		0	3	9	
L. maumeensis	0	1	i	0	0	0	0	0	0	0	6	
L. claparedeanus cervix	- i	3	0	0	0	21	18	18	3	3	18	
Potamothrix moldaviensis	0	15	47	1 .	0	21	3	30	6	18	18	
Branchyura sowerby!	0	0	0	.0	0	9	9	0	0	18	3	
Stylaria	0	0	0	2	0	, 0	0	12	9	12	0	
Gammarus	15	9	0	0	3	3	6	9	9	6	15	
Chironomus (Chironomus)		1	5	5	3	0	3	0	27	117	24	
C.(Cryptochiron	omus)6	14	7	3	4	24	6	9	0	9	21	
Pseudochironomu			2	0	4	0	0	0	.0	0	3	
Polypedilum	C) 11	9	2	0	15	66	9	12	12	24	
Tanytarsus	C	12	2	14	0	27	б	6	48	192	9	
Procladius	3	3 4	4	0	3	3	0	3	3 3	17	6	
Coelotanypus		. 0	2	ŧ	0	0	0	() 3	0	
Caenis	. 10	8 (0	0	1	6	6	() () 3	3	
Oecetis	(0 2	0	0	i	. 0	0) (0	0	

TABLE 4

	6/17	7/17	8/15	9/23	10/29	5/8	6/8	7/7	8/6	9/16	10/7
		0	0	1	0	0	12	0	0	0	0
Amnicola	0			•	0	0	3	0	0	0	0
Bythinia	. 0	l	0	. 0	U					0	0
Sphaerium	2	Ì	ŧ	ł	1	3	0	0			•
Picidium	* *0	0	0	2	0	0	3	0	0	0	0

m

Benthic macroinvertebrates from stations with a gravel and small rock substrate (D6-7,D6-6,D6-5,D6-4,D5-3,D5-4), May through October, 1969 & 1970, expressed as the mean number of organisms per square meter.

			1969					1	970		
	6/17	7/17	8/15	9/23	10/29	5/8	6/8	7/7	8/6	9/16	10/7
Hydra	21	198	1	3	. 0	0	500	92	2	0	36
Planariidae	7	35	0	11	20	0	4	16	0	30	26
Hirudinea	0	3	ı	3	4	2	2	14	12	8	. 8
Oligochaeta (immature)	131	413	19	411	112	906	874	1214	1397	3393	4248
Limnodrilus hoffmeisteri	10	3	i	2	0	38	46	26	42	52	54
L. maumeensis	3	3	1	1	1	0	16	14	14	34	4
L. claparedeanus- cervix	. 1	i	0	. 1	0	24	10	26	10	118	14
Potamothrix moldaviensis	33	22	13	1	0	70	42	112	78	28	35
Branchyura sowerbyi	3	1	0	3	0	Ó	2	4	2	369	4
Nais	0	0	0	6	0	0	C	0	0	6	0
Stylaria	0	11	1	7	0	0	. (50	52	6	0
Gammarus	17	19	7	13	21	4	68	3 66	56	58	7 0
Chironomus (Chironomus)	28	0	5	11	3	0	40	7 2	160	602	92
C.(Cryptochironomu	ıs) 10	9	11	7	19	24	10	6 13	18	4	. 86
Pseudochironomus	1	0	3	2	3	7	1	8 2	0	0	6
Polypedilum	6	0	23	2	1	8	1.	2 2	26	2	38
Tanytarsus	2	29	43	45	0	0	I	0 2	104	315	76
Procladius	5	3	6	2 8	4	0		0 4	2	38	82

TABLE 5 Contid

			1969					1	970		
	6/17	7/17	8/15	9/23	10/29	5/8	6/8	7/7	8/6	9/16	10/7
Coelotanypus	2	0	1	7	0	0	0	0	2	24	14
Polycentropus	0	i	. 0	3	0	0	0	0	0	0	0
Caenis	1	0	0	0	0	0	0	0	2	0	2
Oecetis	0	1	0	i	0	. 0	0	0	0	0	0
Amnicola	0	0	0	9	0	2	10	6	8	8	0
Bythinia	3	3	ı	4	4	0	4	0	0	0	0
Pleurocere- Goniobasis*	4	15	0	0	1	0	0	0	4	0	0
Physa	1	0	0	0	0	0	0	6	2	2	0
Sphaerium	0	0	0	0	0	0	16	ł	6	8	0
Pisidium	5	1	0	19	0	6	6	0	10	28	16

^{*} Cannot distinguish genera with certainty.

ressed as mean number of organisms per square meter.

rable 6 Benthic ma	Benthic macroinvertebrates, April		& May, 1971, expressed as	as mean number of organisms per square meter.	organisms pe	r square meter.
			1261		May 15, 1971	
	Silt, detritus substrate (Al, A2, Bl, B2)	rave rate 1,E2	Gravel, small rock substrate (CI,C2,72)	Silt, detritus substrate (Al, A2, Bl, B2)	Clay,gravel substrate (DI,EI,E2)	Gravel, small rock substrate (Cl,C2,D2)
Hirudinea	· · O	4	4	0	0	0
Oligochaeta (imm.)	4062	220	1176	2535	1220	1808
Limnodrilus hoffmeisteri	159	0	52	180	æ	28
L. maumeensis	99	4	co ·	99	4	28
L. cervix	15	0	80	54	0	20
L. claparedeanus	195	0	. 21	117	0	4
Potamothrix moldaviensis	41	16	20	237	32	64
Branchyura Sowerby I	570	0	20	257	13	12
Nais sp.	18	4	4	21	12	20
Garmarus sp.	Μ.	. 20	0	6	0	ω
Caenis sp.	0	4	0	0	0	0
Chironomus(Chironomus)	171 (sn	4	001	171	0	0
C.(Cryptochironomus)	54	0	48	45	24	84
Polypedilum	0	0	0	0	12	ω
Tanytarsus	0	0	0	12	ω	ω
Procladius	06	0	40	99	0	0
Coelotanypus	0	0	4	0	0	0
•						

TABLE 7

Benthic macroinvertebrates from stations with a bedrock and large boulder substrate (D6-11,D6-10,D6-9,D6-8), May through October 1969 & 1970, expressed as percent of the total number of organisms (%).

			196	9				197	70		
	6/17	7/17	8/15	9/23	10/29	5/8	6/8	7/7	8/6	9/16	10/7
Hydra	89	0	0	19	0	4	4	1*	1*	No Sample	2
Planarildae	5	3	30	13	20	9	9	3		Taken	23
Oligochaeta (immature)	1	30	18	- 27	22	65	2	10	5		10
Limnodrilus hoffmeisteri	0	4	I	1	1	0	*	ļ*	l *	•	0
Nais	0	j	0	2	0	0	2	0	0		 *
Gammarus	1	39	26	10	2	ŀ	44	62	48		33
Hyalella azteca	0	3	2	3	0	0	5	2	1		3
Chironomus (Chironomus)	0	1*	1	2	1	0	16	1	2		1*
C.(Cryptochironomu	ıs) 0	. 2	1	1.	* 0	1	0	13	+ 1		1*
Tanytarsus	0	. *	8	1	* 0	0	0	0	1	*	1*
Procladius	0	5	1	2	4	0	1	i			
Coelotanypus	0) *	13	+ 1	8	0	0	0	0		 *
Polycentropus	ı	* 0	2	i	5	1	l *	: 1	* į	*	۱*
Amnicola	7	5 0	0	6	0	. 0	10	10	18	3	16
Bythinia	(0	4	3	18	C) 0	0	•	*	 *
Pleurocera- Goniobasis**	~ 2	2 l	0	!	* 0	C	0	O) 2	2	1
Physa		1 0	0	!	0	. (0	-		2	i -
Sphaerium	(0 2	0	:	5 1		0 1			2	3
Pisidium		0 0	0		3 4		0 1	C		4	2
Va I vata		0 0	0) (3 0	3	0 1.	() !	5	. 0

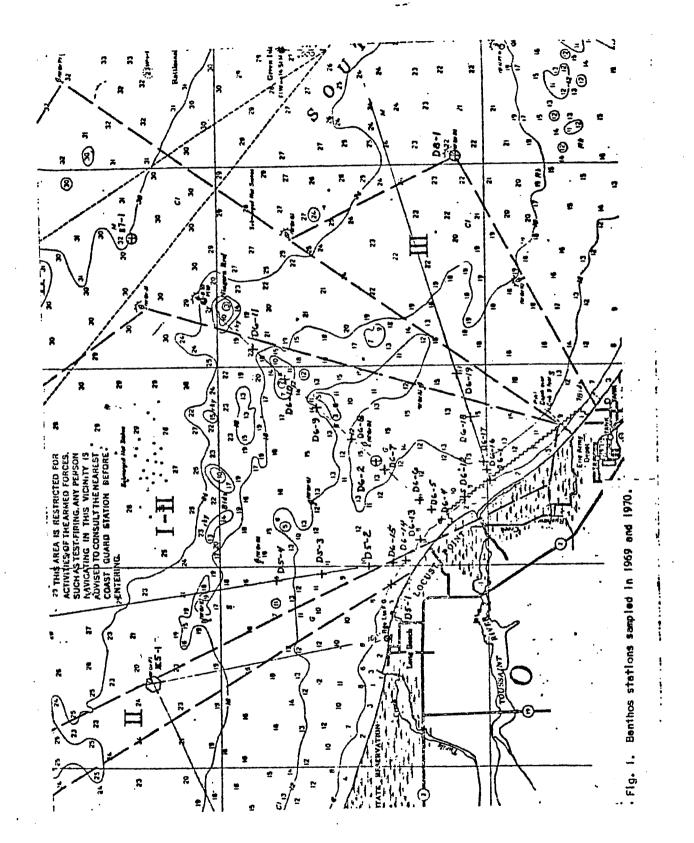
^{*}Indicates less than 1%

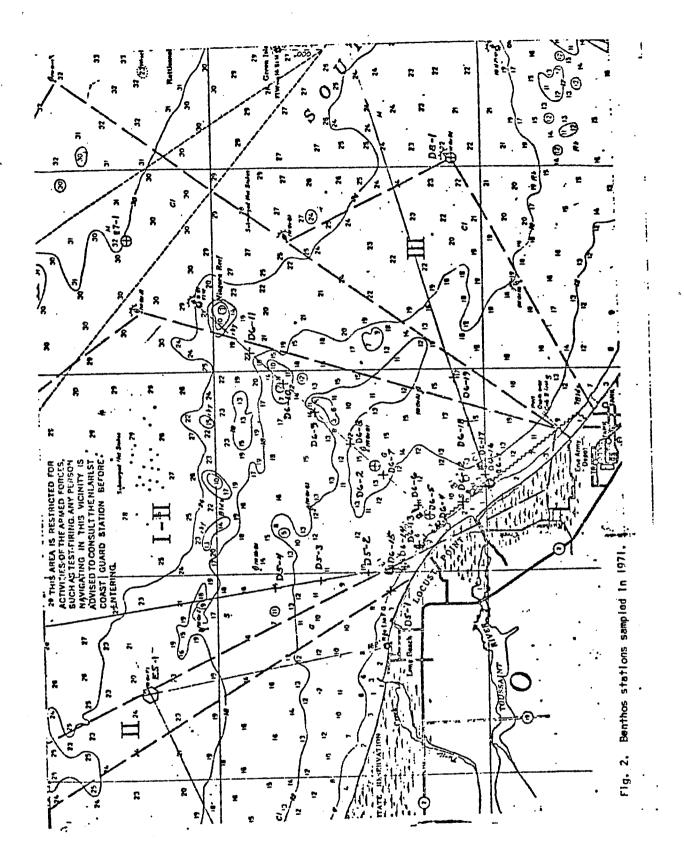
^{**}Cannot distinguish genera with certainty

Benthic macroinvertebrates collected at Niagara, Crib & Toussaint Reefs in April and May, 1967 through 1970 by Ohio Division of Wildlife egg pump, expressed as mean number of organisms per hectare. 1970 1069 Table 8.

•		1967			1968			6961				
	Niagara	۔ ا	Toussaint	Niagara	Cr1b (D6-10)	Toussaint (D6-9)	Niagara (D6-11)	Crib 7 (D6-10)	Toussaint) D6-9)	Niagara (Crib (D6-10)	Toussaint (D6-9)
Planari i dae	2995		62	1489	1269	811	104	991	0	21	62	69
Hirudinea	42	437	187	62	354	83	. 62	83	370	0	0	4
Asellus sp.	624	2766	187	2974	5886	208	229	728	42	0	104	14
Gammarus sp.		105394	83824	74152	62606	54142	52000	28038	52083	12022	9818	10317
Hyalella azteca	1914	936	0	416	1102	0	0	0	0	42	146	Ξ
Orconectes sp.		66	102	104	213	8	410	102	0	98	103	o .
Polycentropus sp.		624	42	125	354	145	0	125	42	21	291	83
Amnicola sp.	15900	420	505	36100	39317	4400	200	34625	40	016	23412	4690
Bythinia sp.	1422	409	818	411	919	1211	101	529	2617	611	1108	8661
Physa sp.	. 116	1418	310	1903	1810	1120	1031	915	2921	207	533	114
Pleurocera- Goniobasis*	3821	1530	1239	2806	13419	4132	3211	10831	3033	3941	13399	4957
Valvata sp.	103	0	0	119	25	21	0	27	0	0	0	0
Sphaerium sp.	431	143	217	644	251	433	327	104	0	0	210	o .
Pisidium sp.	0	122	432	217	473	316	. 0	0	0	0	119	0

*Cannot distinguish genera with certainty





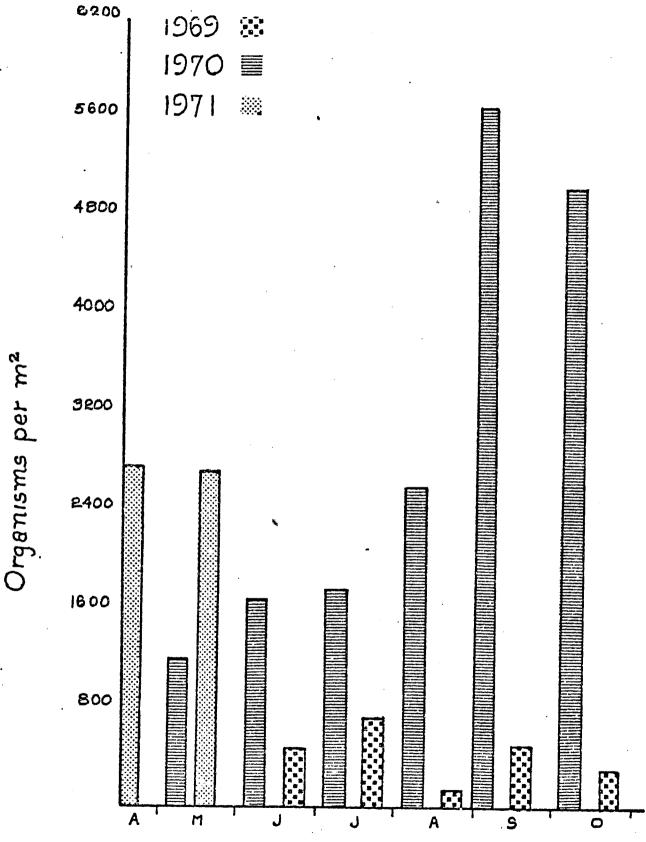


Figure 3. Mean number of organisms/m²/month from June 1969 to May 1971.

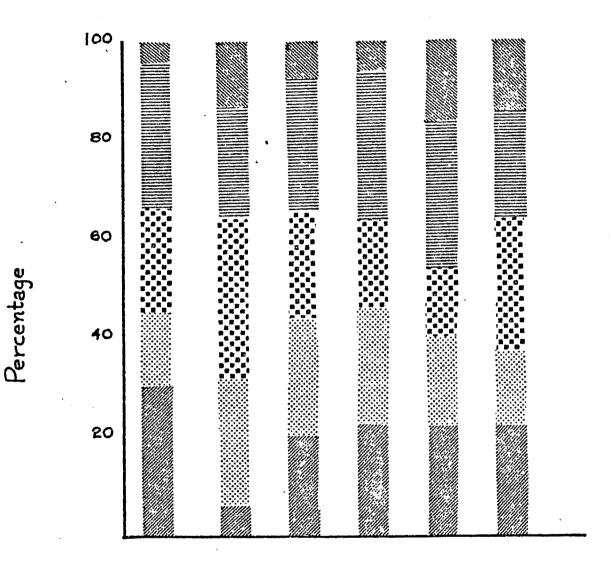


Figure 4. Percentage of benthos found at different water depths, no reef samples

15 feet, 15 feet, 15 feet, 15 feet, 15 feet

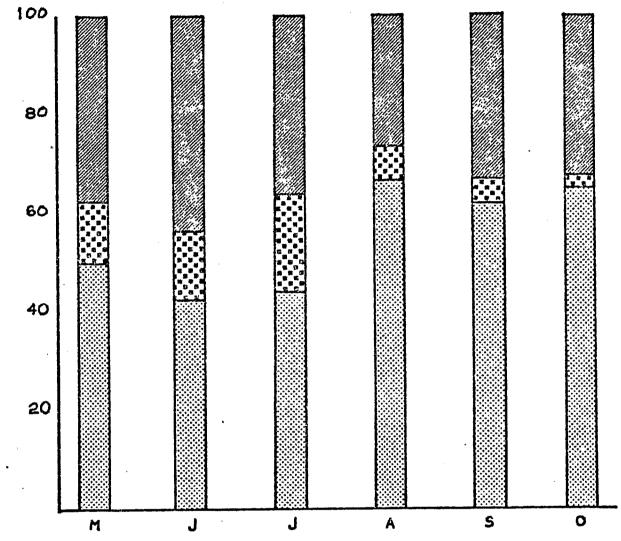


Figure 5. Percentage of organisms on different substrates.

Gravel and small rocks

Clay and gravel

Silt, send and detritus

JOB COMPLETION REPORT

RESEARCH COMPLETION SEGMENT

State of:

Ohio

Date:

May 31, 1972

Project No.:

F-41-R-3

Name:

Environmental Evaluation of

a Nuclear Power Plant

Job No.:

1-C

Title:

Plankton Populations Prior

to Discharge

Period Covered: June 1, 1969-May 31, 1972

ABSTRACT

Zooplankton was sampled monthly in the Locust Point area from June, 1969 through May, 1971 during the ice free portion of the year. In 1969 and 1970 stations were distributed over a wide area of the lake. In 1979 the stations were located near shore, after the Toledo-Edison Company announced that a cooling tower was to be constructed.

Cyclopoid copepods were found in 97.2% of all samples and calanoid copepods found in 84.9% of the samples. Cladocerans were also abundant with Daphnia retrocurva occurring in 80.1% of the samples and Bosmina in 86.3%. Abundant rotifers included Keratella cochlearis and Polyarthra.

The highest densities of all zooplankton (all taxa) appeared in June, July and August. The copepod populations were greatest in June, July and August. Cladocerans and rotifers were most numerous in July and August.

RECOMMENDATIONS

Zooplankton should be sampled in a more restricted area with more frequent samples until the power-plant is in operation. Phytoplankton should be sampled over all seasons before plant operation begins in 1974.

OBJECTIVE

The objective of this research was to determine the character and composition of the zooplankton populations of the Locust Point area of Lake Erie prior to operation of the nuclear power-plant.

TECHNIQUES USED

Plankton samples were taken at 23 stations along three transects radiating outward from the power plant (Figure 1). A summary of the stations and depths is shown in Table 1.

A 3-liter Kemmerer water bottle was used to collect samples at I and 3 meters. Samples were concentrated by passage through a No. 25 silk boiting cloth and zooplankters were then fixed in 5% formalin. The smaller nannoplankters were last with this procedure, but the larger zooplankters fed upon by fishes were retained and an overall estimate of the zooplankton was readily accomplished using this procedure. Zooplankters were counted in a Sedgewick-Rafter counting chamber at 100X magnification. Individual species were identified when necessary at 980X magnification.

FINDINGS

The frequency of occurrence of individual zooplankters is shown in Table 2. The only protozoan found in the samples was Acinetz and it was found only in 1969. Rotifers were quite common in all samples. The ubiquitous Keratella cochlearis was found in 95.2% of all samples and Polyarthra was also abundant occurring in 93.7% of all samples. Brachinous, Keratella quadrula, Asplanchna and Filina were other prominent rotifers.

Copepods were idientified only as cyclopoid or calanoid types and the naupli were counted separately. Naupli were found in every sample taken and the widespread occurrence of calanoid cyclopoid copepods indicated a large number of copepods in the area.

Cladocerans were well represented in the zooplankton. The more numerous Cladocerans included <u>Daphnia retrocurva</u> (80.1% of all samples) and several species of <u>Bosmina</u> (86.3% of all samples) <u>Chydorus</u> and <u>Daphnia</u> galeata were found frequently in the samples.

Seasonally all zooplankton reached peak densities in June, July and August. Some of the stations with the highest numbers of zooplankters are shown in Table 3. Copepods were found in large numbers throughout the summer but Cladocerans reached peak populations in July and August.

The location and depth of all stations with the highest concentrations of zooplankters is shown in Table 3. No apparent relationship between density and depth is discernable from the data collected. At times zooplankton at 1-meter was most abundant and at other times samples at 3-meters had higher populations. There was no clear pattern when numbers of zooplankters near shore stations (less than 6 feet) were compared to off-shore stations.

The number of species identified from offshore stations appeared to be greater than the diversity of the inshore stations. The increased diversity was probably a direct result of the emphasis placed on sampling offshore stations. As the samples were enumerated fewer species were identified in any one offshore station than in one inshore station. The greater diversity of zooplankton was probably an artifact of our sampling techniques.

A few notes were made on the phytoplankters found in the course of counting zooplankton. The spring diatom bloom consists largely of Melosira, Fragellaria, Asterionella, Tabellaria and small numbers of Pediastrum.

During summer algae were few in the samples. Green algae were more abundant than other species Pediastrum and Scinedesmus were fairly common, and Staurastrum and Ceratium were more common than in other seasons.

In the autumn representatives of the blue greens Aphanizomenon and Microcystis were abundant and the diatoms were again prominent. Pediastrum is probably the most common alga at all seasons. Ceratium and Staurastrum are also present throughout the year. (Table 4.)

Table 1. Stations sampled - Distance from shore and approximate depth.

Stations	Distance from shore in ft. (approximate)	Approx. depth in ft.
D5-1	2000	6
D5-2 = E1	7000	10
D5-3	11000	†1
D5-4	17000	16
D6-4 = C2_	1000	6
D6-5	3000	8
D6-6 = C1	4000	11
D6-7	9000	12
D6-8	15000	12
D6 - 9	21000	11
D6-10	25000	8
D6-11	30000	22
D6-12 = B2	2000	б
D6-13 = D2	1500	6
D6-14 = E2	2000	6
D6-15	5000	9
D6-16.	3500	12
D6-17 = A1	5500	13
D6-18	10000	15
D6-19	15000	17
C6-1 = A2	2000	6
BI DI	4000 4000	10 9

⁼ inshore stations

Frequency of occurrence of all plankters collected. (# of samples in which organism was identified) % of samples in which plankter occurs Sept. 70 Sept. 69 July 70 69 69 May 70 Aug. Oct. June July Oct. Aug. Protozoan 1.7 3 3 Acinetz Rotifer 47.3 5 8 15 166 12 11 32 31 8 K.quadrula 15 25 4 95.2 6 15 334 27 33 30 32 30 33 32 30 23 K.cochlearis15 28 93.7 329 29 34 7 15 32 30 33 30 32 30 Polyarthra 15 20 22 24 6.8 10 Pompholyx 7 7 34.2 120 13 27 16 16 8 3 21 15 Asplanchna 66.4 233 30 34 15 15 32 30 32 7 10 12 12 Brach ionus 43 12.3 8 13 11 Kellikotia 10 3.4 12 7 5 Philodina 72 20.5 3 15 8 9 23 4 2 7 1 Filinia 26 7.4 15 9 Trichoerca 1 2.0 7 5 2 Platyias I .3 Testudinea 3.7 13 13 Notholca 6.0 21 21 Conchilus .3 Ascomorpha .3 Proales .3

Total # samples taken
15 29 24 30 32 32 33 32 30 30 34 15 15 351

Rotaria

Table 2. Continued

Table 2. Communa	June 69	July 69	Aug. 69	Sept. 69	0ct. 69	May 70	June 70		Aug. 70	Sept. 70	0ct. 70	April 71	May 71 Total # samples	h plan lected	% of samples in which plankter occurs
Arthropods														•	
Copepods Cyclopoid	15	29	24	30	32	30	32	32	30	30	33	12	12	341	97.2
Calanoid	15	29	24	30	28	27	15	26	28	29	28	9	10	298	84.9
Naupl i	15	29	24	30	32	32	33	32	30	30	34	15	15	351	100.0
Cladocerans D. retrocurva	15	29	24	30	9	9	33	32	30	30	34	1	5	281	80.1
D. galeata	11	29	24	2	-	-	2	14	27	10	5	***	1	125	35.6
D. parvula	6	14	16		***	-	1	•	_	•.•	0	ł		38	10.8
Bosmina	14	29	24	30	32	14	28	32	30	30	34	2	13	312	86.3
Chydorus	9	2	_	30	26	2	10	9	10	30	34	1	-	163	46.4
Diphanisoma	ı	5	3	5	_		1	-	H	16	18	-		60	17.1
Leptodora	2	20	8	1	_	-	2	3	5 7	6	5	-	-	54	15.4
Simocephalus	_	9	7			1946	-					-		16	4.6
Ceriodaphnia	_	2	1		_	-						-		3	0.9
Polyphemus		ì		***		_		. -			. ~			Į	0.3
Camptocerus	***		. 1		***	-								1	0.3
Other															
Lepidurus	_	1	-	-	636		<u>.</u>							1	0.3

Total # samples taken
15 29 24 30 32 32 33 32 30 30 34 15 15 351

Table 3.

Location of Station of Greatest Concentration

			2,000 ft. offshore; mouth of Toussaint	near Niagra reef		south east mouth of loussain	area	north west of mouth of Toussaint	south east mouth of Toussaint	east of mouth of Toussaint	north of mouth of Toussaint	south east of mouth of Toussaint	north east of Long Beach	north east of Long Beach	offshore at Locust Point	south east mouth of Toussaint	
ration) tation	; mouth	near	· •	south	reef area	north	south	eas†	north	south	north	north	offs	sou†	
Concent		Location of Station	ffshore		,		e-	=	€a⇔ Que	<u>.</u>	<u></u>	E	=	Pre-	85-4 13-4	:	
test		oca†	•	=		£.		ton (bn	<u>;</u>	=	=	=	<u>S</u>	5		=	
n of Grea		. .	2,000 +	000 02	000,00	2,000	25,000	1,500	5,500	10,000	3,000	3,500	7,000	11,000	1,500	2,000	
of Statio		Dep th	<u>E</u>	7	Ē	E	E	트	2m	J.n.	Ē	Ē	<u>=</u>	3ª	<u>E</u>	Zm.	
Location of Station of Greatest Concentration		Station	06-12		De-1	1-90	01-90	D6-13	D6-17	BI-90	D6-5	91-90	05-2	05-3	02	A2	
Range of	Densities	Zooplankters/l	265_1454		.78- 420	69-1832	212-1084	79- 767	142- 658	121- 689	439-3902	350-2769	144- 748	49 -700	13- 57	369-1043	
Average	Density	Average #	Zoopi aliki Si Si	CO /	207	519	463	279	256	408	1 722	1 202	376	264	37	571	
				June 1969	July 1969	Aug. 1969	Sent. 1969	0ct. 1969	0791 veW	11 Per 1970	0/61 //111	Aug 1970	Sept. 1970	0ct. 1970	April 1971	May 1971	

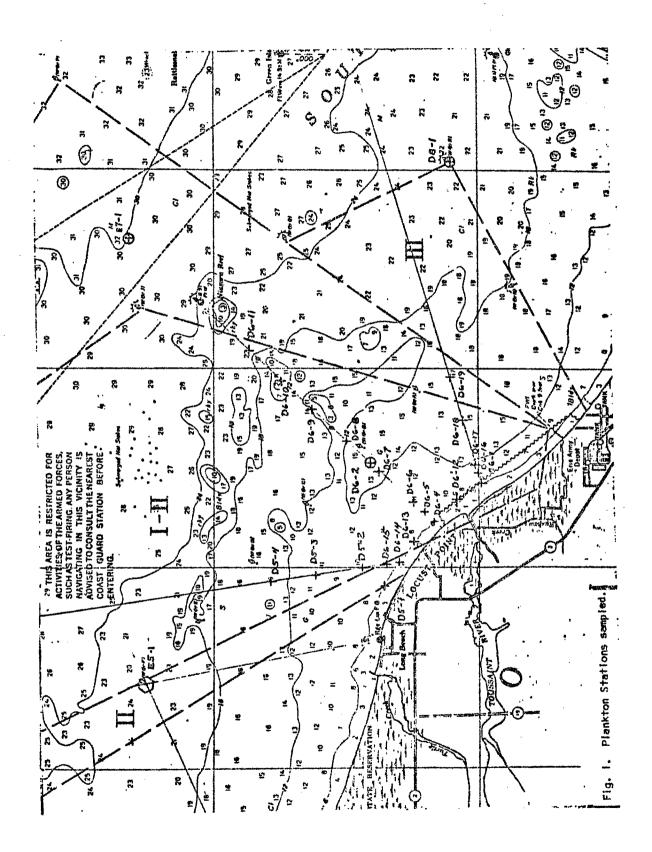
Table 4. Phytoplankton Predominant species noted in monthly samples.

June 1969	Nothing recorded
July 1969*	Microcystis noted once
Aug. 1969	Pediastrum, Starastrum, Microcystis; Aphani heavy in some samples
Sept. 1969*	Aphanizomenon
Oct. 1969	Melosira in many samples; Fragellaria, Pediastrum present
May 1970	Much Melosira; Tabellaria, Fragellaria, Pediastrum present
June 1970*	Pediastrum
July 1970	Aphanizomenon
Aug. 1970	Much Anabaena in all samples; Ceratium also heavy
Sept. 1970	Aphanizomenon in many samples; Pediastrum & Anabaena present
Oct. 1970	Pediastrum, Melsira, Ceratium
April 1971	Many Melosira, Tabellaria, Fragellaria & Asterionella
May 1971	Many Melosira, Tabellaria, Fragellaria & Asterionella

^{*} very few phytoplankton notations in this month

Table 5. Average number of the most common zooplankters /l/ month.

Z 1	May 1970	June 1970	July 1970 Aug. 1970	Aug. 1970	Sept. 1970	Oct. 1970	April 1971	May 1971
Copepoda								
Calanoid	50	55	011	40	5	5	ī	01
Cyclopoid	rv	ľΩ	01	01	20	01	īŪ	ī
Naupli	70	220	582	350	80	50	01	30
Cladocera								
Daphina	2	37	901	94	24	14	0.3	
Bosmina	7	ω	16	150	56	21	0.3	М
Chydorus	0	2	2	4	131	40	0.2	0
Rotifers								
Keratella chochlearis	15	20	310	330	10	40	īυ	70
Polyarthra	35	30	295	135	25	35	5	50
Brachionus	ın	2	140	75	25	20	01	70



JOB COMPLETION REPORT

RESEARCH COMPLETION SEGMENT

State of:

Ohio

Date:

May 31, 1972

Project No.

F-41-R-3

Name:

Environmental Evaluation of

a Nuclear Power Plant

Job No.:

1-A

Title:

Fish Population Prior to

Discharge

Period Covered:

June 1, 1969-May 31, 1972

ABSTRACT

Fish populations were sampled during ice-free months from June, 1969 through May, 1971 using a 150-ft. bag seine, 2750-ft. commercial seine, and three 150-ft. experimental gill nets.

Carp*, gizzard shad, freshwater drum and white bass were found during every sampling period. Carp were the most abundant over-all, normally comprising more than 80% of the sample. Drum and gizzard shad were next in abundance.

In general, the spring and early summer samples contained a greater percentage of adult fish, while the late summer and fall samples reflected the recruitment of young-of-the-year fish.

Chironomid larvae were the most frequently-found food items for most species in all months. There was little evidence of a seasonal change in food habits.

Some species (drum, white bass) showed size-related changes in food habits.

^{*} In this report, carp refers to carp, goldfish and/or carp-goldfish hybrids.

RECOMMENDATIONS

Sampling of fish populations should be repeated after the nuclear power plant is in operation. Seasonal samples between now and then (1974) would be desirable in order to detect any major changes in the populations before discharge.

OBJECTIVES

The objective of this job was to determine the composition and character of the fish populations in the area prior to discharge.

TECHNIQUES USED

Sampling: Three transects in the Locust Point area were established in 1969 for sampling fish populations. The same three transects were used in 1970 and 1971 (Fig. I). Transect I begins 1,000 ft. west of the Toussaint River and runs toward West Sister Island. Transect 2 runs from the mouth of the Toussaint River to Niagara Reef and Transect 3 starts 1,000 ft. east of the river and runs toward South Bass Island.

Mr. Virgil St. Clair, a commercial fisherman, operated his 2750-ft. seine east of the Toussaint River in the area of Transect 3. This net was from 12 to 16 ft. deep with 5" mesh at the outsides. The mesh gradually decreased in size toward the bat, which was 2-1/4" mesh. Fish were sampled with this gear once a month from June through October, 1969, May through October, 1970, and April and May, 1971.

The 150-ft. bag seine was fished at five locations; one haul was made at the base of each transect, one haul between Transects 1 and 2 and one haul between Transects 2 and 3. The net was 6 ft. deep with 3/4" mesh in the wings and 1/4" mesh in the bag. Fish were sampled by this method in July, August and October, 1969, May through October, 1970 and May, 1971.

Three experimental gill nets were set, one along each transect. They were fished overnight perpendicular to shore with the small mesh set closest to shore in about 8 feet of water. The nets were 6 ft. deep and 150 ft. long, consisting of contiguous 30-ft. panels of stretch mesh from 1/4" to 3". Gill nets were set once a month from August through October, 1969 and in May and August, 1970.

Species Composition: The catch of each species by each method was determined after every sampling period, as was the total catch for each gear. Except for carp all fish were weighed and measured and scales taken from representatives of each size group. When the commercial seine catch contained too many carp to process feasibly, Mr. St. Clair estimated the total catch. Catch per unit effort (CPE) was determined for each gear and a comparison was made between the relative numbers of individuals and species for each gill net and 150-ft. seine haul.

Age-Growth: Scales were read using a Bausch & Lomb microprojector and annular measurements made to enable back calculation of growth rate. Length-frequently plots were used for determining ages of shiners. Age data was compared with and supplemented by data from the Lake Erie Research Unit, Ohio Division of Wildlife, and Carlander's (1969) data for Lake Erie fishes.

Food Habits: Representatives of different size groups and species were weighed, measured and their stomachs preserved in 5% formalin as soon as possible after capture. Only live, seined fish were used for this study. Stomach contents were identified as far as possible and enumerated. Because of the small stomach volumes and diversity of food items, the numerical approach was used rather than the volumetric method.

Frequency of occurrence was calculated for each food item for each fish species. Differences from month to month were examined and food habits of different sized individuals of the same species were compared.

FINDINGS

Species Composition: Appendix I is a list of scientific and common names of all fish taken. Table I shows the species present in each month of sampling. Altogether 33 species were found, although the greatest number for any one month was 21 (May, 1970). Fewest species (12) were taken in July and September, 1970.

Freshwater drum, carp (including goldfish and/or hybrids), gizzard shad and white bass were taken during every month sampled, while several species (spotted and white suckers, stonecat, rockbass, smallmouth and largemouth bass, green sunfish and logperch) occurred only once or twice. The number of species in part reflected the methods used, since not all sampling methods were used every month.

In every month except October, 1969 and August, 1970, carp and goldfish made up at least 60% by weight of the total sample. Next in abundance were gizzard shad and drum. In the two other months freshwater drum were most abundant. Total catches were greatest in the late spring and early fall samples and lowest in the summer months.

Tables 2, 3, and 4 show catch per unit effort (CPE) for the three sampling methods for each month. Data for the 2750-ft. seine is expressed as pounds per haul, for the 150-ft. seine as individuals per haul and for the gill nets as individuals per net. Since the 2750-ft. seine captured the large individuals of each species and too many individuals to count feasibly, the catch was expressed as pounds rather than numbers of individuals. The 150-ft. seine, on the other hand, took mostly young-of-the-year fish and shiners; thus it was more practical to express these catches as numbers of individuals.

Tables 5 and 6 are comparisons of the numbers of individuals each month at each sampling location for the gill net and 150-ft. seine catches. Since the 2750-ft. seine was pulled at only one location each month, there is no similar data for it.

The greatest numbers of individuals were taken most often West of the Toulssaint River and the fewest individuals were most often taken East of the river. No seasonal trend in numbers of species or individuals at a given location was detected, but numbers seemed lower in August and September, 1970 than the same months of 1969.

Age-Growth: Data from several sources was combined to give a view of the age structure of fishes in the Locust Point area. Table 7 shows the mean length for each age class of most species collected. The figures are from work done in this study, from the Lake Erie Research Unit of the Ohio Division of Wildlife and from Carlander's (1969) Information on Lake Erie fishes.

Samples in early spring were comprised mostly of adult individuals. As the summer progressed, young-of-the-year individuals, as well as yearlings, became more abundant. Young-of-the-year white bass, shiners, drum, gizzard shad and alewife were taken only in the 150-ft. bag seine. Young-of-the-year carp and goldfish were never taken and only a few young-of-the-year channel catfish were captured.

Table 8 shows the size composition of the species frequently captured, using all three methods. This table reflects type of gear used as well as population changes, since not all sizes of fish were equally susceptible to all types of gear.

Food Habits: From June, 1969 through May, 1971, 1919 stomachs were examined, 71.8% of which contained food. The number of stomachs examined each month and the number containing food is shown in Table 9. A seasonal pattern

was evident, with a greater percentage of stomachs containing food in the summer months than in the spring and fall (Fig. 2). All the percentages may be lower than in actuality since it is common for fish to regurgitate when they are caught and handled.

Table 10 shows the frequency of occurrence of various food items in Locust Point fish stomachs from June, 1969 through May, 1971. The percent frequency of occurrence is based on the number of stomachs containing food. "Unidentifiable debris" included material too digested to be identified as well as sand, silt and gravel. Results are probably biased toward hard-to-digest organisms, since they would remain in the stomach longer.

Stomach contents of carp and goldfish were the most difficult to identify, but almost always included copepods and cladocerans. In addition, insects and amphipod remains were frequently found, as was plant material.

Gizzard shad stomach contents were predominantly zooplankton and phytoplankton, but most contained significant amounts of silt or sand grains.

Freshwater drum under 6 inches long ate no fish; their major food items were chironomid larvae (mostly <u>Chironomus</u> (<u>Chironomus</u>), <u>C. (Cryptochironomus</u>) and <u>Glyptotendipes</u>. Other insects and cladocerans occurred occasionally. The three species of chironomids found were the most abundant ones found in benthos samples from the area. The species were plentiful in all open-lake samples, from all substrate types and seldom occur in emergent vegetation along the shore.

Drum between 6 and 12 inches long ate primarily Chironomidae, but contained a wider variety of other insects, including Hemiptera and Odonata, than those shorter than six inches. Drum larger than 12-inches contained fish

almost exclusively. The apparent seasonal trend toward a greater occurrence of Chironomidae in late summer and fall is probably due to recruitment of young-of-the-year drum into the population rather than an actual change in food habits.

White bass showed a similar size-related pattern, the small individuals utilizing zooplankton and Chironomidae and the larger ones feeding almost entirely on fish. No such pattern was evident for yellow perch. All sizes fed about equally on Chironomidae and fish.

Emerald and spottail shiners fed mainly on insects. The large individuals utilized Cladocera and Copepoda extensively, but diets of young-of-the-year individuals (less than 2.8 inches) were not so restricted. The diversity of insects eaten (Chironomidae and other Diptera, Odonata, Trichoptera, Hemiptera and Coleoptera) indicated the shiners were feeding on the surface and in emergent vegetation, perhaps into the Toussaint River, as well as in the open lake.

Both bullheads and channel catfish were omnivorous, feeding on everything from cladocerans to fish. The occurrence of the midge <u>Cricotopus</u>, dipterans other than Chironomidae, and Coleoptera indicates considerable shallow-water or upstream feeding as well as open-water feeding suggested by the presence of <u>C. (Cryptochironomus)</u>, amphipods, and Gastropoda.

Amphipods were utilized by all species of fish except gizzard shad.

They occurred especially frequently in the spring, perhaps before many small fish were available as food.

All species of fish utilized food organisms found in the Locust Point area, both in the open lake and along the shore or in the river. Food items found included benthic invertebrates from all substitutes in the area (silt and sand bottom, gravel and clay bottom and the reefs). The plankters utilized corresponded with those predominant in most of the plankton samples (Daphnia retrocurva, Rosmina sp., Chydorus sp. and cyclopoid copepods).

LITERATURE CITED

- Baker, Carl. 1969. Lake Erie Fish Population Trawling Survey.

 Dingell-Johnson Project F-35-R-7, Job #3. 32 pp.
- Carlander, K. D. 1969. Handbook of Freshwater Fishery Biology. Vol. I. lowa State Univ. Press, Ames, 10wa. 752 pp.

Table 1. Species compositon of Locust Point fish populations in the months sampled from 1969 to 1971. The presence of a species during a given month is indicated by an X.

•			1969						19	70			1	971	
	ja [*] ,	_J ac*			Oapc	!\ ⁶	abc	jac	Jac	Aapc	Şac	Oac	A ^c	Mac	:
longnose gar	1	T	х					X				1			
bowfin	X	X					1	X	,]					l x	
alewife		X	X	X		X	1	X		x	x	×	x	x	1
gizzard shad	X	X	X	X	Х	X		×	X	x	^	^	x	1 ^	
coho salmon				X						X				l x	
American smelt		X			X	X X	1		1	X					1
northern pike			.,	X		^	- 1	\times	x	X		×	X		
carp	X	×	X	X	X	11	1	$\hat{\mathbf{x}}$	×		X	X		l x	
goldfish	X	X	Х	X	X	∥ ×	1	l	x	X	x	X	×	\ \ \ \	- 1
carp X goldfish	X	X	Х	X	X		- 1	X	^	^	^	^			
silver chub						>	- 1	X	.,	,,		×		١,	
emerald shiner		X	X	X	Х	11	\	X	X	X	×	x			
spottail shiner		×	X	×	X	11 7	`	X	X	^	1^	"			
spotfin shiner		Х				11 .		۸			X	l x	$\ _{x}$	١,	x
quill back	X	Х	X	X		11	X	,			1	X	x	- 1	x
golden redhorse	X			X		11	X X					1 "	ll x		
white sucker						43	x					1			
spotted sucker		١.,				11	x	Х	x	l x	1 _x	X	∥x	-	
channel catfish	X	×	×	1		- 11	1			1	X	\ \ \ \	$\ _{x}$	- 1	x l
brown bullhead	X	X	X	X		-	X	X	X	X	1^	^	\parallel		<u> </u>
stonecat					1		.,	.,		X	X	×	$\ \mathbf{x} \ $.	x l
white bass white crappie black crappie	X	X X		. [X	X		X X X	X	×	Ŷ	×) x̂	∭×		× ×
rock bass				1				X							
smallmouth bass	Ì				X					1				ŀ	
largemouth bass				×			X								1
green sunfish		X	:		1									1	- 1
orange spotted sunfish	,	X		1							×	X			
							X		X	X			- 11	X	
walleye	X)		< x	: x		X	X	X	X	: x			X	X
yellow perch				1					Х			>	< -		,
log perch	×	Ι,		x ,	(x		Х	X	x	×	()×			×	X
freshwater drum	1	1	1				21	17	12	15	5 12	2 1	4 1	3	14
TOTAL SPECIES	13			<u> </u>		$\perp \! \! \! \! \! \! \! \perp$							- !!		<u> </u>

^{*} a=commercial seine

^{*} b=gill nets

^{*} c=150-ft. bag seine

Catch per unit effort (lbs/haul), using the 2750-ft. shore seine. Table 2.

Table 2. Catch per uni	er un	שׁ ב		1001/001/	25 4	n						!	
								1970	o			1971	
			1909						1	+400	ا ر	Anr.	May
	Line	>Int	Aug.	Sept.	Oct.	May	June	July	Aug.	oen :	-	1	
					c	c	0 3	0	0	0	0	0	9.0
Alewife	0	0)	>	>)	1	•	c	0	707	6.0	10.1
Gizzard shad	unknown	UMO	unknown	WD	58	17	23	- Ω	>	7.1			. (
			amoudan	526	55	2055	1405	270	6.1	502	1026	14,000	0001
Carp	UNKU	UNKROWII) -		α	C	0	0	8.	2.8	28	68
Quillback	7	7.8	unknown	,	>	2	,	!	1	-	-	7	C
choist choice	21	9.6	9.6 unknown	5	0	1.2	8, 2	6.5	3.0		-)
	i	. (<u>.</u>	-	C	2,2	2.3	8.3	0.9	3.4	0.5	5,8	7.4
Brown bullheads	6,6	ω.	0.8 unknown	<u>.</u>	>	1	•	,	(ļ	c	ני	4
	0.4	0	0	0	0	1.7	0	0	0	>))	7•7	† •
Political Legion Se	•				(L C	c	C	C	0	0	26	0
White sucker	0	0	0	0	>	0.	>	>	>	•	(L C	-
7. 4. 4. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1.	4	5,3	4.0	30	0	0		7.0	0.4	<u> </u>	0	ວ ບໍ	-
MILIO DOS	•	•		!	(c	C.	α -	c	0.7	0		0.4
Crappie	0.4	0	0 unknown	0,3	0	7	0.0	•	•	i •			,
	C	C	0	0	0	9.4	0	0	0	0	0	2.5	0
2 (a) 10 M))			Ċ	7	- 6	0.5	0.8	0.2	0	5	8
Yellow perch	0.8	0.3	0.3 unknown	7.5	7.0	J.	7	•	·			į	4
Freshwater drum	44	6	unknown	8.2	0	42	91	114	7.5	16.0	0	<i>C</i> /	ე 4
		(ć	ų -	C	C	C	0	1.2	0	0	6.8	0
Coho salmon	0)	5	0.	>	>	>	1					

1238.6 14,188.8 1169.9 total 101.6 35.8 unknown 586.6 113.2 2159.8 1468.4 416,2 16.5 543.3 TOTAL LBS.

*excluding gizzard shad and carp

**excluding gizzard shad

Table 3. Catch per unit effort (numbers per haul), using the 150-ft. bag seine.

			1					1970	_			197	=1
			1969				ou.	711	Aug.	Sept.	Oct.	Apr.	Мау
	June	July	Aug.	Sept.	OCT.	ÁPI	June	6.55					
A low to	ي ا	00	7	90 80	c	0	0.4	0	0	0	0	No Samo le	0
	Sample	7		Sample	, ,	•	c	2519	33	13.4	118.6	- 31	0
Gizzard shad	=	141.2	71.3	p	157	>	>	3) }			F	c
Carn & Goldfish	=	4.2	-		0.2	4.6		0	0	7.0	7.0	;	> ;
nenido bicacan	5	7 × 7	24	/a-	2	11.8	53.6	34.8	3.3	9.01	0.2		264.5
		י ל י	, h	54	9.9	136.2	22.4	5.2	3.3	2.8	0.8	ilia cire	1.3
Sportail sillier		ה ה	•	=	C	0.2	0.2	Ĉ	0	0	0	TT.	0
Channel cattism		7. 0	۲	gr-		c	0	0	0	0	0	i.i.	0
Brown bullhead	<u>.</u>	٥.	· · ·	: :) (, ,		Ö	۲,	σ	0	5	0
White bass	=	32.2	7.6	; •	2.6	0.7	>	ò	•		Ċ	=	. K
Orașoi.e	=	6.8	0.3	=	0.2	0.8	0	0.4	w,	•	ρ . Ο	:	} '
	£		, 0	g o gov	0.2	0.4	ာ	Φ,	0	0	0	Çim Çim	0
rellow per ci	;) }	I =	c	0.2	0	0.2	0	0.4	0.2	to- giv	O
Drum	=	7.0	>	;	,		c	c	C	0.2	0.2	E	0
S unfish	e ·	8.0	0	=	>	>	>	>	, (Ċ	gue (e-	C
Black bass	æ	0	0	ST-4 Gar	0.2	0	0	0	0		>	: ;	, •
+1000	٠ ⋍	0.1	0	L.	0	0	0	0	.7	0	0	qua Eur	-
1 - 1 - 1 mg	5		c	**	0	0	0	0.2	0	0	0	=	0
walleye	:)	>										
,			•			1	ì	0 000	0	i,	121.0		276.9
TOTAL NUMBER		249.9 119.9	6.611		249.0	26.8	0.0/	/2.6 2098.0	, ,		1	,	

Table 4. Catch per unit effort (numbers per net), using experimental gill nets.

June July Aug. Sept. Oct. May June July Aug. Sept. Oct. May June July Aug. Sept. Oc shad 102 386 129 0.3 Sample				1969						ţ				
Shample Sample 102 386 129 0.3 Sample		-frine		Aug.		0ct.	May	June	July	Aug.	Sept.	Oct.	Apr.	May
Sample sa		٥	ON.	102	386	129	0.3	No Samo le	No Samo le	0	No Samole	No Sample	No Sample	No le
ish ii ii ii ii 25 ii ish ii ii ii ii ii ii ii ii ers ii ii ii ii ii ii ii ii ii ish ii ii ii ii ii ii ii ii ii ads ii inum ii ii ii ii ii ii ii ii ii irum ii ii ii ii ii ii ii ii irum ii ii ii ii ii ii ii ii ii irum ii ii ii ii ii ii ii ii irum ii ii ii ii ii ii <	بر د د	Sample	Samp te	1 2 2	17	36	5.3) 1 2 3 3 3		194.7	11.	· .		=
n n 19.5 8.7 0.5 0.7 n 10.3 n n n 12.3 62 0 0.7 n n n n n n n 12.3 62 0 0 0 n n n n n n n 0 0 0 0 n n n 6.7 n n n n 0 0 0 n n n 2.7 n n n n 1 12.3 2.7 0.7 n n n n n n n 0 0.7 0 0 n n n n n n n n 0 0.3 0.3 n.3 n n n n			:	n + + 0	֓֞֞֜֝֞֜֞֝֓֓֓֓֓֓֓֓֓֓֓֓֓֓֓֓֓֓֓֓֓֓֓֓֓֓֓֓֓֓	, M	0	E	e	25	en tru		D:	en en
n n 12.3 62 0 0.7 n n 0 n </td <td>Carp & Goldfish</td> <td>1</td> <td>=</td> <td>19.3</td> <td>χ Ω</td> <td>ر. م</td> <td>•</td> <td></td> <td>•</td> <td>۲۰ د</td> <td></td> <td>er.</td> <td>tt</td> <td>#</td>	Carp & Goldfish	1	=	19.3	χ Ω	ر. م	•		•	۲۰ د		er.	tt	#
5 0.3 101 227.7 "	Emerald shiners	<u></u>	=	12.3	62	0	0.7		:	0.01			:	
n n 6.7 n n 6.7 n n n 0 0 0 0 n n 6.7 n n n 4.7 2.3 1 6.7 n n 12.7 n n n 207.7 85 29.3 3.7 n n 50 n n n 1 12.3 2.7 0.7 n n 6 n n n 1.3 0 0.7 0 n n n 6 n n n 0 0.7 0 n n n n n n n n 0 0.3 0.3 n n n n n n n 0 0.3 0.3 n n n n n n 0 0 0 0 n n n n n n n n n n n			<u>£</u>	c		101	227.7		æ	O		i.a Co-	 b.+	=
n n 6.3 0 4.5 n n 0 0 0 0 n n 0 0 0 0 0 n n 4.7 2.3 1 6.7 n n 12.7 n n 1 12.3 2.7 0.7 n n 6 n n n 1 12.3 2.7 0.7 0 n n 6 n n n 1 0 0.7 0 0 n n 0 n n n 0 0.7 0 0 n n 0 n n n 0 0.3 0.3 n n 0 n n n 0 0 0 0 n 0 n	Sportall similers			>	ı	(*		=	6.7		£.	**	#-
n n 4.7 2.3 1 6.7 n n 2.7 n n n 207.7 85 29.3 3.7 n n 50 n n n 1 12.3 2.7 0.7 n n 6 n n n 1,3 0 0.7 0 n n n n n n 0 0.7 0 0 n n n n n n n 0 0.3 0.3 n n n 0 n n n n 0 0 0 2 n n 2 n	Channel catfish	en ur	<u>.</u> .	Ŋ	0.3	9	4.0		;			No.	7-	=
II <	Brown but theads	*	11	0	0	0	0	=	Œ	7.1			•	:
sh n n 207.7 85 29.3 3.7 n n 50 n 50 n 50 n 1 l2.3 2.7 0.7 n n n 6 n 1 l2.3 2.7 0.7 n n n 1 i ii l iii l ii l		:	ţ	7	ري بر	•=	6.7		F.	12.7		ŧ	Bayl Rem	=
rum " " 1 12.3 2.7 0.7 " " 6 " " 6 " " 6 " " 6 " " 1 1.5 0 0.7 0 " " " 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	White bass	:	•	*	1	•	1		=	, C		î	t	=
rum "	Yellow perch			207.7	82	29.3	3.1	=	:	?	;	:	z	ga-
redhorse " " " 1.3 0 0.7 0 " " " 1 " " 0 " " 1 " 0 " 1 " 1 " 0 " 1 " 1	Erochwater drum	E	ŧ		12.3	2.7	0.7	=	47 ·	9	ř.	pa- Da-	2	: ;
redhorse " " 0 0.7 0 0 " " 0 " " 0 " " " 0 " " " 0 " " " 0 " " " 0 " " " 0 " " " 0 " " " 0 " " " 0 " " " 0 " " " 0 " " " 0 " " " " 0 " " " 0 " " " " 0 " " " " 0 " " " " 0 " " " " 0 " " " " 0 " " " " " " 0 "		بين ح د	E	2	0	0.7	0	£	gu- L=		dan ya	17	Ē	Ë
redhorse " " " " " " " " " " " " " " " " " " "	Crappie	:	.		C	C	0	Um Om	gan gan	0	=	#5	nu See	Ľ
" " 0 0 0.3 0.3 " " 0 " " 0 " " 0 " " 0 " 0 " " 0 " 0	Golden redhorse	=	:	>	•)		:	:	¢	<u>;;</u>	=	4 200	#
" " " 0 0 0 2 " " 2 "	Sme 1+	31	.	0	0	0.3	0.3	Ryss phas	5	>	;	:	ù:	÷
	Walleye	¥	0 3	C	0	0	2	**	U-,	2	=	ius 14	•	:

311.1

417.6 564.6 300.3 256.4

TOTAL NUMBER

Table 5. Numbers of individuals and species taken at each gill net location.

river)	No. Spb.			• !	ī.	7	-	
Transect 5 (Fact of river)	No. indiv.	488	1	CII	300	225	437	
2	mouth) No. SDD.		•	ထ	Ŋ		n (6
Transect 2	(at river mouth) No. indiv. No.		/6]	561	751	· '	9/1	346
	river)		ထ	σ	•	no	7	
+ ((((((((((((((((((((West of F	No. Indiv.	569	659		452	368	. 113
			8/22/69		60/67/6	10/28/69	5/6/70	8/12/70

Table 6. Numbers of individuals and species taken at each 150-ft. bag seine haul location.

	Transect	r! var)	Transect 1-2 (West of rive	1-2 iver)		t 2 louth)	Transect 2-3 (East of river)	2-3 river)	Transect 3 (East of river) No. indiv. No. 5	· 3 ·iver) No. sr
	No. indiv. No. Spp.	No. Spb.	No. indiv.	No. spp.	No. Indiv.	Indiv. No. Spp.	NO. TIMILY	100		
	1	1	717	01	1	ì	1	1	230	7
7/30/69	236	n '	<u>1</u>	. 1	122	Q	ļ	į	11	Z.
8/53/69	691	3 1	l			į.	μ γ	របា	265	ĸ
10/29/69	365	1	349	M	295	^	5	. '	ć	۲
01/3/3	00	Z	287	7	335	ထ	43	9	17	`
01/0/0	2 2	ம	27	2	06	ĸ	91	4	1 16	6 0.
	3	, L	a C	ħſ	275	বর্ত্ত	4113	, MJ	3518	7
7/18/70	R 		200	١. ٩	ŭ	មា	•	1		ì
8/22/70	58	8	4	च ।	, è	` ~	6	v	-	4
9/21/70	2	4	31	v	ဋ	r	<u>.</u>	r	<u>0</u>	4
10/24/70	242	'n	219	צט	117	7	ဆ	4	<u> </u>	• •
17/51/5	657	*****		3	123	М	ę.	1	<u></u>	4

Table 7. Mean total length and range (in inches), where available, of indicated age class for some species captured in the Locust Point area.

	0	ı	11	111	17	٧	VI
Alewife b	1.5-5.9 \$\overline{x}=4.4						
Gizzard shad b	x ≈6.4	≅=10.9	≅=12.8	x=13.6	⊼=14.3	Lay at 1 feet between control time constrained at 1	<u> </u>
Carp C	0.7-8.0 x=6.0	≅=6.5	≅=8.7	⊼=9. 6	<u>≅=13.9</u>	x=13.9	≅=15.7
Goldfish ^C		x=3.5	5.0-6.0				
Quiliback C	1.5-2.2	9.5-9.7	10.9-15.4	14.9-16.5			
Emerald shiner ^{ab}	1.7-3.1b ¤=2.6b	2.2-3.4a					
Spottail shiner ^{ab}	1 0 3 50	3.4-4.6	4.5-5.1a	4.9-5.5 ^a			
Channel catfish ^b	≅=4.8	₹=7.9	≅=10.1	x=12.2	x=13.2	R=15.3	x=15.9
Brown bullhead ^C	2.0-4.9	2.7-6.0					
White bass ^b	2.0-6.0 x=4.1	⊼=10.i	⊼=11.8	x=12.6	x=13.4	≅=14.6	
Yellow perch ^b	2.2-4.7 \$\bar{x}=2.6	5.1-6.9 \$\overline{x}=6.5	6.2-7.9 x =7.2	6.5 - 9.8 ≅=8.3	7.9-10.1 x=9.0	8.6-10.6 x=9.6	
Walleye ^b	₹=9.6	x=15.2	x=16.8	≅=18.4	x=19.5	⊼=19.9	
Freshwater drum ^a	1.5-5.6 x=3.9	5.1-7.5 x=6.4	6.4-9.4 x=8.5	8.9-14.0 x=11.7	10.2-15.4 x=12.3	12.2-16.5 x=14.6	12.3-16.° x=15.1
American smeltbc	1.6-3.6 ^b ≅=2.4 ^b	5.6-6.2 ^C	x=9.5℃				

 $^{^{}a}$ =age determined in the present study b = age determined by Lake Erie Research Unit, Ohio Division of Wildlife c =data from Carlander, Freshwater Fishery Biology, for Lake Erie fish

Table 8. Size range (inches) of fish captured in the Locust Point area by all three mathods of capture.

Oct. abc	2.4-16.6	3.6- 5.4	4.3-24.6	14.9	2.4- 3.7	2.6- 5.5	0	0	0	0	2.7- 6.0	5.2-11.5	3.2	0	2.8- 3.5	0	3.3-15.0	0	7.6
Sept. ab	4.9-14.6	4.1-5.1	4.1-19.8	9.3-13.0	M U		13.6-19.7	6.1- 9.4	13.2-13.9	0	3.6-12.4	5.6- 9.4	13.0	0	7.5	0	2.6-16.1	16.3	0
Aug. abc	1.2-12.0	1.4- 4.1	5.9-19.7	9.3-13.0	1.9- 4.8	1.9- 4.7	5.5-18.0	6.7	0	0	1.8-10.6	5.8-11.5	0	0	6.01-0.3	0	5.5-18.5	0	0
Julyac	1.5-15.8	1.3-2.2	9.5-23.2	12.4-13.3	2.4- 4.4	1.8- 5.4	2.9-16.1	4.1-10.4	0	0	1.5- 7.9	5.0-8.9	0	2.6- 3.0	4.1-8.9	0	6.3-20.9	0	3,3
June	7.0-16.5	0	6.2-29.4	9.6-16.3	0	0	7.2-16.3	7.3-11.6	9.5	0	5.4-9.9	6.5-8.3	0	0	8.3	0	9.3-21.3	o	
	Gizzard	Alewife	Carp & Goldfish	Quí I Iback	Emerald shiners	Spottail shiners	Channel catfish	Brown bullheads	Golden	White sucker	White bass	Yellow perch	Black bass	Sunfish	Crappie	Walleye	Freshwater drum	Coho salmon	Sme 1+

=commercial seine
=gill net
=150-ft, bag seine

Size range (inches) of fish captured in the Locust Point area by all three methods of capture. Table 8.

7.1-15.4	Ō	6.9-16.3	13.1-13.3	3.6	3.4- 4.4	7.9	8.3-8.4	14.7	0	2.4-10.6	0	0	3.7	2.9- 4.1	0	ø	0	0	
1.4-13.1	0	6.7-8.6	5.6-13.9	1.4- 4.3	2.6- 4.9	14.0-17.7	6.7-10.7	0	0	2.0-11.7	7.4	0	1.6	7.8	0	1.1-15.8	0	0	
1.0-15.1	0	7.4-18.1	0	3.0- 5.1	1.0- 4.6	4.8-17.9	6.1-11.4	0	0	1.6-11.1	5.6- 9.2	0	0	3.3- 7.8	6.2-12.8	3.9-17.4	14.1	1.9- 2.3	
1.2-11.0	0	6.2-23.1	0	2.0- 5.2	1.3- 3.7	13.4-17.4	5.1-10.9	0	0	1.5- 7.5							0	0	
6.9-15.5	6.6- 7.4	8.8-16.3	. 0	1.8- 4.2	3.0- 4.8	2,3-16.5	7.5-10.6	0	Ó	5.11-11.6	6.8- 9.0	O	0	6.3- 7.9	0	6.6-15.9	0	٥.	
6.7-14.9	6.7	6.5-27.3	9.8-16.6	1.8- 4.7	3.2-5.3	2.9-18.9	8.5-11.5	16.6	9.2-17.0	4.4-15.6	6.2- 9.3	10.4	o	3.3-14.2	9.4-12.5	6.1-17.9	0	6.6- 7.3	
Gizzard	Alewife	Carp	Goldfish Quiliback	Emerald shiners	Spottail	Channel catfish	Brown bullheads	Golden redhorse	White sucker	White bass	Yellow perch	Black bass	Sunfish	Craphle	Halleye	Freshwater	Coho	Sme1+	
	6.7-14.9 6.9-15.5 1.2-11.0 1.0-15.1 1.4-13.1	6.7-14.9 6.9-15.5 1.2-11.0 1.0-15.1 1.4-13.1	6.7-14.9 6.9-15.5 1.2-11.0 1.0-15.1 1.4-13.1 6.7 6.6-7.4 0 0 0 0 6.5-27.3 8.8-16.3 6.2-23.1 7.4-18.1 6.7-8.6	6.7-14.9 6.9-15.5 1.2-11.0 1.0-15.1 1.4-13.1 6.7 6.6-7.4 0 0 0 0 6.5-27.3 8.8-16.3 6.2-23.1 7.4-18.1 6.7-8.6 1 9.8-16.6 0 0 0 5.6-13.9	6.7-14.9 6.9-15.5 1.2-11.0 1.0-15.1 1.4-13.1 6.7-14.9 6.5-27.3 8.8-16.3 6.2-23.1 7.4-18.1 6.7-8.6 6.5-27.3 8.8-16.3 6.2-23.1 7.4-18.1 6.7-8.6 6.5-13.9 1 1.8-4.7 1.8-4.2 2.0-5.2 3.0-5.1 1.4-4.3	6.7-14.9 6.9-15.5 1.2-11.0 1.0-15.1 1.4-13.1 6.7-14.9 6.9-15.5 1.2-11.0 1.0-15.1 1.4-13.1 6.5-27.3 8.8-16.3 6.2-23.1 7.4-18.1 6.7-8.6 1.8-4.7 1.8-4.2 2.0-5.2 3.0-5.1 1.4-4.3 1.3-5.3 3.0-4.8 1.3-3.7 1.0-4.6 2.6-4.9	6.7-14.9 6.9-15.5 1.2-11.0 1.0-15.1 1.4-13.1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	6.7-14.9 6.9-15.5 1.2-11.0 1.0-15.1 1.4-13.1 6.5-27.3 8.8-16.3 6.2-23.1 7.4-18.1 6.7-8.6 6.5-27.3 8.8-16.3 6.2-23.1 7.4-18.1 6.7-8.6 1.8-4.7 1.8-4.2 2.0-5.2 3.0-5.1 1.4-4.3 1.3-5.3 3.0-4.8 1.3-3.7 1.0-4.6 2.6-4.9 2.9-18.9 2.3-16.5 13.4-17.4 4.8-17.9 14.0-17.7 ds 8.5-11.5 7.5-10.6 5.1-10.9 6.1-11.4 6.7-10.7	6.7-14.9 6.9-15.5 1.2-11.0 1.0-15.1 1.4-13.1 6.7 6.6-7.4 0 0 0 0 6.5-27.3 8.8-16.3 6.2-23.1 7.4-18.1 6.7-8.6 6.5-27.3 8.8-16.3 6.2-23.1 7.4-18.1 6.7-8.6 1.8-4.7 1.8-4.2 2.0-5.2 3.0-5.1 1.4-4.3 1.3.2-5.3 3.0-4.8 1.3-3.7 1.0-4.6 2.6-4.9 2.9-18.9 2.3-16.5 13.4-17.4 4.8-17.9 14.0-17.7 8.5-11.5 7.5-10.6 5.1-10.9 6.1-11.4 6.7-10.7	6.7 6.6-7.4 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	6.7-14.9 6.9-15.5 1.2-11.0 1.0-15.1 1.4-13.1 6.7-14.9 6.9-15.5 1.2-11.0 1.0-15.1 1.4-13.1 1.4-13.1 6.5-27.3 8.8-16.3 6.2-23.1 7.4-18.1 6.7-8.6 6.5-27.3 8.8-16.3 6.2-23.1 7.4-18.1 6.7-8.6 6.5-27.3 8.8-16.3 6.2-23.1 7.4-18.1 6.7-8.6 6.5-13.9 1 1.8-4.7 1.8-4.2 2.0-5.2 3.0-5.1 1.4-4.3 1.8-4.7 1.8-4.7 1.8-4.7 1.0-4.6 2.6-4.9 2.9-18.9 2.3-16.5 13.4-17.4 4.8-17.9 14.0-17.7 6.5 11.5 7.5-10.6 5.1-10.9 6.1-11.4 6.7-10.7 6.0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	6.7 6.6-7.4 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	6.7 6.6-7.4 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	6.7-14.9 6.9-15.5 1.2-11.0 1.0-15.1 1.4-13.1 6.7 6.6-7.4 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	6.7-14.9 6.9-15.5 1.2-11.0 1.0-15.1 1.4-13.1 6.7-14.9 6.9-15.5 1.2-11.0 1.0-15.1 1.4-13.1 6.5-14.9 6.5-27.3 8.8-16.3 6.2-23.1 7.4-18.1 6.7-8.6 6.5-27.3 8.8-16.5 6.2-23.1 7.4-18.1 6.7-8.6 6.5-13.9 1 1.8-4.7 1.8-4.2 2.0-5.2 3.0-5.1 1.4-4.3 1.8-4.7 1.8-4.2 2.0-5.2 3.0-5.1 1.4-4.3 1.8-4.7 1.8-4.7 1.0-4.6 2.6-4.9 2.3-16.5 13.4-17.4 4.8-17.9 14.0-17.7 4.8 1.5-10.6 5.1-10.9 6.1-11.4 6.7-10.7 6.5 1-10.9 6.1-11.4 6.7-10.7 6.5 1-11.6 1.5-7.5 1.6-11.1 2.0-11.7 6.5 1-11.6 1.5-7.5 1.6-11.1 2.0-11.7 6.5-10.7 6.8-9.0 6.8-7.3 5.6-9.2 7.4 6.5-9.2 6.8-9.0 6.8-7.3 5.6-9.2 7.4 6.5-10.7 7.8 7.8 7.8 7.8	6.7-14.9 6.9-15.5 1.2-11.0 1.0-15.1 1.4-13.1 6.7-14.9 6.9-15.5 1.2-11.0 1.0-15.1 1.4-13.1 6.7-14.9 6.9-15.5 6.2-23.1 7.4-18.1 6.7-8.6 0 0 5.6-13.9 1 1.8-4.7 1.8-4.2 2.0-5.2 3.0-5.1 1.4-4.3 1.8-4.7 1.8-4.2 2.0-5.2 3.0-5.1 1.4-4.3 1.3-2.5.3 3.0-4.8 1.3-3.7 1.0-4.6 2.6-4.9 1.3-11.7 4.8-17.9 14.0-17.7 6.8 5.1-10.9 6.1-11.4 6.7-10.7 6.8 5.1-10.9 6.1-11.4 6.7-10.7 6.8 5.1-10.9 6.1-11.4 6.7-10.7 6.8 5.1-10.9 6.1-11.1 2.0-11.7 6.8 5.1-11.6 1.5-7.5 1.6-11.1 2.0-11.7 6.8 5.1-11.6 1.5-7.5 1.6-11.1 2.0-11.7 6.8 5.1-11.6 1.5-7.5 1.6-11.1 2.0-11.7 6.8 5.1-11.6 1.5-7.5 1.6-11.1 2.0-11.7 6.8 5.1-11.6 1.5-7.5 1.6-11.1 2.0-11.7 6.8 5.1-11.6 1.5-7.5 1.6-11.1 2.0-11.7 6.8 5.1-11.6 1.5-7.5 1.6-11.1 2.0-11.7 6.8 5.1-11.6 1.3-7.6 5.3-7.8 7.8 5.1-12.5 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	6.7 6.6-7.4 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	6.7-14.9 6.9-15.5 1.2-11.0 1.0-15.1 1.4-13.1 6.7-14.9 6.5-7.4 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	6.7-14.9 6.9-15.5 1.2-11.0 1.0-15.1 1.4-13.1 1.6.7-14.9 6.9-15.5 1.2-11.0 1.0-15.1 1.4-13.1 1.6.7-14.9 1.6.7-14.9 1.6.7-14.9 1.6.7-14.9 1.6.7-15.1 1.8-4.7 1.8-4.2 2.0-5.2 3.0-5.1 1.4-4.3 1.8-4.7 1.8-4.2 2.0-5.2 3.0-5.1 1.4-4.3 1.8-4.7 1.8-4.7 1.8-4.2 2.0-5.2 3.0-5.1 1.4-4.3 1.8-4.7 1.8-4.7 1.8-4.7 1.0-4.6 2.6-4.9 2.9-18.9 2.3-16.5 13.4-17.4 4.8-17.9 14.0-17.7 2.9-18.9 2.3-16.5 13.4-17.4 4.8-17.9 14.0-17.7 2.9-18.9 2.3-16.5 13.4-17.4 4.8-17.9 14.0-17.7 2.9-18.9 2.3-17.6 5.1-10.9 6.1-11.4 6.7-10.7 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0

=commercial seine
=gill net
=150-ft. bag seine

Size range (inches) of fish captured in the Locust Point area by all three methods of capture. 1261 Table 3.

Mayac	8.1-16.1	6.7-7.3	8.3-12.3	5.2-18.3	1.9- 4.3	3.1- 4.8	0	7.5-11.4	7.8-8.1		5.6-14.6	7.1-9.3	0	0	7.5-8.1	0	5.3-20.7	0	5.0- 5.9
Apr. 3	13.0-13.2	0	8.0-19.1	16.0-20.6	0	0	11.7-19.1	8.7-11.7	13.8-16.2	13.3-18.9	6.5-12.2	6.6-12.4	0	0	9.0- 9.3	9.1-14.6	7.5-17.6	18,3-20.4	
	Gizzard shad	Alewife	Carp & Goldfish	Quillback	Emorald shiners	Spottail shinars	Channel caffish	Brown bullheads	Golden redhorse	White sucker	White bass	Yellow perch	Black bass	Sunfish	Crappie	Walleye	Freshwater drum	Coho	Sme1+

=commercial seine .
=gill net
=150-ft. bag seine

Table 9. Number of fish stomachs examined each month and number containing food, June, 1969 - May, 1971.

Sample Date	Stomachs examined	Stomachs containing food	Percent containing food
1969	en e		
June 26	140	120	85.7
July 4	149	127	85.0
July 26	92	72	78.0
July 30	130	107	82.0
Aug. 24	O	-	
Sept.24	80	51	63.8
Oct. 29	140	88	62.9
970			
May 8	298	172	57.7
June 22	255	181	71.0
July 18	208	178	85.6
Aug. 22	72	60	83.3
Sept.12	89	71	79.8
Oct. 10	33	23	69.7
1971			
April 17	83	51	61.4
May 15	150	76	50.7
TOTAL	1919	1377	71.8

[6]	Debris	0000	67	8		8888	2888		
(Sex)	elds:iitnabinU	2000				manufacture desired topics			
1969 through May,	risi4				·				
ron	Pelecypoda						•		
7	spodontasa					•	•		
136	Decebogs		17			4			
9	sboqidqmA								
s, June,	Insecta (unidentifiable)	19	,			20	83		
fishes,	Psectrocladius								
Point f	Tanytarsus								
	Pseudoch i ronomus								
15115	Cricotopus								
some Locust	Coelotanvens			001	2	•			
SOS	Procladius								
<u>.= </u>	Polypedilum								
i tens	seqibnototqy19								
of food items	C. (Cryptochir- onomus)					,	•		
	Chircnomus)			00			•		
Frequency of occurrence (\$)	*esbincaorid	,						•	
rend	(esbimonorida			001					
COL) ptera(not	1							
90)oleoptera	9							
ò >	richoptera	1	0			m -	.	8	
lenc	obebogs	2 c	100	•		48	0 %	. 0	
יפמו	6 Tecobe l	22	<u>8</u>	23	atranaja a sessandas	20 = 15	67		
			4-000	M M - C	-00	25 4 6	4 - W & U	400-	00
=	≥					1 1 1	1 1 1 1 1	, , , ,	1 1
ا در	80 0	1	•	, , , 4		جام م	M M M	5 5 5 C)
+	se i ped dimes	69,	/69 /69 8/69	5666	07/0 11/7 11/8	fis 9/69 /69 5/69	7/30/69 9/27/69 10/18/69 5/8/70 6/12/70	6/22/70 6/22/70 9/12/70 7/01/01	7/7 5/7
	Fish	Carp 6/28/69 77:./69	7/26/69 7/30/69 9/27/69 10/18/63	5/18/20 5/12/70 5/13/70 3/22/70	0//21/6 10/10/7/ 11//71/4 11//51/2	60/df1sh 5/28/69 7/2/59 7/26/69	7/30/69 9/27/69 10/18/69 5/8/70 6/12/70	6/23/7 6/23/7 9/12/7	4/17/ 5/15/
ميين	Eå	= 1010r	· 0/ 1	1 1 150 F = 189 S	- ,				τ

5	eldsititable Debris	00 00 00 00 00 00 00 00 00 00	20	•	00		53		4	
through May,	Fish				90 22	4	. 50 <u></u>	, 23 ½	3	
ino.	Pe lecypoda			•		•				
Ė	Gastropoda			,				•		
696	Decapoda				100		٧ ح	30	<u>8</u>	20
0	sboqidqmA				2		·		-	
some Locust Foint fishes, June, 1969	stoeenl (eldsilitnebinu)			•	Ä	58		01		
) sho	Psectrocladius								•	
t-1	Tanytarsus							4	`	
Foi	Pseudoch i ronomus					٠		_		
cust	Cricotopus							-		
٥	Coelotanypus							=	=	
SOM	Procladius							ν :	-	
<u>.= </u>	Polypedilum		•				•	ر <u>۵</u>	-	
irems	sedibnototqylə				<i>:</i>			88	77	
food lifems	C. (Cryptochir- onomus)							으 육 :		β
) of	C. (Chironomus)						2	£ 8 1	2 2	67
72 . e.	Chlronomidse*				01	86	•	1		
occurrence (ک	Diptera(not Chironomidae)						21	2	55	
Ö	Coleoptera									7
, o ,	Trichoptera		~ ^		0			ī		_
Suer	epododog	56 50 50 50	50.00		00 0					
Frequency	gnecopalO	89 46 90 64 64	88		8	38	<u> </u>	8	 	······
0.	Finued es	0 0 0 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	0 2 2 - 1	0000	<u> </u>	7.01	0-4	2 2	o - 1	6
	confinued confinued mpled & of stomed	Shad	1 f t 1	1 1 1	ם י	3 4		1 1	1 1	1 1
13516	confin Fish species Cate sampled number of sto	61zzard sh 6/25/69 7/4/69 7/36/69 7/30/69 9/27/69	5/8/70 6/12/70 7/19/70 8/22/70	9/12/70 16/10/70 4/17/71 5/15/11	Freshwate 6/22/69 7/4/69	7/26/69	9/2//09 10/18/69 5/8/70 6/12/70	2/18/70	9/12/70 07/01/01	17/71/4

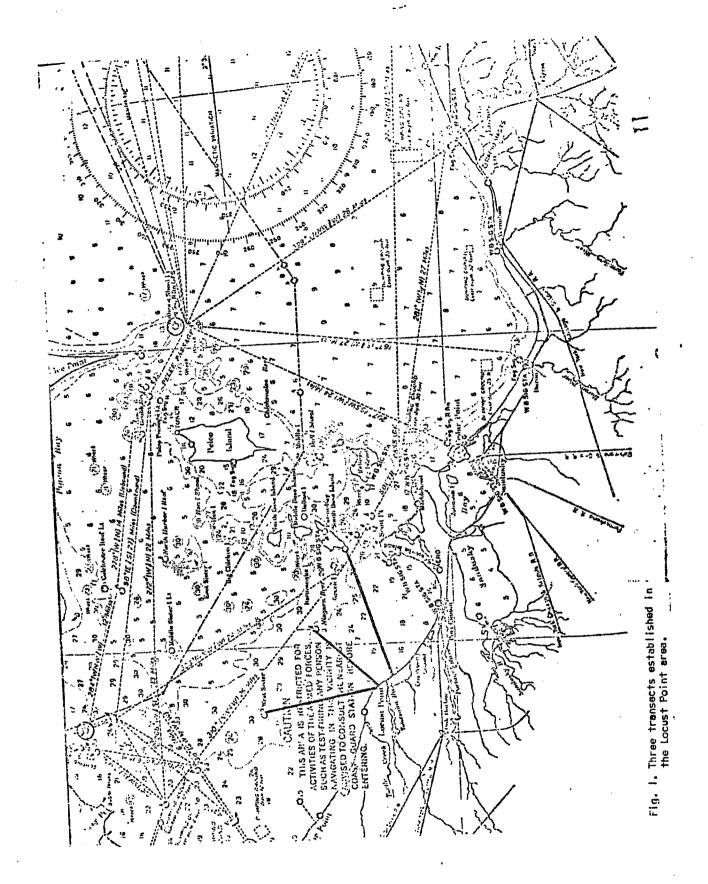
hrough May, 19	Pelecypoda Fish Unidentifiable Debris	94 15 46 63 6 58 10 100 70 21 21 21 20 5 50 6 50 6	100 100 25 75 11 11 75 33 33 100 13
الم	Gastropoda :		
155	Decapoda	m	0 00
1	Spoq i dqmA	88	55 75 85
s, Jurie,	stoerl (aldailitnabinu)	13 8 8 8 25	S.
fishes,	Psectrocladius	6 2	
1	Eushatyns		
Poir	Pseudochironomus		
Lecust Point	Cricotopus	<u>2</u>	
	Coelotenypus	· •	
eulos	Procladius	71	
c.	Polypedilum		
Suc		2 2	25
food thous	eeqibnətotqy19		0
<u>0</u> 0	C. (Cryptochir- onomus)	4	33
o to	C. (Chironomus)	83 24 24	50 100
(3)	^K eabimono⊓idi	9 9 2 40	. 55
nce	CORP. INICHO 11 HC		m 10
urre)iptera(not Aironomidae)	23 83 33	78 25
000	s191qo91o		. 52
o _f o	richoptera		K.
enc./	epodedo	8 16 16 20 20 24 24 24 25 5	•
Frequency of occurrence (\$)	ladocera	54 75 42 20 8 8 6 6 6 29 25	
	Ĭ	_) M - O M M 4 O M M - O M - O M M - O M - O M M - O M M - O M M - O M - O M M - O M - O M M - O M - O M - O M M - O M
10.	() N		
:. q.	conti	w - C	
1	d's s	hite bas 5/28/69 7/25/69 7/25/69 9/27/69 10/18/69 5/3/70 6/12/70 9/12/70 9/12/70 9/12/70 10/10/70	5/2/27 5/4/59 7/26/69 9/27/69 10/18/69 5/8/70 6/12/70 8/22/70 10/10/70 10/10/70
	Fish st	White bas 6/28/69 7/4/69 7/25/69 7/25/69 10/18/69 5/3/70 6/12/70 6/12/70 9/12/70 10/10/70 4/17/71 7/16/70	5/12/0 7/26/69 9/27/69 9/27/69 10/18/69 5/8/70 6/12/70 8/22/70 10/10/70 10/10/70 10/10/70
r	1 44 full		*

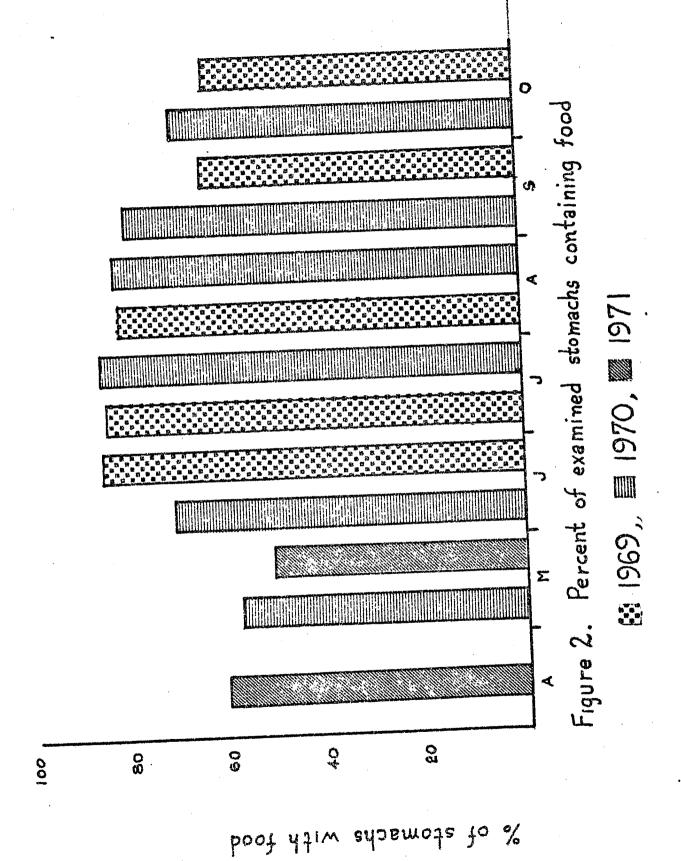
197													
- 1		oldellitnable zinded	200	හි		25			00 c	23 %	20	33	38
1969 through May,		Flsh	46	တ္တ	7.1	8 8 <u>8</u>	83	20	ř. C	5 5	4		8
roug		Pelecypoda				e transport	* *						
#		Spoqontes									33		
1965		Decebogs					Ω.					0	9
- 1		sboqidqm A	4				8		17	50	20 20	۾ ڪ	88
fishes, June,	(stoean! (unidentifiable	21 100		4	25	200		7 33	ß	8	001	
ishe		Psectrocladius										_	
Point fi		Tanytarsus										90	•
G.	S	Pseudoch i ronomus					_					_	
Locust		Cricctopus					100	•				8	
Sons		Coelotanypus				9	33	3			9		23 00
		Procladius				Q					200 200		69
ទ ដែ		Polypedilum					_					_	\oo
itcas		<u>eagibnetotqy10</u>					100					8	
food		C. (Cryptochir-				e design	25	ξ Σ			29	100 100	69
of						11 25	67	ည်			00 09	8	00 60 69
.~		C. (Chironomus)		c	>								
9		Chironomidae*	25	2	2		٠		4				φ S
cocurrence (%		Diptera(not Chironomidae)	17.	<u></u>	43	28	83				33	3 100 53	ò
500		Coleoptera			29	9					20	8	
0		Trichoptera		0									
ric.						6 25					20,		
Frequency		броферода	i _			6 25						0 62	
() 		. gnecobalO	20			مستونه موسود مستونه موسود مستونه موسود			-		20	2	
.0	pa	es ed & stomachs	± 4.0	0 -	- 1- 0	o 74 € 4	<u> </u>	- 70	1 4 0	. 2	0 M W	53 - - 23	n-0 M
	continued	es ed & stom	tfish - 24 - 2	-	1 1		t 1	t 1 · 1.	390	. 1	1 1 1	1 1	1111
Table	lo 0	spacies sampled r of st	catf	_	.	<u></u>	{	2	3	с	(A) (C)	ရှင်	22:
•			1ne l 3/69 (69	7/26/69	59/c	10,12/69 5/8/70 5/12/70 7/16/70	07/2 07/2 7/70	5.7.7.	3rown bu 6/23/69 7/4/69	7/26/69 9/27/69	こここ	8/70 2/70	1007
		Tish si sa	Channel 5/28/69 7/4/69	7/26	1/30/c9 9/77/6	10,/12/65 5/8/70 5/12/70 7/16/70	e/22/ 9/12/	10/ 10/ 4/17/7 5/15/7	Brown bul 6/23/69 7/4/69	3//5	5/6/12		25.2%
	•	21							*				

22

* not identified to genus

Coor			
1971.(cor			
i i	eldsilitnebinU sindeO	25 26 26	
through May,	Fish	100 100 100 100 100	
roug	Pelecypoda		
£	Gastropoda		
196	Decebogs	ω	
je,	sboqidqmA	ru co	
in some Locust Point fishes, June, 1969		23 8 20 2	
ishe	Psectrocladius		
1 t	Tanytarsus		
Poi	Pseudochironomus		
cust	Cricotopus		
٥	Coelotanypus	8	
som	Procladius		
s in	Polypedilum		
i tems	<u>elyptotendipes</u>	20 20	
food	C. (Cryptochir-		
1	C. (Chironomus)	100 25 25 25	
(%)		00	
JCe	Chironomidae*		
occurrence (%) of	ton)snatqid (Ailmononidae)	23.33	
	Coleoptera	<u>o</u> ,	
· of			
Jency	Сорерода	38 42 75	
Frequency	Cladocera	67 67	
	Cha	0 = - 2 - 0 0 2 2 2 - 4 - 2	
0	ss ad &	11111111111	
ا م	species sampled ar of sto		
,	Fish sp Date sa number		
	Fish Date numbe	6/23/6 1/26/17/50/7/30/19/10/18 9/27/ 9/27/ 9/12/ 10/16 5/15/ 5/15/	





Appendix 1. Scientific names of fishes found in the Locust Point area, June, 1969 - May, 1971.

Alewife

American smelt

Black crappie

Bowfin

Brown bullhead

Carp

Channel catfish

Coho salmon

Common emerald shiner

Common white sucker

Freshwater drum

Gizzard shad

Golden redhorse

Goldfish

Green sunfish

Largemouth bass

Logperch

Longnose gar

Northern pike

Orangespotted sunfish

Oulliback

Rock bass

Silver chub

Smallmouth bass

Alosa pseudoharengus

Osmerus eperlanus mordax

Pomoxis nigromaculatus

Amia calva

Ictalurus nebulosus

Cyprinus carpio

Ictalurus punctatus

Oncorhynchus kisutch

Notropis atherinoides

Catostomus commersoni

Aplodinotus grunniens

Dorosoma cepedianum

Moxostoma erythrurum

<u>Carassius</u> <u>auratus</u>

Lepomis cvanellus

Micropterus s. salmoides

Percina caprodes

Lepisosteus osseus

Esox lucius

Lepomis humilis

Carpiodes cyprinus

Ambioplites rupestris

<u>Hybopsis</u> <u>storeriana</u>

Micropterus d. dolomieui

Appendix 1. (contid)

Spotted sucker

Spotfin shiner

Spottail shiner

Stonecat

Walleye

White bass

White crappie

Yellow perch

Minytrema melanops

Notropis spilopterus

Notropis hudsonius

Noturus flavus

Stizostedion v. vitreum

Morone chrysops

Pomoxis annularis

Perca flavescens

JOB COMPLETION REPORT

RESEARCH PROGRESS SEGMENT

State of:

Ohio

Date:

May 31, 1972

Project No .:

Period Covered:

F-41-R-3

Name:

Environmental Evaluation of

a Nuclear Power Plant

Job No.:

2-A

Title:

Temperature Preferences of

Locust Point Fishes

ABSTRACT

June 1, 1971-May 31, 1972

Temperature preferences were determined for adult and young-of-the-year white bass, smallmouth bass, yellow perch and emerald shiners during four seasons from July, 1971 through May, 1972.

Fish specimens for experiments were collected from local areas by shore seining, trap netting, hook-and-line fishing and from commercial fishermen.

Most fish were held in the laboratory at or near ambient lake temperatures for only short periods prior to testing. Fish tested in winter were caught during late fall and held at ambient temperatures until they were tested.

Seasonal differences in temperature selection existed for all four species within the 2-3 day testing periods. With the exception of emerald shiners in summer, all species preferred above ambient lake temperatures each season. In general, white bass and smallmouth bass selected similar high temperatures, yellow perch preferred intermediate temperatures while emerald shiners selected low water temperatures. Fish were distributed about a narrow range of temperatures in the summer and were widely distributed over a large range of temperatures during fall. A relatively constant temperature preference was reached within several hours in summer, but required 2-3 days of progressive acclimation in the temperature gradient during winter. Young

yellow perch and emerald shiners selected temperatures differing from those selected by the adults during the same season, while the young and adults of white bass and smallmouth bass preferred very similar temperatures.

RECOMMENDATIONS

The study of the seasonal temperature preferences of fishes should continue with emphasis on species from the bottom habitat of the Locust Point area. Effort should be expended to obtain healthy test specimens and any differences in temperature selection between healthy and unhealthy individuals should be clearly defined.

OBJECTIVE

The objective of this job is to determine the temperature preferences of Locust Point fishes.

TECHNIQUES USED

A horizontal temperature gradient approximately 24 m in length and 25 cm in depth was established for testing the temperature preferences of fish during four seasons of the year. Within a wooden tank 8.72 m long, 79.0 cm wide and 50 cm high, a system of alternating transverse baffles formed a series of 28 compartments without greatly restricting the movements of fish. Filtered lake water (1-2 l/min) passed through l/4" Tygon tubing within a cooling reservoir and into the low temperature end of the gradient; the water was then heated progressively higher by immersion heaters as it flowed to a standpipe at the opposite end of the trough.

A Vicore 500 watt heater, ARC static switch relay and corresponding Juno thermoregulator maintained a constant water temperature $\frac{1}{2}$ 0.15C in the center

of each compartment. Each season a different gradient was established by controlling the temperature at the thermoregulator of each compartment 0.5-1.0C above that of the previous compartment. The gradient ranged from a low of several degrees below ambient lake temperature (summer, fall and spring), or slightly above ambient (winter), to high of 15-26C above ambient.

Aeration from three air stones in each compartment greatly reduced vertical temperature stratification of the water column (Table I) and created saturated, or nearly saturated, $^{0}_{2}$ levels during all seasons (Table 2). Oxygen measurements were made each season using a model 54 YSI oxygen meter and probe.

Most fish were caught by trapping, shore seining and hook-and-line fishing near the F. T. Stone Laboratory on South Bass Island. Adult fish were sexually mature. Young fish were primarily young-of-the-year, although some immature (I+ year old) perch and smallmouth were tested in spring. Fish for winter experiments were caught during November and held at ambient lake temperatures until they were tested. During other seasons fish were held only for short periods of time at lake temperatures. Fish were maintained and tested under normal seasonal photoperiods. Natural lighting from windows in north and west walls was adequate for almost all observations.

Prior, to testing, each fish or group of fish was held in an acclimation tank similar to the gradient apparatus for 24-48 hrs. The acclimation tank was half the length of the gradient tank, identical to it in compartmentation (without heaters and thermoregulators) and maintained at ambient lake temperatures. In the acclimation tank fish were observed for visible signs of poor condition, aggressive behavior and randomness of distribution.

Fish were then transferred from the behavioral acclimation tank to the compartment of the gradient with a temperature nearest the ambient lake temperature. The number of fish tested at one-time varied with the species and size of individual fish. Large smallmouth bass were tested singly, while

young-of-the-year emerald shiners were run in groups of 20-25 fish. After the transfer, fish moved freely about the thermal gradient for 4-6 hours before the first observation period. In summer, the gradient ranged from below ambient to 36C. During fall and winter, the testing procedure was modified because many fish moved into temperatures beyond their upper lethal limits while exploring the gradient trough. Fish were screened within a limited gradient with a maximum temperature below the suspected upper lethal temperature of each species, and were allowed into progressively higher temperatures as their selected temperatures increased.

Observations of fish distribution within the test apparatus were initiated approximately 4-6 hours after fish had been introduced into the temperature gradient. Fish were observed from behind a blind during three periods each day. The number of fish in each compartment was recorded every 10 min. for 80-100 min. in the morning, at mid-day and just before sunset. The water temperatures at the center of every other compartment were measured with a YSI multi-channel telothermometer (with fixed probes) and were recorded before and after each observation period. The water temperatures in compartments without temperature probes were interpolated from adjacent water temperatures and periodically confirmed by actual measurement.

During the summer and fall most preference tests lasted 48-hours (6 observation periods). Spring tests for each species group consisted of one 72 hr. test followed by one or more test of 48 hrs. Winter tests were 72 hours long. Five day (120 hr.) tests were conducted for three of the four species in summer and occasionally during the remaining seasons.

FINDINGS

Temperatures selected by each species during the 2-3 day tests changed progressively through the four seasons. Seasonal thermal preferences are represented by the modes in the distributions of each species about temperatures in the laboratory gradient (Figures 1,2,3,4). Although white bass, smallmouth bass and yellow perch preferred temperatures above ambient lake temperatures during the four seasons, the interval between the selected temperature and ambient varied from season to season. The smallest difference between the seasonal preferred temperatures and ambient temperatures occurred in summer. The targest difference was during winter when the preference was not considered stable until fish had been in the gradient for 2 to 3 days. The difference between temperatures selected during summer and winter was greatest (II-I7C) for emerald shiner, about IOC for white bass and yellow perch and least (5C) for smallmouth bass. Temperatures selected by most fish during the fall : (falling field temperatures) were similar to those preferred in summer. However, temperatures selected in spring (rising field temperatures) were nearest winter preference values. Emerald shiners, the exception, selected very similar temperatures during fall and spring.

Although variation existed between temperatures selected during a given test and those selected in replicate tests, each species appeared to prefer a relatively precise zone of temperatures in the thermal gradient. Figures 2,3,4 and 5 show the variability of modal temperatures selected within given tests, between replicate tests and between species. Temperature selection appeared most consistent during summer and least definite in fall when wide differences existed within tests and between replicate tests. During all seasons, most emerald shiners selected a narrow range of temperatures (± 2C about their preference temperatures) with little differences between

tests or over successive observation periods within a test. White bass and smallmouth bass, also, were fairly precise in thermal selection, although preferences of these species changed over successive observation periods, especially during winter. Yellow perch were the least precise species in selecting a temperature. Yellow perch formed tight schools at ambient temperatures in the behavioral acclimation tank, but were widely spaced in the temperature gradient and moved as a group back and forth between high and low temperature areas. This behavior usually resulted in fairly reliable modal temperature values (with a wide range in observed distribution), but periodically produced erratic modal values.

The time required for fish to select a relatively constant zone of temperatures varied seasonally. Although most groups of fish demonstrated a precise temperature preference within several hours during summer months, a few groups (especially yellow perch) remained inactive at ambient or nearambient temperatures for almost a day before initiating exploratory behavior in the gradient and then making a temperature selection. Temperature frequency distribution of fish within the gradient of temperatures were pooled at 2C temperature intervals. The data were analyzed by Spearman's rank correlation coeficients to determine differences between temperatures selected during successive days from the initiation of each test. Results indicated that no significant difference existed for any species between temperatures selected the first day and those selected the second day during the summer. A standard 2-day test period was established during summer to insure adequate time for selection of temperatures and to allow time for changes in temperature preference. Tests of 5-days duration were conducted once during summer on most species age groups. Only slight fluctuations (1-4C) occurred in thermal preferences made by fish through the 5th or 6th day in the gradient (where data was available).

During fail, selected temperatures fluctuated widely with successive observations but definite upper and lower preference limits were evident for each species within the 2-day test period. Preferendum temperatures were below those of the same species during the summer period. During winter, higher temperatures were preferred during the first day and, generally, the fish moved toward a temperature below the summer selected temperatures, with the exception of young white bass and smallmouth bass. Young-of-the-year white bass appeared to select decreasing temperatures after the 2nd day. Young and adult smallmouth bass (small sample sizes) selected temperatures after 3-days near temperatures preferred in summer. In spring, smallmouth bass, young yellow perch and adult white bass preferred increasing temperatures during the first day, as in winter. However, other species and age groups made relatively stable selections shortly after their introduction.

Differences between temperatures selected by young and adults were largest in yellow perch and emerald shiners. During all seasons young perch selected temperatures 4C or more above temperatures preferred by adults. Adult emerald shiners chose temperatures higher than young in summer, fall and spring, but preferred waters about 5C lower than young in winter. Very similar temperatures were selected by the young and adults of both white bass and smallmouth bass.

Table I. Seasonal temperatures (°C) of surface (S) and bottom (B) waters of the temperature gradient apparatus.

O water and No	CLRAN	4ED	FAL	ı	WINT	ER	SPRI	NG
Compartment No.	SUMN S	B	S	В	S	В	S	В
1	20.8	20.5	11.0	10.7	2.0	2.0	9.9	9.8
2	21.0	20.8	13.5	13.3	5.0	5.0	12.2	12.0
3	21.2	21.0	14.0	14.0	6.0	6.0	12.5	12.5
4	21.8	21.6	15.5	15.5	6.8	6.8	13.1	3.0
5	22.2	22.0	16.2	16.0	7.5	7.5	14.1	14.1
6	22.5	22.3	17.0	17.0	8.4	8.4	15.0	15.0
7	22.7	22.6	17.2	17.2	9.8	9.8	15.3	15.2
8	23.0	23.0	18.0	18.0	10.2	10.2	16.1	16.0
9	23.8	23.6	18.5	18.5	11.2	11.2	17.2	17.2
10	24.0	24.0	19.3	19.2	12.2	12.2	18.0	18.0
11	24.7	24.6	20.0	20.0	13.5	13.2	19.0	19.0
12	25.5	25.2	20.5	20.5	14.2	14.2	20.2	20.0
13	25.5	25.4	21.6	21.5	15.2	15.2	20.5	20.5
14	25.9	25.6	22.3	22.1	16.0	16.0	22.1	22.1
15	26.6	26.5	23.0	23.0	17.0	17.0	23.6	23.5
16	27.2	27.2	24.2	24.2	18.0	18.0	24.2	24.2
17	28.0	28.0	25.0	25.0	18.9	18.8	25.7	25.5
18	28.8	28.8	26.0	26.0	19.8	19.8	26.0	26.0
19	2918	29.8	27.7	27.5	21.0	21.0	27.1	27.0
20	30.8	30.6	29.0	29.0	22.1	22.1	28.3	28.0
21	31.6	3.15	30.0	30.0	23.0	23.0	29.2	29.0
22	32.5	32.5	32.2	32.2	23.9	23.9	30.2	30.2
23	33.3	33.4	33.0	33.0	25.0	25.0	31.2	31.1
24	34.5	34.3	34.1	34.0	26.1	26.0	32.7	32.5
25	35.6	35.5	35.4	35.3	27.5	27.4	33.7	33.5
26	36.1	36.0	35.9	35.8	28.1	28.1	34.1	34.0
27	36.0	35.9	36.0	36.0	29.1	29.1	34.3	34.2
28	35.9		35.8	35.8	29.5	29.5	35.0	34.8

Table 2. Seasonal oxygen concentrations (mg/l) in surface (S) and bottom (B) waters of the temperature gradient apparatus.

- 4 No	SUMM	FR	FAL	L	WIN	TER	SPR	ING
Compartment No.	S	В	S	В	. S	В	S	В
1	8.1	8.1			11.2	11.2	10.4	10.4
2	8.2	8.2	10.0	9.9	11.0	11.0	10.4	10.4
3	8.2	8.2	10.0	9.8	10.9	10.9	10.4	10.4
4	8.2	8.2	9.8	9.7	10.8	10.8	10.4	10.4
5	8.1	8.1	9.8	9.6	10.6	10.6	10.2	10.2
6	8.1	8.1	9.8	9.6	10.4	10.4	10.2	10.2
7	8.1	8.1	10.0	9.6	10.2	10.2	10.1	10.0
8	8.0	8.0	10.0	9.4	10.0	10.0	10.0	10.0
9	8.0	8.0	9.6	9.4	9.8	9.7	9.9	9.9
10	8.0	8.0	9.6	9.2	9.6	9.6	9.7	9.7
11	7.9	7.9	9.7	9.2	9.5	9.5	9.7	9.7
12	7.9	7.9	9.8	8.9	9.2	9.2	9.6	9.5
13	7.8	7.8	9.4	8.9	8.8	8.8	9.5	9.5
14	7.7	7.7	9.3	8.7	8.6	8.6	9.1	9.1
15	7.7	7.6	9.1	8.6	8.5	8.5	8.8	8.8
16	7.6	7.5	9.6	8.4	8.4	8.4	8.7	8.7
17	7.4	7.3	9.0	8.3	8.2	8.2	8.6	8.6
18	7.3	7.3	9.5	8.2	8.0	8.0	8.6	8.5
19	7.2	7.1	9.0	8.0	7.9	7.9	8.4	8.4
20	7.0	7.0	9.5	7.8	7.8	7.7	8.3	8.3
21	7.0	6.9	9.5	7.6	7.6	7.6	8.2	8.1
22	6.8	6.8	9.9	7.5	7.5	7.5	8.0	8.0
23	6.7	6.7	9.3	7.4	7.4	7.4	7.8	7.8
24	6.6	6.6	9.4	7.2	7.3	7.3	7.5	7.5
25	6.6	6.5	9.4	7.2	7.2	7.2	7.4	7.4
26	6.6	6.6	9.4	7.2	7.0	7.0	7.4	7.4
27	6.6	6.6	9.5	7.1	7.0	7.0	7.5	7.5
28	6.6	6.6	9.1	7.1	6.9	6.9	7.4	7.5

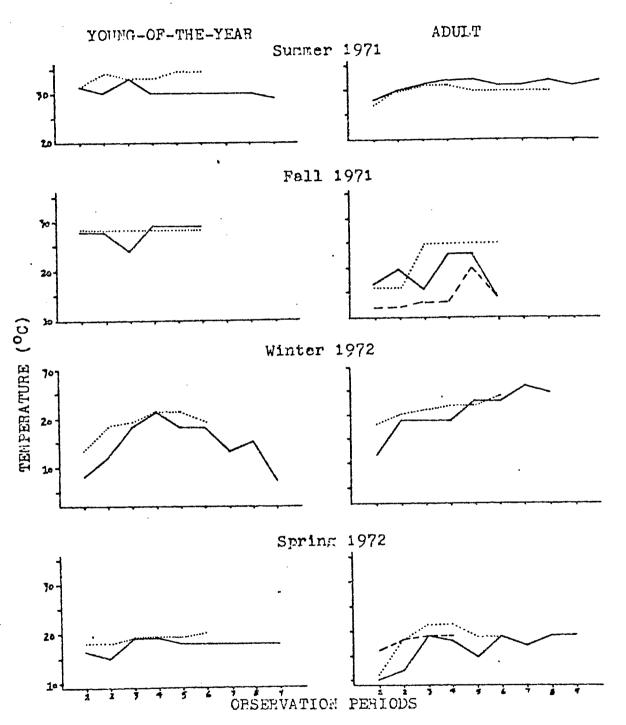


Fig. 1. Modal temperatures of white bass distribution in the thermal gradeint during successive observation — periods from initiation of each test (3 observation periods equal one day).

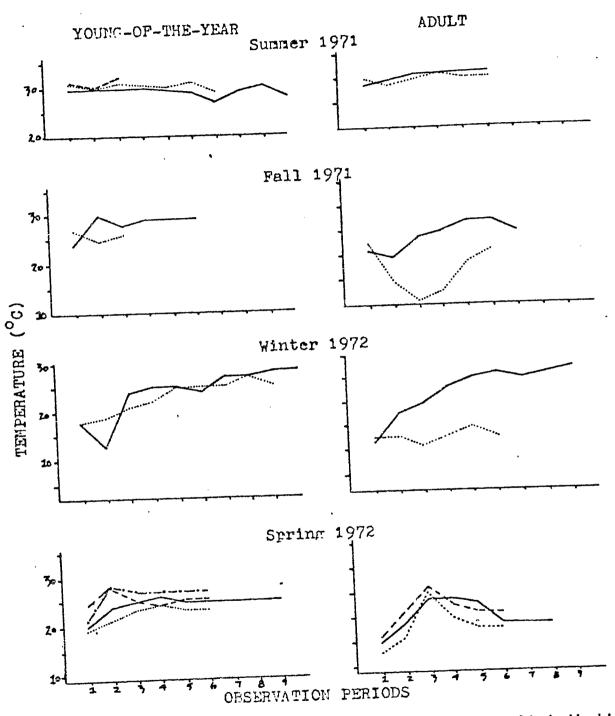


Fig. 2. Modal temperatures of smallmouth bass distribution in the thermal gradient during successive observation periods from initiation of each test (3 observation periods equal one day).

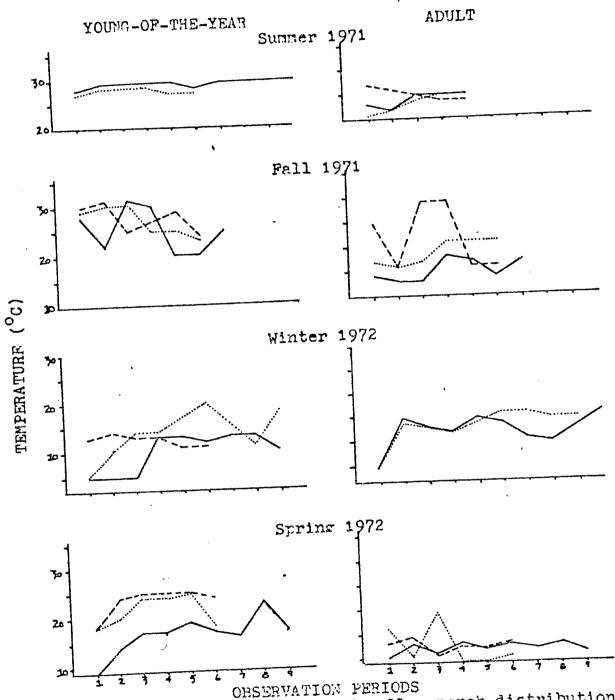


Fig. 3. Modal temperatures of yellow perch distribution in the thermal gradient during successive observation periods from initiation of each test (3 observation periods equal one day).

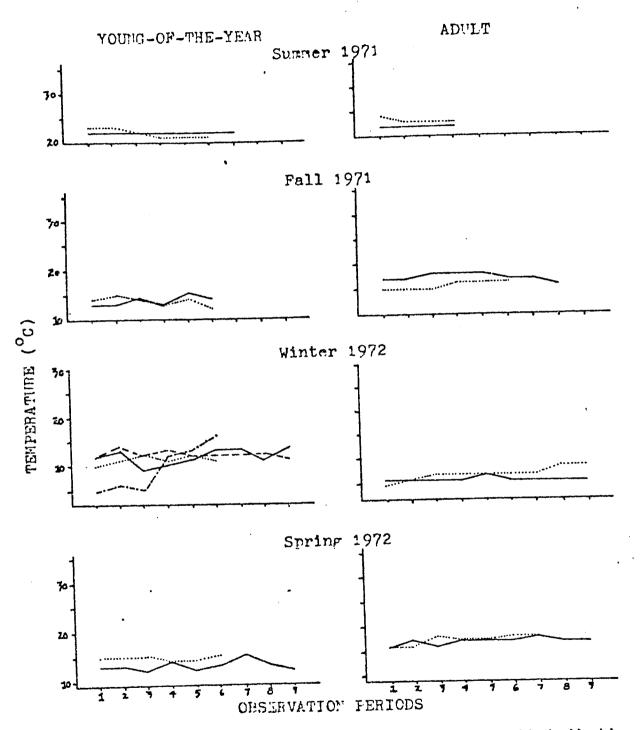


Fig. 4. Modal temperatures of emerald shiner distribution in the thermal gradient during successive observation periods from initiation of each test (3 observation meriods equal one day).

PREPARED BY:	L.S. Putnam Project Leader	APPROVED BY:	Fish Research Supervisor
DATE:	August 25, 1972	DATE:	September 15, 1972
PREPARED BY	: Juchard a Duff	APPROVED BY	: Delma Hassella Federal Aid Coordinator
DATE:	aust 25 1972	DATE:	Lestenber 22, 1972

JOB COMPLETION REPORT

RESEARCH COMPLETION SEGMENT

State of:

Ohio

Date:

May 31, 1972

Project No.:

Period Covered:

F-41-R-3

Name:

Environmental Evaluation of a

Nuclear Power Plant

Job No.:

1-B

Title:

Benthos Populations Prior to

Discharge

ABSTRACT

June 1, 1969-May 31, 1972

Benthos was sampled monthly in the Locust Point area during the ice-free months from June, 1969 through May, 1971. In 1969 and 1970, 21 stations along three transects were sampled; in 1971, the far-offshore stations were deleted and additional near-shore stations were added. In 1969 all samples were taken with a Petersen dredge; after that, the rocky substrates were sampled with a pump sampler, (Baker and Scholl, 1971).

Samples were taken in the reefs in April and May, 1967 through 1970 by the Lake Erie Research Unit, Ohio Division of Wildlife. Reef samples were analysed to provide supplemental information.

The most abundant organisms collected were Chironomidae larvae, Tubificidae and Gastropoda. The greatest diversity occurred on the gravel-small rock substrate. Diversity was least on silt-detritus substrate, where density was greatest. Clay supported only a few species and at low population densities.

RECOMMENDATIONS

Sampling should be repeated after the power plant is in operation and results compared with this survey. Seasonal samples between 1972 and 1974 are desirable in order to detect any major changes that occur before the plant becomes operational.

OBJECTIVES

The objective of this job was to determine the species distribution and density of benthic populations prior to discharge.

TECHNIQUES USED

Twenty one stations in the Locust Point area were established in 1969 (Fig. 1). These varied in depth from 6 to 22 feet and included substrates of silt, sand, detritus, gravel, clay, small rocks, boulders and bedrock. The same 21 stations were sampled monthly from June through October, 1969, and from May through October, 1970.

Late in 1970, Toledo-Edison announced plans to build a cooling tower substantially reducing the area affected by the heated effluent. The sampling program for the spring of 1971 was modified accordingly by deleting the deeper, offshore stations and adding stations at the 6 and 10-foot contours (Fig. 2).

Samples were collected in 1969 with a Petersen dredge (A=0.0833 m^2). In 1970, a pump-type sampler was used on the boulder and bedrock reef areas. This sampler consisted of a gasoline-powered centrifugal pump, 25 feet of 2-inch pressure hose and a 12-inch diameter head (A=0.073 m^2). Mr. Russell Scholl and Mr. Ed Driscoll of the Ohio Division of Wildlife helped design the sampler and locate parts for it.

During 1969, each sample consisted of three dredge hauls which were analysed separately. However, the replicates proved to be very similar, and in 1970 and 1971 only one dredge haul was taken at each station.

All samples were sieved through a Number 35 U.S. Soil Series screen (0.5 mm mesh) and preserved in 10% formalin. Samples taken in 1970 and 1971 were stained with Rose Bengal. Samples were rough-sorted using a 10X dissecting microscope and the organisms identified to genus (species when possible) and counted.

Samples taken by the Ohio Division of Wildlife on the reefs in the Locust Point area were also examined. These were samples collected in April and May, 1967 through 1970 with the egg pump described by Manz (1964). The pump was towed over 0.024 hectares and the organisms sieved through standard brass screen (opening of 0.420mm) and preserved in 10% formalin.

FINDINGS

Forty-five species were found in the benthos samples between June, 1969 and May, 1971 (Table I). Thirteen species were oligochaetes and nine were chironomids. The greatest number of species collected in any month was 30 (September, 1969) and the fewest species (16) were taken in April and May, 1971.

Figure 2 shows graphically the mean numbers of organisms per square meter and the number of species collected each month is shown in Table 2. In this figure, all substrate types and water depths were pooled to show differences due only to season. The 1969 data does not show a seasonal pattern, but this was probably caused by inexperience on the part of the field crews. For example, the average number of organisms/m² in August was much lower than in July or September. However, in August, 1969 Transect 3 was not sampled because of the firing schedule at Camp Perry. Since the stations on Transect three were usually the most densely populated, the omission of the transect probably resulted in the lower average numbers.

A second factor probably affecting the 1969 samples was the method of sorting and counting, especially samples containing high amounts of detritus and silt. In 1969, samples were preserved in 10% formalin and sorted in white enamel pans. After 1969, samples were stained with Rose Bengal (100 mg/l) before sorting. Rose Bengal is a red dye with an affinity for lipids.

Organisms were stained bright red and were much more easily seen. No doubt many small oligochaetes and chironomids in the 1969 samples were unnoticed.

The 1970 samples show a four-fold increase in numbers of organisms between May and September. This increase is due primarily to an increase in oligochaetes in late summer. There was little change in the numbers of species present over the summer. Apparently the total numbers of species in 1970 was less than in 1969, but this is probably because the reef samples were included in the 1969 figures. Several species were only found on the reefs.

In 1971, samples were taken in April and May. Samples were restricted to the six and 10-foot contours. The number of organsims per square meter was greater than in May, 1970, but the number of species was lower. At the six-foot contour stations the number of organisms was greater in April 1971 than in May 1971. Lower populations were probably caused by shifting sand bars in the area after heavy winds (Fig. 2).

The affect of water depth on species distribution and population density in 1970 is shown in figure 3. The 1970 data was chosen because 1970 was consistently sampled during all seasons. The distribution of organisms over the seasons did not appear to be dependent on depth. At the 6-foot stations there was considerable variation both in numbers of species and in percentage of the total organisms present. These fluctuations were probably caused by shifting sand bars and wave action. The greatest percentage of organisms was usually found between 10 and 15 feet where wave action was diminished but bottom conditions were suitable for high populations. The fewest organisms were usually taken at the 6-foot stations. The greatest numbers of species occurred at the 10 and 12-foot stations. The lowest species diversity was found at stations deeper than 15 feet.

Figure 4 and Tables 3-6 indicate how the distribution of species was related to substrate composition. The greatest diversity of species occurred

in gravel-small rock substrate and the greatest percentage of organisms was found in silt-detritus. Clay-gravel substrate supported the fewest organisms and the least diversity. The increase in percentage of organisms is silt-detritus in late summer corresponded with the increase in oligochaetes.

The most abundant taxa overall were Oligochaeta and Chironomidae.

Gastropoda were fairly abundant at stations deeper than 10 feet. Aquatic insects other than chironomids were very scarce; Caenis was the only Ephemeropteran found and three genera of Trichoptera (Athripsodes, Oecetis and Polycentropus) occurred occasionally.

The four reef stations (D6-II, Niagara Reef; D6-IO, Crib Reef; D6-9, Toussaint Reef; D6-8) have been treated separately because different sampling methods were used. In 1969, the Petersen dredge was used and gave very poor results, certainly underestimating the population. The pump sampler used in 1970 probably overestimated the population, though the samples are more representative of the reef environment. The pump head did not remain in one spot during sampling and the exact area sampled cannot be determined. The estimates showed the composition and relative abundance of species in the reef community. Table 7 shows the relative abundance of various species during the months sampled.

The reef data was supplemented by analyses of samples taken on the three reefs by the Ohio Division of Wildlife (Table 8). The additional pumped samples were sieved through a coarser screen than was used in our sampling and showed a different species composition. Very few chironomids or oligochaetes were retained by the screen, but some organisms not captured by the smaller pump (Orconectes, Asellus and some gastropods) were taken with the larger pump. The pump was towed over a known area and the results are expressed as mean number per hectare for the season (April and May).

LITERATURE CITED

- Baker, Carl T. and Russel L. Scholl. 1971. Walleye spawning area study in western Lake Erie, Ohio Division of Wildlife Dingell-Johnson Rept. F35 R-10 Job I. Mimeographed 24 p.
- Manz, J. V. 1964. A pumping device used to collect walleye eggs from offshore spawning areas in western Lake Erie. Trans. Am. Fish Soc. 93(2):204-205.

Benthic macroinvertebrates found in the Locust Point area Table 1. June, 1969 through May, 1971.

Hydra

Planariidae

Hirudinea

Oligochaeta

Limnodrilus hoffmeisteri

Limnodrilus maumeensis

Limnodrilus cervix

Limnodrilus claparedeanus

Limnodrilus claparedeanus-cervix Limnodrilus uderemianus

Awlodrilus sp.

Peloscolex ferox

Potamothrix maldaviensis

Potamothrix vejdovskyi

Branchyura sowerbyi

Nais sp.

Stylaria sp.

Bryozoa

Isopoda

Ascellus sp.

Amphipoda

Gammarus sp.

Hyalella azteca

Decapoda

Orconectes virilis

Ephemeroptera

Caenis sp.

Trichoptera

Oecetis sp.

Athripsodes sp.

Polycentropus sp.

Chironomidae

Chironomus (Chironomus) sp.

C. (Cryptochironomus) sp.

Polypedilum sp.

Pseudochironomus sp.

Tarivtarus sp.

Procladius sp.

Coelotanypus sp.

Cricotopus sp.

Psectrocladius sp.

Gastropoda

Amnicola sp.

Bythinia sp.

Physa sp.

Pleurocera - Goniobasis

Gyraulus sp.

Volvata

Pelycepoda

Sphaerium sp.

Pisidium sp.

Lampsilis sp.

Proptera elata

Table 2. Numbers of organisms/ m^2 and species at various depths.

6961	- Inc	1969 - Includes reef stations sampled by	station	s sample	d by Peters	Petersen dredge.					-	
		June		· ·	July	¥	Aug.	Se	Sept.	ဝ	oct.	
	N N	No. indiv. No. spp.		No. indiv.	. No. spp.	No. indiv. No.	. No. spp.	No. indiv.	indiv. No. spp.	No. indiv.	/. No. spp.	
6 ft. (5 sta)		38		239	12	137	12	76	<u>-1</u> 3	340		
5		67	4	469	17	159	6	208	<u>8</u>	191	<u>6</u>	
(4		 0	22	521	5	78	8	928	28	135	13	
15 ft. (4 sta)		33	1 8	1272	25	149	12	625	23	128		
>15 ft. (2 sta)	•	748	91	1048	9	40	4	464	9	12	2	
Total species	Ñ	27 2092 ÷ 5=418.4	27 4	3549÷5=709	27 709.8	563-5=112.6	23 112.6	2301+5=460.2	30 60.2	26 376 + 5=295.2	26 295 . 2	

stations.
reef
include
not
Does
1
1970

	May	June	July	Aug.	sept.	OCT.	
6 4+ (5 s+a)	6 791	1055 17	645 8	572 9		3341 16	
10 44 (5 545)	71 9791	1761	2338 17	4000		5882 15	
10 11 (2 51d)	1320 7	71 8792	1670	2361 18	4220 22	6511 18	
15 th (2 sta)	854 12	2119 15		2944			
(0+0 1) +1 51	19/ F/O	2. ACT.	1703				
712 TT. (1 STa)	047	040	•	•			
Total snecies	20	24	23	. 23	24	22	
Total/m ²	5909-5=1181.8	8141+5=1628,2	8262+5=1652.4	12856-5-2571.2	2833345=5666.6	25059+5=5011.8	

8

1971 - Ten nearshore stations.

Mav	8	91	-	<u>1</u> 6	2756.5
M	981	5327			5513+2=2756.5
Anril	427 70	5045 16	•	91	5472+2=7736
	6 ft. (5 sta)	10 ft. (5 sta)		Total species	Total/m2

TABLE 3

Benthic macroinvertebrates from stations with a silt, sand and detrital substrate (D6-12,C6-1,D6-16,D6-17, D6-18,D6-19), May through October, 1969 & 1970, expressed as the mean number of organisms per square meter.

			1969			agang ayaran di salayan d		1970			
·	6/17	7/17	8/15	9/23	10/29	5/8	6/8	7/7	8/6	9/16	10/7
Hydra	7	0	No Sample Taken	0	0	0	4	0	0	0	0
Hirudinea	0	0	Idveii	0	0	0	2	2	0	0	0
Oligochaeta (immature)	329	778		25	2212	635	1307	1012	2836	6737	6489
Limnodrilus Hoffmeisteri	21	82		0	12	5 6	34	42	52	132	172
L. maumeensis	45	72		ı	9	8	102	156	100	160	70
L. ciaparedeanus- cervix	17	23		0	18	82	118	114	78	345	306
Potamothrix Moldaviensis	43	77		0	10	. 12	50	108	190	26	108
Branchyura sowerby i	10	3		1	138	154	244	248	259	569	1192
Chironomus (Chironomus)	86	24		10	126	345	126	291	499	1273	1124
C.(Cryptochironomo	us) 15	7		3	63	12	2	8	4	4	52
Polypedilum	23	į		0	15	. 0	2	6	4	. 8	2
Tanytarsus	3	92		0	9	2	0	0	4	14	4
Procladius	45	10		0	15	155	54	0	16	12	16
Coelotanypus	19	0		9	.9	8	6	12	14	108	86
Caenis	1	3		0	0	0	0	Ó	0	0	0
Sphaerium	0	4		0	0	0	2	: C	0	0	0
Gammarus	0	5		0	б	2	2 0) 8	6	24	4

TABLE 4

Benthic macroinvertebrates from stations with a clay-gravel substrate (D6-13,D6-14,D6-15,D5-2), May through October, 1969 & 1970, expressed as the mean number of organisms per square meter.

			1969					19	70		
	6/17	7/17	8/15	9/23	10/29	5/8	6/8	7/7	8/6	9/16	10/7
Hydra	0	4	0	0	0	0	108	0	0	0	0
Hirudinea	0	0	0	0	0	0	6	0	0	3	0
Oligochaeta (immature)	1	95	46	116	28	249	396	810	3 96	465	198
Limnodrilus hoffmeisteri	0	2	2	0	0	0	0	0	0	3	9
L. maumeensis	0	F	i	0	0	0	0	0	. 0	0	6
L. claparedeanus cervix	- 1	3	0	0	0	21	18	18	3	3	18
Potamothrix moldaviensis	0	15	47	1 .	0	21	3	30	6	18	18
Branchyura sowerbyi	0	0	0	0	0	9	9	0	0	18	3
Stylaria	0	0	0	2	0	0	0	12	9	12	0
Gammarus	15	9	0	0	3	3	6	9	9	6	15
Chironomus (Chironomus)	ı	1	5	5	3	0	3	0	27	117	24
C.(Cryptochiron	omus)6	14	7	3	4	24	6	9	0	9	21
Pseudoch i ronomu	s 3	2	2	0	4	0	0	0	0	0	3
Polypedilum	0	11	9	2	0	15	66	9	12	12	24
Tanytarsus	C	12	2	14	0	27	б	6	48	192	9
Procladius	7	3 4	4	O	3	3	0	3	3	17	6
Coelotanypus	!	0	2	i	0	0	0	C	0	3	0
Caenis	. 10	8 (0	0	1	6	6	Ċ) 0	3	3
Oecetis	() 2	0	0	ı	0	0	C) (0	0

TABLE 4

	6/17	7/17	8/15	9/23	10/29	5/8	6/8	7/7	8/6	9/16	10/7
Amnicola	0	0	0	1	0	0	12	0	0	0	0
Bythinia	. 0	. !	0	0	0	0	3	0	0	0	0
Sphaerium	2	İ	l	. 1	1	3	0	0	0	0	0
Pisidium	0	0	0	2	0	0	3	0	0	0	0

TABLE 5

m

Benthic macroinvertebrates from stations with a gravel and small rock substrate (D6-7,D6-6,D6-5,D6-4,D5-3,D5-4), May through October, 1969 & 1970, expressed as the mean number of organisms per square meter.

			1969					١	970		
	6/17	7/17	8/15	9/23	10/29	5/8	6/8	7/7	8/6	9/16	10/7
Hydra	21	198	1	3	0	0	500	92	2	0	3 6
Planariidae	7	35	0	11	20	0	4	16	0	30	26
Hirudinea	0	3	1	3	4	2	2	14	12	8	8
Oligochaeta (immature)	131	413	19	411	112	906	874	1214	1397	3393	4248
Limnodrilus hoffmeisteri	10	3	1	2	0	38	46	26	42	52	54
L. maumeensis	3	3	1	1	1	0	16	14	14	34	4
L. claparedeanus- cervix	. 1	1	0	. 1	0	24	10	26	10	118	14
Potamothrix moldaviensis	33	22	13	1	0	. 70	42	112	78	28	35
Branchyura sowerbyi	3	1	0	3	0	0	2	4	2	369	4
Nais	0	0	0	6	0	. 0	(0 0	0	6	0
Stylaria	0	11	1	7	0	0	(50	52	б	0
Gammarus	17	19	7	13	21	4	6	8 66	56	58	70.
Chironomus (Chironomus)	28	0	5	. 11	3	0	40	7 2	160	602	92
C.(Cryptochironom	us) 10	9	11	7	19	24	. 1	6 13	18	4	86
Pseudochironomus	1	0	3	2	. 3	7	•	8 2	2 0	0	6
Polypedilum	6	. 0	23	2	. 1	8	3 1	2 2	26	2	38
Tanytarsus	2	29	43	45	. 0	C)	0 2	2 104	315	76
Procladius	5	3	6	28	, 4	. ()	0 4	1 2	38	82

TABLE 5 Contid

			1969	:				1	970		
•	6/17	7/17	8/15	9/23	10/29	5/8	6/8	7/7	8/6	9/16	10/7
Coelotanypus	2	0	i	7	0	0	0	0	2	24	14
Polycentropus	0	1	. 0	3	0	0	0	0	0	0	0
Caenis	1	0	0	0	0	. 0	0	0	2	0	2
Oecetis	O	ì	0	1	0	0	0	0	0	0	0
Amnicola	0	0	0	9	0	2	10	6	8	8	0
Bythinia	3	3	į	4	4	0	4	0	0	0	0
Pleurocere- Goniobasis*	1	15	0	0	1	0	0	0	4	0	0
Physa	t	0	0	0	0	0	0	6	2	2	0
Sphaerium	0	0	0	0	0	0	16	. 1	6	8	0
Pisidium	5	1	0	19	0	6	6	0	10	28	16

^{*} Cannot distinguish genera with certainty.

Benthic macroinvertebrates, April & May, 1971, expressed as mean number of organisms per square meter. Table 6.

• • • • • • • • • • • • • • • • • • • •		April 17 1971	126		May 15, 1971		
	Silt, detritus substrate (AI, A2, BI, B2)	ravel rate 1,E2)	Gravel, small rock substrate (C1,C2,D2)	Silt, detritus substrate (Al, A2, Bl, B2)	Clay,gravel substrate (DI,EI,E2)	Gravel, small rock substrate (CI,C2,D2)	
Hirudinea	0	4	4	0	0	0	
Oligochaeta (imm.)	4062	220	1176	2535	1220	1808	
Limnodrilus hoffmeisteri	159	0	52	180	ω .	28	
L. maumeensis	99	4	ω ·	99	4	28	
L. cervix	15	0	&	54	0	20	
L. claparedeanus	195	0	12	1117	0	4	
Potamothrix moldaviensis	11	91	20	237	32	64	
Branchyura Sowerby!	570	0	20	257	12	12	
Nais sp.	18	4	4	21	12	20	
Gammarus sp.	Μ.	20	0	O	0	ω	
Caenis sp.	0	4	0	0	0	0	
Chironomus (Chironomus)	171	4	100	171	0	0	
C. (Cryptochironomus)	54	0	48	45	24	84	
Polypedilum	0	0	0	0	12	ω	
Tanytarsus	. 0	0	0	12	ట	ω	
Procladius	06	0	40	99	0	0	
Coelotanypus	6	0	4	0	0	0	

TABLE 7

Benthic macroinvertebrates from stations with a bedrock and large boulder substrate (D6-II,D6-I0,D6-9,D6-8), May through October 1969 & 1970, expressed as percent of the total number of organisms (%).

			196	9		-		19	70		
	6/17	7/17	8/15	9/23	10/29	5/8	6/8	7/7	8/6	9/16	10/7
Hydra	89	0	0	19	0	4	4	1*	۱*	No Sample	2
Planariidae	5	3	30	13	. 20	9	9	3		Taken	23
Oligochaeta (immature)	, 1	30	18	27	22	65	2	10	5		10
Limnodrilus hoffmeisteri	0	4	1	1	1	0	ļ*	*	1 +	;	0
Nais	0	1	0	2	0	0	2	0	0		 *
Gammarus	1	39	26	10	2	1	44	62	48		33
Hyalella azteca	0	3	2	3	0	0	5	2	1		3
Chironomus (Chironomus)	0	1*	1	2	1	0	16	i	2		1*
C.(Cryptochironomu	ıs) 0.	2	1	. 13	• 0	1	0	1 30	ŀ		i *
Tanytarsus	0	, I *	8	1 >	ŧ 0	0	0	0	1.	×	1*
Procladius	0	5	I	2	4	0	. 1	i	1		. 1
Coelotanypus	0	!*	1*	i	8	0	0	0	0		1*
Polycentropus	13	ŧ 0	2	ł	5	1	ļ*	l s	+ 1	*	1*
Amnicola	3	0	0	. 6	0	0	10	10	18		16
Bythinia	0	0	4	3	18	0	0	0	I	*	1*
Pleurocera- Goniobasis**	2	1	0	1.	* 0	0	0	0	2		1
Physa	,1	0	0	ı	0	0	0	- 3	2	•	I
Sphaerium	0	2	0	5	1	C) [1		<u>.</u>	3
Pisidium	. 0	0	0	3	4	C) . I	0			2
Valvata	0	0	0	0	8	C) 1	0	-	5	. 0

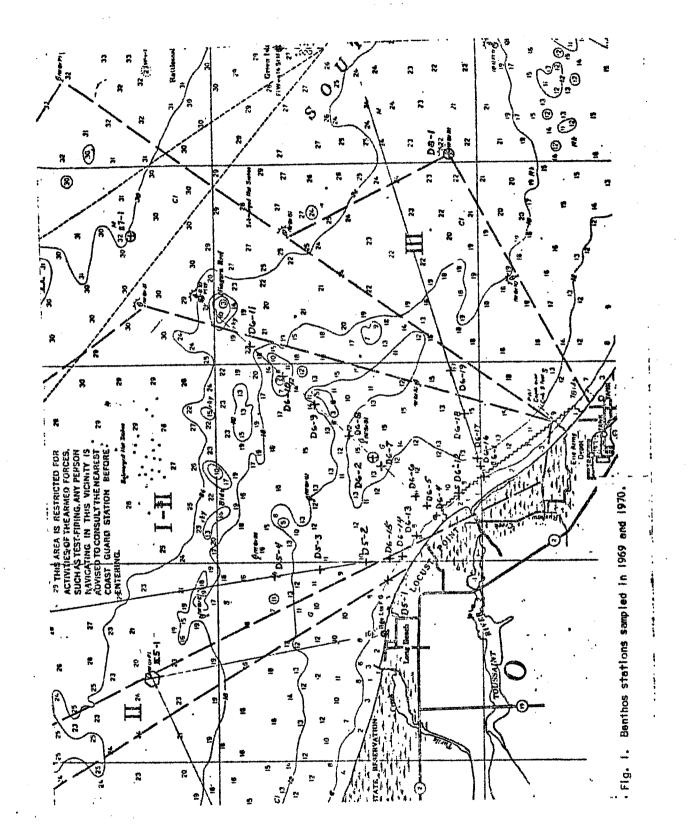
^{*}Indicates less than 1%

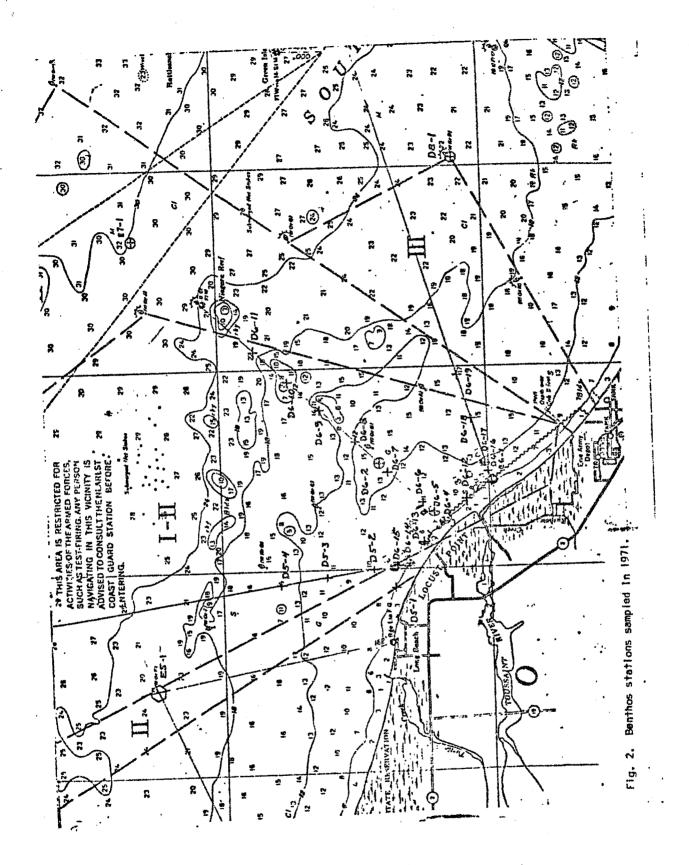
^{**}Cannot distinguish genera with certainty

Benthic macroinvertebrates collected at Niagara, Crib & Toussaint Reefs in April and May, 1967 through 1970 by Ohio Division of Wildlife egg pump, expressed as mean number of organisms per hectare. Table 8.

2	Toussaint (D6-9)	69	4	14	10317		0	83	4690	1998	114	4957	0	0	1
1970	Crib (D6-10)	62	0	104	8186	146	103	291	23412	1108	533	13399	10	210	
	Niagara	21	0	0	12022	42	98	21	016	61	207	3941	0	0	
	Toussaint D6-9)	0	370	42	52083	0	0	42	40	2617	2921	3033	0	0	
1969	Crib (D6-10)	991	83	728	28038	0	102	125	34625	529	915	10831	27	104	
	Niagara (D6-11)	104	62	229	52000	0	410	0	200	101	1031	3211		327	
	Toussaint (D6-9)	811	83	208	54142	0	8	145	4400	1211	1120	4132	21	433	
1968	Crib (D6-10)	1269	354	5886	62606	1102	213	354	39317	919	1810	13419	25	251	
	Niagara (D6-11)	1489	62	2974	74152	416	104	125	36100	4	1903	2806	119	644	
	Toussaint (D6-9)	62	187	187	83824	0	102	42	505	818	310	1239	0	217	
1961	Crib (D6-10)		437	2766	105394	936	66	624	420	409	1418	1530	0	143	
	Niagara (2995	42	624	38750	1914	101	. 208	15900	1422	116	3821	103	431	
•		Planariidae	Hirudinea	Asellus sp.	Gammarus sp.	Hyalella azteca	Orconectes sp.	Polycentropus sp.	Amnicola sp.	Bythinia sp.	Physa sp.	Pleurocera- Goniobasis*	Valvata sp.	Sphaerium sp.	

*Cannot distinguish genera with certainty





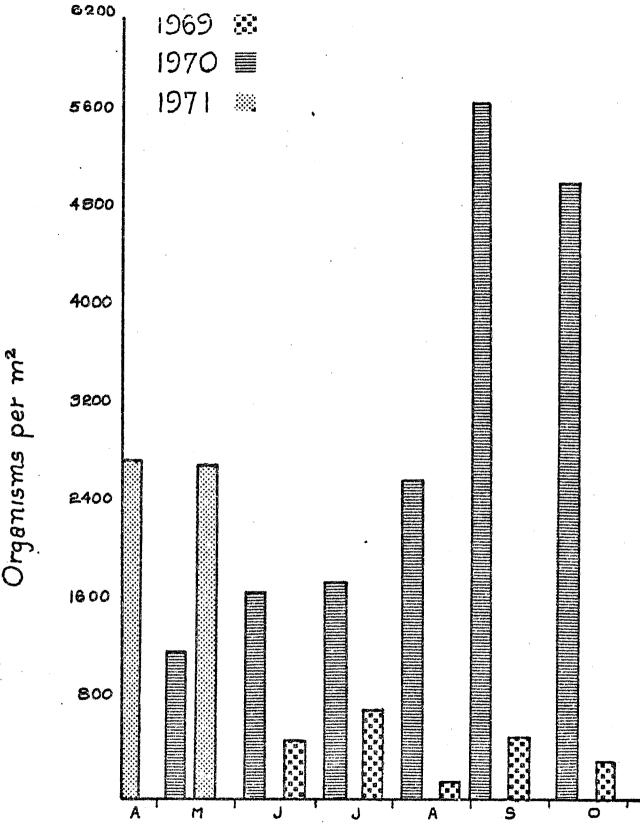


Figure 3. Mean number of organisms/m²/month from June 1969 to May 1971.

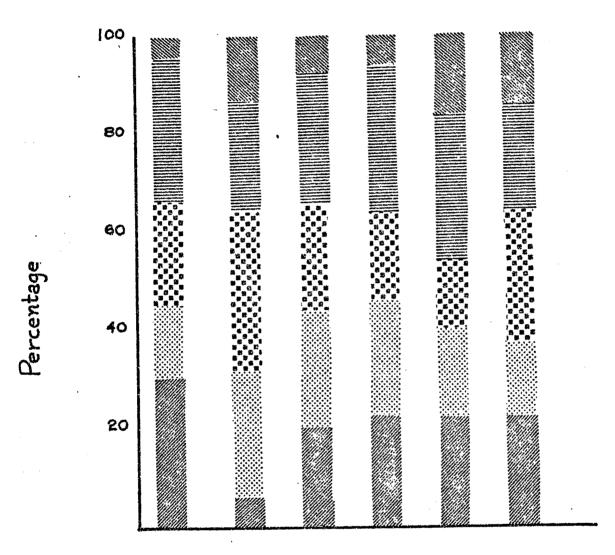


Figure 4. Percentage of benthos found at different water depths, no reef samples

15 feet, 15 feet, 15 feet, 15 feet, 15 feet

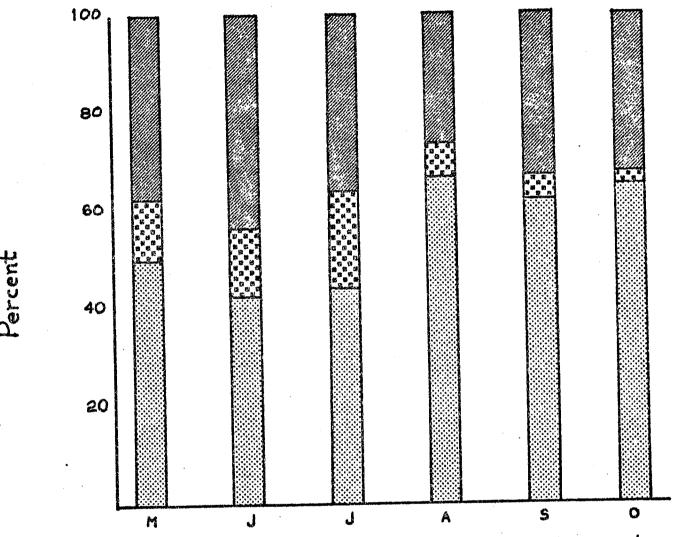


Figure 5. Percentage of organisms on different substrates.

Gravel and small rocks

Clay and gravel

Silt, send and detritus

JOB COMPLETION REPORT

RESEARCH COMPLETION SEGMENT

State of:

Ohio

Date:

May 31, 1972

Project No.:

F-41-R-3

Name:

Environmental Evaluation of

a Nuclear Power Plant

Job No.:

1-C

Title:

Plankton Populations Prior

to Discharge

Period Covered: June 1, 1969-May 31, 1972

ABSTRACT

Zooplankton was sampled monthly in the Locust Point area from June, 1969 through May, 1971 during the ice free portion of the year. In 1969 and 1970 stations were distributed over a wide area of the lake. In 1971 the stations were located near shore, after the Toledo-Edison Company announced that a cooling tower was to be constructed.

Cyclopoid copepods were found in 97.2% of all samples and calanoid copepods found in 84.9% of the samples. Cladocerans were also abundant with Daphnia retrocurva occurring in 80.1% of the samples and Bosmina in 86.3%. Abundant rotifers included Keratella cochlearis and Polyarthra.

The highest densities of all zooplankton (all taxa) appeared in June, July and August. The copepod populations were greatest in June, July and August. Cladocerans and rotifers were most numerous in July and August.

RECOMMENDATIONS

Zooplankton should be sampled in a more restricted area with more frequent samples until the power-plant is in operation. Phytoplankton should be sampled over all seasons before plant operation begins in 1974.

OBJECTIVE

The objective of this research was to determine the character and composition of the zooplankton populations of the Locust Point area of Lake Erie prior to operation of the nuclear power-plant.

TECHNIQUES USED

Plankton samples were taken at 23 stations along three transects radiating outward from the power plant (Figure 1). A summary of the stations and depths is shown in Table 1.

A 3-liter Kemmerer water bottle was used to collect samples at I and 3 meters. Samples were concentrated by passage through a No. 25 silk bolting cloth and zooplankters were then fixed in 5% formalin. The smaller nannoplankters were last with this procedure, but the larger zooplankters fed upon by fishes were retained and an overall estimate of the zooplankton was readily accomplished using this procedure. Zooplankters were counted in a Sedgewick-Rafter counting chamber at 100X magnification. Individual species were identified when necessary at 980X magnification.

FINDINGS

The frequency of occurrence of individual zooplankters is shown in Table 2. The only protozoan found in the samples was Acinetz and it was found only in 1969. Rotifers were quite common in all samples. The ubiquitous Keratella cochlearis was found in 95.2% of all samples and Polyarthra was also abundant occurring in 93.7% of all samples. Brachinous, Keratella quadrula, Asplanchna and Filina were other prominent rotifers.

Copepods were idientified only as cyclopoid or calanoid types and the naupli were counted separately. Naupli were found in every sample taken and the widespread occurrence of calanoid cyclopoid copepods indicated a large number of copepods in the area.

Cladocerans were well represented in the zooplankton. The more numerous Cladocerans included <u>Daphnia retrocurva</u> (80.1% of all samples) and several species of <u>Bosmina</u> (86.3% of all samples) <u>Chydorus</u> and <u>Daphnia</u> galeata were found frequently in the samples.

Seasonally all zooplankton reached peak densities in June, July and August. Some of the stations with the highest numbers of zooplankters are shown in Table 3. Copepods were found in large numbers throughout the summer but Cladocerans reached peak populations in July and August.

The location and depth of all stations with the highest concentrations of zooplankters is shown in Table 3. No apparent relationship between density and depth is discernable from the data collected. At times zooplankton at 1-meter was most abundant and at other times samples at 3-meters had higher populations. There was no clear pattern when numbers of zooplankters near shore stations (less than 6 feet) were compared to off-shore stations.

The number of species identified from offshore stations appeared to be greater than the diversity of the inshore stations. The increased diversity was probably a direct result of the emphasis placed on sampling offshore stations. As the samples were enumerated fewer species were identified in any one offshore station than in one inshore station. The greater diversity of zooplankton was probably an artifact of our sampling techniques.

A few notes were made on the phytoplankters found in the course of counting zooplankton. The spring diatom bloom consists largely of Melosira, Fragellaria, Asterionella, Tabellaria and small numbers of Pediastrum.

During summer algae were few in the samples. Green algae were more abundant than other species <u>Pediastrum</u> and <u>Scinedesmus</u> were fairly common, and <u>Staurastrum</u> and <u>Ceratium</u> were more common than in other seasons.

In the autumn representatives of the blue greens Aphanizomenon and Microcystis were abundant and the diatoms were again prominent. Pediastrum is probably the most common alga at all seasons. Ceratium and Staurastrum are also present throughout the year. (Table 4.)

Table I. Stations sampled - Distance from shore and approximate depth.

Stations	Distance from shore in ft. (approximate)	Approx. depth in ft.
D5-1	2000	6
D5-2 = E1	7000	10
D5 -3	11000	11
D5-4	17000	16
D6-4 = C2	1000	6
D6-5	3000	8
D6-6 = C1	4000	11
D6-7	9000	12
D6-8	15000	12
D6-9	21000	11
D6-10	25000	8
D6-11	30000	22
D6-12 = B2	2000	6
D6-13 = D2	1500	6
D6-14 = E2	2000	6
D6-15	5000	9
D6-16	3500	12
D6-17 = A1	5500	13
D6-18	10000	15
D6-19	15000	17
C6-1 = A2	2000	. 6
BI DI	4000 4000	9

⁼ inshore stations

(# o	,	ř	. 69	69	69			70	. 02	70	02	7.1		# samples ich plankte	samples in n plankter cs
	June 69	July 69	Aug. 6	Sept.	0ct. 6	May 70	June 70	July	Aug.	Sept.	Oct.	April	May 71	Total in whi	% of si
Protozoan Acinetz	4=	3	3		-		•	***	-			-	-		1.7
Rotifer K.quadrula	15	25	4	***	8	31	32	12	11	***	5	8	15	166	47.3
K.cochlearis	s 15	2 8	23	30	32	30	33	32	30	27	33	6	15	334	95.2
Polyarthra	15	20	22	30	32	30	33	32	30	29	34	7	15	329	93.
Pompholyx	_	7	7	_	-	-	***	-	-		10	***		24	6.
Asplanchna	15	_	3	21	16	8	ł	-	13	27	16	-	***	120	34.
Brachionus	10	12	12	4	-	32	7	32	30	30	34	15	15	233	66.
Kellikotia	10	11		-	••	13	8	-	***	**	1	-		, 43	12.
Philodina	7	5				-		-	-			_	-	12	3.
Filinia	7	ŧ	2	_	**	23	4	8	9	_		3	15	72	20.
Trichoerca	ł	9	15		-		-	_	**		. 1	-		26	7.
Platyias		5	2		-	-	-							7	2.
Testudinea	_	Į	-			***		-		-				ı	•
Notholca	-	•••		***	***	13	-	turt	•	-			_ ,	13	3.
Conchilus	***	_	,	-				21	-					21	б
Ascomorpha	_	_	i	-		-				. ,				. 1	
Proales	***	_	1		_	-					<u>.</u> . •			. 1	
Rotaria		_	ł							•		_	 =	- 1	

Total # samples taken
15 29 24 30 32 32 33 32 30 30 34 15 15 351

Table 2. Continued

14510 21 OSM 7,144	June 69	July 69	Aug. 69	Sept. 69	0ct. 69	May 70	June 70	July 70	Aug. 70	Sept. 70	0ct. 70	April 71	-	lotal # samples in which plankter was collected	<pre>% of samples in which plankter occurs</pre>
Arthropods															
Copepods Cyclopoid	15	29	24	30	32	30	32	32	30	30	33	12	12	341	97.2
Calanoid	15	29	24	30	28	27	15	26	28	29	28	9	10	298	84.9
Naup I i	15	29	24	30	32	32	33	32	30	30	34	15	15	351	100.0
Cladocerans D. retrocurva	15	29	24	30	9	9	33	32	30			ł	5	281	80.1
D. galeata	11	29	24	2	-	100	2	14	27	10	5		ŀ	125	35.6
D. parvula	6	14	16	-	-		l	-	-	e.d	2.4	i	-	38	10.8
Bosmina	14	29	24	30	32	14	28	32	30	30	34	2	13		86.3
Chydorus	9	2	-	30	26	2	10	9	10	30	34	1	~	163	46.4
Diphanisoma	l	5	3	5	-		. 1	•	- 11	16	18	-		60	17.1
Leptodora	2	20	8	ı	-	_	2	3	7	6	5	-	_	54	15.4
\$imocephalus	-	9	7		-	, ten						-	em	16	4.6
Ceriodaphnia	_	2	. 1	, _	_							_		. 3	0.9
Polyphemus	-	1	***	-	tru	_				_ =				- 1	0.3
Camptocerus		, 	. 1	-		. •	÷ -		_ `-		_ ~		. .	- 1	0.3
0ther															
Lepidurus	-	. !	-	-	•		 17			•		•			0.3

Total # samples taken
15 29 24 30 32 32 33 32 30 30 34 15 15 351

Table 3.

Location of Station of Greatest Concentration

	•		Rance of	Location	of Statio	Location of Station of Greatest Concentration	est Conce	ntration
		Average Density	Densities					
	•	Average #	Zooplankters/l	Station	Dep th	, L	Location of Station	Station
		zooplankters/l				·	•	+ 4 1 CO 2010 T 7 7 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
eurl.	1969 Inne	763	365-1454	D6-12	Ē	2,000 f	t. offshor	2,000 ft. offshore; mouth of loussain
	0901 7111	702	,78- 420	De-11	3m	30,000	=	near Niagra reef
γ. υ Σ Δ	1969	519	69-1832	1-90	<u>=</u>	2,000	gar gar gar	south east mouth of Toussaint
• †	1060	463	212-1084	01-90	Ē	25,000	11	reef area
oep.	3ep1 • 1707	976	79- 767	D6-13	<u>m</u>	1,500	gain Çani Çani Çina	north west of mouth of Toussaint
	0701	7.7. 7.7.	142- 658	D6-17	Æ.	5,500	En- cha Cha	south east mouth of Toussaint
way	May 1970	40 A	121- 689	06-18	3,n	10,000	22 20 20 20	east of mouth of Toussaint
in .	Oron alloc	CO+ -	439-3902	06-5	E	3,000	11	north of mouth of Toussaint
וחר	0/61 VIUL	77.1	9470-035	06-16	E	3,500	-	south east of mouth of Toussaint
Aug	Aug. 1970	202,1	144- 748	05-2	Ë	000,7	Spin Spin Spin Spin Life	north east of Long Beach
des C	Sept. 1970		49 –700	05-3	3m	11,000	Eron E-ci Sam Gam	north east of Long Beach
Anr	Anril 1971	37	13- 57	02	<u>E</u>	1,500	Brown Charl Char Shap-	offshore at Locust Point
May	May 1971	57.1	369-1043	A2	3m	2,000	£	south east mouth of Toussaint
•								

Table 4. Phytoplankton Predominant species noted in monthly samples.

June 1969	Nothing recorded
July 1969*	Microcystis noted once
Aug. 1969	Pediastrum, Starastrum, Microcystis; Aphani heavy in some samples
Sept. 1969*	Aphani zomenon
Oct. 1969	Melosira in many samples; Fragellaria, Pediastrum present
May 1970	Much Melosira; Tabellaria, Fragellaria, Pediastrum present
June 1970*	Pediastrum
July 1970	Aphanizomenon
Aug. 1970	Much Anabaena in all samples; Ceratium also heavy
Sept. 1970	Aphanizomenon in many samples; Pediastrum & Anabaena present
Oct. 1970	Pediastrum, Melsira, Ceratium
April 1971	Many Melosira, Tabellaria, Fragellaria & Asterionella
May 1971	Many Melosira, Tabellaria, Fragellaria & Asterionella

^{*} very few phytoplankton notations in this month

Table 5. Average number of the most common zooplankters /l/ month.

	May 1970	May 1970 June 1970	July 1970	Aug. 1970	Sept. 1970	0ct. 1970	April 1971	May 1971
Copepoda	•							
Calanoid	50	55	011	40	2	<u>.</u>	Ę,	0
Cyclopoid	72	IC	10	0_	. 20	0	ī	Ŋ
Naupli	70	220	582	350	80	50	01	30
Cladocera								
Daphina	2	37	901	94	24	14	0.3	
Bosmina	8	æ	16	150	56	21	0.3	٣
Chydorus	0	2	2	4	131	40	0.2	0
0.4.1.4.0.r.c								
Keratella chochlearis	. 15	50	310	330	2	40	īŪ	70
Polyarthra	35	. 30	295	135	25	35	īU	50
Brachionus	5	2	140	75	25	20	01	70

