POWER AUTHORITY OF THE STATE OF NEW YORK
JAMES A. FITZPATRICK NUCLEAR POWER PLANT

316(b) DEMONSTRATION SUBMISSION

PERMIT NO. NY 0020109

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SUMMARY AND CONCLUSIONS

The major findings of this document in regard to the effect of the cooling water intake of the James A. FitzPatrick Nuclear Power Plant on the aquatic community in the vicinity of Nine Mile Point are summarized below. Intake effects on major trophic levels and designated representative important species were assessed. The demonstration follows the procedures provided in the draft document, "Guidance for Determining Best Technology Available for the Location, Design, Construction, and Capacity of Cooling Water Intake Structures for Minimizing Adverse Environmental Impact," dated May 1977. The study outline follows that approved by the U.S. EPA on 29 December 1976.

1. The James A. FitzPatrick Nuclear Power Plant has a combined cooling water flow of 22.23 m^3/sec (785 cfs) with a maximum plant temperature rise of 17.5 C (31.5 F). Cooling water is withdrawn from Lake Ontario through a submerged intake structure located in approximately 7.9 m (26 ft) of water 275 m (900 ft) offshore. The calculated intake velocity at the lake interface is 0.37 m/sec (1.2 ft/sec).

2. The FitzPatrick plant was placed in commercial operation on 28 July 1975 and has continued to operate with intermittent shutdowns through March 1977. The relatively constant intake operation and plant loads sustained during this period were sufficient to have produced observable effects on the trophic levels being studied, if any were to have occurred.

3. An analysis of the abundance and distribution of major phytoplankton groups in the Nine Mile Point vicinity during 1975 and 1976 yielded no evidence of plant-induced depression or enhancement of total phytoplankton, diatoms, green algae, or

blue-green algae. Chlorophyll a concentrations in the vicinity of the plant were not measurably affected while the data did indicate slight increases in primary productivity. Entrainment viability studies done during 1976 and 1977 indicated reductions in chlorophyll a and primary productivity of approximately 13 and 30% due to plant passage during the summer months. Chlorophyll a values were generally unaffected throughout the remainder of the year, while primary productivity was generally enhanced during the cooler periods. Averaged over the year, plant passage effects on chlorophyll a were minimal (2% reduction) with general enhancement (2 to 13% increase) of primary productivity rates indicated. Analysis of plume entrainment effects showed a slight increase in primary productivity, but little effect on chlorophyll a concentrations. The plant passage and plume entrainment study results supported the conclusion of minimal plant effect reached from the lake studies.

4. Examination of zooplankton abundances at both plant and control transects revealed no discernible differences in 1975 or 1976. Zooplankton entrainment viability studies yielded seasonal mortalities attributable to plant passage of between 3.1 and 37.6% for the total zooplankton entrained with an average annual mortality of 20.3%. Plume entrainment was found to have little or no effect on zooplankton mortality. The mortality rate imposed on plant-passed organisms is not considered sufficient to have an impact on the zooplankton community in light of the short natural turnover rates for these organisms. Based on the combined results of the plant and plume entrainment studies, it would not be possible to detect the small decreases in zooplankton abundances in the vicinity of the plant.

5. Analysis of the benthic data collected during 1976 showed no discernible spatial or temporal trends attributable to plant

operation. Gammarus fasciatus, a representative important species, was constantly observed at near-plant stations in abundances that were within the range of natural variability in the study area. Based on 12 months of study, the number of G. fasciatus cropped due to entrainment into the plant circulating water system was shown to constitute less than one-half of one percent of the seasonal standing stock estimates in the study area. Cropping, in terms of equivalent acres completely cropped ranged from 0.4 to 8.3 acres for the 12 month period April 1976 through March 1977. These extremely low cropping rates would have a negligible impact on the local Gammarus population.

6. Ichthyoplankton studies during 1975 and 1976 showed the normal seasonal cycle of spawning activity in the vicinity of the plant. Out of a total of 12 species observed, alewife and rainbow smelt larvae dominated the collections. Substantial spawning activity in the Nine Mile Point vicinity appears to be restricted to only these two representative important species since neither eggs or larvae of the other species were collected in significant numbers in either entrainment or lake sampling.

   Estimates of both local and lake-wide (inside 110-ft contour) cropping of eggs and larvae by plant entrainment were made for the alewife and rainbow smelt. Insufficient numbers of other species were observed in entrainment collections to warrant cropping calculations. Cropping of both alewife and rainbow smelt eggs was extremely low as would be expected in the case of demersal eggs. Based on average fecundity data, the total numbers of eggs entrained in terms of equivalent spawning alewife and smelt females represented 0.0055 and 0.0026%, respectively, of the estimated populations of mature females in the Oswego Sector of the lake as defined by NYSDEC.

Estimates for local water body segment cropping of alewife and rainbow smelt larvae by the FitzPatrick plant produced relatively high cropping rates, due primarily to the conservative nature of the analysis. When examined in light of lake-wide larval abundance estimates for both species, cropping rates due to FitzPatrick and Nine Mile Point are sufficiently low (0.26% for both species) as to have negligible impact on the populations. It was not possible to compute lake-wide entrainment impacts for plants other than Nine Mile Point and FitzPatrick since entrainment and mortality rates were not available from other plants.

7. Local trends in abundance and species composition of ten fish species including all the representative important species were examined for the years 1974 through 1976. The comparisons of catch/effort, seasonal abundance fluctuations, and length frequency between preoperational and postoperational years revealed no alterations attributable to plant operation.

A number of methods were used to assess the impact of impingement on the selected species of fish including the representative important species. For the alewife and rainbow smelt standing stock estimates were derived from NYSDEC trawl catch/effort data for the Oswego Sector of Lake Ontario, U.S. waters inshore of the 110-m depth contour, and all U.S. waters. These estimates revealed that during 1976 0.32% of the alewives and 0.22% of the rainbow smelt estimated to be within the Oswego Sector were impinged by the FitzPatrick plant. These cropping estimates are both considered conservatiely high since the population estimates on which they are based are underestimates of the standing stock. The NYSDEC trawl data included a low percentage of young fish relative to the higher percentage

observed in impingement collections. Since neither trawl efficiency nor the low vulnerability of young fish to the trawl were considered, the stock estimates are biased both low and toward adult fish. These cropping estimates are considered negligible in the face of yearly fluctuations of the population size (standardized catch/effort) of approximately a half an order of magnitude.

No standing stock information on threespine sticklebacks is available, so a cropping estimate could not be done. However, an analysis of four years of impingement data at the adjacent Nine Mile Point plant suggests an increasing local population and indicates that the operation of FitzPatrick will not affect this species.

The results of tagging studies conducted in the Nine Mile Point vicinity since 1972 by Storr were used to evaluate impingement impacts on the yellow perch population. A total of 4107 yellow perch have been tagged since 1972 with no tagged fish being observed in impingement collections at the FitzPatrick or Nine Mile Point plants prior to 1976. Based on the one tag recovered at FitzPatrick during 1976 and the number of tagged fish available (after adjustment for annual mortalities), FitzPatrick impingement losses represent 0.19% of the available yellow perch. A comparison of the annual total yellow perch impingement at FitzPatrick to the commercial fishery shows impingement to be equivalent to 0.77% of the commercial catch. The minimal exploitation rate and low losses relative to commercial fishing both support the conclusion that impingement of yellow perch has no effect on the yellow perch population.

A total of 1421 white perch have been tagged by Storr since 1972, with 488 tagged during 1976. No tagged white perch have

been recovered in Nine Mile Point impingement collections during the entire study period, and only one at FitzPatrick (April 1977). Since no annual mortality data were available for white perch the number of available tags at the time of the recovery was taken to be 50% of those tagged in 1976. Using this conservative estimate, an exploitation rate of 0.82% was calculated for FitzPatrick. This is undoubtedly high since the actual number of tags available was higher than used in the calculation. By way of comparison, 1976 white perch impingement at FitzPatrick was equivalent to 1.16% of the commercial catch during the same year. The relative difference between impingement and fishing pressure would be even greater if sport fishing catches were considered.

Of a total of 126 smallmouth bass tagged by Storr since 1972, none have been recovered in impingement collections at either Nine Mile Point or FitzPatrick indicating an extremely low exploitation of this species by impingement. Based on the total of 19 tags returned from other fishing pressures, exploitation by impingement can be assumed to be an order of magnitude less than that due to other fishing pressures.

Salmonid impingement losses due to impingement at FitzPatrick were compared to NYSDEC annual stocking rates. The coho salmon, brown trout, and lake trout impinged represented 0.0002, 0.006, and 0.004% of the 1976 stocked fish, respectively. These levels of exploitation are considered negligible in comparison to natural mortality and existing fishing pressure.

Annual impingement of brown bullheads was equivalent to 0.46% of the commercial harvest and represented 0.06% of the available fish based on tag returns. Since no tagged fish of the other

species tagged in sufficient numbers (pumpkinseed, rock bass, white sucker, and bluegill) were collected in impingement samples, impingement losses of these species are considered negligible.

Based on an individual species analysis of impingement impacts, the numbers of fish impinged at FitzPatrick are judged to represent a negligible portion of the fish community and no alteration to the existing populations would result due to plant operation. This conclusion is supported by the results of the lake monitoring program.

8. Lake-wide impingement cropping estimates including the effect of all nine operating power stations on Lake Ontario were done for the representative important species. These calculations yielded cropping estimates of 0.04% for both the alewife and rainbow smelt. These estimates are considered conservatively high in that the standing stock estimates were derived from data that did not include younger fish. Since Storr's tagging studies have indicated the presence of two yellow perch populations in Lake Ontario, one occupying the southern and eastern shores, with the other occupying the northern shore, cropping estimates included only the effect of the U.S. plants on the southern population. An exploitation rate of 0.7% was calculated by expanding the tagging results to account for the additional U.S. plants. Total impingement at U.S. power plants was equivalent to 1.81% of the 1976 commercial yellow perch harvest. Annual impingement cropping of smallmouth bass around the entire lake could not be calculated since no population estimates are available. However, based on no tag returns in impingement collections from 228 tagged fish at Nine Mile Point and Ginna locations, impingement losses of 1395 fish for the entire lake are judged to have a negligible effect on the smallmouth bass

population. Since salmonid impingement at Canadian plants was not species specific, impingement cropping of coho salmon and brown trout was evaluated for U.S. plants only. Total annual U.S. impingement of brown trout and coho salmon was 0.05 and 0.002% of the respective 1976 stocking totals for U.S. waters.

The cropping or exploitation rates calculated for Lake Ontario were compared to those computed for Lake Michigan and from a nationwide survey of populations sustaining various exploitation rates. The Lake Ontario results were similar in magnitude to those determined from Lake Michigan (generally less than 1%) and much lower than the rates reported by McFadden for other populations. The rates are sufficienty low to preclude any impact on the populations and are in addition well below exploitation rates of commercial and sport fishing.

I. INTRODUCTION

The Federal Water Pollution Control Act Amendments of 1972 (PL 92-500) require that the design, construction and operation of the intake structures of electric generating stations minimize adverse environmental impact. The purpose of this evaluation is to assess any impacts associated with operation of the intake for the Power Authority of the State of New York's James A. FitzPatrick Nuclear Power Plant. The evaluations include all major biotic categories, and are based for the most part on at least one year of postoperational data.

On 22 May 1974, the staff of Region II of the U.S. Environmental Protection Agency (EPA) issued a draft "National Pollutant Discharge Elimination System" (NPDES) permit for the James A. FitzPatrick Nuclear Power Plant (JAF). On 30 June 1974, the Power Authority of the State of New York (PASNY), pursuant to Section 316(a) of the Federal Water Pollution Control Act Amendments (FWPCA), requested the Regional Administrator impose alternative thermal effluent limitations to those designated in the draft permit. On 27 February 1975, EPA issued a final NPDES permit for the FitzPatrick plant which did not contain the requested alternative thermal effluent limitations. On 1 January 1977, PASNY submitted a 316(a) demonstration to EPA in support of its request for alternative thermal effluent limitations. No decision on this request has been made at this time.

The NPDES draft and final permits for the JAF station require assessment of entrainment and impingement effects on Lake Ontario populations. In particular, representative important species were designated for the purposes of the 316(a) demonstration and for assessment of impingement and entrainment effects. On 19 August

1976 the proposed outline for 316(b) (intake) evaluations was submitted to EPA and was subsequently approved in a letter from Mr. Lunenfeld dated 29 December 1976. This evaluation follows the outlines submitted to EPA.

The JAF station has been in operation since the summer of 1975, and thus, well over one year of postoperational data have been collected to assess the impacts of the intake. In this sense, the demonstration of intake impacts is based on the absence of appreciable harm during the period of operation. The conclusions are further substantiated by calculations and predictions based on that year of data to demonstrate the absence of impact due to operation of the station's intake. In accordance with draft 316(b) guidance manuals which have been issued periodically by EPA, all biotic categories are considered in this demonstration, although emphasis is placed on those representative important species selected by EPA Region II for specific evaluations with respect to Sections 316(a) and 316(b). In particular, the phytoplankton evaluations are based on major groups, plus chlorophyll a and carbon-14 evaluations. Zooplankters are evaluated as major groups and the representative important species Gammarus fasciatus, although the greatest portion of the Gammarus population is benthic in nature. Benthos are based on selected species, major groups, and again, the representative important species, Gammarus fasicatus. The plant takes in very few ichthyoplanktors and the evaluations described in this document are limited to those representative important species collected at the intake in sufficient numbers to permit an impact evaluation. And lastly, nekton evaluations are based on the representative important species and selected other species for which data are available.

The format of this demonstration follows a logical step-by-step presentation of the plant facilities involved, the biotic communities potentially impacted by the intake operation, and an assessment of the degree of the impact.

Chapter II provides a description of the FitzPatrick plant including the physical structures and operating history pertinent to the demonstration. Chapter III contains a physical description of Lake Ontario with emphasis on the hydrologic and morphometric characteristics of the JAF site vicinity at Nine Mile Point. This chapter also provides descriptive information on other major water intakes on Lake Ontario, as background for the analysis of cumulative impingement impacts presented in Chapter V.

Chapter IV begins with a discussion of the representative important species selected by the EPA and transmitted to PASNY. The basis for selection of each species is discussed and data on the characteristics of each species are provided, including information on the distribution of each species in Lake Ontario. Subsequent individual sections of Chapter IV deal with phytoplankton, zooplankton, benthos, ichthyoplankton, and adult and juvenile fish. Each section describes the community in Lake Ontario, with emphasis on the local Nine Mile Point area, based on recent biological investigations. Specific attention is given to variations in the local community that would be indicative of intake-related effects. The lake community descriptions for each trophic level are followed by a presentation of the intake-related studies (entrainment and impingement). Since intake and discharge effects are difficult to separate in entrainment studies, both plant passage and plume entrainment effects are evaluated to provide a complete analysis of plant effects in addition the combined intake-discharge effects and in the evaluation of the lake monitoring program. Mortality rates are computed for each group and, where sufficient information was available, are applied to standing stock estimates to provide a quantification of impact. Each section of Chapter IV contains a final conclusionary subsection summarizing the identified effects of intake operation.

Chapter V evaluates the combined effects of all the operating Lake Ontario generating station intakes on adult and juvenile fish through a comparison of impingement data with lake standing stock information where available. The impacts of the various intakes are also compared to commercial and sport fishing impacts and known stocking rates.

II. PLANT DESCRIPTION

A. LOCATION AND GENERAL FEATURES

The James A. FitzPatrick Nuclear Power Plant (JAF) is located in the Town of Scriba, New York, on the south shore of Lake Ontario (Figures IIA-1 and IIA-2). The plant is a single generating unit with a boiling water reactor producing 821 MWe (net output). It is located approximately 915 m (3,000 ft) east of the Nine Mile Point Nuclear Station and approximately seven miles east of the Oswego Steam Station.

B. CIRCULATING WATER SYSTEM

JAF uses once-through cooling to dissipate waste heat from the main condensers and auxiliary cooling systems. Circulating water is withdrawn from Lake Ontario through a submerged inlet, circulated through the main condensers and auxiliary systems, and returned to the lake through a submerged jet diffuser (Figure IIB-1).

When operating to maximum power output, the plant requires a total flow of 23.36 m^3/sec (825 cfs).* Of the total flow, 22.23 m^3/sec (785 cfs) is for the main condensers, where the temperature is raised 18.0 C (32.4 F), and 1.13 m^3/sec (40 cfs) is for service water requirements which produce a 7.5 C (13.5 F) rise in temperature. The combined condenser and service water discharge flow has a temperature rise of 17.5 C (31.5 F). These cooling water characteristics remain essentially the same throughout the year, except that during the winter months as much as 30% of the discharge flow may be recirculated through the intake (tempering), resulting

*A dye dilution study of the FitzPatrick cooling water system measured total plant flows of 23.66 m^3/sec (836 cfs) and 23.73 m^3/sec (838 cfs) (Aquatec 1975).

GENERAL LOCATION MAP

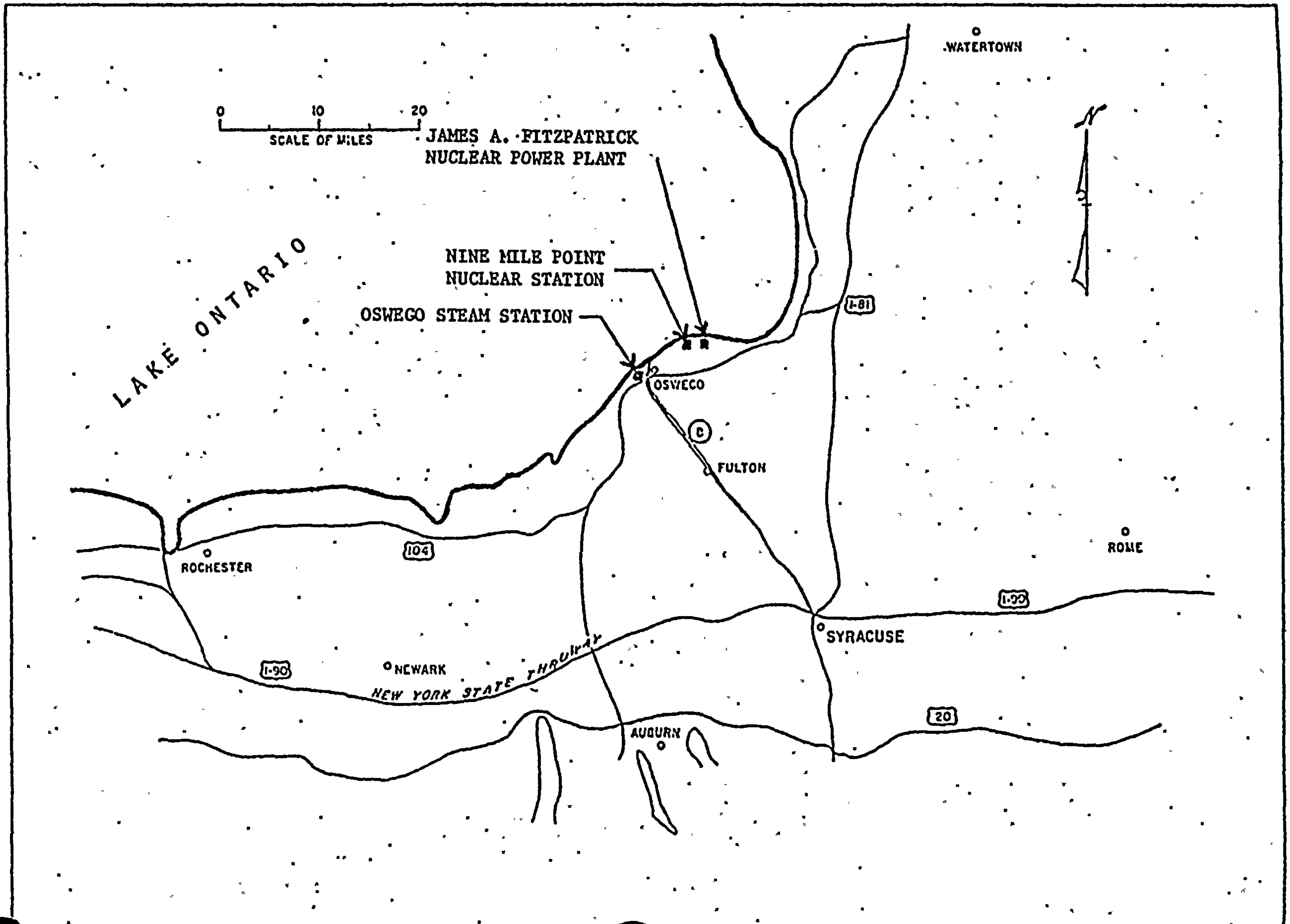


FIGURE IIA-1

PLAN

JAMES A. FITZPATRICK
NUCLEAR POWER PLANT

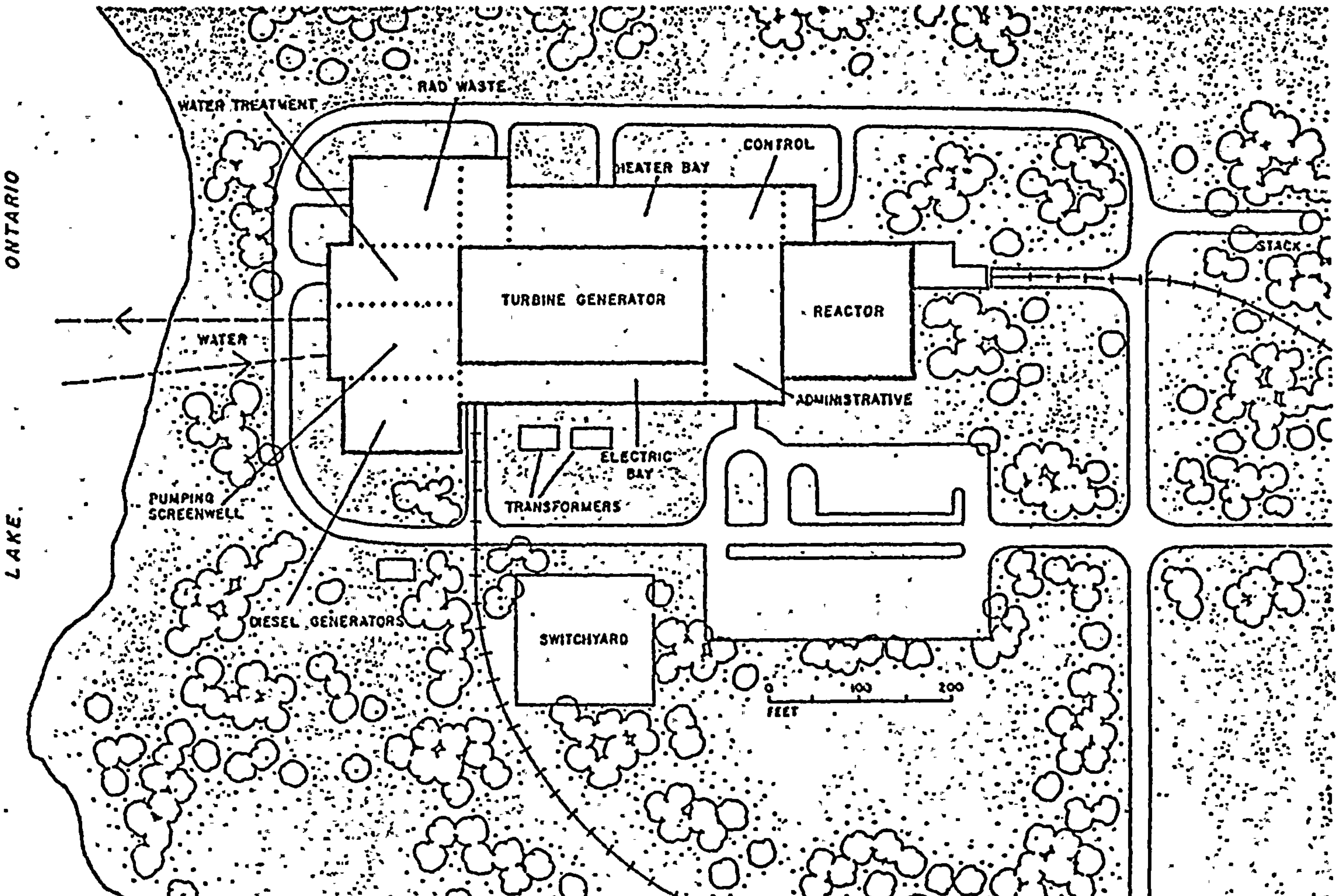


FIGURE IIA-2

WATER INTAKE AND DISCHARGE ARRANGEMENT

JAMES A. FITZPATRICK NUCLEAR POWER PLANT

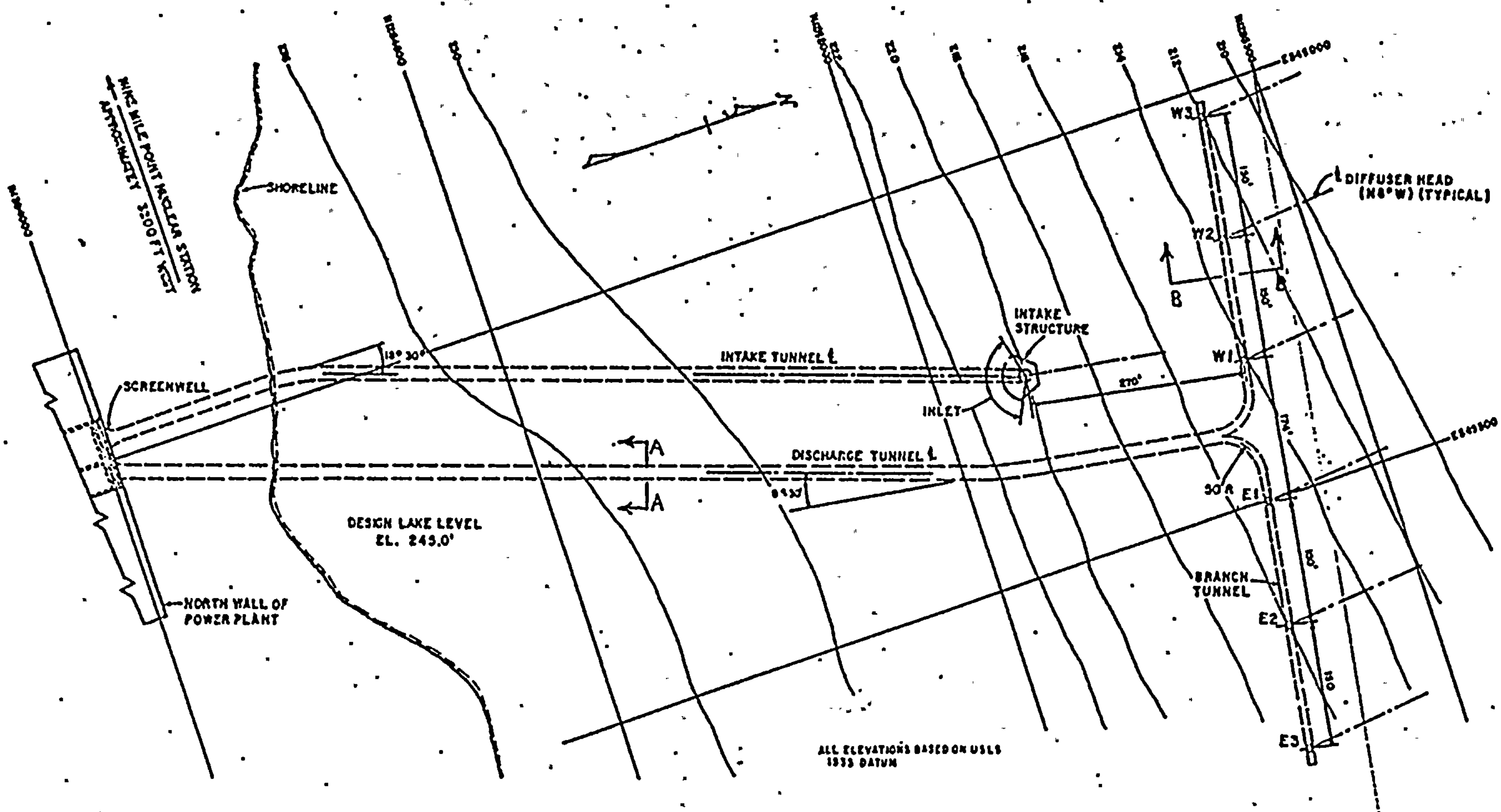


FIGURE IIB-1

in a proportional increase in the across-the-plant temperature rise and reduction in intake flow.

The total heat rejected to the lake is a function of electrical load, increasing with an increase in electrical generation. With the exception of NRC imposed limitations, the Power Authority expects to operate the plant at full load except when maintenance or refueling is required. The heat rejection rate at 100% load is calculated to be 5.714 x 10^9 Btu/hr.

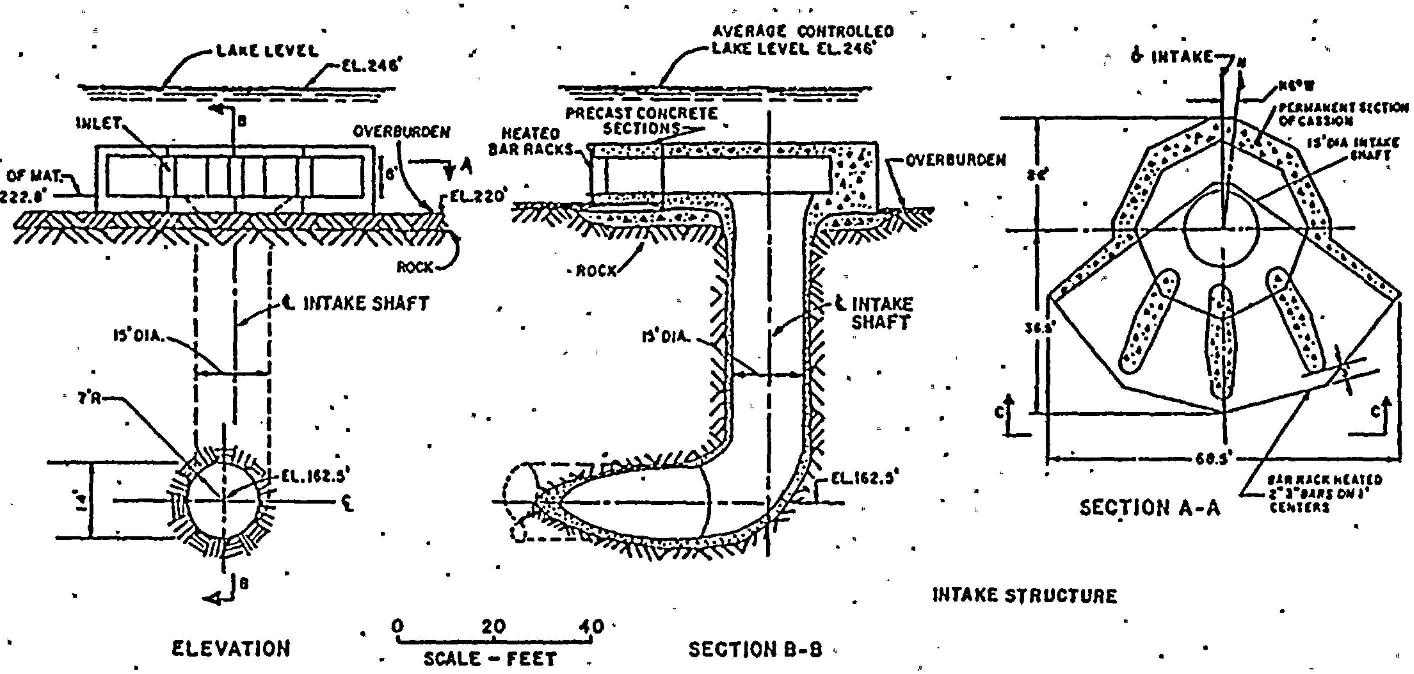
1. Intake System

The intake structure is located on the lake bottom 274.3 m (900 ft) offshore of the plant in 7.9 m (26 ft) of water at the average controlled lake surface level of 75 m (246 ft). The structure is 20.9 m (68.5 ft) across at its widest point and 4.3 m (14 ft) high (Figure IIB-2). There are four intake openings on the south side of the structure and a solid wall on the north side. This configuration was designed to prevent any recirculation of heated water from the discharge structure located 82.3 m (270 ft) farther out in the lake.

Each of the four intake openings is 2.4 m (8 ft) high with a maximum width of 6.7 m (22 ft) at the bar racks. There is a total horizontal clear opening of 21.3 m (70 ft). The intake openings are 0.9 m (2.8 ft) above the lake bottom and the entire structure is covered by a solid roof. The intake cover restricts flow to a primarily horizontal direction. A bar rack system covers the entire open area of the intake structure to prevent the entry of large debris. In addition, the bar racks are heated to prevent ice formation. The calculated intake velocity through the bar racks is 0.43 m/sec (1.4 ft/sec) at capacity operation. The velocity immediately in front of the bar racks is calculated to be 0.37 m/sec (1.2 ft/sec).

INTAKE STRUCTURE

JAMES A. FITZPATRICK NUCLEAR POWER PLANT



INTAKE STRUCTURE

FIGURE IIB-2

After passing through the submerged intake openings, the water flows down a 4.6 m (15 ft) diameter vertical shaft to a horizontal tunnel 18.3 m (60 ft) below the lake bottom (Figure IIB-3). The water passes through the tunnel at 1.4 m/sec (4.7 ft/sec) and then rises in a vertical shaft to the onshore screenwell forebay (Figure IIB-4). Under normal flow conditions the water then flows horizontally through open gates 5, 6, and 7, through the trash racks and traveling screens (0.95 cm mesh), and finally to the three circulating water pumps located in wells behind the traveling screens (Figure IIB-4). From the pumps the water flows through a closed piping system under pressure to the main condensers; during condenser passage, the temperature is elevated over a transit time of approximately eight seconds. The discharge from the condensers flows via a covered rectangular canal to the discharge aftbay. Under normal operation the full discharge flow then passes through gates 1 and 2 (Figure IIB-4), down a vertical shaft and horizontally out beneath the lake bottom. During the winter months gate 4 is opened and gates 1 and 2 may be partially closed to allow a portion of the discharge flow to recirculate through the intake forebay. This tempering procedure prevents a loss in plant operating efficiency due to excessive cooling in the condenser when lake inlet temperatures are low. The intake/discharge system also has the capability of reversing the direction of flow in the intake and discharge tunnels and lake structures. This can be done for brief periods in the winter months but this system has not been used to date.

2. Discharge Structures

The multiport discharge structure is located 356.6 m (1,170 ft) offshore of the plant (Figure IIB-3). The discharge tunnel extends from the onshore screenwell to two branch tunnels positioned approximately parallel to the shoreline. Each branch tunnel has three

INTAKE AND DISCHARGE TUNNELS

JAMES A. FITZPATRICK NUCLEAR POWER PLANT

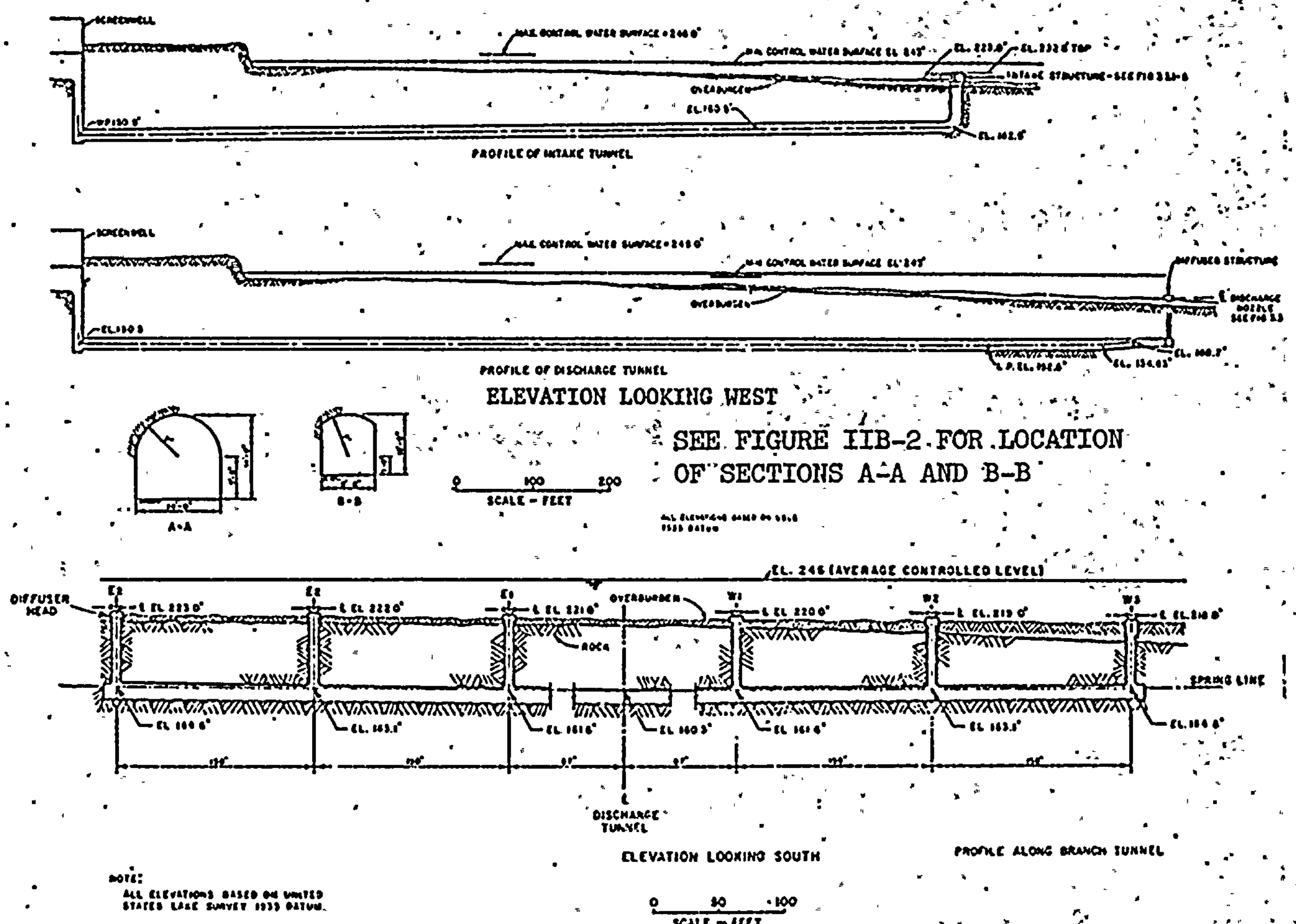
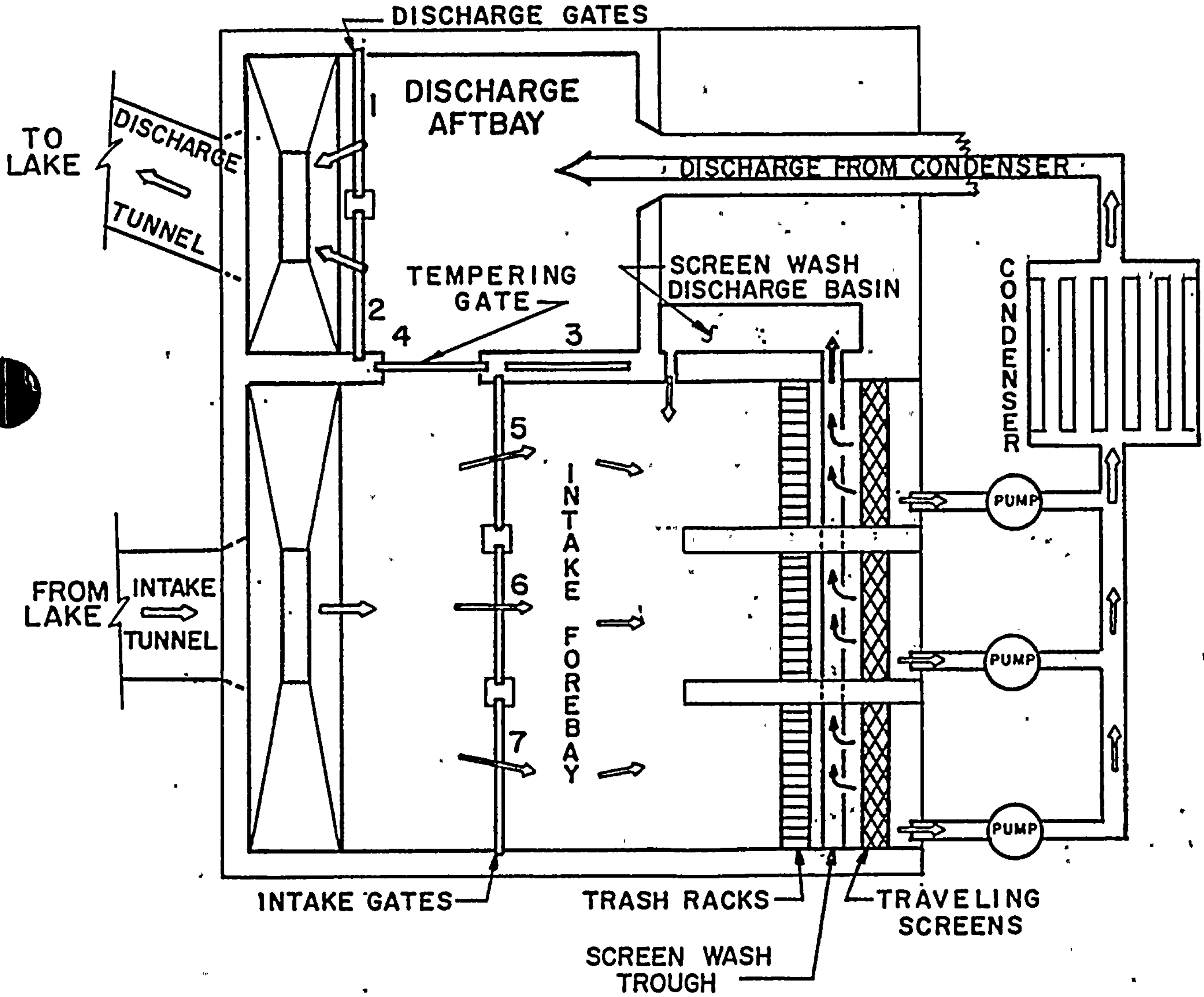


FIGURE IIB-3

SCHEMATIC DIAGRAM OF INTAKE AND DISCHARGE BAYS

JAMES A. FITZPATRICK NUCLEAR POWER PLANT



diffuser heads spaced 45.7 m (150 ft) apart, with two discharge nozzles at each head, directed away from the shoreline. The submergence of the diffuser heads varies from 7.0-8.5 m (23-28 ft), depth of submergence increasing from east to west along the branch tunnels. The nozzles of each pair are separated by a horizontal angle of 42 degrees and each nozzle has a 0.76 m (2.5 ft) diameter opening (Figure IIB-5). The circulating water system is designed to produce a 4.3 m/sec (14 ft/sec) exit velocity at each diffuser port.

The NPDES permit for JAF places the following limitations on the discharge effluent:

(1) The discharge temperature shall not exceed 44.5 C (112 F).

(2) The discharge-intake temperature* difference shall not exceed 17.8 C (32.4 F).

(3) The net rate of addition of heat to the receiving water shall not exceed 1.44 billion Kcal/hr (5.72 billion Btu/hr).

(4) The pH shall not be less than 6.5 nor greater than 8.5 at any time.**

(5) No algicides shall be added to the condenser and auxiliary cooling water.

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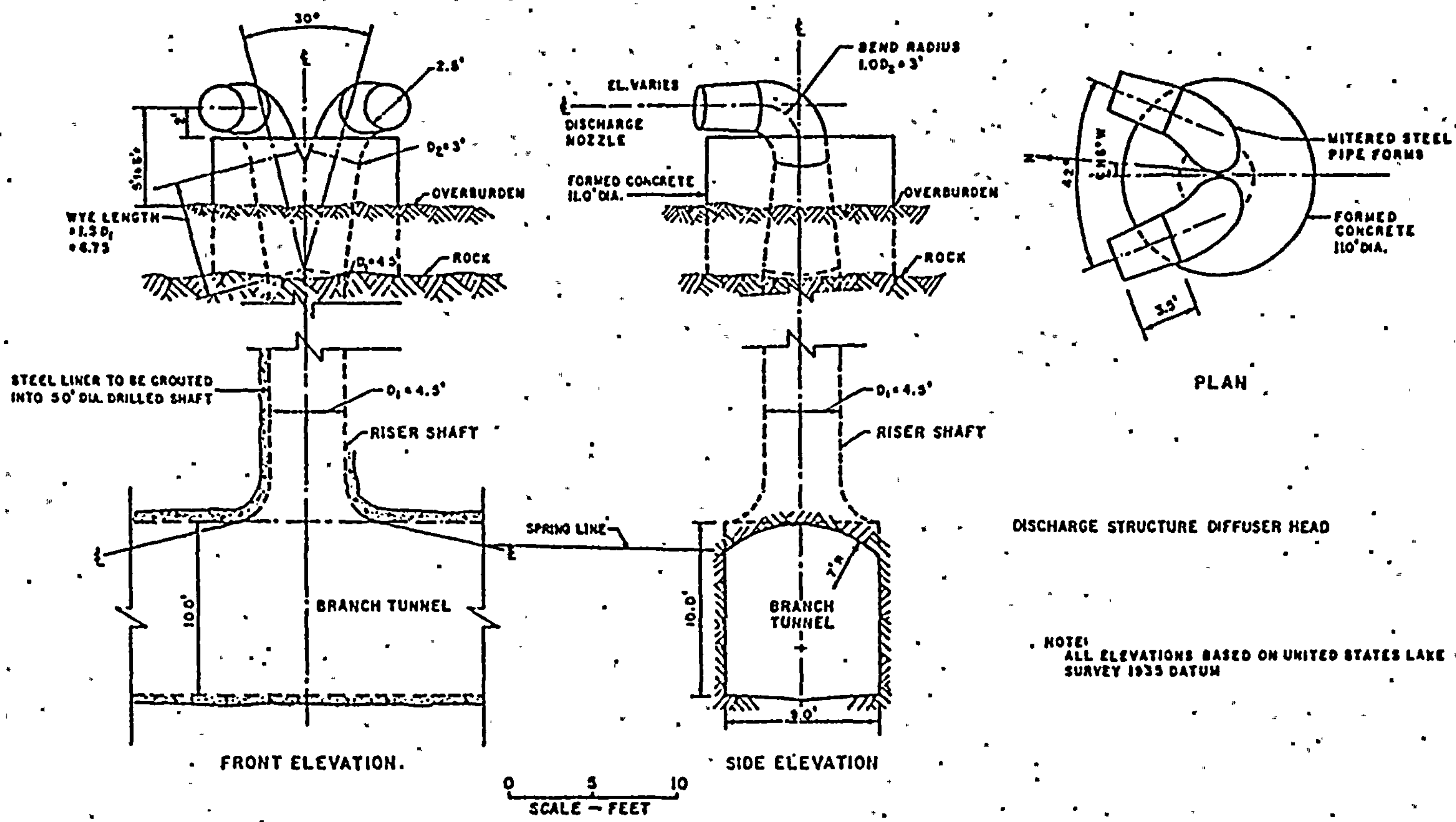
* During those periods when intake water tempering occurs, the intake temperature shall be considered that temperature existing after tempering.

**The pH of the discharge shall not exceed 8.5 unless the pH of the intake water is greater than this value; in this case, the pH of the discharge shall not exceed the pH of the intake by more than 0.1 pH unit.

DISCHARGE STRUCTURE TYPICAL DIFFUSER HEAD

JAMES A. FITZPATRICK NUCLEAR POWER PLANT



DISCHARGE STRUCTURE DIFFUSER HEAD

NOTE:
ALL ELEVATIONS BASED ON UNITED STATES LAKE SURVEY 1935 DATUM

FIGURE IIB-5

C. OPERATING HISTORY

JAF achieved criticality in November 1974 and began commercial operation on 28 July 1975. Between these dates the plant went through a period of startup testing during which there was intermittent operation at increasingly higher power levels.

Table IIC-1 summarizes the plant electrical output (gross MWe) from 1 July 1975 to 31 March 1977. During this interval the plant was consistently above 500 MWe gross output when the unit was on line. Figure IIC-1 provides a frequency histogram of daily average discharge temperatures for the fall of 1975 and the spring and summer of 1976. There were a total of 30 generation outages with durations ranging from less than 24 hours to all or part of 68 days (Table IIC-2). During four outages there was a brief resumption of generation. However, each outage was counted as a single event because the plant did not reach a high power level for a sustained period. The circulating water systems were in operation during outages, and except for 7 days during the outage in December 1975, the average flow was at least 8.7 m^3/sec (307.5 cfs) averaged over one day periods.

PLANT ELECTRICAL OUTPUT*

JAMES A. FITZPATRICK NUCLEAR POWER PLANT - 1 JULY 1975-31 MARCH 1977

DATE	1975																	
	JULY			AUGUST			SEPTEMBER			OCTOBER			NOVEMBER			DECEMBER		
	MIN	MAX	AVG	MIN	MAX	AVG	MIN	MAX	AVG	MIN	MAX	AVG	MIN	MAX	AVG	MIN	MAX	AVG
1			126			638			0	0	0	0	0	0	0	675	749	718
2			191			645			0	0	498	180	0	0	0	757	780	773
3			194			572			0	496	632	541	0	0	0	770	776	773
4			201			0			0	596	633	622	0	492	303	771	801	779
5			201			163			0	624	631	625	504	590	543	799	814	805
6			254			402			0	625	633	625	595	700	658	796	801	797
7			322			480			157	624	628	624	705	780	744	800	802	688
8			6			548			363	625	627	626	771	779	774	0	0	0
9			8			622			525	626	632	628	772	778	775	0	0	0
10			326			672			524	629	633	631	775	780	776	0	0	0
11			467			665			161	266	636	512	0	779	350	0	0	0
12			542			674			0	480	521	483	0	382	102	0	0	0
13			607			686			0	528	538	535	0	0	0	0	348	237
14			635			693			0	549	629	612	0	0	0	0	451	314
15			592			696			0	611	628	620	0	0	0	0	0	0
16			460			175			28	626	639	633	0	0	0	0	0	0
17			0			471			387	623	641	633	0	0	0	0	0	0
18			21			492			541	636	641	635	0	0	0	0	0	0
19			361			607			628	639	661	638	0	295	65	0	0	0
20			462			680			702	653	755	702	295	561	443	0	0	0
21			565			701			742	682	794	773	534	584	555	0	0	0
22			622			498			743	0	795	457	557	563	560	0	0	0
23			617			517			739	0	168	24	560	562	561	0	0	0
24			616			520			748	175	590	446	560	563	563	20	290	115
25			607			521			750	594	706	658	554	567	562	60	370	278
26			611			515			749	705	796	770	556	559	558	10	330	103
27			614			511			609	384	792	761	553	559	554	330	780	398
28			616			509			719	562	794	765	554	557	555	510	620	547
29			624			515			748	0	793	692	550	583	558	620	690	660
30			633			553			418	0	0	0	613	692	670	680	690	687
31			634			434				0	0	0				540	690	598

*Gross MWe

TABLE IIC-1[illegible] (Continued)

PLANT ELECTRICAL OUTPUT*

DATE	1976																	
	JANUARY			FEBRUARY			MARCH			APRIL			MAY			JUNE		
	MIN	MAX	AVG	MIN	MAX	AVG	MIN	MAX	AVG	MIN	MAX	AVG	MIN	MAX	AVG	MIN	MAX	AVG
1	548	560	550	0	0	0	0	0	0	410	590	509	530	690	665	770	780	775
2	440	570	498	0	0	0	0	0	0	520	620	582	690	750	722	770	780	771
3	480	530	514	0	0	0	0	0	0	500	630	553	730	750	743	770	780	771
4	510	520	514	0	0	0	0	0	0	200	600	361	670	750	728	0	770	351
5	510	610	560	0	0	0	0	0	0	200	570	459	730	750	741	0	0	0
6	580	600	585	0	0	0	0	0	0	590	620	604	740	760	747	30	430	295
7	570	590	580	0	0	0	0	0	0	590	610	601	740	760	751	430	500	480
8	570	590	580	0	0	0	0	0	0	590	660	614	740	760	750	490	600	516
9	579	657	618	0	0	0	0	0	0	640	700	671	730	750	747	640	750	693
10	654	726	687	0	0	0	0	0	0	680	720	706	730	750	743	740	780	764
11	730	783	755	0	0	0	0	0	0	700	730	716	730	750	739	750	780	767
12	788	805	799	0	0	0	0	0	0	710	720	715	730	740	737	770	780	776
13	797	805	801	0	0	0	0	0	0	690	720	712	0	750	315	780	780	780
14	798	803	801	0	0	0	0	0	0	690	710	700	0	0	0	770	790	778
15	799	803	800	0	0	0	0	0	0	560	710	684	30	160	13	780	800	785
16	0	803	473	0	0	0	0	0	0	640	700	671	240	420	353	770	790	782
17	0	0	0	0	0	0	0	0	0	680	700	690	420	580	513	770	790	775
18	0	0	0	0	0	0	0	0	0	680	690	688	590	680	631	0	780	139
19	0	0	0	0	0	0	0	0	0	680	700	687	680	740	719	0	460	198
20	0	0	0	0	0	0	0	0	0	680	700	697	730	750	741	460	630	554
21	0	0	0	0	0	0	0	0	0	500	710	676	730	760	746	640	760	710
22	0	0	0	0	0	0	0	0	0	490	600	558	600	770	727	760	780	773
23	0	0	0	0	0	0	0	0	0	580	690	648	680	740	704	0	783	446
24	0	0	0	0	0	0	101	180	29	700	720	707	740	790	770	0	681	505
25	0	0	0	0	0	0	90	310	184	700	720	712	780	790	781	670	760	714
26	0	0	0	0	0	0	310	360	331	710	730	718	780	790	781	770	780	774
27	0	0	0	0	0	0	350	450	408	710	730	723	770	790	782	750	760	753
28	0	0	0	0	0	0	450	510	466	720	740	733	770	790	778	740	760	751
29	0	0	0	0	0	0	510	540	430	720	740	726	770	780	776	740	760	755
30	0	0	0	0	0	0	220	580	507	520	730	692	770	780	776	0	500	215
31	0	0	0	0	0	0	280	550	501				770	780	778			

*[illegible]s MWe

TABLE II (Continued)

PLANT ELECTRICAL OUTPUT*

DATE	1976																	
	JULY			AUGUST			SEPTEMBER			OCTOBER			NOVEMBER			DECEMBER		
	MIN	MAX	AVG	MIN	MAX	AVG	MIN	MAX	AVG	MIN	MAX	AVG	MIN	MAX	AVG	MIN	MAX	AVG
1	150	580	248	740	760	750	470	680	603	650	730	724	690	770	728	730	740	735
2	580	690	633	740	760	751	680	760	723	720	740	730	760	790	778	730	740	735
3	700	770	743	740	760	748	760	780	772	720	730	729	760	780	770	480	740	716
4	750	770	762	740	750	747	780	790	780	700	730	721	760	780	770	620	740	688
5	760	770	767	740	750	747	770	790	779	720	730	729	530	780	740	640	650	647
6	760	780	771	560	750	725	770	790	782	720	730	728	550	630	591	650	740	707
7	760	780	773	560	680	632	780	790	786	720	730	727	630	700	664	730	740	735
8	740	780	769	670	750	718	780	790	785	200	730	607	700	780	738	730	740	736
9	770	600	750	750	780	769	770	790	782	0	260	123	0	790	435	730	740	738
10	690	770	751	760	780	771	590	790	723	0	0	0	0	0	0	425	740	718
11	760	780	765	760	780	771	710	740	735	0	0	0	0	200	30	690	740	720
12	750	780	765	770	790	783	720	740	735	0	0	0	0	0	0	730	740	736
13	0	780	715	620	800	777	730	740	735	0	0	0	0	0	0	730	740	738
14	0	0	0	760	790	785	730	740	731	0	250	97	0	0	0	730	750	738
15	0	0	0	780	790	788	720	740	733	250	370	322	0	280	48	160	750	644
16	0	0	0	780	790	788	720	740	731	360	380	370	290	560	421	0	80	4
17	0	330	113	780	790	788	620	740	724	360	400	367	560	750	647	0	340	58
18	350	600	503	780	800	792	720	740	733	390	470	439	730	750	737	360	530	465
19	596	672	637	780	800	791	720	740	729	470	540	512	0	740	24	540	640	587
20	678	759	721	690	800	785	730	740	730	520	540	530	0	0	0	640	710	675
21	0	780	462	770	800	788	730	740	732	530	540	533	0	0	0	710	740	731
22	0	0	0	780	800	786	730	740	730	530	580	550	0	0	0	730	750	737
23	0	0	0	780	800	786	730	740	735	580	640	616	0	0	0	740	750	741
24	0	0	0	780	800	792	650	740	730	640	700	672	0	450	265	450	740	716
25	0	0	0	780	800	789	720	740	733	710	730	718	430	590	513	710	750	733
26	0	0	0	780	790	786	720	740	733	700	720	713	580	630	605	730	740	737
27	0	0	0	600	790	763	730	740	733	700	720	712	630	690	660	730	740	738
28	0	400	73	600	730	622	730	740	733	700	710	708	720	730	721	730	750	741
29	420	620	543	730	790	775	730	740	730	520	710	687	730	740	736	730	750	741
30	610	660	635	0	790	650	730	740	730	550	620	581	730	740	736	730	750	743
31				670	730	695	0	430	157	620	690	682				460	750	717

TABLE IIC-1 (Continued)

PLANT ELECTRICAL OUTPUT*

DATE	1977								
	JANUARY			FEBRUARY			MARCH		
	MIN	MAX	AVG	MIN	MAX	AVG	MIN	MAX	AVG
1	710	740	734	0	741	553	0	430	76
2	730	740	736	0	0	0	420	520	483
3	730	740	740	0	0	0	410	550	512
4	730	740	737	0	200	75	450	550	499
5	730	740	738	0	320	134	530	610	573
6	730	740	740	319	437	394	610	670	645
7	410	740	703	420	510	491	0	720	410
8	480	570	538	490	505	499	0	420	79
9	570	660	609	490	505	501	440	520	470
10	660	730	695	500	510	503	510	690	643
11	730	750	741	0	510	479	0	690	64
12	730	750	738	70	500	410	410	540	473
13	730	740	738	510	570	537	550	680	633
14	510	740	729	580	650	613	680	730	701
15	730	750	739	640	710	681	720	750	740
16	730	750	740	720	750	738	730	750	740
17	740	750	741	740	750	740	736	742	740
18	740	750	741	410	750	703	414	750	725
19	730	740	738	430	540	683	729	750	737
20	730	740	738	540	600	569	730	750	740
21	430	740	700	600	680	642	730	750	742
22	0	420	231	680	740	713	730	760	741
23	0	600	243	730	740	737	730	750	741
24	590	680	626	730	740	738	510	750	711
25	690	740	712	450	740	707	520	680	580
26	730	740	738	450	750	684	680	740	717
27	730	740	738	730	750	738	730	750	740
28	730	750	740	0	750	687	740	750	741
29	730	740	735				740	750	743
30	730	740	735				740	750	743
31	730	740	737				740	750	742

TABLE II C-2

OUTAGES BETWEEN 1 JULY 1975 AND 31 MARCH 1977

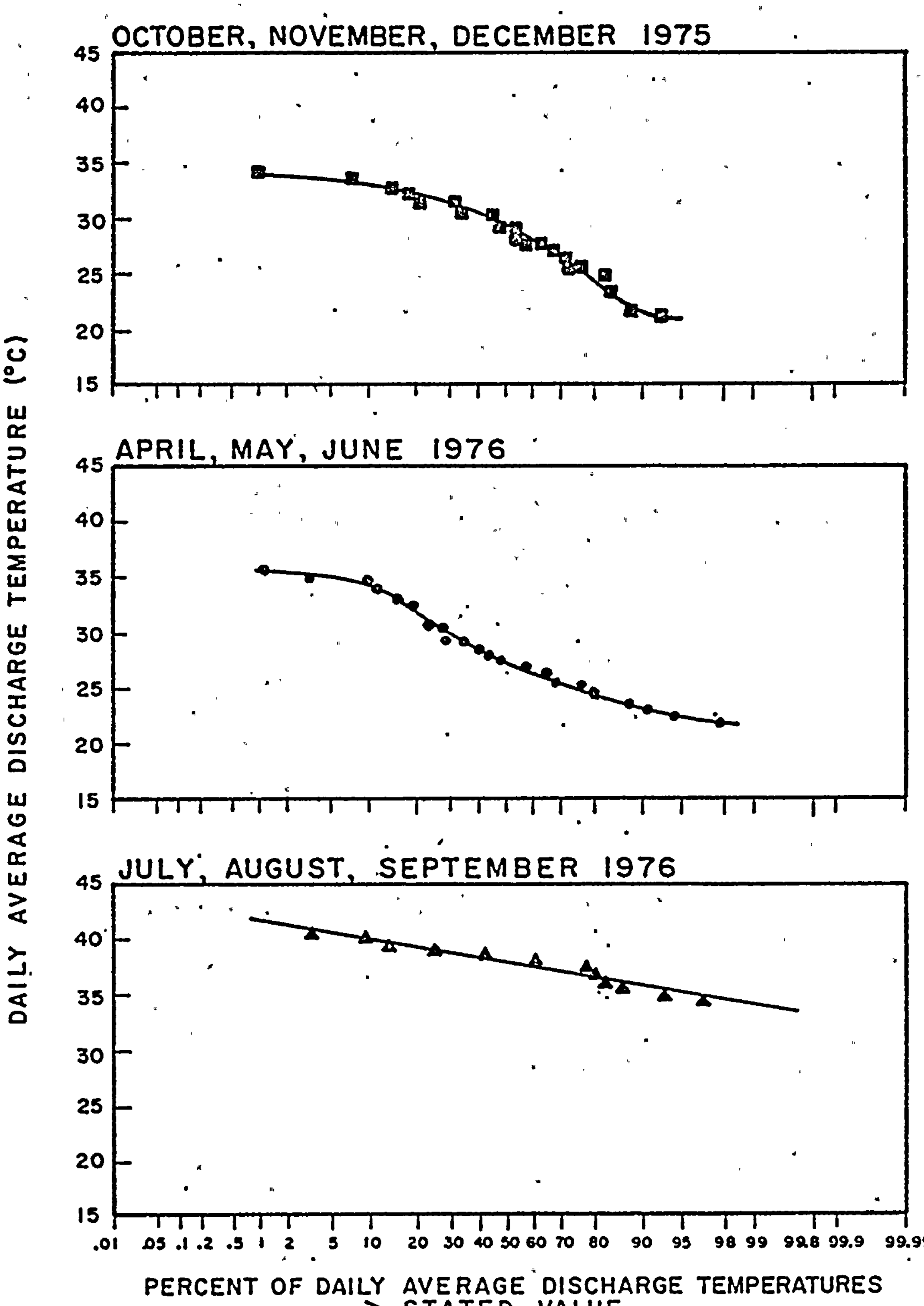
JAMES A. FITZPATRICK NUCLEAR POWER PLANT

NUMBER	START DATE	END DATE	DURATION IN DAYS*
1	17 JUL 1975	17 JUL 1975	< 1
2	4 AUG	4 AUG	< 1
3	1 SEP	6 SEP	6
4	12	15	4
5	1 OCT	2 OCT	< 2
6	22	23	< 2
7	29	4 NOV	< 7
8	11 NOV	19	< 9
9	8 DEC	23 DEC	16
10	16 JAN 1976	23 MAR 1976	<68
11	13 MAY	14 MAY	< 2
12	4 JUN	5 JUN	< 2
13	18	19	< 2
14	23	24	< 2
15	30	30	< 1
16	13 JUL	17 JUL	< 5
17	21	28	< 8
18	30 AUG	31 AUG	< 2
19	31 SEP	31 SEP	< 1
20	9 OCT	14 OCT	< 7
21	9 NOV	15 NOV	< 8
22	19	24	< 7
23	16 DEC	17 DEC	< 2
24	22 JAN 1977	23 JAN 1977	< 2
25	1 FEB	4 FEB	< 4
26	4	5	< 2
27	11	11	< 1
28	28	1 MAR	< 2
29	7 MAR	8	< 2
30	11	11	< 1

*Dates are inclusive in the outage. An outage could span two consecutive dates but have a total duration ranging from less than three hours to more than 45 hours. Incident number 8, for example, could be a little more than 7 days but could not exceed 9 days.

FREQUENCY HISTOGRAM OF DAILY AVERAGE DISCHARGE TEMPERATURES UNDER CONSTANT FULL FLOW OPERATION*

JAMES A. FITZPATRICK NUCLEAR POWER PLANT — 1975-1976



* Discharge Temperatures Calculated by Addition of 17.8°C to 1975-76 Intake Temperatures

III. BASELINE HYDROGRAPHIC CHARACTERISTICS

A. INTRODUCTION

The circulating water system of JAF is designed to minimize the impact of the plant's operation on the thermal characteristics of Lake Ontario in the vicinity of Nine Mile Point. Lake Ontario temperature characteristics, general circulation and local current patterns, lake bed topography, and existing water uses were the important design criteria used in the development of the circulating water system. The baseline hydrographic characteristics of Lake Ontario relevant to the assessment of the operation of the Fitz-Patrick Plant are discussed in the following sections.

B. GENERAL FEATURES OF LAKE ONTARIO

1. Seasonal Temperature Structure

a. Spring Warming and the Thermal Bar

Lake Ontario is a large temperate lake which experiences seasonal changes in its thermal structure. Natural warming of the lake begins in mid-March and continues until mid-September. At the onset of warming the surface water temperature in the shallow littoral zone rises more rapidly than in regions just offshore. By May this difference has created a sharp horizontal temperature gradient with inshore water temperatures above 4 C (39 F) and the offshore water temperature below 4 C (39 F). There is a convergence zone where water from the relatively warm inshore region mixes with the cold offshore water (Rodgers 1966). As a consequence of the nonlinear temperature/density relationship of freshwater, the mixed water produced in this

transition zone is heavier than the water on either side and sinks, setting up a bar that may reduce free exchange of water between the shallow littoral zone and the deeper part of the lake. The thermal bar moves gradually and steadily offshore with spring warming of the lake until it dissipates in late June. It is estimated that the spring thermal bar may exist for as long as eight weeks (Sweers 1969).

As the thermal bar moves offshore, the inshore water continues to warm and a thermocline develops separating the warm surface water from the cold deep water. The thermocline restricts vertical mixing to the epilimnion, but in mid-lake on the offshore side of the thermal bar mixing extends from surface to bottom. About four weeks after emergence of the bar the inshore area constitutes approximately half the area of the lake (Sweers 1969).

b. Summer Stratification

The disappearance of an offshore surface temperature of 4 C (39.2 F) in late June defines the start of the summer season in the lake. In general, vertical stratification is established over the entire basin by the combined effects of lake warming and the advection of the warmer, nearshore water. The sporadic appearance of surface temperature minima during summer are related to upwellings. As warming continues, stratification intensifies and the thermocline is more sharply defined, with vertical temperature gradients in excess of 1 C/m (0.6 F/ft). As a consequence of stratification, heat transfer and mixing are confined largely to the epilimnion. The lake's mean surface temperature reaches 21 C (69.8 F), and the hypolimnion temperature varies with depth, ranging between 3.8 and 4.0 C (38.0 and

39.2 F) (Sweers 1969). The thermocline forms near the surface in early summer but descends due to continued warming and reaches a characteristic depth of approximately 21 m (70 ft) (Casey et al. 1965).

c. Fall Cooling

In late September the warming process ends, the lake's mean surface temperature rapidly drops below 17 C (62.6 F), and the rate of descent of the thermocline increases. The vertical temperature gradient decreases as the surface layer and deeper water effectively mix. Mixing is the consequence of convection caused by cooling at the surface and is enhanced by the weakening of the thermocline which permits wind-induced turbulence to extend to greater depths.

The fall cooling process resembles spring warming. When nearshore water cools below the temperature of maximum density, a "reverse" thermal bar develops separating colder inshore water from warmer offshore water. The fall thermal bar has a weaker thermal gradient than the spring thermal bar.

d. Winter Cooling

The breakdown of stratification throughout the lake marks the onset of the winter season. The offshore water mass is well mixed, attaining a nearly isothermal condition. The date of overturn differs from year to year depending on the occurrence of storms. The lake surface is cooled below 4 C (39 F) and surface isotherms tend to be parallel to shore. As cooling continues and surface temperatures drop below 4 C (39 F), vertical stratification is again produced, with colder buoyant

water above the warmer 4 C (39 F) water at depth. Vertical circulation at times extends as deep as 100 m (328 ft) (Sweers 1969). With continued cooling ice forms in the nearshore region. Under normal climatic conditions the greatest extent of ice cover is found in the east end of the lake in mid-March, while in a severe winter ice covers about 25% of the lake surface (U.S. Army Corps of Engineers 1975).

2. Lake Circulation

The large-scale circulation of Lake Ontario is counter-clockwise (cyclonic flow) with flow to the east along the south shore in a relatively narrow band and a somewhat less pronounced flow to the west along the north shore. The conceptual model that explains this general circulation is presented below.

A cool mound of water extends from surface to bottom in spring and from below the thermocline to the bottom in summer and fall (Sweers 1969). The baroclinic flow resulting from the horizontal temperature differences is initially directed outward from mid-lake towards the shore. Although the Coriolis effect is acting to turn the flow to the right (clockwise), its effect is diminished due to bottom friction. This outward flow brings water to the inshore area where it begins to pile up. A surface slope, higher inshore than in mid-lake, develops into a barotropic current initially directed lakeward. The barotropic current tends to the right because of the Coriolis effect. The result is that Coriolis effect and the barrier effect of the coastline trap the flow against the shoreline. The flow continues along the shoreline in a counter-clockwise direction as long as the surface slope is maintained.

Inflow from the Niagara River causes the western end of the lake surface to be higher than the eastern end (on the average). The

resulting flow down the gradient is held against the lake's south shore by the Coriolis effect, thereby enhancing the barotropic flow already existing along the south shore. Wind stress averaged over the year tends further to accelerate the flow to the east and decelerate the flow to the west.

The general circulation in winter is less well documented. In late fall after overturn has occurred, the lake is essentially isothermal, thereby permitting a free exchange of water from surface to bottom. Wind direction in winter is primarily from the west-northwest. The net surface flow that results is eastward with westward return flow developing below the surface. The surface layer in the western end is advected to the east and is replaced by subsurface water (Sweers 1969). This large scale upwelling at the upwind end of the lake and downwelling at the downwind end mixes the surface and subsurface water on a scale that is not likely to occur during the rest of the year.

3. <u>Perturbations of the General Circulation Pattern</u>

The general circulation described above has been documented by observations collected over long periods (months). The circulation patterns that are observed at any given time, however, are more complex as a result of the lake's response to the shifting winds. At times a major wind shift can alter the currents in a matter of hours, while at other times some features of the current pattern have continued even with an opposing wind (Csanady 1972). The response time of the currents to a shift in wind distribution is partially related to the scale of the current; large offshore longshore currents respond sluggishly while the response of longshore currents nearer to shore is more rapid, six hours or less. In addition, the deeper the current, the more slowly it responds.

Two important examples of wind-induced changes in the general circulation are upwelling and internal oscillations. Upwelling occurs when a water mass is forced from depth to the surface, and is observed to some degree in all lakes during all seasons (Mortimer 1971); however, it is more conspicuous during seasons of stratification when the upwelled water is much colder than the surface water that it displaces. Wind stress and associated currents depress the thermocline to below equilibrium level at the downwind end of the basin, while at the upwind end the thermocline is displaced upward and may intersect the surface. Upwelling motions are strongly influenced by the Coriolis force. Depression of the thermocline is greatest to the right of the downwind end of the basin and upwelling is strongest to the left of the upwind end (Mortimer 1971). For example, in Lake Ontario, a west wind causes upwelling along the northwest shore, and the thermocline is deepest along the southeast shore.

A variety of mechanisms have been proposed to account for the observed periodic displacement of the thermocline. The most direct explanation is that an upwelling event displaces the thermocline from equilibrium by converting kinetic energy of the wind to potential energy of the thermocline position. When the wind stress is removed, internal waves are set in motion and contribute to the dissipation of this energy. Internal waves increase in amplitude after storms, and in Lake Ontario the oscillations have a period of nearly 17.5 hours, roughly three complete oscillations every two days. These oscillation events are a common feature of lake temperature records and are prominent in the intake temperature records at many power plants.

C. SITE FEATURES

1. Bottom Sediments

A number of observations of the bottom sediments have been made along the south shore of Lake Ontario. Sutton et al. (1970) examined nearshore bottom sediments (0-33 m, 0-108.3 ft) in 1968 and 1969 between Rochester and Stony Point, and stated several conclusions relevant to the FitzPatrick site:

a. There is generally a west-to-east transport of sediment.

b. Sites of sediment accumulation occur in nearshore shallow areas where the shoreline is irregular and where there are local deviations from the above transport pattern.

c. In general, the coarser sands, boulders, pebbles, and cobbles lie in the beach or nearshore area, and finer sediments are found lakeward.

d. Several small patches of sand occur offshore between Oswego and Mexico Bay, and it is hypothesized that these originate from the Oswego River.

Visual observations made in the Nine Mile Point vicinity during the 1974 sampling period corroborate some of the earlier observations of Sutton et al. (1970). The two western transects, NMPW and NMPP, are dominated more by bedrock and rubble than sand and silt, whereas the FITZ and NMPE transects have bedrock and rubble near shore with sand and silt prevailing beyond the 6.1 m (20 ft) depth contour. The presence of a finer grained sediment to the east probably corresponds to the dominance of patchy sand deposits in Mexico Bay.

The irregularity of the shoreline at Nine Mile Point could possibly be the cause of minor sand and silt deposition at that point and eastward. In general, finer grained sediments are more dominant farther offshore.

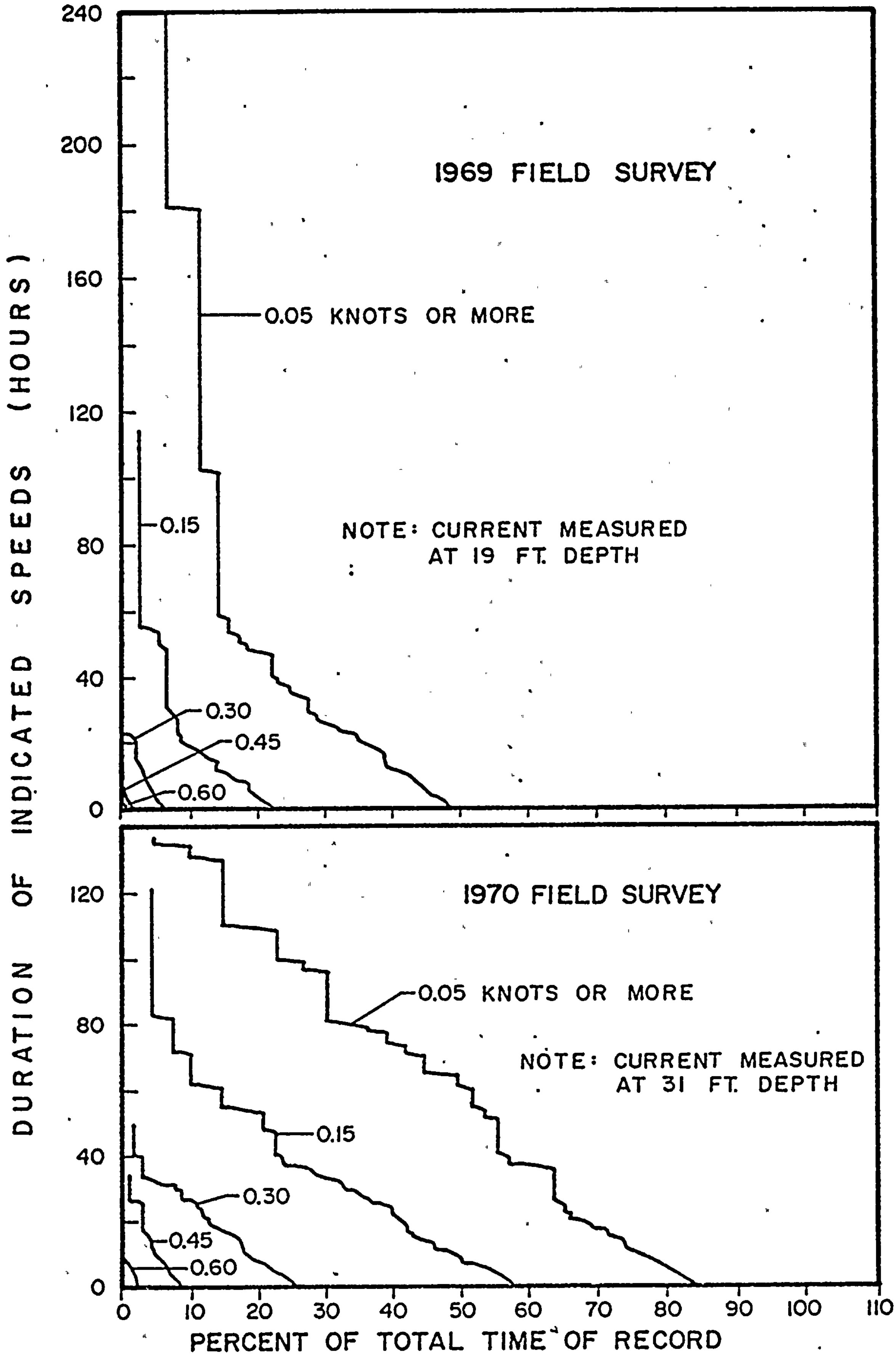
2. Local Currents

In the course of preoperational studies for JAF, current measurements were made off the Nine Mile Point promontory from May to October 1969, and from July to October 1970. Two fixed underwater towers were placed in the lake, one in 7.3 m (24 ft) of water, and one in 14.0 m (46 ft) of water, and provided average hourly current speed and direction. In addition, two drogue surveys were conducted in 1969 to obtain the overall current pattern at the site. These studies were reported by Gunwaldson et al. (1970) and the Power Authority (PASNY 1971). Figure IIIC-1 presents frequency-duration data derived from these studies. These data are consistent with wind-induced current frequencies reported by Palmer and Izatt (1970) for a similar water depth near Toronto.

The field data clearly illustrate a correlation between summer currents and wind speed. The correlation is an accepted principle of hydrodynamics as theorized by Ekman (1928) and subsequently verified by numerous oceanographers (e.g., Neumann and Pierson 1966). Measurements of wind currents at lightships (Haight 1942) have been analyzed to determine the ratio of current speed to wind speed. Reported values of this ratio, commonly called the "wind factor," range between .005 and .030.

The wind speed frequency data indicate that over the year a speed in excess of 32 km/hr (20 mph) occurs 21.6% of the time, based on readings averaged over a six-hour period. For the summer months,

DURATION OF LAKE ONTARIO CURRENT



June through September, winds in excess of 32 km/hr (20 mph) occur 13.9% of the time. The current speed of six-hour duration exceeded with comparable frequency in 14 m (46 ft) of water is about 15 cm/sec (0.5 fps) (see Figure IIIC-2). For a persistence of 24 hours, the current speed exceeded 13.9% of the time is 13.7 cm/sec (0.45 fps).

The predominant direction of currents in the studies described above is alongshore, as dictated by continuity. On those occasions when onshore or offshore currents were observed, their magnitudes were substantially less than those for alongshore currents. The reported frequencies of various current directions during the summer are presented in Figure IIIC-2. This figure indicates that currents alongshore from the west or east are equally frequent at 35% of the time for each. Onshore and offshore currents each account for 5% of the observations. The remaining 30% of the observations were below the meter threshold, 0.05 knots (2.5 cm/sec, 0.09 fps). At the 6.4 m (21 ft) depth in 14.0 m (46 ft) of water, the mean onshore current speed was 3.0 cm/sec (0.09 fps) and the mean offshore current speed was 6.0 cm/sec (0.2 fps). On the other hand, alongshore currents from the west and east averaged 9 cm/sec (0.3 fps).

Vertical profiles of currents have been recorded in several lake studies. Current profiles with depth, however, are sensitive to the turbulent momentum exchange coefficient and ambient stratification. A theoretical profile was computed for the homogeneous shallow waters found near the Nine Mile Point site and indicates the absence of any significant Ekman spiral.

Lake currents were measured at selected locations in the immediate vicinity of the Oswego Steam Station on five days between 12 October and 19 November 1970. These surface current velocities were mostly alongshore with speeds that ranged from very low (less than 2.5 cm/

LAKE ONTARIO CURRENT DIRECTIONS

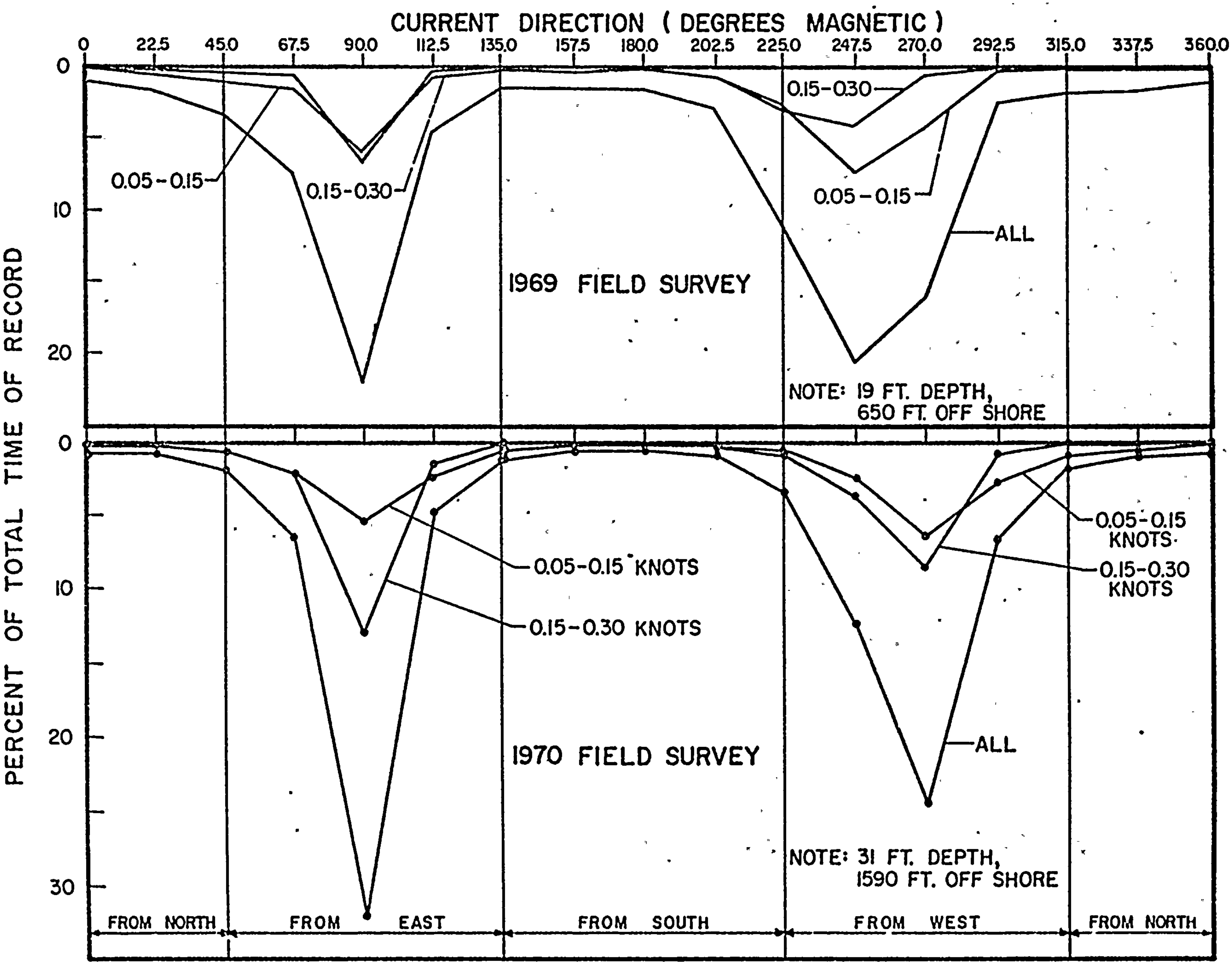


FIGURE IIIC-2

sec, 0.08 fps) up to 15 cm/sec (0.50 fps). This is in general agreement with the measurements at Nine Mile Point.

3. Local Lake Thermal Structure

Data on the thermal structure of the lake in the vicinity of Nine Mile Point are available from studies conducted offshore of JAF in 1969 and 1970, from temperature data recorded in the existing intake for Oswego Units 1-4 (see Figure IIA-1 for location) from 1968 through 1972, and from studies conducted offshore of the Oswego/Nine Mile Point area during 1973. A short description of each of these studies is presented in subsequent paragraphs. These data were used to determine the vertical temperature variations and the surface temperatures in the vicinity of JAF.

In conjunction with the lake current studies carried out in 1969 and 1970 as part of the preoperational surveys for JAF (PASNY 1971), water temperatures were also recorded. Three types of temperature measurements were made:

a. intermittent vertical profiles obtained in 18.3 and 30.5 m (60 and 100 ft) of water

b. continuous temperature recordings, using seven self-contained underwater instruments mounted on the two underwater towers, obtained at various depths

c. surface temperatures measured by airborne infrared radiometry.

The 1970 studies offshore of Oswego consisted of the collection of weekly temperatue data at four locations near the discharge of Oswego Unit 6. Temperatures were measured at one-meter increments

from surface to lake bottom for seventeen consecutive weeks from July through November 1970 (QLM 1972).

Temperature data in the Oswego/Nine Mile Point area were obtained during 1973 from west of Oswego to the east of Nine Mile Point. Vertical temperature profiles were obtained weekly from June through mid-December 1973 along five transects (QLM 1974).

Data from these studies were used to evaluate the vertical temperature structure and to determine whether persistent stratification exists in this area. Vertical temperature profiles revealed the existence of transient thermal gradients equal to or greater than 1 C/m (1.6 F/3.2 ft) throughout the study area. The gradients appeared to be seasonal since they existed primarily in the summertime. They were not "seasonally stable," since they were generated and destroyed by surface heating and cooling and mixing within the water column over periods dependent upon meteorological conditions. Although gradients were observed on sequential weeks for up to a three-week period, the gradients observed were at different temperatures and at different depths from week to week and, therefore, were not persistent. In addition, when the gradients were observed, they appeared to be uniform from station to station. A more complete discusion is presented in the documents previously submitted to the EPA (LMS 1976).

These data were also used to determine the surface temperature in the area. During 1970 the maximum surface temperature recorded was 25.5 C (77.9 C). The temperature data recorded in the existing intake of the Oswego Steam Station were statistically analyzed and are shown in Figure IIIC-3. Since the lake is generally isothermal in the top 6 m (20 ft), the temperature obtained at the intake depth of 4.9 m (16 ft) can be considered to be representative of the

FREQUENCY DISTRIBUTION FOR LAKE ONTARIO WATER TEMPERATURE MEASURED AT OSWEGO FOR SUMMER (JUNE, JULY, AUG., SEPT.) 1968 – 1972

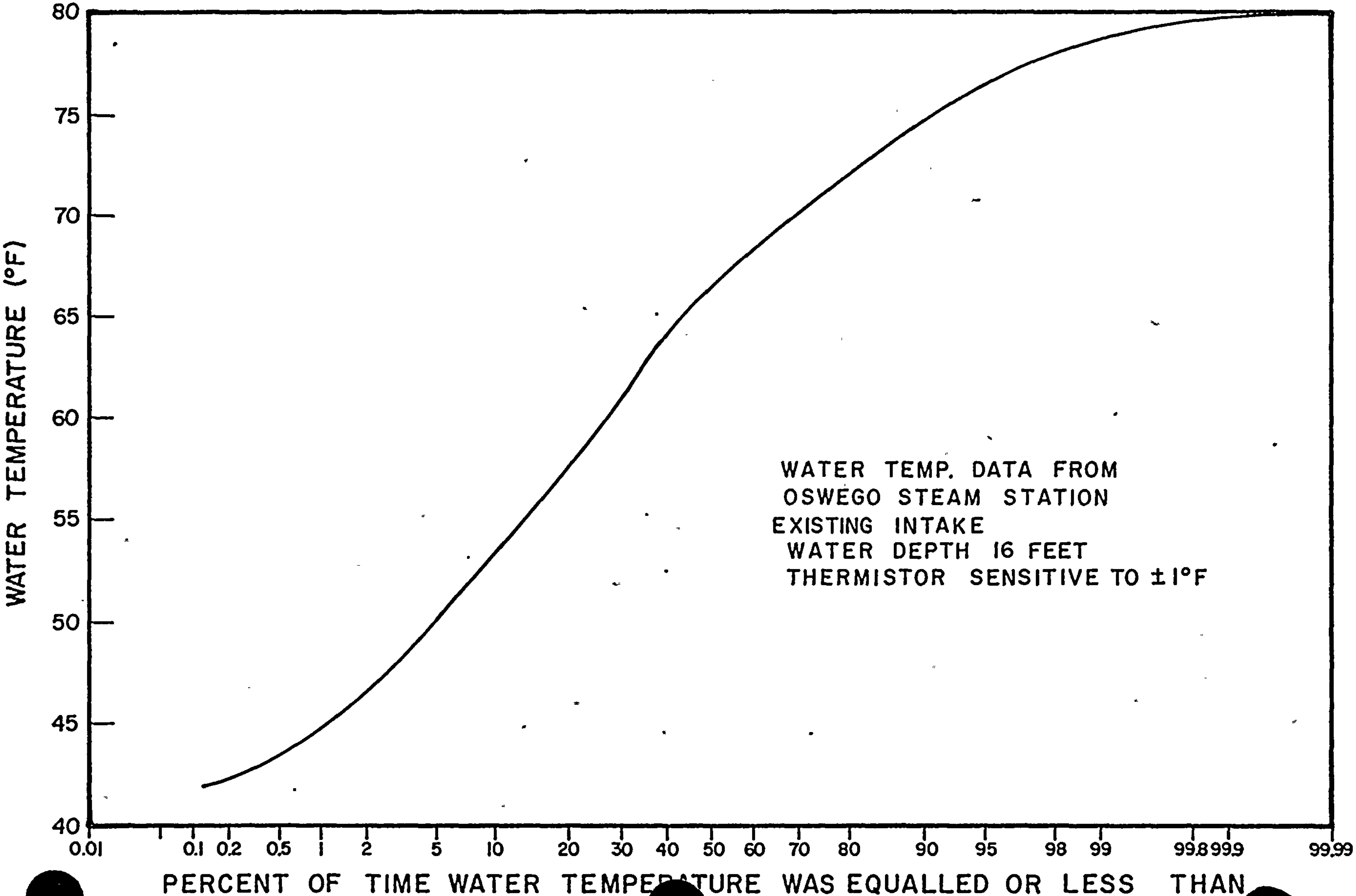


FIGURE IIIC-3

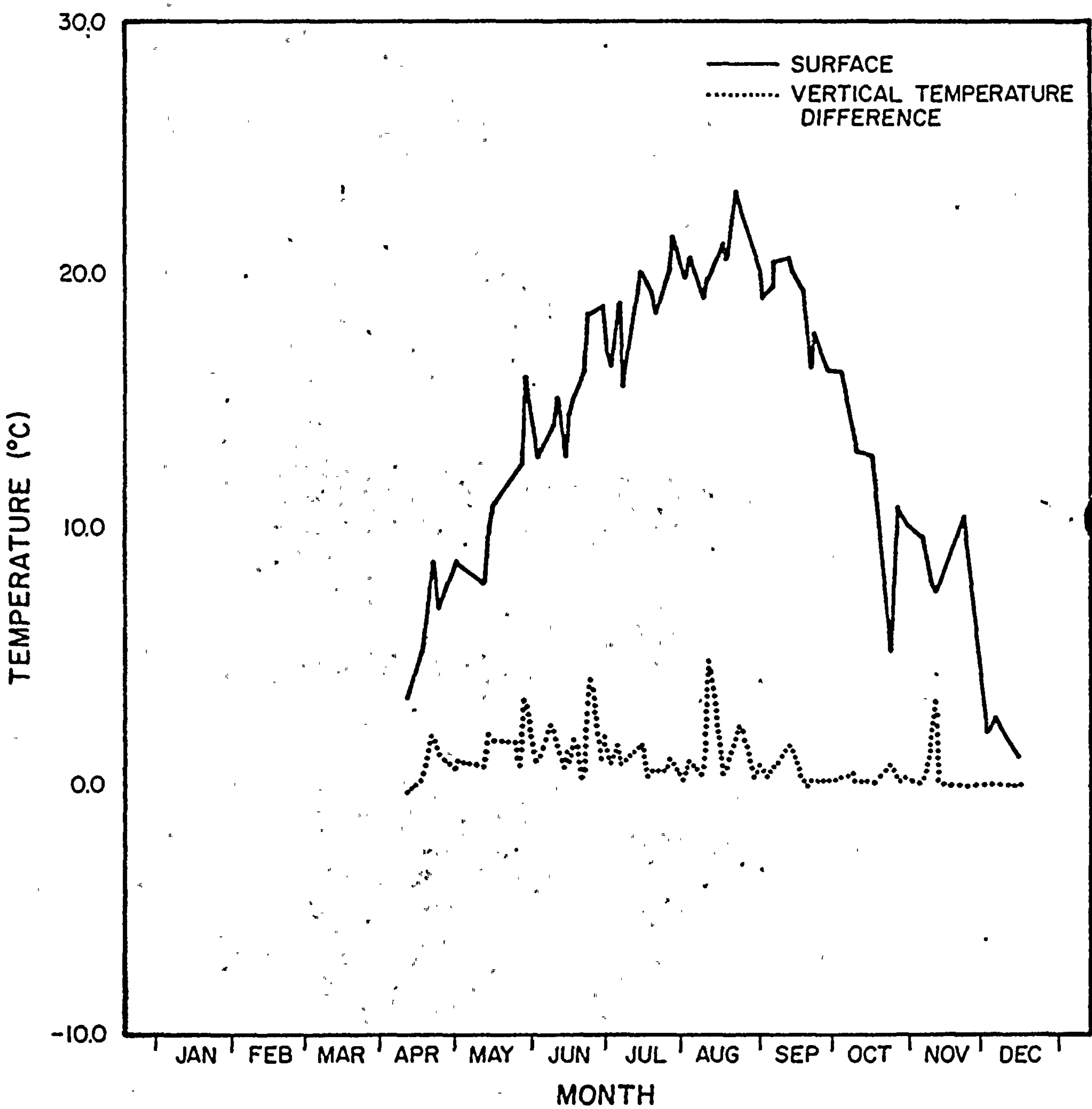
surface water temperatures. The analysis shows that temperatures in excess of 22.3 C (74 F) occurred only 10% of the time during the summer months and less than 1% of the time on an annual basis.

The natural seasonal progression of temperatures in the Nine Mile Point vicinity from mid-April through December 1976 is shown in Figures IIIC-4 and IIIC-5 for the 20 and 40-ft depth contours, respectively, at the NMPE transect. This transect was selected to represent the natural temperature cycle in the lake as it had the highest density of data over the year and is sufficiently distant from the Nine Mile Point and FitzPatrick discharges to minimize any influence of the thermal discharges. The degree of natural short-term variation in surface temperature and the vertical stratification imposed on the long-term seasonal temperature cycle is evident from both figures. Although the degree of variation in surface temperature is similar between the 20 and 40-ft locations, the magnitude of vertical stratification is consistently greater at the 40-ft depth contour as a result of increased insulation from surface warming and the greater effect of cold water masses intruding from the deeper areas of the lake. The maximum surface temperatures recorded at the 20 and 40-ft contours were 23.2 and 22.3 C on 23 and 25 August, respectively. Minimum surface temperature at both locations was 1.1 C during mid-December.

The plot of vertical temperature differences shows approximately ten occurences of cold water intrusions at the NMPE-40-ft station during the sampling period. Table IIIC-1 indicates the dates of these occurrences along with the approximate duration and magnitude of the stratification. Table IIIC-1 also identifies the cold water intrusions which affected the NMPE-20-ft station. Temperature effects at the 20-ft contour as a result of the intrusions were generally smaller than at the 40-ft contour along this transect.

TEMPERATURE AT NMPE 20-FT STATION

NINE MILE POINT VICINITY-1976

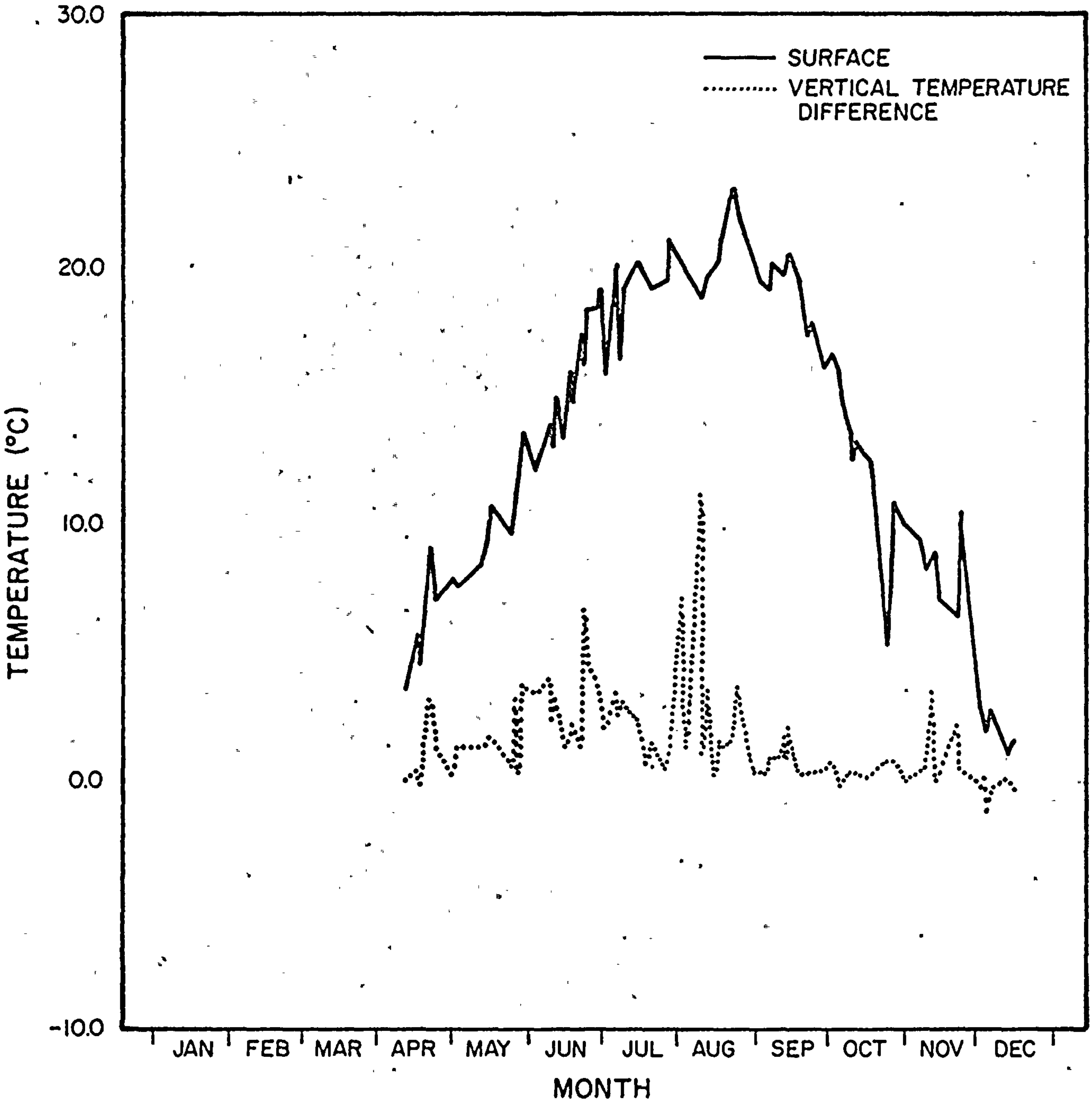


SURFACE TEMPERATURE = MEAN OF ALL SURFACE TEMPERATURES RECORDED WITH THE BIOLOGICAL SAMPLING PROGRAMS PER DATE

VERTICAL TEMPERATURE DIFFERENCE = DIFFERENCE BETWEEN THE MEAN SURFACE AND BOTTOM TEMPERATURES

TEMPERATURE AT NMPE 40-FT STATION

NINE MILE POINT VICINITY-1976



SURFACE TEMPERATURE = MEAN OF ALL SURFACE TEMPERATURES RECORDED WITH THE BIOLOGICAL SAMPLING PROGRAMS PER DATE

VERTICAL TEMPERATURE DIFFERENCE = DIFFERENCE BETWEEN THE MEAN SURFACE AND BOTTOM TEMPERATURES

TABLE IIIC-1

COLD WATER INTRUSIONS AT NMPE-20 AND 40-FT STATIONS

NINE MILE POINT VICINITY - 1976

DATE	APPROXIMATE DURATION (DAYS)	MAXIMUM OBSERVED STRATIFICATION AT NMPE-40 FT STATION (°C)	INTRUSION OBSERVED AT NMPE-20 FT STATION (x)
19 APR	1	3.2	x
28 MAY	1	3.7	x
2 JUN	8	5.4	x
22 JUN	8	6.9	x
7 JUL	2-7	3.0	
2 AUG	2	12.3	
10 AUG	1	11.2	x
25 AUG	2	2.6	x
16 SEP	2	1.9	x
15 NOV	1	3.4	x
26 NOV	1	1.5	

The largest observed intrusions at NMPE-40-ft station during the sampling year occurred on 2 and 10 August. The 2 August event apparently began about 26 July. A secondary intrusion also occurred on or about 25 August.

D. OTHER EXISTING WATER INTAKE STRUCTURES IN LAKE ONTARIO

1. Nine Mile Point Unit 1 (Niagara Mohawk Power Corporation)

Nine Mile Point Nuclear Station Unit 1, which has been in operation since 1969, uses a boiling water reactor to provide 610 MWe (net) of electrical power.

The cooling water for Unit 1 is taken from the lake into a hexagonal intake structure located in a water depth of approximately 5.5 m (18 ft), about 260 m (850 ft) from the shoreline. The flow characteristics are outlined in Table IIID-1, in which they are compared with those of the JAF station.

2. Oswego Water Supply (City of Oswego)

The water supply intake of the City of Oswego is located about a mile west of the Oswego STeam Station Unit 5 water intake, and some 1890 m (6200 ft) out into the lake, at a depth of 16.5 m (54 ft). Water withdrawal from the lake in 1970 was 17 MGD (26.30 cfs, 0.746 m^3/sec) for the City of Oswego and 36 MGD (55.70 cfs, 1.581 m^3/sec) for the Metropolitan Water Board of Onondaga County, a combined maximum capacity total of 53 MGD (82 cfs, 2.327 m^3/sec).

3. Oswego Steam Station Units 1-4 (Niagara Mohawk Power Corporation)

The Oswego Steam Station's Units 1-4 have a maximum output of 407 MWe. These units were constructed during the period from 1938 to 1956.

The cooling water for these units is taken from the lake at a point some 76.2 m (250 ft) north of the northwestern tip of the Oswego Harbor breakwater and 137.2 m (450 ft) southeast of the Oswego Unit 5 intake. A flow of up to 21.58 m^3/sec (762 cfs), when operating at the maximum capacity rating, is circulated through the condensers of the four units. Table IIID-1 shows some of the hydraulic characteristics of the intake of the existing units compared with JAF.

4. Oswego Steam Station Unit 5 (Niagara Mohawk Power Corporation)

The Oswego Steam Station Unit 5 has a maximum output of 850 MWe (net). This unit began operating during 1975.

The cooling water for this unit is taken from the lake into a hexagonal-shaped intake structure located in a water depth of 22 ft (6.71 m) about 365.8 m (1200 ft) from the shoreline. The flow characteristics are outlined in Table IIID-1.

5. Ginna Nuclear Station (Rochester Gas and Electric Corporation)

The Ginna Nuclear Station has a maximum design output of 490 MWe.

The cooling water for the Ginna station is drawn from the lake through a submerged intake structure which is located 945 m (3100 ft) from shore in 10 m (33 ft) of water. The intake characteristics are given in Table IIID-1.

6. Lennox Generating Station (Ontario Hydro)

The Lennox Generating Station, located 22 miles west of Kingston, Ontario, consists of four 550 MWe oil-fired units. Circulating water for all four units is withdrawn from the lake through a common

TABLE IIID-1

INTAKE CHARACTERISTICS FOR ELECTRIC GENERATING STATIONS ON LAKE ONTARIO*

PLANT NAME	DESIGN FLOW	VELOCITY AT LAKE INTERFACE	APPROACH VELOCITY AT TRAVELING SCREENS
James A. FitzPatrick	23.36 m^3/sec 825 cfs	0.37 m/sec 1.20 fps	0.28 m/sec 0.92 fps
Nine Mile Point Unit 1	17.98 m^3/sec 635 cfs	0.58 m/sec 1.90 fps	0.26 m/sec 0.85 fps
Oswego Steam Station Units 1-4	21.58 m^3/sec 762 cfs	0.53 m/sec 1.75 fps	0.79 m/sec 0.94 fps
Unit 5	17.98 m^3/sec 635 cfs	0.30 m/sec 1.00 fps	0.30 m/sec 0.97 fps
Unit 6	17.98 m^3/sec 635 cfs	0.30 m/sec 1.00 fps	0.30 m/sec 0.97 fps
Ginna Nuclear Station	25.00 m^3/sec 893 cfs	0.20 m/sec 0.65 fps	0.28 m/sec 0.80 fps
Lennox Generating Station	63.60 m^3/sec 2272 cfs	1.42 m/sec 4.65 fps	
Pickering Generating Station (4 Units)	120.40 m^3/sec 4300 cfs	0.40 m/sec 1.32 fps	0.24 m/sec 0.77 fps
Hearn Generating Station	47.00 m^3/sec 1679 cfs	0.46 m/sec 1.50 fps	0.46 m/sec 1.50 fps
Lakeview Generating Station	65.90 m^3/sec 2353 cfs	0.3-0.6 m/sec 1.00-2.00 fps	0.67 m/sec 2.20 fps

*Based on maximum design flow

submerged intake structure located in approximately 7.6 m (25 ft) of water 311 m (1020 ft) offshore. The intake characteristics of the Lennox station are given in Table IIID-1.

7. Pickering Generating Station (Ontario Hydro)

The Pickering Generating Station is comprised of four 540 MWe nuclear units. The station is located on Lake Ontario in Pickering Township, Ontario, east of Toronto. Circulating water for all four units is withdrawn from the lake through an intake canal formed by two artificial groins which extend approximately 305 m (1000 ft) into the lake to a water depth of approximately 4.6 m (15 ft). The intake characteristics for the Pickering station are given in Table IIID-1.

8. Lakeview Generating Station (Ontario Hydro)

The Lakeview Generating Station, located on Lake Ontario at Toronto, is a 2400 MWe fossil-fueled plant which began operation in 1968. Circulating water for the plant is withdrawn from the lake through an intake canal formed by groins extending 610 m (2,000 ft) from shore. The intake characteristics for the Lakeview Generating Station are given in Table IIID-1.

9. Hearn Generating Station (Ontario Hydro)

The Hearn Generating Station is a fossil-fueled plant located just east of Toronto, Ontario which began operation in 1961. The station has an onshore intake, with a water depth of approximately 9.2 m (30 ft). The intake characteristics for the Hearn station are given in Table IIID-1.

IV. SITE BIOLOGY AND CONDITIONS RELATED TO PLANT IMPACTS

A. INTRODUCTION

The occurrence of such changes in the aquatic community that may result from the withdrawal of water for use in once-through cooling is determined in part by assessing the abundance, distribution, trophic relationships, and the dynamic aspects of the aquatic biota of the withdrawal water bodies. Studies of composition, diversity, and type of community associations in natural and intake-affected aquatic regions are used to delineate the degree of response of the aquatic organisms to a possible stress. In this chapter, an assessment of four major biological groups present in the vicinity of JAF is presented along with a discussion on the integrity of the biological community. Where appropriate, emphasis has been placed on those species selected as representative important species.

Aquatic ecological studies have been conducted in the vicinity of JAF and NMP-1 since 1969; aquatic monitoring programs continue in accordance with the NRC requirements. The programs conducted by LMS (QLM 1973, 1974; LMS 1975, 1976, 1977) in the Nine Mile Point area have consisted of surveys of plankton (phytoplankton, zooplankton, and ichthyoplankton), benthos, and fish populations during the spring through fall periods at various depths and transect locations. Impingement and entrainment of nektonic and planktonic populations were also monitored at the stations' intakes. Each trophic level of the community within the vicinity of Nine Mile Point is discussed in the following sections. Other studies were conducted in the study area by McNaught and Fenlon (1972), McNaught and Buzzard (1973), Storr (1973), and Lake Ontario Environmental Laboratory (LOTEL) (RGE 1974).

The following analysis is based on data collected through March of 1977, with emphasis on the 1976-1977 data since this period includes the first full year of operation at JAF. A presentation of the 1976 data (LMS 1977) has been submitted as part of this submittal. References to the 1976 data contained in the annual report (LMS 1977) contain the text page, table number(s), or figure number(s) in which the cited information may be found.

B. SELECTION OF IMPORTANT REPRESENTATIVE SPECIES

1. Rationale

The purpose of selecting important representative species is to permit an assessment of plant effects on the ecosystem without resorting to a study of numerous species at each trophic level. The species selected are considered characteristics of the ecosystem; therefore, an assessment of plants effects on these species provides an assessment of ecosystem effects.

The Regional Administrator, after consulting with the Commissioner of New York State Department of Environmental Conservation, the Secretary of Commerce and the Secretary of Interior, selected the following species as Representative Important Species for the James A. FitzPatrick Nuclear Power Plant (letter from Mr. Gerald Hansler to Mr. George Berry dated August 11, 1975).

1.	Alewife	*Alosa pseudoharengus*
2.	Brown trout	*Salmo trutta*
3.	Coho salmon	*Oncorhynchus kisutch*
4.	Rainbow smelt	*Osmerus mordax*
5.	Smallmouth bass	*Micropterus dolomieui*
6.	Threespine stickleback	*Gasterosteus aculeatus*
7.	Yellow perch	*Perca flavescens*
8.	*Gammarus fasciatus*	

Four criteria were used to aid in the selection of important representative species as required for the 316(a) demonstration for the James A. FitzPatrick Plant. The criteria were: (1) the species is important for a recreational or commercial fishery, (2) the species is numerically abundant or represents a major portion of the biomass of its trophic level, (3) the species is important because its existence in the lake is endangered or it is a nuisance, (4) the species has an important functional role in the ecosystem.

The sources of information which were used include: (1) published literature regarding the biology of a given species; (2) determinations of importance to the ecosystem based on biological and plant monitoring programs which have been conducted in the Nine Mile Point/Oswego area since 1963; and (3) design features, location, and predicted plumes of the thermal discharge which may impact on the distribution and abundance of the selected species. The important representative species are given below with the rationale for inclusion of each species in the list.

a. Alewife

The alewife was selected as a representative species because it is numerically abundant, a major portion of the total fish biomass, an important forage species for valuable recreational fishes, at times a nuisance, and a potentially important commercial species. Alewife was the dominant species in the vicinity of Nine Mile Point and in impingement sampling from 1973 through 1975. In 1975, it made up 75% of the annual lake catch (all gears combined) and 79.6% of the total number of fish collected during annual impingement monitoring. In 1976 it made up 56.7% of the lake catch and 89.9% of the impinged fish. This species is the forage base for a number of recently introduced salmonids and constitutes a portion of the diet of all large piscivorous

fishes in Lake Ontario. Annual spring and summer die-offs of alewives have clogged water intake systems and fouled shoreline areas with rotting carcasses. The alewife is not commercially exploited in Lake Ontario.

b. Brown Trout and Coho Salmon

The brown trout and coho salmon were selected because they are important recreational species; and are among several salmonids being stocked in large numbers by the State of New York and the Province of Ontario. These two species, along with other salmonids, feed heavily on alewives and thereby convert a nuisance species into a useful resource. Although salmonids are presently collected in low numbers in lake and impingement sampling, their recreational value, as well as their relationship to the alewife, has led to their inclusion as representative species.

c. Rainbow Smelt

The rainbow smelt was selected for the representative species list because it is numerically abundant and represents a major portion of the total fish biomass of the lake. Smelt are harvested commercially in Lake Ontario and formerly supported a sport fishery on the Canadian side of the lake. The rainbow smelt increased in abundance dramatically in the late 1940's and may have important ecological relationships with other lake species. It is collected in substantial numbers in lake and impingement sampling at Nine Mile Point and at the FitzPatrick plant.

d. Smallmouth Bass

The smallmouth bass is an important sport fish and an important piscivore in the nearshore are of the lake. Smallmouth bass were collected in small numbers compared to alewife, although they are found in the nearshore area and in impingement collections.

e. Threespine Stickleback

The threespine stickleback is listed as a representative species because it is important as forage for many piscivores, very abundant in the nearshore area, and collected in relatively large numbers in impingement collections at Nine Mile Point and at the FitzPatrick plant. Threespine stickleback spawn in the Nine Mile Point area.

f. Yellow Perch

The yellow perch was chosen as a representative species because it is important for sport and commercial fisheries and abundant in the nearshore area. Christie (1973) felt that the increased commercial catch of this species indicates a substantial increase in its abundance in the eastern end of Lake Ontario. It is collected in substantial numbers in lake and impingement sampling at Nine Mile Point and FitzPatrick, and there is evidence of a minimal amount of spawning in the Nine Mile Point area.

g. *Gammarus* sp.

Gammarus sp., an amphipod, is considered representative of the benthic invertebrates that are important forage for the young

and adults of many fish species. Several species of _Gammarus_ are found in Lake Ontario with _Gammarus fasciatus_ the most abundant. Unlike most benthic invertebrates, _Gammarus_ is quite mobile and migrates upward away from the bottom. It is thus entrained into the cooling system of the Nine Mile Point and FitzPatrick plants (LMS 1975) and into the discharge plumes.

h. Threatend and Endangered Species

Lists of threatened and endangered species are published by the U.S. Department of the Interior. A review of these publications, current issues of the Federal Register, and technical literature indicates that the following species from Lake Ontario are considered threatened, endangered, or rare:

Lake sturgeon (_Acipenser fulvescens_)
Blue pike (_Stizostedion vitreum glaucum_)
Kiyi (_Coregonus kiyi_)
Blackfin cisco (_Coregonus nigripinnis prognathus_)
Shortnose cisco (_Coregonus reighardi_)

None of these fishes have been collected at the plants in the vicinity of either Nine Mile Point or Oswego in the course of the extensive biological monitoring programs of the last five years (1972 to 1976). A discussion of the decline in abundance of the species listed above may be found in Christie (1973).

2. Life Histories of Representative Species

a. Alewife (_Alosa pseudohorengus_)

The alewife is an anadromous species that spends most of its adult life in marine waters and returns to fresh water to spawn. It occurs from Newfoundland to North Carolina (Scott and

Crossman 1973), and, in addition, is landlocked in many lakes along its range, including Lake Ontario.

In Lake Ontario, adult alewives reside in the open lake and migrate inshore during the spring and summer to spawn in streams or in nearshore shallow water areas with sand and gravel bottoms. During the spring spawning season, the greater numbers of alewives move inshore at night; a decrease in alewife abundance in the spawning areas during the day indicates the occurrence of short diurnal migrations near the spawning grounds. Spawning occurs at 16-28 C (60.8-82.4 F). The freshwater female may lay from 10,000 to 22,400 eggs (Odell 1934; Norden 1967). Mansueti (1956) noted that the eggs are broadcast at random and are demersal, essentially nonadhesive. The hatching period ranges from 48 to 96 hours at 22 C (71.6 F) and increases to six days at 15.5 C (59.9 F) (Rounsefell and Stringer 1943). More detailed temperature data appear in Appendix A.

Following spawning, the adults move offshore into deeper waters during August and overwinter there until March (Graham 1956). Christie (1973) noted offshore migrations of alewives to depths of 35 m (120 ft) during the late summer. Summer lethal threshold temperatures range from 3 C (5.4 F) above acclimation to a temperature of 32 C (89.6 F).

Like adults, juvenile alewives migrate inshore during the spring and undertake diurnal movements while inshore. They may be found in shallow water at night and on the bottom in 2-3 m (6-10 ft) of water during the day (Scott and Crossman 1973). Odell (1934) noted that in Seneca Lake, New York, alewife fry migrate to mid-depth lake waters during the fall and winter. Graham (1956) also indicated that young-of-the-year alewives

remain near the spawning grounds until the late larval stage; they then migrate to shallow protected areas prior to movement into deep water. The young may attain a length of 51-75 mm by the fall (Scott and Crossman 1973).

In a study of alewife growth in Lake Ontario, Graham (1956) noted that alewives experience an early period of rapid growth, the rate of which decreases with the onset of sexual maturity at age 2 for males and age 3 for females. Pritchard (1929) reported that females grow faster than males and attain a greater size throughout their life. The adult alewife are filter-feeders and prey principally on zooplanktonic organisms such as cladocerans, copepods, ostracods, and mysids; in fresh water they therefore compete with the indigenous forage fish species for food. Alewives are also an important food source for large piscivorous fish such as lake trout, burbot, and salmon. Since its introduction into Lake Ontario during the 1800's, the alewife has increased substantially in abundance.

b. Brown Trout (*Salmo trutta*)

The brown trout is native to Europe and western Asia. It was introduced into North American waters during the 1800's and may be found throughout the Great Lakes region and the northeast coast of the United States (Scott and Crossman 1973). This species is annually stocked in the New York portion of Lake Ontario by the New York State Department of Environmental Conservation.

Brown trout usually spawn during late autumn/early winter; in one study, Mansell (1966) noted that brown trout spawned during mid-October through early November in Ontario Province when

water temperatures ranged from 6.7-8.9 C (44.1-48.0 F). Spawning usually takes place in the shallow headwaters of streams over a gravel bottom, although Eddy and Surber (1960) observed that many spawned on rocky reefs along the shore of Lake Superior. The number of eggs deposited by a spawning female trout is proportional to her size: the larger females deposit more eggs.

Age and growth studies of Lake Ontario brown trout indicated that individuals of this species may live for 13 years (Marshall and MacCrimmon 1970); brown trout reached a length of 427 mm at age 4 (Mansell 1966). Brynildson et al. (1963) noted that the optimum temperature range is 18.3-23.9 C (64.9-75.0 F). Brown trout feed upon a broad spectrum of aquatic organisms including insects, crayfish, salamanders, molluscs, and other fishes. Smaller trout may be consumed by large brown trout which may, in turn, be preyed upon by mergansers (diving ducks).

c. Coho Salmon (*Oncorhynchus kisutch*)

The coho salmon is an anadromous species which occurs naturally in the Pacific Ocean and in rivers and streams which drain northwestern North America. Attempts to establish the coho salmon in the Great Lakes were unsuccessful until the 1960's when there were reports of limited natural reproduction occurring in Michigan (Scott and Crossman 1973). In New York State, the New York State Department of Environmental Conservation annually stocks coho salmon in tributary streams of Lake Ontario.

The spawning runs of the coho in the Great Lakes take place from September to early October, although actual spawning occurs from October to November or from November to January, depending upon

the spawning run (Scott and Crossman 1973). Swift-running tributaries with gravel bottoms are usually selected as the spawning site.

The number of eggs deposited by the females varies with size of the female, location, and year. The adults die shortly after they spawn. Eggs hatch during the spring in 35-50 days, depending upon the water temperature. The yolk sac is absorbed by the alevins during a 2-3 week period as they remain in the gravelly stream bottom. When fry emerge, which may occur from March to July, some individuals will migrate to the sea or open lake, although most fry remain in freshwater streams or tributaries for a one-year period. Schools of salmon migrate to the ocean or lake during the spring of the year following emergence. The majority of the migratory population spends about 18 months in the lake or at sea and returns to spawn at age 3 or age 4 during the fall (Scott and Crossman 1973).

The coho have lethal thermal thresholds of at least 2 C (3.6 F) above acclimation temperature, up to 25 C (77.0 F). In fresh water, the young cohos feed upon insects, oligochaetes, and the young of chub and pink salmon. Large coho salmon prey primarily upon rainbow smelt and alewives; they, in turn, are prey for large birds and mammals including man, as well as the sea lamprey.

d. Rainbow Smelt (*Osmerus mordax*)

The original range of the rainbow smelt in eastern North America was restricted to the Atlantic coastal drainage basin from New Jersey to Labrador; whether or not the smelt is native to Lake Ontario is uncertain. Hubbs and Lagler (1958) believe that it

is, whereas Scott and Crossman (1973) are of the opposite opinion. In either case, the first report of rainbow smelt taken from Lake Ontario was in 1931 by Mason (1933). They now occur in all of the Great Lakes and in many other Canadian and United States lakes. The smelt is an anadromous species, leaving the sea or large lakes in spring to spawn in freshwater streams. In Lake Ontario, spawning often occurs along the lake edge in shallow water on gravel shoals; Rupp (1965) believes that shore spawning may be as successful as stream spawning. Spawning runs of ripe smelt begin in March and continue through May (McKenzie 1964). In Lake Ontario, spawning runs do not occur until water temperatures rise at least to 8.9 C (48 F) and the runs do not continue at temperatures warmer than 18.3 (65 F).

Spawning occurs at night and the spawners move downstream to the lake during the day (Bailey 1964). Smelt eggs are demersal, adhesive, and attach to bottom gravel. The number of eggs deposited is dependent upon the size of the female, ranging in number from approximately 8,000-30,000 (Scott and Crossman 1973).

The smelt are a schooling, pelagic species and inhabit streams only during the spawning period. They are sensitive to temperature and light and remain in deep, bottom waters during the day.

Smelt are carnivorous and prey upon a variety of organisms including insects, oligochaetes, crustaceans, and other fish. Smelt are, in turn, preyed upon by lake trout, walleye, perch, salmon and a variety of birds.

e. Smallmouth bass (*Micropterus dolomieui*)

Smallmouth bass are distributed in North America from southern Canada to Alabama, and west to Oklahoma (Hubbs and Lagler 1958). Spawning occurs in streams or shallow bays from May through July usually over a period of 6-10 days. Spawning activities commence when temperature is in the range of 12.8-20.0 C (55.0-68.0 F) egg deposition occurs primarily at 16.1-18.3 C (61.0-65.0 F) (Scott and Crossman 1973). The male builds a nest on a gravel or rocky bottom usually near the protection of rocks or dense vegetation. The number of eggs deposited varies with the size of the female, ranging from 5,000-14,000. Smallmouth bass eggs are demersal, adhesive, and attach to stones in the nest. Hatching takes place over a period of 4-10 days in Canadian waters (Scott and Crossman 1973).

Initially, growth is rapid, whereas growth of older fish is variable; reported landings include a female 13 years old, 584 mm in fork length. Males attain sexual maturity in their third to fifth year; females mature in their fourth to sixth year of life.

Diet and seasonal movements occur partly in response to ambient temperature fluctuations. Adults are found in shallow water on the spawning grounds during the spring; with the onset of summer temperatures, they move to greater depths. Studies have indicated that tagged fish undertake limited migrations of 0.8-8.0 km (0.5-5 miles) from the place of capture; some males have been observed to return to the vicinity of the nest in subsequent years during the spawning season. During the winter, smallmouth bass congregate near the bottom and are relatively inactive.

The diet of smallmouth bass varies with age. Bass prey upon plankton and immature insects during early life, whereas adult bass include crayfish and a variety of fish in their dietary spectrum. Predators that feed upon bass eggs and fry include yellow perch, catfish, gar pike, sunfish, and turtles. (Scott and Crossman 1973.)

A total of 126 smallmouth bass were tagged at Nine Mile Point from 1972 to 1976 (Storr 1977). Limited data on movements and distribution were obtained from the 19 tags returned. The majority of tag returns were from a short distance from the point of tagging, generally within 10 miles. Two fish moved to the mouth of the St. Lawrence River, a distance of at least 50 miles. There was no consistent pattern of movement discernable in the data.

f. Threespine Stickleback (*Gasterosteus aculeatus*)

The threespine stickleback is widely distributed in fresh and marine waters of North America. It ranges from Chesapeake Bay north to the Hudson Bay region.

The threespine stickleback spawns during the summer (June-July) in fresh water, building its nest in shallow, sandy areas (Scott and Crossman 1973). The male entices the female to the nest by a distinctive courtship display; eggs are then laid in clusters and are adhesive to each other. Breder and Rosen (1966) stated that hatching occurs in 7 days at 19 C (66.2 F). The males tend the eggs and the young for several days after hatching.

Growth is rapid during the first year, but slows during the second year of life, with a maximum size of 102 mm attained in

fresh water. Sexual maturity is attained during the first year and the individuals probably do not live longer than 3-1/2 years.

A voracious feeder, the threespine stickleback consumes various annelids, crustaceans, insects, and eggs and larvae of fish. They, in turn, are preyed upon by fish-eating birds as well as by larger fish including trout and salmon, and therefore, serve as an important forage species.

g. White Perch (*Morone americana*)

Although white perch is not a representative important species, a life history is given since the species is discussed in the submission.

White perch occur along the Atlantic coast of North America from New Brunswick, Prince Edward Island, and Nova Scotia to South Carolina. This species has been introduced into Lake Ontario and is common in the Hudson River below Albany, New York (Scott and Crossman 1973).

In Lake Ontario, the white perch spawns during the spring from mid-May through June (Sheri and Power 1968). Water temperatures during the spawning period range from 11-15 C (51.8-59.0 F). Spawning usually takes place over a period of 1-2 weeks with successive releases of eggs during this time (Mansueti 1961). Spawning is accomplished over a variety of substrates. The eggs are adhesive and attach to rocks, vegetation and debris. The number of eggs spawned is dependent upon the size of the female and may range from 20,000-300,000 (Scott and Crossman 1973). Hatching is controlled by ambient water

temperature and ranges from approximately 4 days at 15 C (59.0 F) to 30 hours at 20 C (68.0 F). Thoits (1958) indicated that the young attained a length of 40-65 mm by July and August.

White perch growth rates vary with region and population. Landlocked populations, such as Lake Ontario white perch, exhibit a slower growth rate. Sex differences are also indicated with respect to growth: females appear to be, on the average, slightly larger than males.

Diurnal migrations have been noted for white perch, which appear to move to offshore waters during the night. Sheri and Power (1968) also observed migration to the surface at night and a descent to deeper waters during the daylight hours.

The diet of freshwater populations is composed of insects, (especially chironomids) crustaceans, annelids, molluscs, and fish. Fish, including such species as yellow perch, johnny darter and white perch, represent a signficant portion of the diet of large white perch.

h. <u>Yellow perch</u> (<u>Perca flavescens</u>)

There is some question as to whether there are one, two, or three separate species of yellow perch-like fish in the Northern Hemisphere. In any case, the yellow perch and its sister species or sub-species have a circumpolar distribution in fresh water. In North America, the yellow perch occurs from Nova Scotia south along the Atlantic coast, previously to South Carolina, but now apparently to Florida and Alabama.

The yellow perch is a commerically valuable species throughout its range, and consequently there is considerable literature on

various aspects of its life history. These fish are considered very adaptable because of the wide range of habitats in which they are found, including warm to cooler areas from large lakes to ponds, or quiet rivers. They are most abundant in the open water of large lakes with moderate vegetation (Scott and Crossman 1973). Yellow perch are usually considered shallow water fishes and are usually not collected in water depths below 9.2 m (30 ft).

Both the young and adults form loose aggregations of 50 to 200 individuals segregated by size. The groups of young are found in shallower water and nearer shore than adults. Individuals of schools of adults are close together in summer and more separate in winter (Scott and Crossman 1973).

Scott (1955), Hergenrader and Hasler (1968), and Muncy (1962) found that yellow perch undertake a spring migratory movement. Storr (1973) reported that, in the southeastern portion of Lake Ontario, migratory movements to the spawning ground occurred in the winter. In addition, movements inshore and out, vertical diel movements, and seasonal movements into and out of deeper water have been reported. These latter movements are probably responses to temperature and distribution of food. In the Bay of Quinte, Lake Ontario, yellow perch make yearly spring movements in large numbers to the spawning grounds (Griffiths 1974).

Everest (1973) found at the Hearn Generating Station on Lake Ontario that yellow perch were concentrated in the plume area as compared to a control area, especially during October. Yellow perch were found only from June to November. During October they were collected at temperatures of from 13-22 C (55.4-71.6 F) at a time when ambient temperatures were around 9-11 C

(55.4-71.6 F) at a time when ambient temperatures were around 9-11 C (48.2-51.8 F). The final temperature preference for the species has been experimentally determined at 21-24 C (69.8-75.2 F) (Ferguson, 1958). Data from the vicinity of Nine Mile Point do not support the results obtained by Everest (1973). Statistical tests show no significant differences in yellow perch abundance near the surface (where the buoyant plume exists) or at the plant transect as compared to controls in 1974 (LMS 1975).

Sheri and Power (1968) estimated the fecundity of yellow perch in the Bay of Quinte, Lake Onatario, to range from 3,035-61,465 eggs for fish 131-257 mm long. Muncy (1962) reported that the fecundity of yellow perch in the Severn River varied from 5,900 eggs for a fish 173 mm in length to 109,000 eggs for one 358 mm long. Mean egg production for 20 fish ranging in size from 173-295 mm was 17,940 eggs while 5 larger females 302-358 mm had a mean egg production of 32,200 eggs.

Between 1972 and 1976, 4,107 yellow perch were tagged in the vicinity of Nine Mile Point to determine the distribution and movements of this species (Storr 1977). Returns from 538 fish showed regular seasonal movements between the Nine Mile Point area and the eastern end of Lake Ontario. During fall, yellow perch moved eastward from Nine Mile Point and concentrated in the area of Sandy Pond where they overwintered and probably spawned the following spring. In spring they moved westward along the south shore of the lake and were recaptured in the Nine Mile Point area from June through September. The lake sampling in the Nine Mile Point vicinity indicated peak abundance of yellow perch from July through September.

The tagging data indicate that some individuals do not follow the migratory pattern described above and travel great distances from Nine Mile Point. A perch traveled as far west as the mouth of the Genessee River, approximately 63 shoreline miles and another fish moved north to the Canadian side of the lake at the mouth of the St. Lawrence River, more than 50 shoreline miles. The total shoreline range covered by yellow perch tagged at Nine Mile Point was in excess of 110 miles.

i. Gammarus fasciatus

The amphipod Gammarus fasciatus is widely distributed in the fresh waters of North America. Its range extends from the Caribbean seacoast north to the St. Lawrence River System, and from the Atlantic coastal area as far west as the Mississippi River (Clemens 1950).

Clemens (1950), in describing the reproductive cycle of G. fasciatus, noted that the sexes are separate and that reproduction is entirely sexual. Males are longer at the attainment of sexual maturity than females, for which the size at maturing varies with the temperature; at 6 C (42.8 F) females mature at 8.8 mm, while at 26 C (78.8 F) they mature at 5.4 mm. Egg production is positively correlated with body length and season. Clemens (1950) observed that the average monthly egg production per female decreased from April to September; the average number of eggs per female for the entire season was seventeen. Mature females lay eggs subsequent to each adult molt, and copulation occurs just subsequent to moulting, during ovulation, and for a short time afterward. The proximity of the two sexes at the time for fertilization is ensured by the act of pairing, whereby the male carries the female until copulation is completed.

During incubation the fertilized eggs are carried in a brood pouch or marsupium under the female. The incubation period depends on temperature; at constant temperatures of 24, 22, 20, 18 and 15 C (75.2, 71.6, 68.0, and 59 F) incubation lasted 7, 8, 9, 14, and 22 days, respectively. The maximum number of incubation periods or broods produced per female per year was estimated to be seventeen in Lake Erie. However, the actual number of broods produced per female is probably between five and eleven.

Immature gammarids reached maturity after seven molts (Clemens 1950), with the interval between molts decreasing with increased temperature. In the laboratory at 21 C (69.8 F), gammarus young required 42 to 53 days to reach maturity, whereas at temperatures varying from 14 to 22 C (57.2 to 71.6 F) young achieved maturity in 66 to 85 days.

An omniverous feeder, Gammarus fasciatus devours living and dead plant and animal matter, and may prey on such zooplankton as Daphnia, Leptodora and copepods (Clemens 1950). It also eats benthic organisms such as insect larvae, oligochaetes, and small isopods (Burbanck, personal communication 1972); in addition, male gammarids in particular are cannabalistic. G. fasciatus plays an important role in the trophic structure of many aquatic environments since it is in turn consumed extensively by a wide variety of fish and invertebrate predators (Scott and Crossman 1973; QLM 1974; LMS 1975).

Pentland (1930) observed that it is capable of enduring high temperatures. New York University (1975) observed that Gammarus sp. acclimated at 25 C (77 F) suffered no mortality when exposed for 1 hour to a temperature of 35.6 C (96 F); 92% of the organisms exposed to a temperature of 37 C (99 F) for 1 hour died within 24 hours.

C. PHYTOPLANKTON

1. Community Description

a. Species Composition and Abundance

(i) Lake Ontario and Nine Mile Point Vicinity

Phytoplankton, which are microscopic, free-floating plants distributed throughout the water column, play an essential role in the energy flow through the Lake Ontario ecosystem. Phytoplankton succession in the surface waters of Lake Ontario has been documented by Munawar and Nauwerck (1971) and Vollenweider et al. (1974). They reported that diatoms generally dominate the phytoplankton from January through May; their subsequent decrease in June is accompanied by an increase in dinoflagellates, cryptophytes, and chrysophytes. The phytoplankton, during July and August, are dominated by either green or blue-green algae. From September to December diatoms increase while other algae decrease in importance. The succession of phytoplankters in nearshore waters of Lake Ontario generally parallels that in offshore waters, with apparent differences between the two communities related to the influence of the thermal bar and meteorological conditions.

During 1976, the phytoplankton community in the Nine Mile Point vicinity of Lake Ontario was monitored monthly from April through December at 16 stations located from the 10 to 60-ft depth contour (Figure IVC-1); species composition, abundance and biovolume, chlorophyll a concentration, and primary productivity (C-14) were recorded. Whole water

PLANKTON SAMPLING STATIONS
NINE MILE POINT VICINITY – 1976

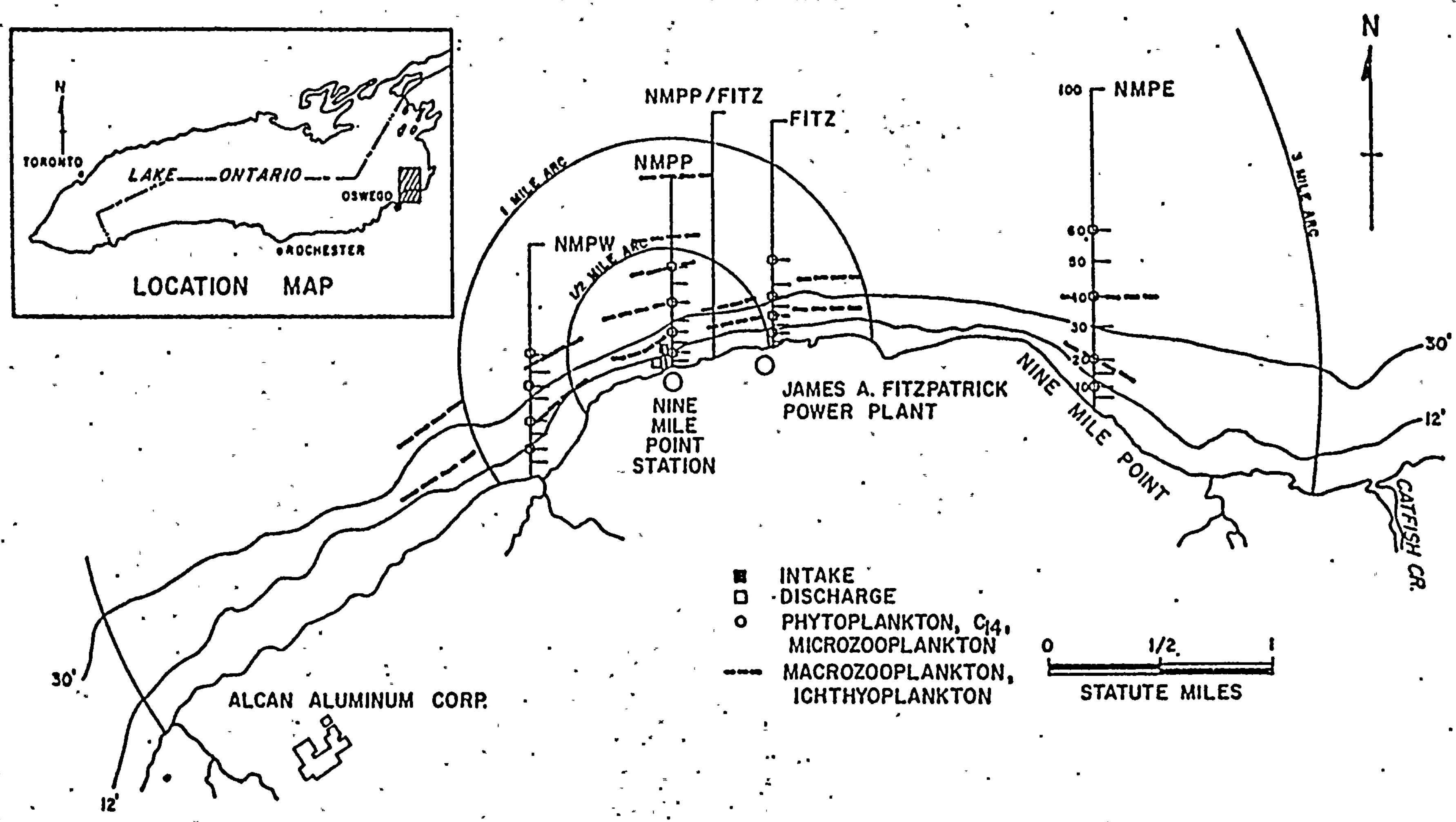


FIGURE IVC-1

samples were collected with PVC Van Dorn samplers from just below the water surface at all 16 sample locations and at specific light transmittance levels (i.e., 50, 25, and 1% light transmittance levels) at only the NMPE-40-ft station. The 50% light level samples were collected 0.2 to 0.5 meters below the surface, the 25% light level samples 0.5 to 2.0 meters below the surface, and the 1% light level samples 3.0 to 12.0 meters below the surface. Eight of the nine collections were made during near-maximum plant load operating conditions at the FitzPatrick station. Samples were analyzed for species composition, abundance and biovolume, following the Utermohl method (Utermohl 1958; Lund et al. 1958). Chlorophyll a concentrations were measured following the method outlined in Golterman (1971). C-14 uptake (primary productivity) was determined following the procedure of Vollenweider et al. (1974) and APHA (1976): two light and one dark bottles were incubated at a constant 1000 foot-candles and at ambient lake temperature for four hours.

The phytoplankton community in the Nine Mile Point vicinity was represented by the following taxa: Myxophyceae (blue-green algae), Chlorophyceae (green algae), Euglenophyceae, Chrysophyceae, Bacillariophyceae (diatoms), Cryptophyceae, and Dinophyceae. The occurrence of phytoplankton by date during 1976 is presented in Tables IVC-1 and IVC-2. The greatest number of taxa identified belonged to the Class Chlorophyceae; however, the Class Myxophyceae comprised the greatest percentage of the phytoplankton community (approximately 34-68% by abundance) on seven of the nine collection dates (Table IVC-3).

OCCURRENCE OF PHYTOPLANKTON BY DATE

NINE MILE P[illegible] VICINITY - 1976

TAXON	30 APR	27 MAY	17 JUN	28 JUL	26 AUG	23 SEP	19 OCT	16 NOV	14 DEC
MYXOPHYCEAE									
ANACYSTIS SP.						X			
ANACYSTIS AERUGINOSA				X	X	X			
ANACYSTIS INCERTA				X					
APHANOCAPSA DELICATISSIMA					X	X	X	X	
CHROOCOCCUS LIMNETICUS						X	X	X	
CHROOCOCCUS MINUTUS					X				
CHROOCOCCUS DISPERSUS	X	X	X	X	X	X	X	X	X
CHROOCOCCUS DISPERSUS VAR. MINOR	X	D	D	D	D	D	D	D	X
COELOSPHAERIUM KUETZINGIANUM					X	D	D	X	D
COELOSPHAERIUM NAEGELIANUM			X		X	X	X	X	X
GOMPHOSPHAERIA LACUSTRIS	X	X	X		X	X	X	X	X
MERISMOPEDIA TENUISSIMA			X	X	X	X		X	
SYNECHOCCUS SP.						X			
MARSONIELLA ELEGANS			X						
LYNGBYA LIMNETICA						X	X		X
LYNGBYA MAJOR						X			
OSCILLATORIA SP.									X
OSCILLATORIA AGARDHII			X	X		X	X	X	X
OSCILLATORIA LIMNETICA	D	D	D	X	X	X	D	D	X
OSCILLATORIA TENUIS						X	X		
OSCILLATORIA GEMINATA			X			X		X	
OSCILLATORIA MINIMA				X		X			X
OSCILLATORIA AMPHIBIA		X	X	X	X	X	X		
PHORMIDIUM SP.			X				D	D	D
PHORMIDIUM MUCICOLA				X					
RHAPHIDIOPSIS SP.				X	X	X	X	X	
ANABAENA SP.	X	X	X	X	X		X		
ANABAENA CIRCINALIS					X	X		X	X
ANABAENA FLOS-AQUAE					X		X	X	X
ANABAENA SPIROIDES					X	X			
ANABAENA PLANCTONICA					X	X			
APHANIZOMENON FLOS-AQUAE		X	X	X	X	D	X	X	X
CHLOROPHYCEAE									
CARTERIA SP.		X			X	X	X	X	X
CARTERIA CORDIFORMIS	X	X		X	X	X	X	X	
CHLAMYDOMONAS SP.	X	X	X	X	X	X	X	X	X
CHLAMYDOMONAS GLOBOSA	X								
EUDORINA ELEGANS	X	X		X	X	X	X	X	X

TABLE IVC-1 (CONT)

TAXON	DATE 30 APR	27 MAY	17 JUN	28 JUL	26 AUG	23 SEP	19 OCT	16 NOV	14 DEC
CHLOROPHYCEAE(cont.)									
PANDORINA MORUM		X	X	X	X	X	X	X	
PEDINOMONAS MINUTISSIMA	X	X							
LOBOMONAS AMPLA				X					
POLYTOMA SP.			X				X	X	X
POLYTOMA MICROSPHAERICUM	X								
POLYTOMA GRANULIFERUM	X	X	X			X	X	X	X
GYROMITUS SP.						X	X		
POLYTOMELLA SP.	X	X							
ELAKOTOTHRIX GELATINOSA								X	
GLOEOCYSTIS SP.		X							
GLOEOCYSTIS GIGAS				X	X	X	X		X
GLOEOCYSTIS PLANKTONICA								X	
SPHAEROCYSTIS SCHROETERI		X	X	X	X	X	X	X	X
TETRASPORA LACUSTRIS		X	X	X	X	X	X		
GEMINELLA MUTABILIS								X	
ULOTHRIX SP.								X	X
ULOTHRIX SUBTILISSIMA							X		
OEDOGONIUM SP.		X	X		X	X	X	X	X
MOUGEOTIA SP.	X	X	X	X	X	X	X	X	X
CLOSTERIUM SP.		X	X		X	X	X	X	X
CLOSTERIUM ACICULARE	X	X	X	X	X	X	X	X	X
CLOSTERIUM VENUS					X	X			
CLOSTERIUM GRACILE						X	X	X	X
COSMARIUM SP.		X	X	X	X	X	X	X	X
STAURASTRUM SP.	X		X	X	X	X	X	X	X
ACTINASTRUM HANTZSCHII	X	X	X	X	X	X			
ANKISTRODESMUS FALCATUS	X	X	X	X	X	X	X	X	X
ANKISTRODESMUS SPIROTAENIA	X	X	X	X	X	X	X	X	X
ANKISTRODESMUS NANNOSELENE	X	X	X	X	X	X	X	X	X
CHODATELLA CILIATA					X	X	X	X	X
CHODATELLA CITRIFORMIS						X	X		X
CHODATELLA SUBSALSA			X			X	X		
CHODATELLA QUADRISETA	X	X	X	X	X	X	X	X	X
CHLORELLA SP.			X	X	X	X	X	X	X
CLOSTERIOPSIS LONGISSIMA				X	X				
COELASTRUM CAMBRICUM				X	X		X		
COELASTRUM MICROPORUM	X	X	X	X	X	X	X	X	X
COELASTRUM RETICULATUM					X	X	X	X	X
COELASTRUM SPHAERICUM							X		
CRUCIGENIA RECTANGULARIS				X					
CRUCIGENIA IRREGULARIS				X					
CRUCIGENIA TETRAPEDIA	X		X	X	X	X	X	X	
DICTYOSPHAERIUM EHRENBERGIANUM			X			X			
DICTYOSPHAERIUM PULCHELLUM	X	X	X	X	X	X	X		X
DICTYOSPHAERIUM ELEGANS	X			X	X	X	X		X
ECHINOSPHAERELLA LIMNETICA			X	X	X	X	X		
ERRERELLA BORNHEMIENSIS				X	X	X			
FRANCEIA DROESCHERI		X	X	X	X	X	X	X	X
FRANCEIA OVALIS		X				X			
GOLENK[illegible] RADIATA	X	X	X	X	X	X	X	X	
KIRCHN[illegible]LA CONTORTA	X	X	X	[illegible]	X	X	X	X	
KIRCHN[illegible]LLA OBESA				X					

TAXON	DATE 30 APR	27 MAY	17 JUN	28 JUL	AUG	23 SEP	19 OCT.	16 NOV	14 DEC
CHLOROPHYCEAE(cont.)									
KIRCHNERIELLA SUBSOLITARIA				X	X				
MICRACTINIUM PUSILLUM	X	X	X	X	X	X		X	
NEPHROCYTIUM AGARDIANUM				X					
NEPHROCYTIUM LIMNETICUM					X				
OOCYSTIS SP.	X	X	X	X	X	X	X	X	
OOCYSTIS BORGEI	X	X	X	X	X	X	X	X	X
OOCYSTIS LACUSTRIS					X		X	X	X
OOCYSTIS PARVA	X	X		X	X	X	X	X	X
OOCYSTIS PUSILLA	X	X	X	X	X	X	X	X	X
OOCYSTIS SOLITARIA	X					X	X		
OOCYSTIS SUBMARINA		X				X	X		
PEDIASTRUM BORYANUM		X	X	X	X	X	X	X	X
PEDIASTRUM DUPLEX	X	X		X	X	X	X		X
PEDIASTRUM SIMPLEX					X	X	X	X	X
PEDIASTRUM TETRAS				X	X	X	X	X	
QUADRIGULA CHODATII	X	X	X	X					
QUADRIGULA LACUSTRIS		X			X				
SCENEDESMUS ABUNDANS	X	X	X	X	X	X	X	X	X
SCENEDESMUS ACUMINATUS		X		X		X	X	X	
SCENEDESMUS BIJUGA	X	X	X	X	X	X	X	X	X
SCENEDESMUS DENTICULATUS			X	X	X	X	X	X	X
SCENEDESMUS DIMORPHUS	X	X	X	X	X	X	X	X	X
SCENEDESMUS INCRASSATULUS					X				
SCENEDESMUS LONGUS								X	
SCENEDESMUS OBLIQUUS				X					
SCENEDESMUS OPOLIENSIS	X	X	X	X		X	X		
SCENEDESMUS QUADRICAUDA	X	X	X	X	X	X	X	X	X
SCENEDESMUS BIJUGATUS			X	X					
SCENEDESMUS INTERMEDIUS			X	X		X	X		
SCENEDESMUS BIJUGA V. FLEXUOSUS				X					
SCHROEDERIA JUDAYI		X		X	X	X	X	X	X
SCHROEDERIA SETIGERA	X	X	X	X	X	X	X	X	X
SELENASTRUM GRACILE	X								
SELENASTRUM MINUTUM	X	X	X	X	X	X	X	X	X
TETRAEDRON SP.					X	X	X		
TETRAEDRON CAUDATUM	X	X	X	X		X			
TETRAEDRON MINIMUM	X			X	X	X	X	X	X
TETRAEDRON MUTICUM	X			X	X	X			
TETRAEDRON REGULARE			X	X	X				
TETRASTRUM HETERACANTHUM	X	X	X	X	X	X		X	X
TETRASTRUM STAUROGENIAEFORME	X	X	X	X	X	X	X	X	X
TETRASTRUM ELEGANS	X	X							
TREUBARIA SETIGERUM	X	X				X	X		
TREUBARIA TRIAPPENDICULATA	X	X	X	X			X	X	
TROCHISCIA SP.						X			
CORANASTRUM AESTIVALE				X					
PARANASTIX SP.	X	X						X	

TABLE IVC-1 (CONT)

TAXON	DATE								
	30 APR	27 MAY	17 JUN	28 JUL	26 AUG	23 SEP	19 OCT	16 NOV	14 DEC
EUGLENOPHYCEAE									
EUGLENA GASTEROSTEUS	X	X	X						X
PHACUS SP.				X		X			
PHACUS PYRUM	X	X							
TRACHELOMONAS SP.		X							
LEPOCINCLIS SP.	X								
CHRYSOPHYCEAE									
DINOBRYON SP.						X	X		
DINOBRYON BAVARICUM			X					X	
DINOBRYON SOCIALE	X	X	X	X				X	X
DINOBRYON SOCIALE VAR. AMERICANUM								X	X
MALLOMONAS SP.	X	X	X	X	X	X	X	X	X
CHRYSOCHROMULINA PARVA	X	X	D	X	X	X	X	X	X
CHROMULINA SP.	X	X	X	X	X	X	X	X	X
STELEXMONAS DICHOTOMA	X	X							X
KEPHYRION SP.	X								
AULOMONAS PURDYI	X	X					X	X	X
RHIZOCHRYSIS SP.	X	X	X		X	X	X	X	X
CHRYSOCOCCUS SP.	X		X			X			
CHRYSAMOEBA SP.	X								
OCHROMONAS SP.	X	X	X	X	X	X	X	X	X
UROGLENA SP.	X	X	X					X	X
CODONOSIGA BOTRYTIS	X	X	X				X		
CODONOSIGA FURCATA						X	X		
BICOECA SP.	X	X	X	X		X	X	X	X
BICOECA CRYSTALLINA	X	X							
CODONOSIGOPSIS ROBINI	X	X	X				X	X	
MONOSIGA OVATA						X	X	X	X
MONAS SP.	X	X	X	X	X	X	X	X	X
BODO SP.	X	X				X	X		
ERKENIA SUBAEQUICILIATA	X	X							
BACILLARIOPHYCEAE									
COSCINODISCUS ROTHII		X		X	X	X	X	X	
CYCLOTELLA ATOMUS	X	X	X	D	X	X	X	D	D
CYCLOTELLA GLOMERATA	X	X	X	X	X	X	X	X	
CYCLOTELLA MENEGHINIANA	X	X	X	D	X	X	X	X	X
MELOSIRA BINDERANA	D	X	X			X		X	X
MELOSIRA DISTANS	X	X	X	X				X	
MELOSIRA GRANULATA			X		X	X			
MELOSIRA ISLANDICA	X	X	X					X	X
MELOSI[illegible]ALICA		X	X			X			
MELOSI[illegible]ALICA VAR. SUBARCTICA	X	X	X	X		X	X	X	

TABLE [illegible] (CONT)

TAXON	DATE 30 APR	27 MAY	17 JUN	28 JUL	26 AUG	23 SEP	19 OCT	16 NOV	14 DEC
BACILLARIOPHYCEAE (cont.)									
MELOSIRA GRANULATA VAR. ANGUSTISSIMA				X		X	X		
RHIZOSOLENIA SP.								X	X
STEPHANODISCUS ASTREA	X			X		X	X	X	
STEPHANODISCUS HANTZSCHII	D	X	X	X		X	X	X	D
STEPHANODISCUS NIAGARAE	X		X			X	X		X
STEPHANODISCUS ASTREA VAR. MINUTULA	X	X	X	X	X	X	X	X	X
ACHNANTHES SP.						X			
AMPHIPRORA SP.	X								
ASTERIONELLA FORMOSA	X	X	X	X		X	X	X	X
CYMATOPLEURA SOLEA	X	X							
DIATOMA ELONGATUM	X	X	X			X	X	X	X
DIATOMA VULGARE	X	X				X	X	X	
DIATOMA ELONGATUM V. TENUIS	X	X	X			X	X		
FRAGILARIA SP.									X
FRAGILARIA CAPUCINA	X	X	X	X	X	X	X	X	X
FRAGILARIA CROTONENSIS	X	X	X	X	X	X	X	X	D
FRAGILARIA VAUCHERIAE	X	X	X		X	X		X	
GOMPHONEMA OLIVACEUM		X							X
GYROSIGMA SP.		X							
NAVICULA SP.	X	X					X	X	X
NAVICULA CRYPTOCEPHALA		X							X
NAVICULA TRIPUNCTATA	X							X	X
NAVICULA SALINARUM VAR. INTERMEDIA						X			
NAVICULA LANCEOLATA		X				X		X	
NITZSCHIA SP.	X	X	X	X		X		X	X
NITZSCHIA ACICULARIS	X	X	X	X			X		
NITZSCHIA DISSIPATA	X	X				X		X	X
NITZSCHIA FONTICOLA						X			
NITZSCHIA GRACILIS	X	X	X						
NITZSCHIA HOLSATICA	X	X	X	X		X	X		
NITZSCHIA LINEARIS		X							
NITZSCHIA PALEA	X	X		X	X	X	X	X	
RHOICOSPHENIA CURVATA	X	X	X	X		X		X	X
SURIRELLA SP.			X						
SURIRELLA ANGUSTATA		X				X			
SURIRELLA OVATA				X				X	
SYNEDRA SP.	X	X	X						
SYNEDRA ACUS	X								
SYNEDRA ULNA	X	X	X				X	X	X
SYNEDRA ACUS VAR. RADIANS			X	X		X		X	X
SYNEDRA RUMPENS								X	X
TABELLARIA FENESTRATA		X	X			X	X	X	X
CRYPTOPHYCEAE									
CRYPTOMONAS SP.		X						X	
CRYPTOMONAS EROSA	X	X	X	D	X	X	X	X	X
CRYPTOMONAS OVATA	X	X	X	X	X	X	X	X	X
CRYPTOMONAS EROSA VAR. REFLEXA	X	X	X	X	X	X	X	X	X
CRYPTOMONAS CAUDATA						X			
CRYPTOMONAS MARSSONII			X	X	X	X	X	X	X

TABLE IVC-1 (CONT)

TAXON	DATE								
	30 APR	27 MAY	17 JUN	28 JUL	26 AUG	23 SEP	19 OCT	16 NOV	14 DEC
CRYPTOPHYCEAE (cont.)									
CRYPTOMONAS REFLEXA	X	X	X	X	X	X	X	X	X
CRYPTOMONAS ROSTRATA	X	X	X						
CRYPTOMONAS PARAPYRENOIDIFERA	X								
CRYPTOMONAS PYRENOIDIFERA	X	X	X	X	X	X	X	X	X
CRYPTOMONAS CURVATA	X	X				X	X	X	X
CRYPTOMONAS ROSTRATIFORMIS		X	X				X	X	
KATABLEPHARIS OVALIS	X	X	X	X	X	X	X	X	X
RHODOMONAS MINUTA	X	X	X	X	X	X	X	X	X
RHODOMONAS MINUTA VAR. NANNOPLANCTICA*	D	D	X	D	D	X	D	D	X
SENNIA PARVULA		X							
CRYPTAULAX SP.								X	X
CRYPTAULAX RHOMBOIDEA		X							
MONOMASTIX SP.	X						X		
CHILOMONAS PARAMAECIUM		X							
DINOPHYCEAE									
GYMNODINIUM SP.	X	X	X	X		X	X	X	X
GYMNODINIUM HELVETICUM	X	X	X			X	X	X	X
GYMNODINIUM VARIANS	X	X	X	X	X	X	X	X	X
GYMNODINIUM EURYTOPUM		X							
CERATIUM HIRUNDINELLA					X	X	X		
GLENODINIUM SP.	X	X	X	X	X	X	X	X	X
GLENODINIUM PULVISCULUS	X								
PERIDINIUM SP.	X			X	X	X	X	X	
PERIDINIUM ACICULIFERUM	X	X	X		X				
PERIDINIUM CINCTUM			X	X	X	X			

X *PRESENT AT ONE OR MORE STATIONS* ; MEAN OR R-1 AND R-2; SURFACE COLLECTION
D *ABUNDANCE OF 15 PCT. OR MORE AT ONE OR MORE STATIONS* PER DATE

* Identified as Chroomonas acuta in 1975

TABLE IVC-2

OCCURRENCE OF PHYTOPLANKTON BY DATE

50, 25, AND 1 PCT. LIGHT TRANSMITTANCE LEVELS AT NMPE 40 STATION

TAXON	30 APR	27 MAY	17 JUN	28 JUL	26 AUG	23 SEP	19 OCT	16 NOV	14,19 DEC
MYXOPHYCEAE									
ANACYSTIS AERUGINOSA				X					
APHANOCAPSA DELICATISSIMA						X		X	
CHROOCOCCUS LIMNETICUS							X		
CHROOCOCCUS DISPERSUS	X		X	X	X		X		
CHROOCOCCUS DISPERSUS VAR. MINOR	X	D	D	D	D	D	D	D	D
COELOSPHAERIUM KUETZINGIANUM					X	X	X	X	
COELOSPHAERIUM NAEGELIANUM					X	X	D	X	X
GOMPHOSPHAERIA LACUSTRIS	X	X				X	D	X	
MERISMOPEDIA TENUISSIMA					X				
OSCILLATORIA AGARDHII								X	X
OSCILLATORIA LIMNETICA	D	X	D	X	X	X		X	D
OSCILLATORIA GEMINATA			X			X			
OSCILLATORIA AMPHIBIA		X	X	X	X	X	X		
PHORMIDIUM SP.								X	D
PHORMIDIUM MUCICOLA	X			X					
ANABAENA FLOS-AQUAE							X		
ANABAENA SPIROIDES					X				
APHANIZOMENON FLOS-AQUAE		X		X	X	X	X	X	
CHLOROPHYCEAE									
CARTERIA SP.		X				X			
CARTERIA CORDIFORMIS	X			X		X	X		
CHLAMYDOMONAS SP.	X	X	X	X	X	X	X	X	X
CHLAMYDOMONAS GLOBOSA	X								
EUDORINA ELEGANS			X	X	X			X	
PANDORINA MORUM					X	X		X	
PEDINOMONAS MINUTISSIMA	X								
POLYTOMA SP.		X					X	X	X
POLYTOMA GRANULIFERUM	X	X	X			X	X	X	
GLOEOCYSTIS SP.	X								
GLOEOCYSTIS GIGAS				X	X				
GLOEOCYSTIS VESICULOSA						X			
SPHAEROCYSTIS SCHROETERI				X	X	X	X		X
TETRASPORA LACUSTRIS			X	X	X	X			
ULOTHRIX SP.								X	X
OEDOGONIUM SP.			X			X	X	X	X
MOUGEOTIA SP.	X	X	X		X				
CLOSTERIUM SP.			X		X			X	X
CLOSTERIUM ACICULARE	X	X		X	X	X	X	X	

TABLE IVC-2 (Continued)

TAXON	DATE								
CHLOROPHYCEAE (cont.)	30 APR	27 MAY	17 JUN	28 JUL	26 AUG	23 SEP	19 OCT	16 NOV	14,19 DEC
CLOSTERIUM VENUS						X			
CLOSTERIUM GRACILE						X	X		
COSMARIUM SP.						X	X	X	
STAURASTRUM SP.					X	X	X	X	
ACTINASTRUM HANTZSCHII	X	X							
ANKISTRODESMUS FALCATUS	X	X	X	X	X	X	X	X	X
ANKISTRODESMUS SPIROTAENIA	X	X	X	X		X		X	X
ANKISTRODESMUS NANNOSELENE	X	X	X		X	X		X	
CHODATELLA CILIATA					X	X	X	X	
CHODATELLA CITRIFORMIS							X		
CHODATELLA SUBSALSA						X			
CHODATELLA QUADRISETA	X	X	X	X	X	X	X	X	
CHLORELLA SP.			X	X	X	X	X	X	
CLOSTERIOPSIS LONGISSIMA				X					
COELASTRUM CAMBRICUM					X				
COELASTRUM MICROPORUM		X		D	X	X	X	X	X
COELASTRUM RETICULATUM					X	X	X	X	
CRUCIGENIA TETRAPEDIA		X	X			X	X		
DICTYOSPHAERIUM EHRENBERGIANUM			X						
DICTYOSPHAERIUM PULCHELLUM	X			X	X	X	X		
DICTYOSPHAERIUM ELEGANS				X					
ECHINOSPHAERELLA LIMNETICA				X			X		
ERRERELLA BORNHEMIENSIS					X	X			
FRANCEIA DROESCHERI				X	X	X	X	X	
GOLENKINIA RADIATA	X	X	X	X	X	X	X	X	
KIRCHNERIELLA CONTORTA		X		X	X		X		
MICRACTINIUM PUSILLUM	X	X	X	X	X	X			
OOCYSTIS SP.	X				X	X			
OOCYSTIS BORGEI			X	X	X	X	X	X	X
OOCYSTIS LACUSTRIS								X	
OOCYSTIS PARVA							X	X	
OOCYSTIS PUSILLA			X	X	X	X	X	X	X
OOCYSTIS SOLITARIA						X			
OOCYSTIS CRASSA					X				
OOCYSTIS SUBMARINA							X		
PEDIASTRUM BORYANUM			X	X	X	X	X		
PEDIASTRUM DUPLEX				X	X	X	X		
PEDIASTRUM SIMPLEX					X	X	X		
PEDIASTRUM TETRAS								X	
QUADRIGULA CHODATII			X		X				
SCENEDESMUS ABUNDANS	X	X	X	X	X	X	X		
SCENEDESMUS ACUMINATUS					X	X	X		
SCENEDESMUS BIJUGA	X	X	X	X	X	X	X	X	X
SCENEDESMUS DENTICULATUS				X		X	X	X	
SCENEDESMUS DIMORPHUS	X	X	X	X	X	X		X	X
SCENEDESMUS INCRASSATULUS					X	X			
SCENEDESMUS OPOLIENSIS		X	X						
SCENEDESMUS QUADRICAUDA	X	X	X	X	X	X	X	X	X
SCENEDESMUS BIJUGATUS			X						
SCENEDESMUS BIJUGA V. PLEXUOSUS									
SCHROEDERIA JUDAYI			X	X	X	X	X		X
SCHROEDERIA SETIGERA					X				

TABLE IVC-2 (Continued)

TAXON	DATE								
CHLOROPHYCEAE(cont.)	30 APR	27 MAY	17 JUN	28 JUL	26 AUG	23 SEP	19 OCT	16 NOV	14,19 DEC
SELENASTRUM MINUTUM	X		X	X	X	X			X
TETRAEDRON MINIMUM	X			X	X	X	X	X	
TETRAEDRON MUTICUM					X	X			
TETRASTRUM HETERACANTHUM	X	X	X	X					X
TETRASTRUM STAUROGENIAEFORME	X	X	X	X	X		X		X
TREUBARIA SETIGERUM							X		
TREUBARIA TRIAPPENDICULATA	X	X	X	X					
PARAMASTIX SP.	X								
EUGLENOPHYCEAE									
EUGLENA GASTEROSTEUS	X	X							
PHACUS PYRUM	X								
CHRYSOPHYCEAE									
DINOBRYON SP.						X			
DINOBRYON SOCIALE	X	X	X					X	
MALLOMONAS SP.	X			X	X	X	X	X	X
CHRYSOCHROMULINA PARVA	X	X	X	X	X	X	X	X	X
CHROMULINA SP.	X	X	X	X	X	X	X	X	X
STELEXMONAS DICHOTOMA	X								X
AULOMONAS PURDYI	X	X							X
RHIZOCHRYSIS SP.	X	X	X	X			X		X
OCHROMONAS SP.	X	X	X	X	X	X	X	X	X
UROGLENA SP.	X	X							X
CODONOSIGA BOTRYTIS	X		X				X		
BICOECA SP.	X	X	X				X	X	
BICOECA CRYSTALLINA	X								
CODONOSIGOPSIS ROBINI					X		X		
MONOSIGA OVATA						X	X	X	X
MONAS SP.	X		X		X			X	
ERKENIA SUBAEQUICILATA	X								
BACILLARIOPHYCEAE									
COSCINODISCUS ROTHII				X		X	X	X	
CYCLOTELLA ATOMUS	X	X	X	X	X	X	X	X	D
CYCLOTELLA GLOMERATA	X		X	X			X		
CYCLOTELLA MENEGHINIANA	X	X	X	D	X	X	X	X	X
MELOSIRA SP.	X								
MELOSIRA BINDERANA	D	X	X						X
MELOSIRA DISTANS				X					
MELOSIRA GRANULATA			X						
MELOSIRA ISLANDICA	X	X	X						X
MELOSIRA ITALICA						X			
MELOSIRA ITALICA VAR. SUBARCTICA	X	X	X	X					
STEPHANODISCUS ASTREA								X	
STEPHANODISCUS HANTZSCHII	X	X	X			X	X	X	X

TABLE IVC-2 (Continued)

TAXON	DATE 30 APR	27 MAY	17 JUN	28 JUL	26 AUG	23 SEP	19 OCT	16 NOV	14,19 DEC
BACILLARIOPHYCEAE (cont.)									
STEPHANODISCUS NIAGARAE							X		X
STEPHANODISCUS ASTREA VAR. MINUTULA	X		X		X	X	X	X	X
ASTERIONELLA FORMOSA	X	X	X	X			X	X	X
DIATOMA ELONGATUM	X	X	X					X	X
DIATOMA ELONGATUM V. TENUIS	X	X	X						
FRAGILARIA SP.									X
FRAGILARIA CAPUCINA	X	X					X		X
FRAGILARIA CROTONENSIS	X	X	X	X					X
FRAGILARIA VAUCHERIAE		X	X		X	X			X
NAVICULA SP.		X							
NITZSCHIA SP.	X		X						X
NITZSCHIA ACICULARIS				X					
NITZSCHIA DISSIPATA	X								
NITZSCHIA GRACILIS	X	X	X						
NITZSCHIA HOLSATICA		X							
NITZSCHIA PALEA	X			X					
RHOICOSPHENIA CURVATA						X			X
SYNEDRA SP.		X	X						
SYNEDRA ACUS	X								
SYNEDRA ULNA	X	X	X					X	X
SYNEDRA ACUS VAR. RADIANS			X	X		X			X
SYNEDRA RUMPENS									X
TABELLARIA FENESTRATA		X					X	X	X
CRYPTOPHYCEAE									
CRYPTOMONAS SP.								X	
CRYPTOMONAS EROSA	X	X	X	D	X	X	X	X	X
CRYPTOMONAS OVATA	X	X		X		X		X	
CRYPTOMONAS EROSA VAR. REFLEXA	X	X	X	X	X	X	X	X	X
CRYPTOMONAS CAUDATA						X			
CRYPTOMONAS MARSSONII				X	X	X	X		
CRYPTOMONAS REFLEXA	X	X	X	X		X	X	X	X
CRYPTOMONAS PLATYURIS	X								
CRYPTOMONAS PARAPYRENOIDIFERA				X					
CRYPTOMONAS PYRENOIDIFERA				X		X	X		X
CRYPTOMONAS CURVATA	X						X		
CRYPTOMONAS ROSTRATIFORMIS		X	X						
KATABLEPHARIS OVALIS	X	X	X	X	X	X	X	X	X
RHODOMONAS MINUTA	X	X	X	X	X	X	X	X	X
RHODOMONAS MINUTA VAR. NANNOPLANTICA*	X	D	X	X	X	X	D	D	X
CRYPTAULAX SP.								X	X
MONOMASTIX SP.							X		
DINOPHYCEAE									
GYMNODINIUM SP.	X	X			X			X	X
GYMNODINIUM HELVETICUM	X	X					X	X	X
GYMNODINIUM VARIANS	X	X	X			X		X	X
CERATIUM HIRUNDINELLA					X	X	X		
GLENODINIUM SP.		X	X	X	X		X	X	X
GLENODINIUM PULVISCULUS	X								
PERIDINIUM SP.							X	X	X
PERIDINIUM ACICULIFERUM	X	X							
PERIDINIUM CINCTUM			X	X	X				

X PRESENT AT ONE OR MORE LEVELS; MEAN OF R-1 AND R-2
D ABUNDANCE OF 15 PCT. OR MORE AT ONE OR MORE LEVELS PER DATE

*Identified as Chroomonas acuta in 1975

TABL[illegible]-3

PERCENT COMPOSITION* OF THE MAJOR PHYTOPLANKTON TAXA

NINE MILE POINT VICINITY - 1976

TAXON	30 APR	27 MAY	17 JUN	28 JUL	26 AUG	23 SEP	19 OCT	16 NOV	14, 19 DEC
BACILLARIOPHYCEAE	33.99	31.52	7.73	20.31	0.99	2.87	2.77	11.67	37.68
CHLOROPHYCEAE	18.16	19.35	8.16	19.92	16.02	24.97	19.49	10.80	9.06
CHRYSOPHYCEAE	14.20	3.15	12.87	1.70	6.71	7.14	8.39	7.10	10.27
CRYPTOPHYCEAE	9.65	11.11	2.89	18.12	10.76	15.48	21.37	19.07	4.97
DINOPHYCEAE	0.56	0.36	0.03	0.11	0.23	0.15	0.23	0.30	0.34
EUGLENOPHYCEAE	3.20	0.07	<0.01	<0.01	0	<0.01	0	0	<0.01
MYXOPHYCEAE	20.28	34.45	68.32	39.84	65.31	49.40	48.35	51.13	37.73
TOTAL PHYTOPLANKTON (cells/ml)	5281.8	9041.3	16208.1	13133.4	18087.6	10840.6.	3963.8	1847.6	2803.6

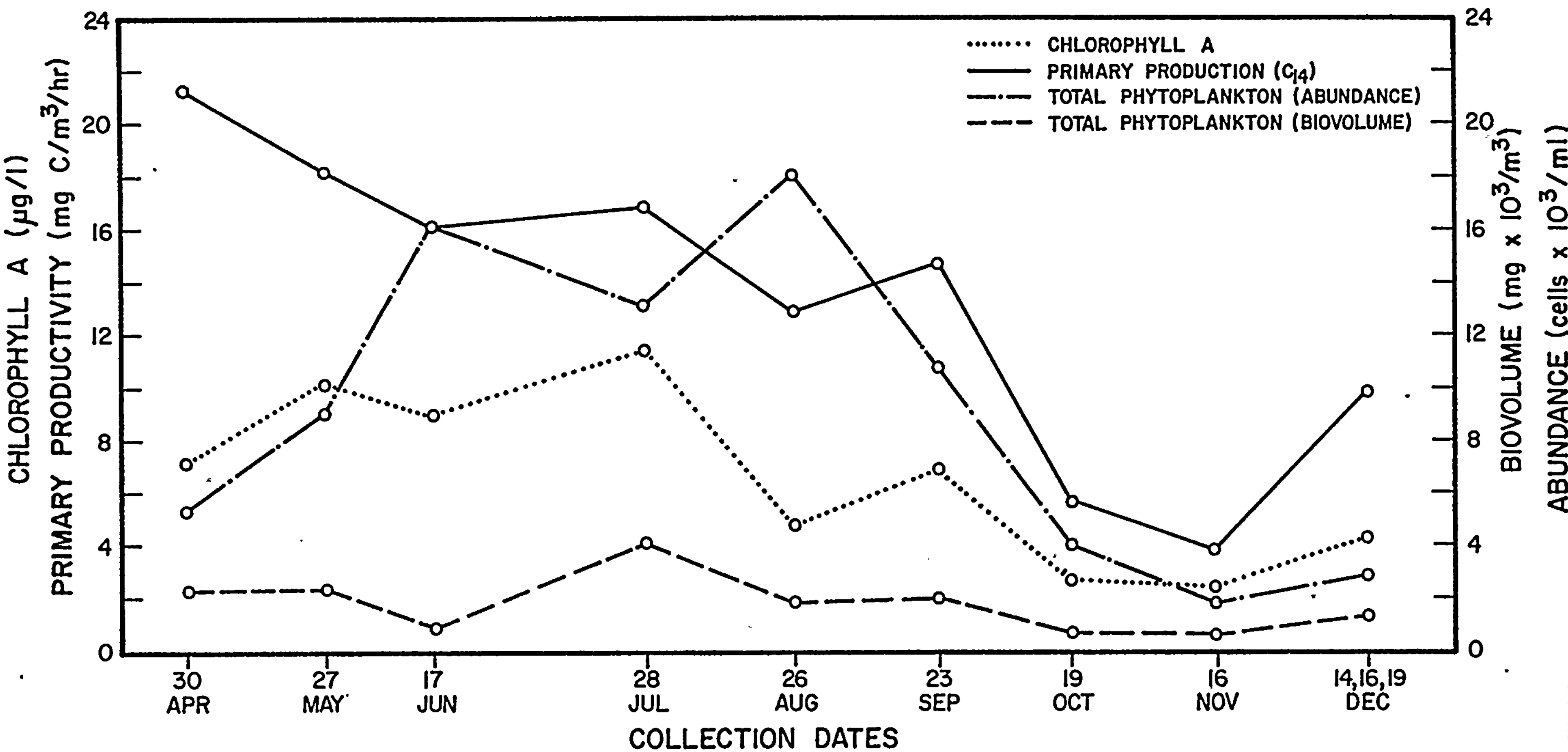
*Percent composition based on mean abundance by date for surface whole water collections; summarized from LMS 1977, Appendices VA-2a through VA-2h.

The maximum daily mean abundances of total phytoplankton in the Nine Mile Point vicinity during 1976 were recorded during June, July, and August (Figure IVC-2); total abundance generally followed the seasonal temperature cycle. The June and August peaks were attributable primarily to the increased numbers of blue-green algae (LMS 1977, Appendix VA-2g) and, to a lesser extent, to an increase in chrysophytes (LMS 1977, Appendix VA-2c); the July value reflected primarily an increase in diatoms, green algae, and cryptophytes (LMS 1977, Appendices VA-2a, VA-2b, and VA-2d). In summary, the diatoms and blue-green algae were the numerically dominant taxa of the phytoplankton community in early spring (April and May) and winter (December). The green algae population showed a major peak in September following a minor peak in July (LMS 1977, Appendix VA-2b).

In general, the total phytoplankton community in surface waters in the Nine Mile Point vicinity decreased in abundance with distance from shore; this trend was particularly noticeable in the Bacillariophyceae (diatoms) and Myxophyceae (blue-green algae) (LMS 1977, Appendices VA-2a and VA-2g). The reverse trend, i.e., an increase in abundance further from shore, was observed for the less abundant taxa, Chrysophyceae and Cryptophyceae (LMS 1977, Appendices VA-2c and VA-2d). Abundance values were lowest in the 25% light transmittance samples for diatoms, while green algae were more abundant at depth below 0.5 meter (25% or 1% light samples) in eight of the nine collections (Figure IVC-3). The abundance values for phytoplankton among the three sample depths were variable over time for the remaining taxa (LMS 1977, Appendices VA-2c through VA-2g).

PHYTOPLANKTON SEASONAL CYCLE

NINE MILE POINT VICINITY - 1976



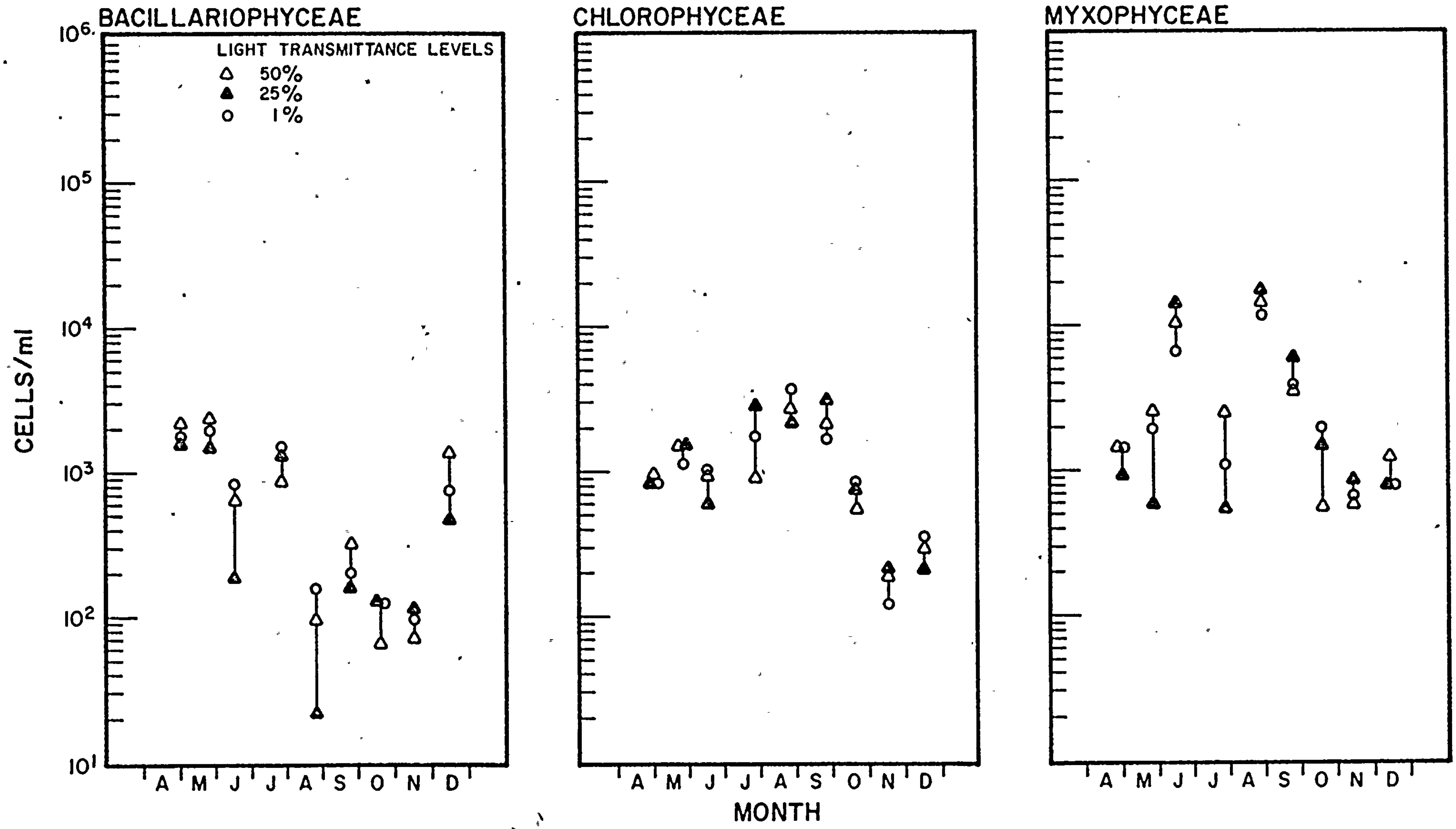
Chlorophyll a and abundance and biovolume of phytoplankton: daily mean of 16 stations; two replicates per station; surface samples; day collection

Primary productivity (C-14); daily mean of 16 stations; 2 light and 1 dark bottle per station; surface samples; day collection

FIGURE IVC-2

ABUNDANCE OF SELECTED PHYTOPLANKTON TAXA AT SELECTED LIGHT LEVELS*

NMPE-40 FT STATION – NINE MILE POINT VICINITY – 1976



*[illegible]OLE WATER COLLECTIONS, MEAN OF R-1 and R-2 ; DAY [illegible]LECTION

FIGURE IVC-3

(ii) 40-ft Depth Contour - Nine Mile Point vicinity

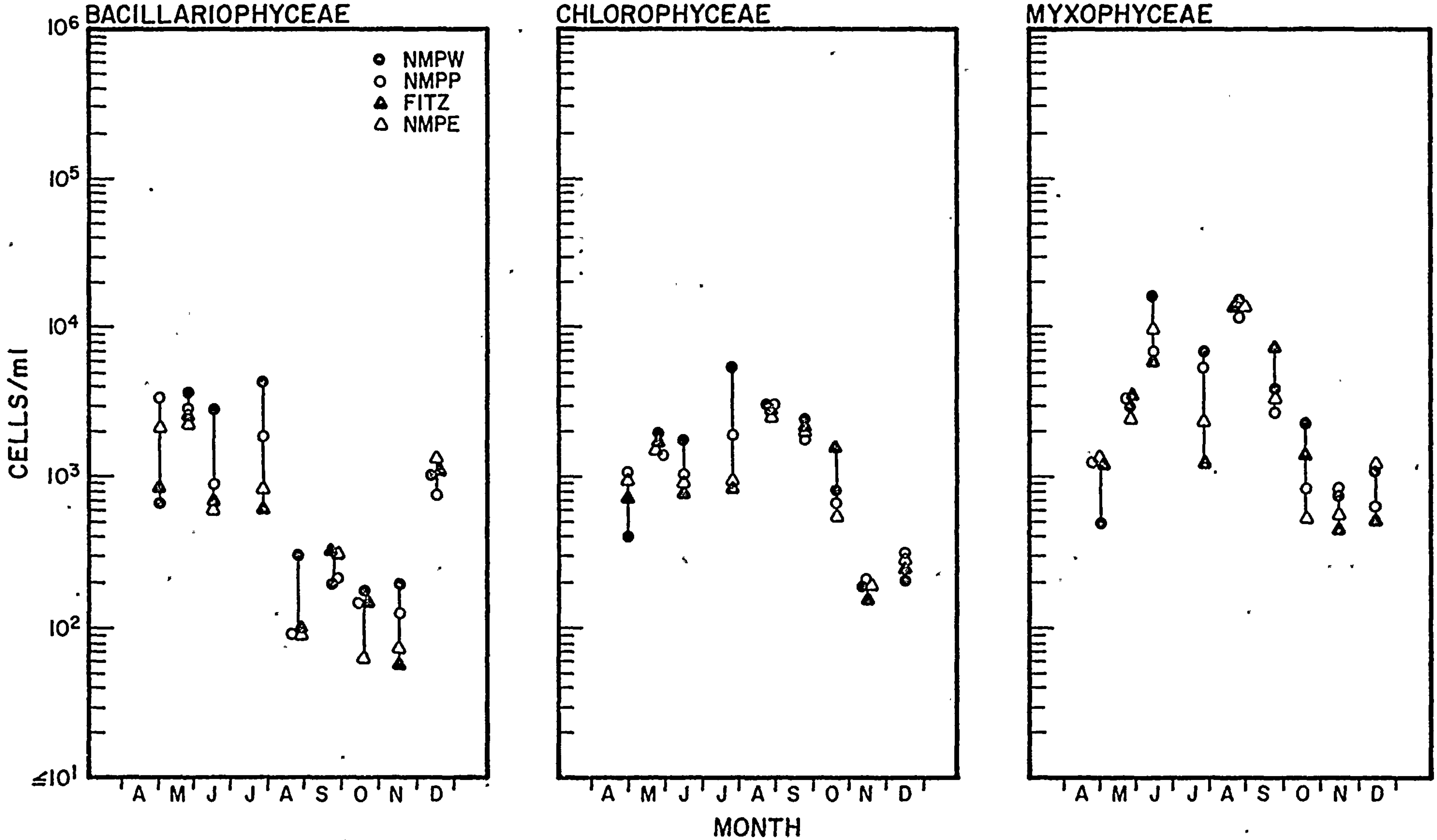
Since the main effect of the operation of the FitzPatrick intake on the phytoplankton community would be on those organisms passing through the plant and returning to the lake via the discharge, any impact of the operation would be observed as a composite intake-discharge effect in the vicinity of the discharge. Review of plume studies done during 1976 (Stone and Webster 1976a, 1976b, 1976c) indicates that the 40-ft contour on the FITZ transect shows the most consistent presence of the plume, as indicated by both temperature and dye. Temperature data collected during the 1976 field proram also showed this station to be the most consistently affected by the plume (LMS 1977,p. IV-3). For this reason, the spatial and temporal trends for the three major taxa (Myxophyceae, Bacillariophyceae and Chlorophyceae) were examined along the 40-ft depth contour. The grand mean abundance values, based on monthly sampling from April through December, was greatest at NMPW transect for all three taxa (LMS 1977, Appendices VA-2g, VA-2a, and VA-2b, respectively); however this transect exhibited the greatest daily abundance in only six of the nine collections for diatoms and in only four of the nine collections for either green or blue-green algae. The concentration of blue-green algae, green algae, and diatoms along the 40-ft depth contour showed no consistent spatial distribution over the year (Figure IVC-4). Observations at the FITZ transect were generally within the range of values observed at the remaining transects along the 40-ft contour. This indicates that the operation of the FitzPatrick station had no discernible effect on the distribution or abundance of phytoplankton and natural variation is far greater than any possible plant induced effects.

ABUNDANCE OF SELECTED TAXA OF PHYTOPLANKTON

IN SURFACE WHOLE WATER COLLECTIONS*

40-FT DEPTH CONTOUR

NINE MILE POINT VICINITY - 1976



*Mean of R-1 and R-2; day collection

FIGURE IVC-4

b. Chlorophyll *a*

(i) Lake Ontario and Nine Mile Point vicinity

Chlorophyll *a* concentration as a measure of phytoplankton standing stock has been reported by Chau et al. (1970), Munawar and Nauwerck (1971), Glooshenko et al. (1972), and Thomas (1974) for Lake Ontario waters. Three pulses annually have been reported for chlorophyll *a*: two pulses between February and June, constituting the spring bloom, and the third pulse between August and October, constituting the fall bloom.

In the Nine Mile Point vicinity, chlorophyll *a* concentrations, based on the daily mean concentration during 1976 sampling, showed a spring peak from May through July and a fall peak in September (Figure IVC-2). This parallels the peaks in total phytoplankton biovolume and also primary productivity (C-14 uptake)(Figure IVC-2) as described below. The major peak in chlorophyll *a* concentration occurring in July was coincident with an increase in the numbers of diatoms, green algae, and cryptophytes (LMS 1977, Appendices VA-2a, VA-2b, and VA-2d), the latter representing the greatest percent composition of the phytoplankton population by biovolume (approximately 59%) (LMS 1977, Appendices VA-3d and VA-3h). The fall chlorophyll *a* peak was coincident primarily with an increase in the numbers of green algae and cryptophytes and to a lesser degree with the numbers of diatoms (LMS 1977, Appendices VA-2b, VA-2d, and VA-2a, respectively); however, the greatest increase in percent composition by biovolume in the fall was recorded for diatoms and cryptophytes (LMS 1977, Appendices VA-3a, VA-3d, and VA-3h).

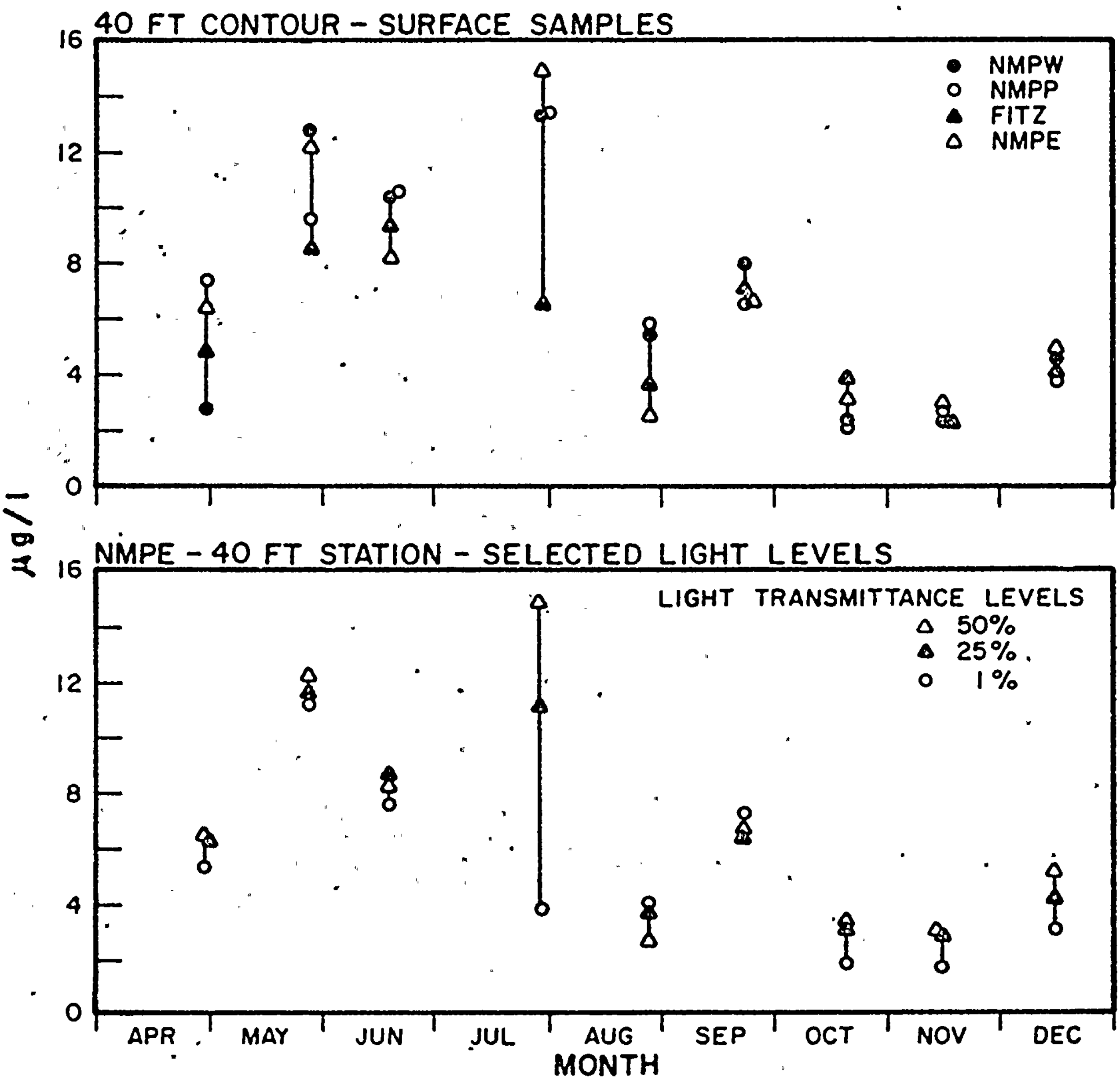
The decrease noted in the concentrations of total phytoplankton abundance in the offshore direction (LMS 1977, Appendix VA-2h) was evident in the chlorophyll a data only in April (LMS 1977, Appendix VA-6). The lack of a consistent offshore trend and the patchiness in nearshore areas (i.e., within the 60-ft depth contour) of chlorophyll a have previously been documented in the literature (Glooshenko et al. 1972; LMS 1975).

(ii) 40-ft Contour - Nine Mile Point vicinity

The grand means for chlorophyll a based on monthly sampling from April through December were equal at NMPW, NMPP, and NMPE transects during 1976 (LMS 1977, Appendix VA-6). A lower grand mean value for the FITZ transect was mainly a reflection of the 28 July collection, which yielded a chlorophyll a value approximately one-half that recorded at the other three transects (Figure IVC-5). This reduction is attributed to circulation patterns established in the area of the discharge by discharge flow and not to plant or plume thermal effects since the plant was not generating at the time of sampling and had been offline (no heat) for the previous 24 hours. It appears that the low value was due to the mixing of low concentrated bottom water with the discharge flow which was also drawn from bottom water at the intake.

The photic zone appeared well mixed on all sampling dates except 28 July, when a significant difference in chlorophyll a concentrations was seen between the surface and 1% light transmittance level samples (Figure IVC-5), the latter collected 12 m below the surface (LMS 1977, Appendix VA-1).

CHLOROPHYLL A CONCENTRATIONS AT SELECTED PHYTOPLANKTON STATIONS* NINE MILE POINT VICINITY – 1976



*Day Collections; mean of two replicates

The stratification of chlorophyll a at the control station (NMPE-40 ft) suggests that the reduction in chlorophyll a in the surface sample at the FITZ-40-ft station was a function of the circulation pattern of the FitzPatrick plant; that is, bottom waters are drawn into the plant and mixed with subsurface waters as the discharge rises to the surface. Thus the near-surface waters within the discharge area would be expected to have chlorophyll a concentrations intermediate between observed surface and bottom concentrations. The surface concentrations observed on 28 July support this hypothesis. Such an occurrence would only be expected during periods of lake stratification.

The fact that such an occurrence of reduced chlorophyll a values can be identified from the data would indicate that reductions in chlorophyll a due to normal plant operation would be similarly identifiable. Figure IVC-5 shows, however, that for the remainder of the sampling dates, surface chlorophyll a values at the FITZ-40-ft station were within the range of values observed at the other three transects. This lack of a discernible difference at the FITZ-40-ft station indicates that the operation of JAF has not had any measurable effect on chlorophyll a concentrations in the vicinity of the plant.

c. Primary Productivity (C-14)

(i) Lake Ontario and Nine Mile Point vicinity

One lake-wide study of primary production in Lake Ontario has been published (Glooshenko et al. 1972) and its results, using the C-14 uptake method, indicate that primary production was greatest during late April (10-25 mg C/m^3/hr). A

decrease occurred in May followed by an increase and a plateau from June through mid-October (10 mg C/m^3/hr) and then a decrease to winter levels (<5 mg C/m^3/hr).

In the Nine Mile Point vicinity, C-14 uptake was monitored at all phytoplankton stations monthly from April through December 1976. Primary productivity reached greatest values during April, followed by a gradual decline through November and a subsequent minor peak in December (Figure IVC-2). The occurrence of peak production in April was consistent with the numerical and biovolume dominance of diatoms (LMS 1977, Appendices VA-2a and VA-3a) and with the fact that production rates in nearshore waters (10 and 20-ft depth contours) were greater than those in offshore waters (40 and 60-ft contours) (LMS 1977, Appendix VA-8). The secondary increase in production in December also paralleled the increase in numbers and biovolume of diatoms (LMS 1977, Appendices VA-2a and VA-3a), although the production at the offshore stations was greater than at nearshore stations. This offshore-onshore seasonal shift in production rates follows that reported in lake-wide studies in Lake Ontario (Glooshenko et al. 1972).

The seasonal trend in primary production parallels that of the phytoplankton standing stock as measured by chlorophyll a concentrations and total phytoplankton biovolume (Figure IVC-2), except for the decrease in production coincident with an increase in chlorophyll a and biovolume between April and May.

(ii) 40-ft Contour - Nine Mile Point vicinity

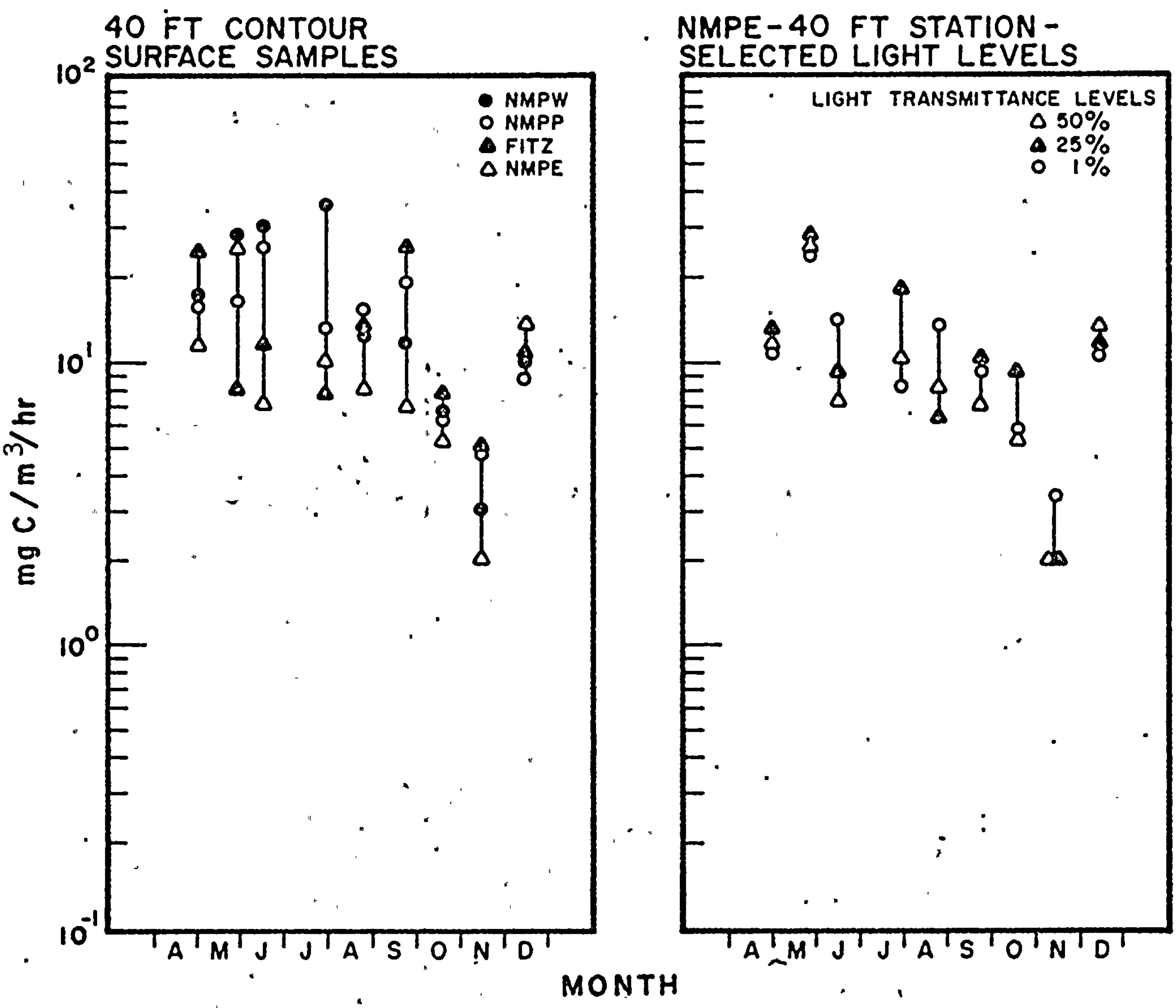
The grand mean production rate based on monthly sampling from April through December, was greatest at NMPW transect, paralleling the values recorded for total phytoplankton abundance and biovolume (LMS 1977, Appendices VA-8, VA-2h, and VA-3h, respectively). The spatial-temporal distribution of primary productivity at the 40-ft contour is presented in Figure IVC-6. Productivity was the lowest at NMPE transect in six of the nine collections and at FITZ transect in two of the nine collections. The low value at FITZ transect on 28 July parallels those of chlorophyll a and total phytoplankton by biovolume and abundance, discussed above. As with chlorophyll a this is attributed to the circulation patterns and natural stratification in the vicinity of the FitzPatrick discharge and not the plant load. The data suggest that productivity might have been slightly enhanced during the latter part of the year (August-December) since the FITZ values are the highest in three of the five observations and second highest on the remaining two dates.

2. Phytoplankton Entrainment Studies

a. Study Description

Phytoplankton entrainment viability studies were conducted at JAF from 14 April 1976 to 21 March 1977. Samples for both chlorophyll a and C-14 analyses were collected on two dates per month, both day and night, from the intake and discharge bays of the plant circulating water system and once per month (weather permitting) from the lake discharge plume. The objectives of the program were to evaluate the effects on phytoplankton of

PRIMARY PRODUCTIVITY AT SELECTED STATIONS*
NINE MILE POINT VICINITY - 1976



*Day Collections; 2 Light and 1 Dark Bottle reading, 4-hr Incubation period in the Laboratory for both replicates

passage through the circulating water system and of entrainment with ambient dilution water into the submerged jet discharge in the lake. Viability studies were always conducted under conditions of high plant load. The minimum intake-discharge temperature rise measured during the viability studies was 12.0 C, with the majority of the collections done at ΔT's between 13 and 16 C (LMS 1977, Table VIII-5).

The effects of passage through the plant cooling system were evaluated from the intake and discharge bay samples. In order to evaluate the effects of complete plant passage all samples collected from the plant discharge bay were held at the discharge temperature for an additional time period equivalent to the estimated travel time from the collection point to the diffuser ports. After the holding time, phytoplankton discharge samples were put in an ice bath until the sample temperature dropped to within 2-3 F of the intake temperature. This procedure was used to simulate the normally occurring temperature reduction subsequent to discharge to the lake. The time required to reduce the temperature to within 2-3 F of the intake temperature using this method was greater than the actual time required for the same temperature reduction to occur by dilution in the discharge plume. Therefore, the phytoplankton discharge samples were subject to temperature exposures of longer duration than they would normally experience in the rapid mixing of the near-field lake plume.

The effects of entrainment into the discharge jet were evaluated by subjecting in-plant samples to various time-temperature exposures (simulations) and by collecting samples from the discharge plume in the lake. In order to evaluate the effect of jet entrainment, intake sample water was added to discharge

sample water to simulate the mixing of ambient lake water and discharge water. From April through June, the addition was completed instantaneously with the ratio of intake to discharge water volume being determined by the required dilution to reduce the measured plant temperature rise to either 2 or 3 F. For the period July through March, the dilution scheme was changed to a time series of dilutions, designed to simulate the time-temperature regime of organisms entrained into the plume. The times of travel to the temperature rises above 2 F were doubled to insure maximum exposure of the organisms. Due to the length of the estimated time interval to the 2 F isotherm, a period of five minutes was allowed between the 3 and 2 F simulated temperature rises. Thus, the phytoplankton simulation samples represent a mixture of plant-passed and lake dilution water organisms in proportions similar to those that would be found at the 2 or 3 F isotherms in the lake. The organism in the samples have been subjected to time-temperature exposures in excess of those experienced in the actual plume.

The phytoplankton viability program also included the monthly (weather permitting) collection of samples from approximately the 3 and 2 F temperature rise isotherm in the lake plume. When lake samples were obtained, no in-plant 3 or 2 F simulations were conducted. The locations, frequencies, and methodologies for the phytoplankton viability program are summarized in Table IVC-4. A complete description of the program is contained in the 1976 annual report (LMS 1977).

All phytoplankton viability collections were analyzed for chlorophyll a, phaeopigment, and C-14 (primary productivity). Chlorophyll a and phaeopigment were given immediate analysis during the entire sampling period (April 1976 - March 1977),

TABLE IVC-4

PHYTOPLANKTON[a] VIABILITY SAMPLING PROGRAM

JAMES A. FITZPATRICK NUCLEAR POWER PLANT AND VICINITY - 1976

SAMPLE TYPE	FREQUENCY[b]	DAY/NIGHT[c]	LOCATION OF SAMPLING	PROCEDURE OUTLINE[d]
INTAKE	2/MON(Apr-Dec)	Day and night	INTAKE FOREBAY[e]	Pump
DISCHARGE	2/MON(Apr-Dec)	Day and night	DISCHARGE AFTBAY	Pump; hold for travel time to diffuser; put in ice bath until within 3°F of intake water temperature
SIMULATION[f] 3°F	1/MON(Apr-Dec) 2/MON(Apr-Dec)	Day Night	DISCHARGE AFTBAY (May-June Collections) DISCHARGE AFTBAY (Jul-December Collections)	Pump; hold for travel time to diffuser; instantaneous dilution of discharge water with unfiltered intake water following dilution ratios appropriate for recorded ΔT Pump; hold for travel time to diffuser; dilute discharge sample with unfiltered intake water, time series dilution scheme
SIMULATION[f] 2°F	Same as 3°F simulation	Same as 3°F simulation	Same as 3°F simulation	Same as 3°F simulation
3°F PLUME ISOTHERM (LAKE)[b]	1/MON(Apr-Dec)	Day	VISIBLE BOIL (0.5 m below surface)	Pump
2°F PLUME ISOTHERM (LAKE)[b]	1/MON(Apr-Dec)	Day	1200-1500 ft FROM BOIL ALONG TRAJECTORY OF PLUME	Pump

2/MON = Twice monthly
1/MON = Once monthly

[a]Chlorophyll a and ^{14}C determination
[b]Frequency of lake collections contingent on weather conditions
[c]Day = 1000 hrs; Night = 2200 hrs
[d]Incubation periods variable:
C-14 determination: day samples: 4,7,24,48, and 72 hr incubation periods
night samples: 7,24,48, and 72 hr incubation periods
Chlorophyll a determination: immediate analysis: April-December collections
7,24,48, and 72 hr incubation periods: 22 September-December collections
[e]Intake forebay sample taken on lake side of entrainment rack, prior to tempering
[f]Simulated studies for phytoplantkon are conducted whenever lake sampling is cancelled due to inclement weather

with additional chlorophyll a analysis performed on all samples after 7, 24, 48, and 72-hour incubation periods from 22 September through 21 March. C-14 primary productivity determinations were made after 4, 7, 24, 48, and 72 hours of incubation for all day samples and after 7, 24, 48, and 72 hours for all night samples. For the purposes of this report, the immediate chlorophyll a analysis and the 4 and 7-hour C-14 analyses will be used to evaluate the effect of entrainment on phytoplankton. All the 1976 phytoplankton viability data are presented in the 1976 Nine Mile Point aquatic ecology report (LMS 1977, Appendix VIIIA).

b. Results of the Entrainment Viability Studies

(i) Chlorophyll a

Mean immediate chlorophyll a values reached maximum levels of 19.4 and 17.8 µg/l at intake and discharge, respectively, for the day sample on the first survey date (14 April). Pigment levels generally declined to between 5.0 and 6.0 µg/l in late May. With the exception of the 20 July night values, chlorophyll a levels remained below 9.0 µg/l from June 1976 through March 1977. Generally low values (<5.0 µg/l) were recorded during the winter months, except on one occasion when intake and discharge values approached 9 µg/l on 1 December 1976 (LMS 1977, Appendix VIIIA-2a). There were relatively small and inconsistent variations between corresponding day and night samples throughout the sampling period.

In order to evaluate the effects of the various entrainment processes (plant passage and plume entrainment), the ratio

of the chlorophyll a levels observed in the temperature-affected samples to the levels observed in the corresponding intake samples is plotted for the 1976-1977 survey period (Figures IVC-7 through IVC-9).

The daytime discharge/intake chlorophyll a ratios (Figure IVC-7) were less than one (i.e., discharge value less than intake value) on ten of eleven dates from 26 May through 20 October, indicating partial degradation of photosynthetic pigment after plant passage during this period of relatively warm ambient lake temperature. The average ratio over the July-September period was 0.87 while average three month ratios for the other periods were all greater than 1.0, with an annual mean of 0.98 (Table IVC-5). These results indicate a minimal effect on chlorophyll a due to plant passage except for the warm summer months when low level degradation may occur.

The results of the ratio analysis of the day 2 and 3 F simulation samples (Figure IVC-7) showed only small deviations from 1.0, and showed no apparent temporal trend. The analysis of night 2 and 3 F simulation results (Figure IVC-8) showed slightly increased variation around the 1.0 value with the larger deviations generally greater than 1.0. The absence of any consistent trend in deviations of the ratio values from unity for the simulation samples indicates that chlorophyll a levels were substantially unaffected by exposure to time-temperature regimes in excess of those experienced by plume-entrained organisms.

The results of the ratio analysis of chlorophyll a in lake plume samples are shown in Figure IVC-9. The 3 F lake

TABLE IVC-5

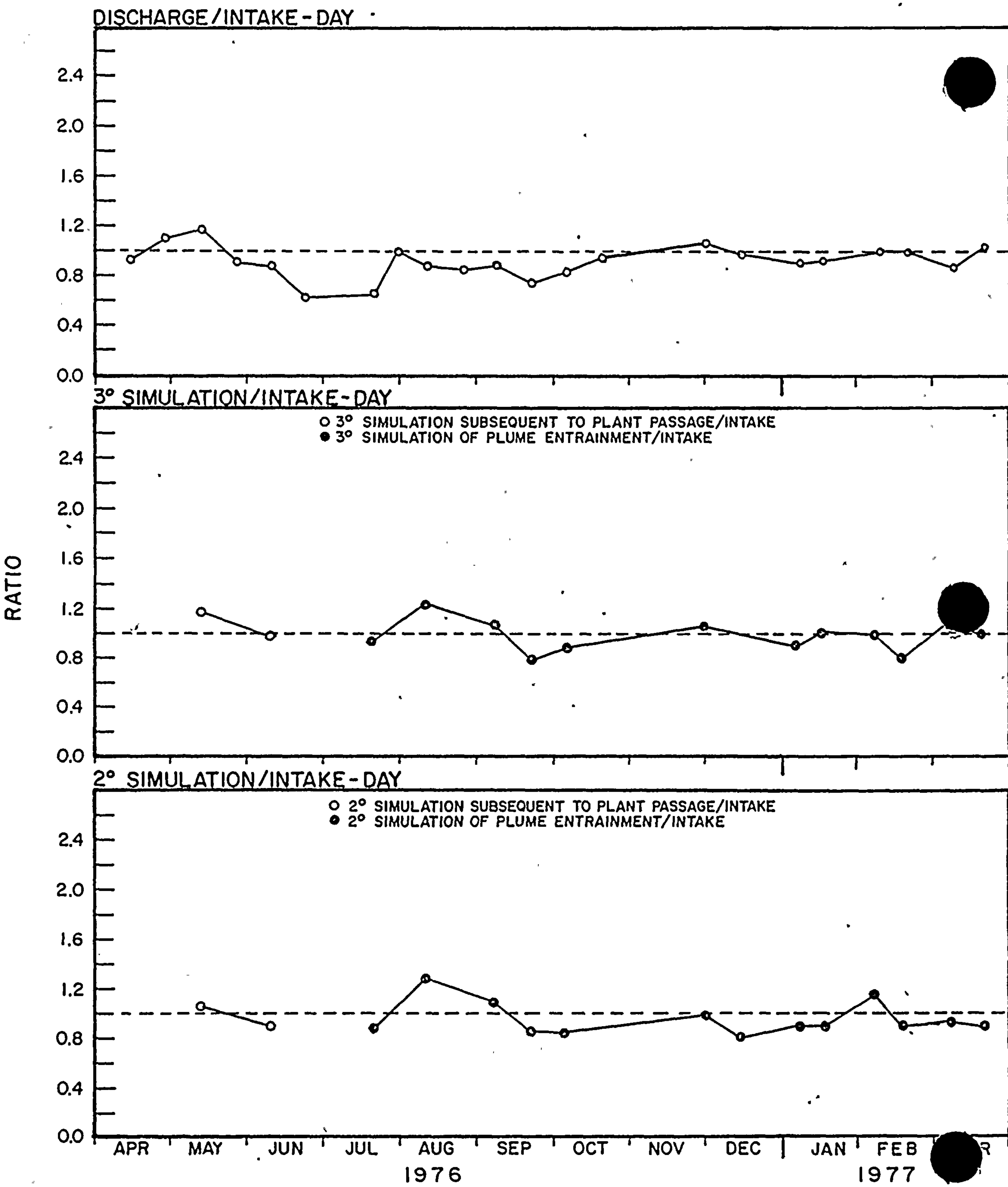
SEASONAL CHLOROPHYLL A AND PRIMARY PRODUCTIVITY RATIOS

JAMES A. FITZPATRICK NUCLEAR POWER PLANT - 1976-1977

SAMPLING PERIOD	CHLOROPHYLL A RATIOS DISCHARGE/INTAKE DAY-NIGHT	PRIMARY PRODUCTIVITY RATIOS DISCHARGE/INTAKE		
		FOUR-HOUR DAY	SEVEN-HOUR DAY	SEVEN-HOUR NIGHT
APR-JUN	1.00	1.12	1.10	1.06
JUL-SEP	0.87	0.72	0.70	0.96
OCT-DEC	1.01	1.12	0.85	1.04
JAN-MAR	1.03	1.59	1.43	1.22
ANNUAL MEAN	0.98	1.13	1.02	1.07

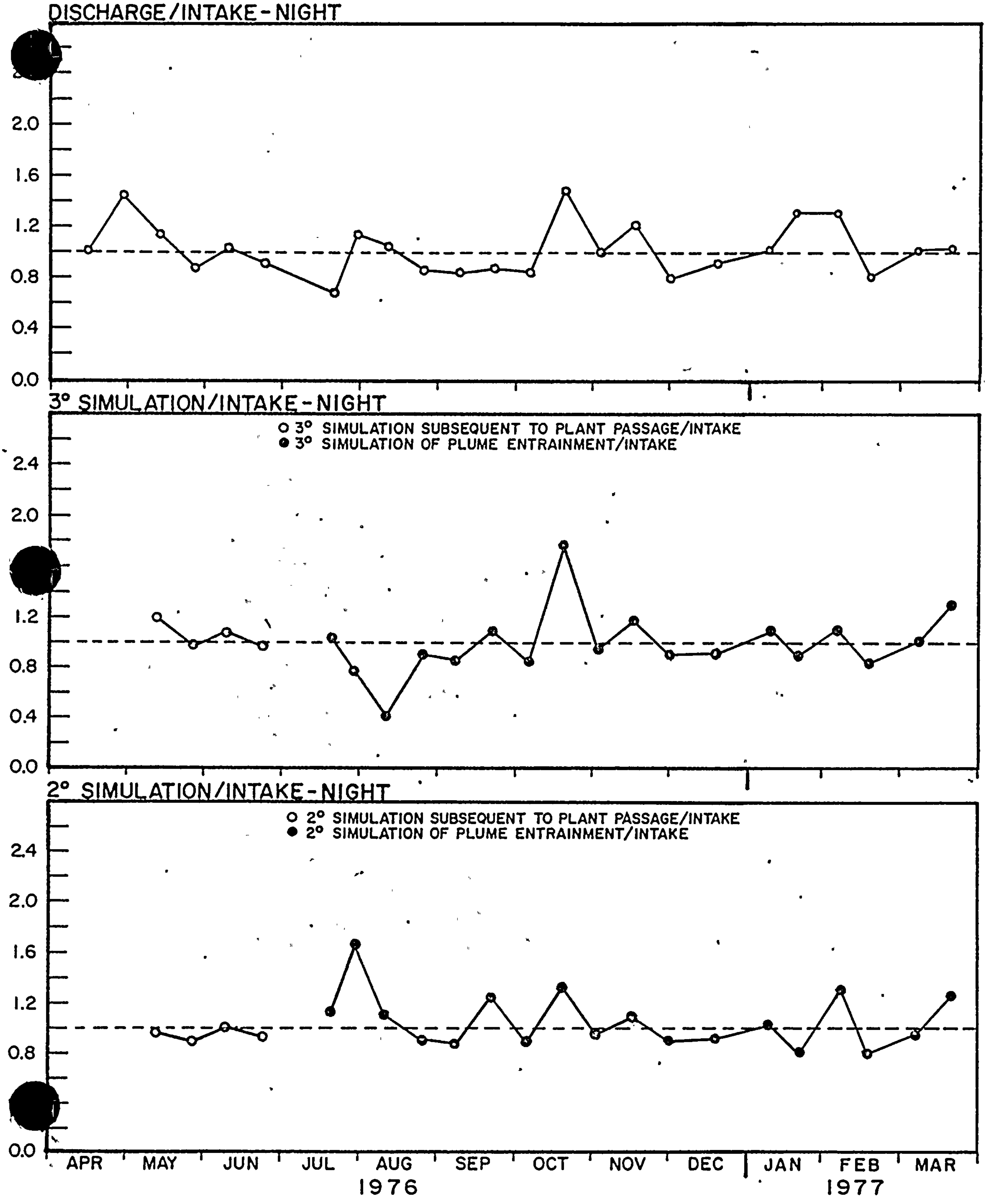
FIGURE IVC-7

CHLOROPHYLL A RATIOS
DISCHARGE/INTAKE AND SIMULATIONS/INTAKE *
JAMES A. FITZPATRICK NUCLEAR POWER PLANT 1976-1977



*NIGHT COLLECTIONS; IMMEDIATE ANALYSIS

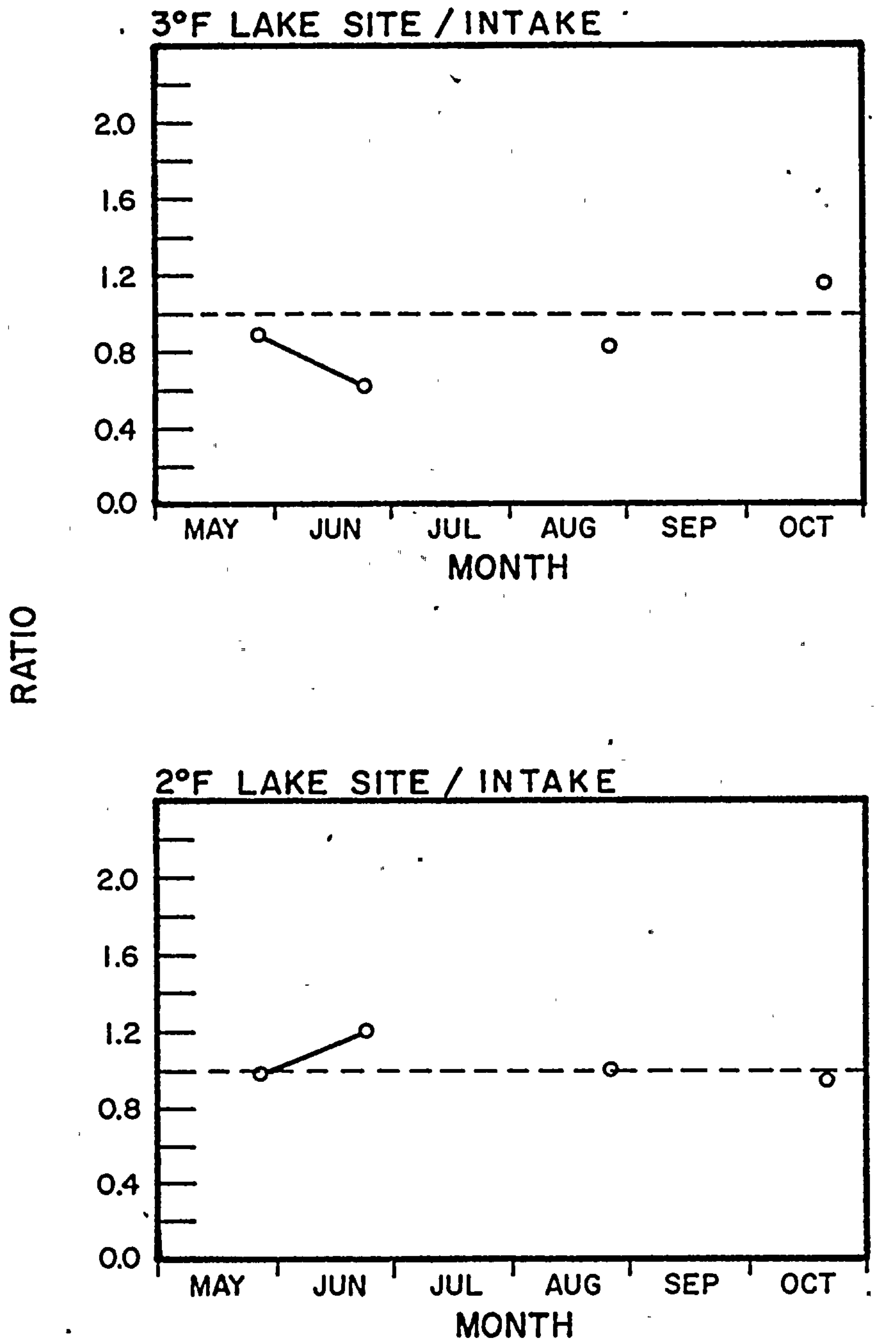
CHLOROPHYLL A RATIOS
DISCHARGE/INTAKE AND SIMULATIONS/INTAKE*
JAMES A. FITZPATRICK NUCLEAR POWER PLANT 1976-1977



*NIGHT COLLECTION; IMMEDIATE ANALYSIS

CHLOROPHYLL A RATIOS:*
LAKE/INTAKE

JAMES A. FITZPATRICK NUCLEAR POWER PLANT AND VICINITY — 1976



*DAY COLLECTIONS:

samples showed lower chlorophyll a levels than the intake collection on three of the four collection dates while the 2 F samples had two values slightly less than 1.0. While the low number of data points precludes any analysis of temporal trends, the data do indicate a possible degradation of chlorophyll a at the 3 F isotherm but no effect farther out in the plume at the 2 F isotherm.

(ii) Primary Productivity

For the 26 May through 6 October period, mean four-hour primary productivity values (day only) generally ranged between 10 and 29 mg $C/m^3/hr$ at both the intake and discharge, except on 29 July when productivity was depressed to between 6 and 9 mg $C/m^3/hr$ at both locations (LMS 1977, Appendix VIIIA-4a). From 6 October through 7 March, production remained below 10 mg $C/m^3/hr$, except on 1 December when marked increases to 28.34 and 33.64 mg $C/m^3/hr$ were recorded at the intake and discharge, respectively. These increases correspond to the simultaneous increases in chlorophyll a levels noted above, and as well as to the increased productivity observed in lake samples (see Figure IVC-6). Four-hour productivity values from October 1976 through February 1977 showed a generally decreasing trend to values of less than 3 mg $C/m^3/hr$. The 21 March 1977 discharge sample showed an increase to 18.48 mg $C/m^3/hr$. Greatest mean four-hour incubation values (day only) for intake and discharge samples for the entire sampling period were recorded on 25 August (28.50 mg $C/m^3/hr$ for the intake and 12 May (44.21 mg $C/m^3/hr$ for the discharge (LMS 1977, Appendix VIIIA-4a). The observed values and trends of the intake and discharge productivity data generally agreed with the values observed in the lake (see Figure IVC-6).

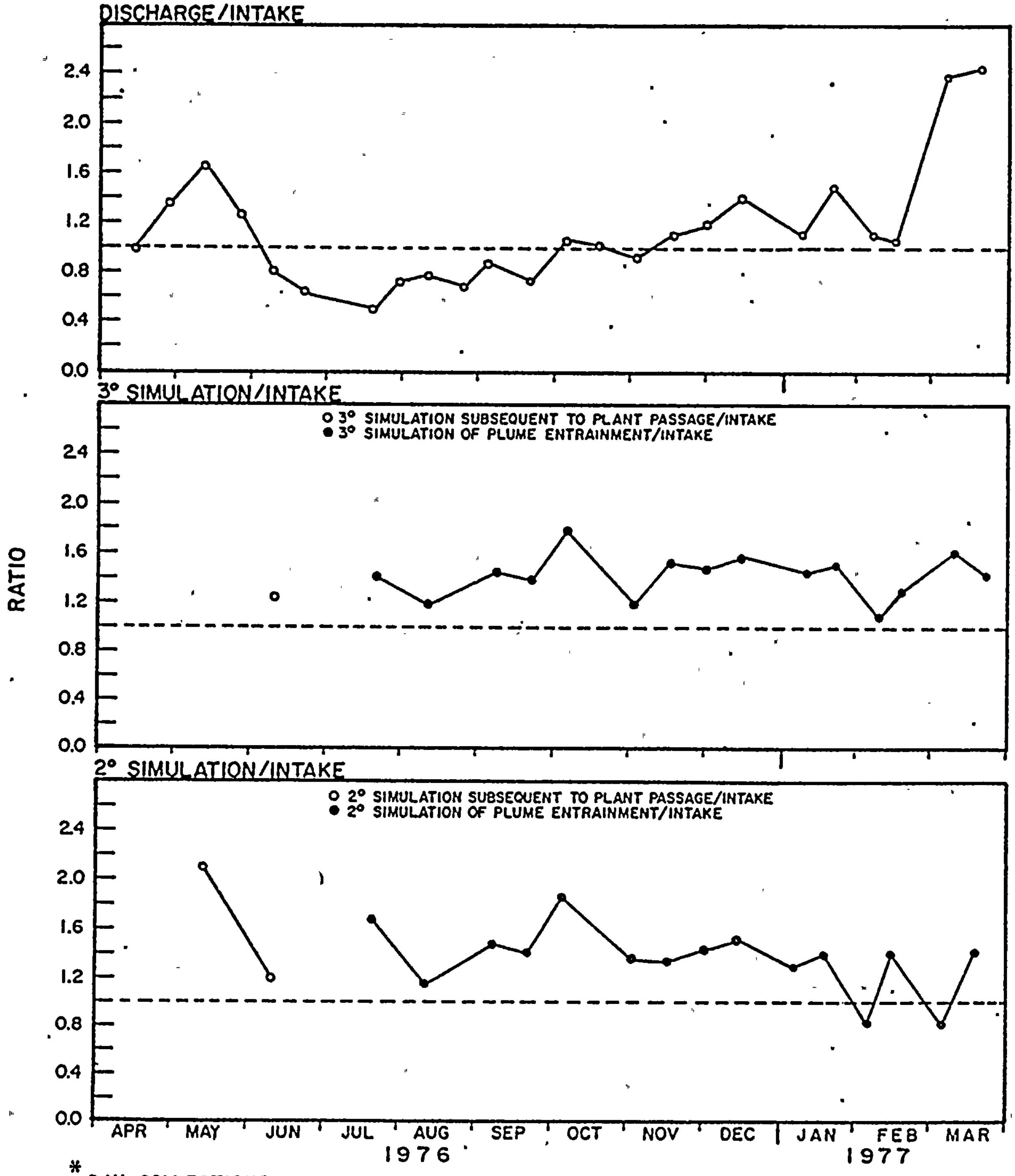
Mean seven-hour productivity values (LMS 1977, Appendix VIIIA-4b) and patterns (day and night) resembled those of four-hour incubation experiments. April through August night intake collections generally yielded productivity values lower than corresponding day samples, while for the remainder of the period no consistent difference was observed. Relatively low productivity was observed at both the intake and discharge on 29 July similar to the four-hour productivity.

As for the chlorophyll a data, a ratio was calculated for all temperature-affected sample results vs. the corresponding intake results to determine whether plant passage or jet entrainment had a stimulatory or inhibitory effect on primary productivity.

The four-hour incubation productivity ratios for day samples are shown in Figure IVC-10. Figure IVC-10 and the seasonal average ratios in Table IVC-5 both indicate an inhibitory effect during the warmer summer months and a possible stimulatory effect during the other cooler periods of the year, especially for the January-March period.

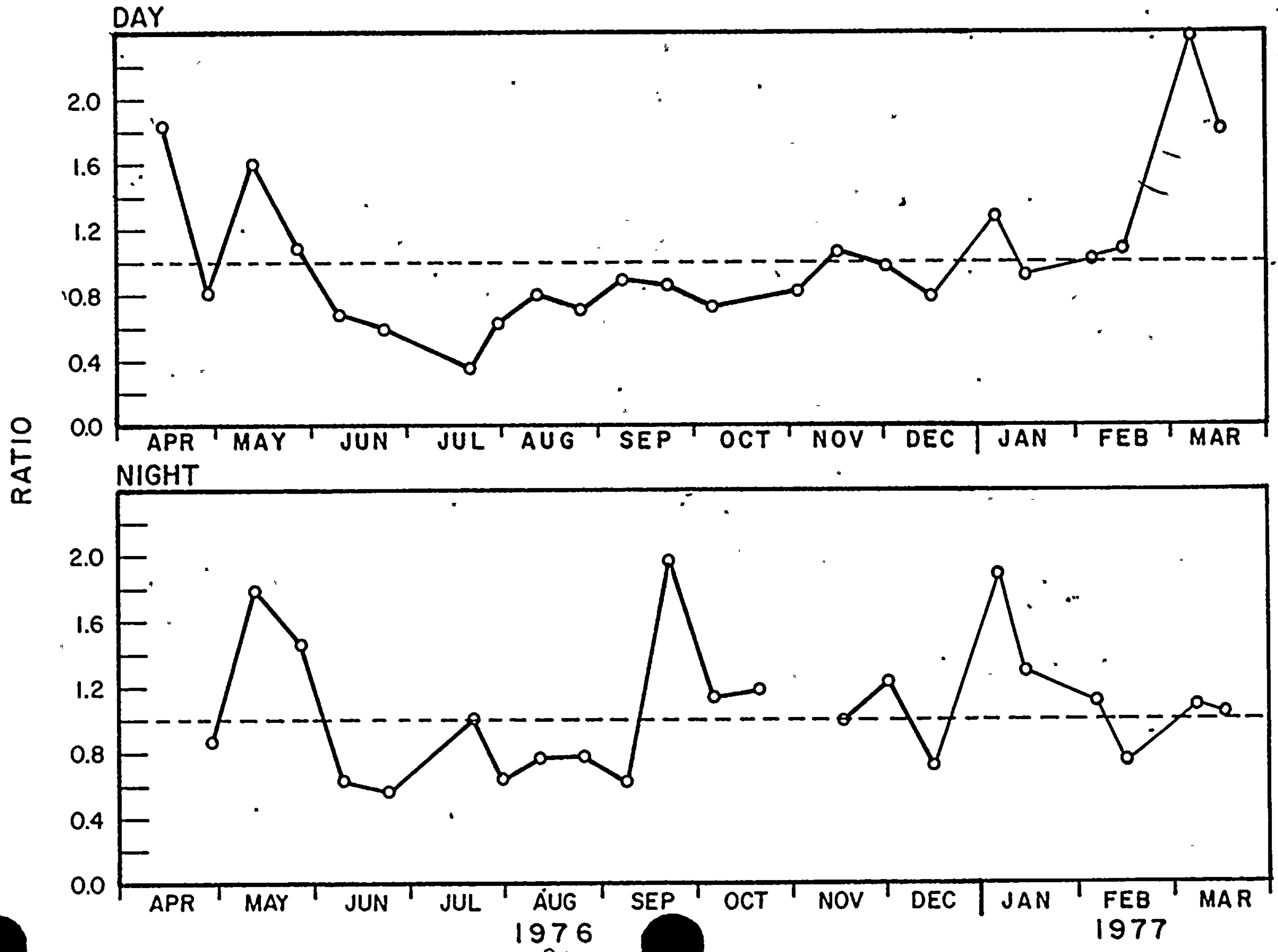
The seven-hour incubation productivity ratios between discharge and intake values (Figure IVC-11 and Table IVC-5) show a similar pattern to the four-hour results with summer inhibition and winter stimulations. Day results show inhibition occurring in the fall as well as the summer. The night seven-hour discharge/intake ratios (Figure IVC-11 and Table IVC-5) show generally less inhibition than was observed in day collections. In general, the data indicate that during periods of warmer lake temperature,

FOUR-HOUR INCUBATION PRIMARY PRODUCTION RATIOS:
DISCHARGE/INTAKE AND SIMULATIONS/INTAKE*
JAMES A. FITZPATRICK NUCLEAR POWER PLANT 1976-1977



* DAY COLLECTIONS

SEVEN-HOUR INCUBATION PRIMARY PRODUCTION RATIOS: DISCHARGE/INTAKE*
JAMES A. FITZPATRICK NUCLEAR POWER PLANT 1976-1977



*Mean of two replicates; mg C/m^3/hr.

FIGURE IVC-11

plant passage may have an inhibitory effect on phytoplankton productivity but that during the colder months, stimulation may occur with the annual averages indicating general stimulation.

The four-hour incubation results from the plume entrainment simulation samples (Figure IVC-10) show a generally consistent stimulatory effect for both the 2 and 3 F simulations. The seven-hour simulation results for day samples (Figures IVC-12 and IVC-13) also show a predominantly stimulatory effect with only one value substantially less than 1.0. The seven-hour night sample results (Figures IVC-12 and IVC-13) were more variable than the day results, showing values above and below 1.0 with no apparent seasonal trend.

The general stimulatory effect at the 2 and 3 F isotherms was also observed in both the four and seven-hour lake samples (see Figure IVC-14) where all but one sample showed a stimulatory effect.

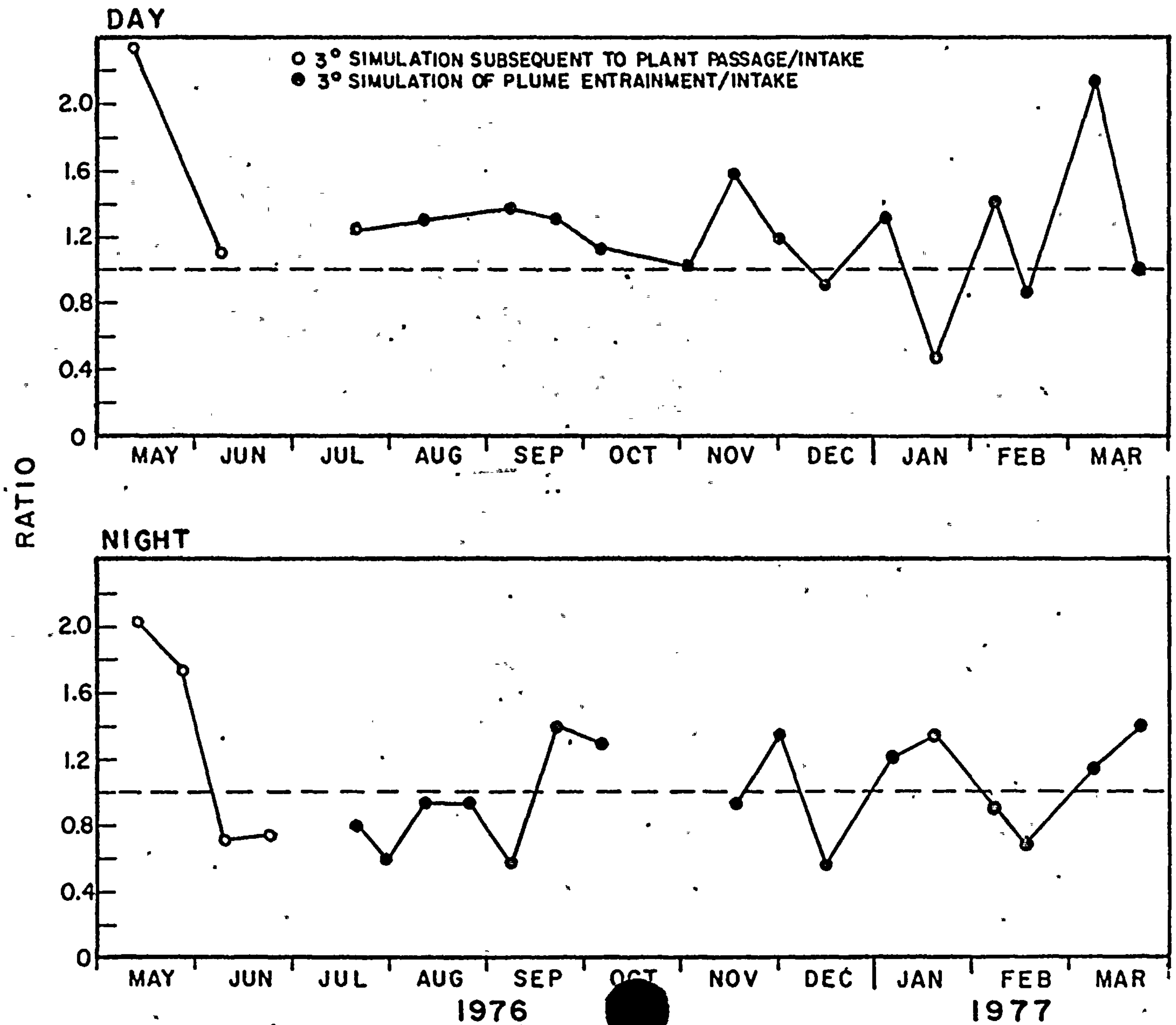
3. Conclusions

The results of the 1976 phytoplankton studies in the vicinity of the JAF plant show no discernible effects of plant operation on phytoplankton distribution and abundance. A comparison of chlorophyll *a* values observed at four transects along the 40-ft contour shows the FITZ transect values to be within the ranges observed at the remaining transects, while there is an indication that primary productivity may be slightly higher at the FITZ transect during the latter portion of the year (August through December).

The range of values and seasonal trends for both chlorophyll *a* and primary productivity was similar between intake and lake

SEVEN-HOUR INCUBATION PRIMARY PRODUCTION RATIOS: 3° SIMULATION / INTAKE*

JAMES A. FITZPATRICK NUCLEAR POWER PLANT 1976-1977

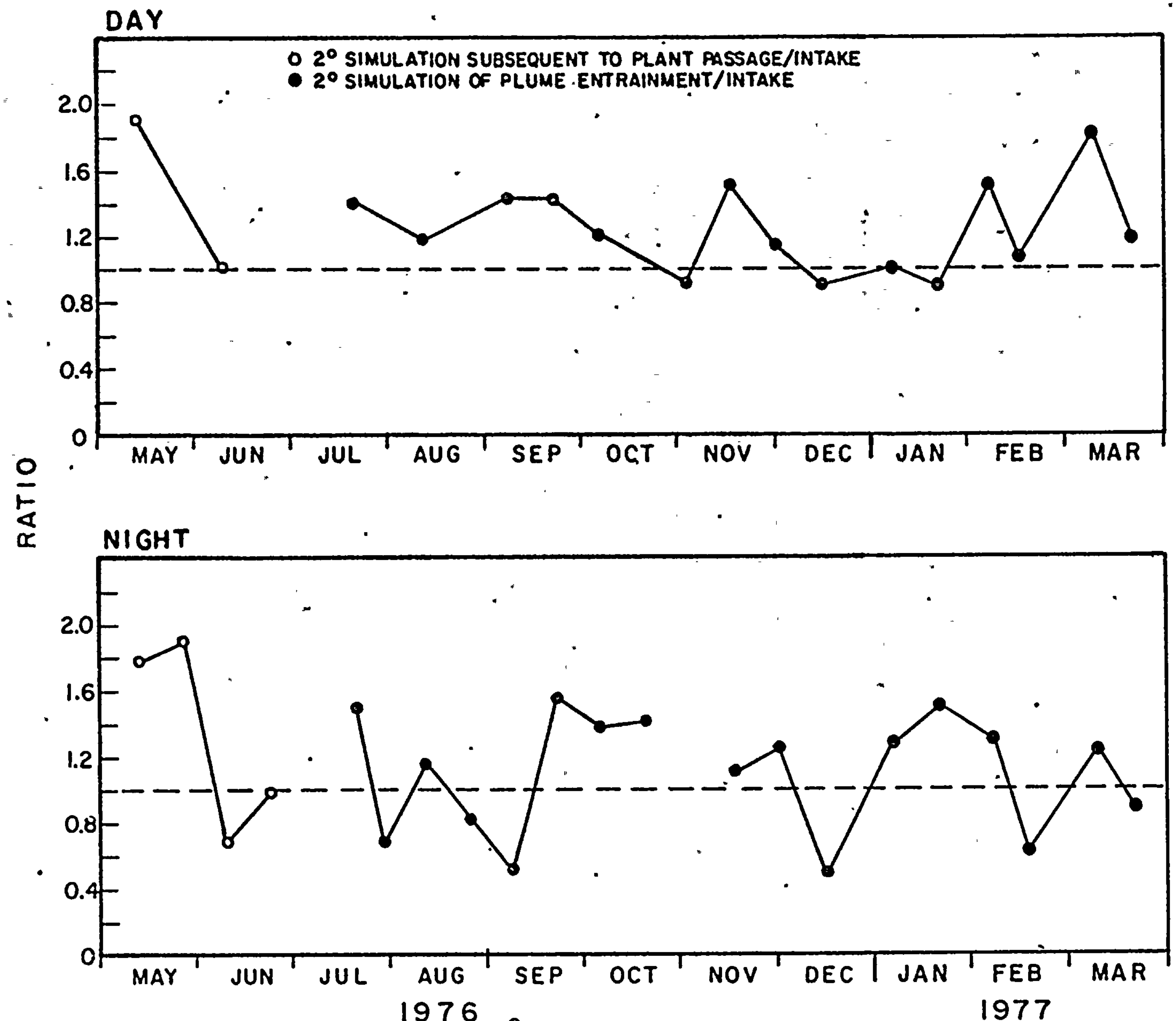


*Mean of two replicates; mg C/m3/hr

FIGURE IVC-12

SEVEN-HOUR INCUBATION PRIMARY PRODUCTION RATIOS: 2°SIMULATION / INTAKE

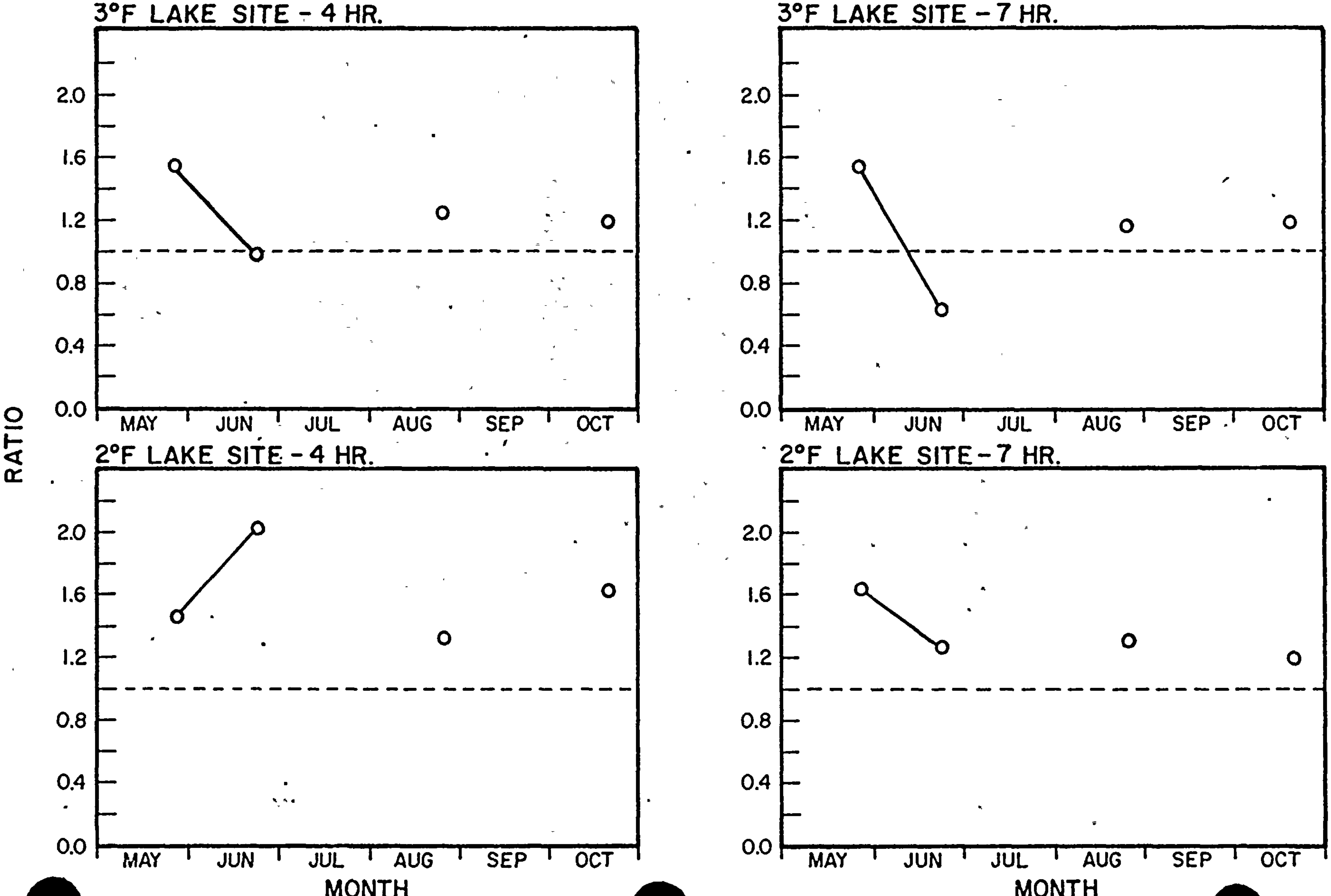
JAMES A. FITZPATRICK NUCLEAR POWER PLANT 1976-1977



*Mean of two replicates; mg C/m^3/hr.

FIGURE IVC-13

FOUR AND SEVEN-HOUR INCUBATION PRIMARY PRODUCTION RATIOS:* LAKE/INTAKE
JAMES A. FITZPATRICK NUCLEAR POWER PLANT AND VICINITY – 1976



*DAY COLLECTIONS:

FIGURE IVC-14

collections throughout the year. Both the chlorophyll a and the primary productivity entrainment data indicate that passage of phytoplankton through the circulating water system of the JAF plant causes inhibition of photosynthetic activity during the warmer months (June through September/October) and stimulates productivity during the remaining colder months. The data on plume-entrained organisms indicate a general stimulation of phytoplankton activity throughout the year.

The lack of any observable differences in major phytoplankton taxa or photosynthetic activity between plant and control transects, coupled with the two balancing effects of plant passage inhibition vs. plant entrainment stimulation, supports the conclusion that the operation of the JAF intake does not have any substantial impact on the phytoplankton community in the vicinity of the plant.

The results of the viability studies indicate that productivity is slightly enhanced in the plume, and the lake monitoring results support the conclusion for the period August through December. Both the entrainment and lake studies indicate that no substantial plant induced changes in the phytoplankton community can be discerned within the natural variation in the area, and that such changes would have been detected had they occurred.

D. ZOOPLANKTON

1. Community Description

a. Lake Ontario and Nine Mile Point Vicinity

For the purpose of this report, the zooplankton community is defined as being composed of those organisms collected and

retained in a 76μ mesh net. Zooplankton are planktonic organisms which feed primarily upon algae and detritus and are in turn grazed upon by other invertebrates and fish.

Zooplankton studies in Lake Ontario have focused primarily on the Crustacea (e.g., copepods and cladocerans); other zooplankton groups (e.g., rotifers and protozoans) have received relatively little attention (Anderson and Clayton 1959; Patalas 1969; Nauwerck et al. 1972; Wilson and Roff 1973; Watson 1974; Watson and Carpenter 1974).

During 1976, zooplankton concentrations were monitored monthly in the Nine Mile Point vicinity from May through December at 16 stations ranging between the 10 and 60-ft depth contours (Figure IVC-1). Six of the eight collections were made during near-maximum plant load operating conditions at JAF, while the 18 June and 28 July collections were conducted under relatively low plant loads (LMS 1977, Table III-6). Zooplankton were collected with a Clarke-Bumpus sampler fitted with a 76μ mesh net. The sampler was towed obliquely from just above the bottom to the surface at each station. Organisms were identified and counted with the aid of a Sedgwick-Rafter cell.

The total zooplankton population in the Nine Mile Point vicinity exhibited a gradual increase in abundance to the July peak (1,422,918 organisms/m^3); a subsequent decrease was observed through October, followed by a minor peak in November (417,822 organisms/m^3) with an eventual low in December (16,817 organisms/m^3) (LMS 1977, Appendix VB-1h). Rotifers constituted the majority of the zooplankton community in the terms of both number of taxa identified (Table IVD-1) and the percent composition by abundance (Figure IVD-1). The rotifers dominated the community from May through September, with an intermittent

TABLE IVD-1

OCCURRENCE OF ZOOPLANKTON BY DATE

NINE MILE POINT VICINITY - 1976

TAXON	DATE							
	28 MAY	17,18 JUN	28 JUL	26,27 AUG	23,26 SEP	19 OCT	16 NOV	19 DEC
PROTOZOA								
SARCODINA								
DIFFLUGIA SP.		X		X	X	X		
SUCTORIA								
ACINETA SP.	X	X	X	X	X			X
TOKOPHRYA SP.	X	X						
THECACINETA SP.	X						X	X
PARACINETA SP.			X					
STAUROPHRYA ELEGANS	X							
CILIATA								
CODONELLA CRATERA	D	X	X	X	X	X	X	X
VORTICELLIDAE	X	X	X	X		X		X
EPISTYLIDAE	X	X	X	X	D	D	X	X
ROTIFERA (ASCHELMINTHES)								
BDELLOIDEA (class)	X	X						
MONOGONONTA (class)								
BRACHIONIDAE								
BRACHIONUS ANGULARIS	X	X	X	X		X		X
BRACHIONUS CALYCIFLORUS	X	X						X
BRACHIONUS URCEOLARIS	X							
BRACHIONUS BUDAPESTINENSIS				X				
EUCHLANIS DILATATA				X	X			
KELLICOTTIA LONGISPINA	X	D	X	X	X	X	X	X
KERATELLA CRASSA	X	X	X	D	X	X	X	X
KERATELLA COCHLEARIS	D	X	X	X	X	X	X	X
KERATELLA EARLINAE	X	D	X	X	X	X	X	X
KERATELLA HIEMALIS	X						X	X
KERATELLA QUADRATA	X	X	X	X		X	X	X
NOTHOLCA ACUMINATA	X	X						X
NOTHOLCA SQUAMULA	X	X						X
NOTHOLCA LAURENTIA	X	X						X
NOTHOLCA FOLIACEA	X							
LECANIDAE								
MONOSTYLA SP.								X
NOTOMMATIDAE								
CEPHALODELLA SP.	X							
TRICHOCERCIDAE								
TRICHOCERCA SP.					X			
TRICHOCERCA CYLINDRICA				X	X	X		X
TRICHOCERCA LONGISETA		X			X			
TRICHOCERCA MULTICRINIS	X	X	X	X	X	X	X	X
TRICHOCERCA PORCELLUS				X			X	X
TRICHOCERCA SIMILIS				X				
GASTROPIDAE								
ASCOMORPHA SP.				X	X	X		
ASCOMORPHA ECAUDIS				X	X	X		X
ASPLANCHNIDAE								
ASPLANCHNA PRIODONTA	X	D	X	X	X	X	X	X
SYNCHAETIDAE								
PLOESOMA LENTICULARE			X	X	X			
PLOESOMA HUDSONI		X	X	X	X	X		
PLOESOMA TRUNCATUM	X	X	D	X	D	X		
POLYARTHRA EURYPTERA			X	X	X	X	X	X
POLYARTHRA VULGARIS	X	X	X	X	X	X	X	X
POLYARTHRA DOLICHOPTERA	X	X	X	X	X	X	X	X
POLYARTHRA MAJOR	X	X	X	X	D	X	X	X
POLYARTHRA REMATA	X	X	X	X	X	X	X	X
SYNCHAETA LACKOWITZIANA	D	X				X	X	X
SYNCHAETA PECTINATA	X	X		X	X	X	X	X
SYNCHAETA STYLATA	X	D	X	X	D	X	X	X

TABLE IVD-1 (Continued)

OCCURRENCE OF ZOOPLANKTON BY DATE (Continued)

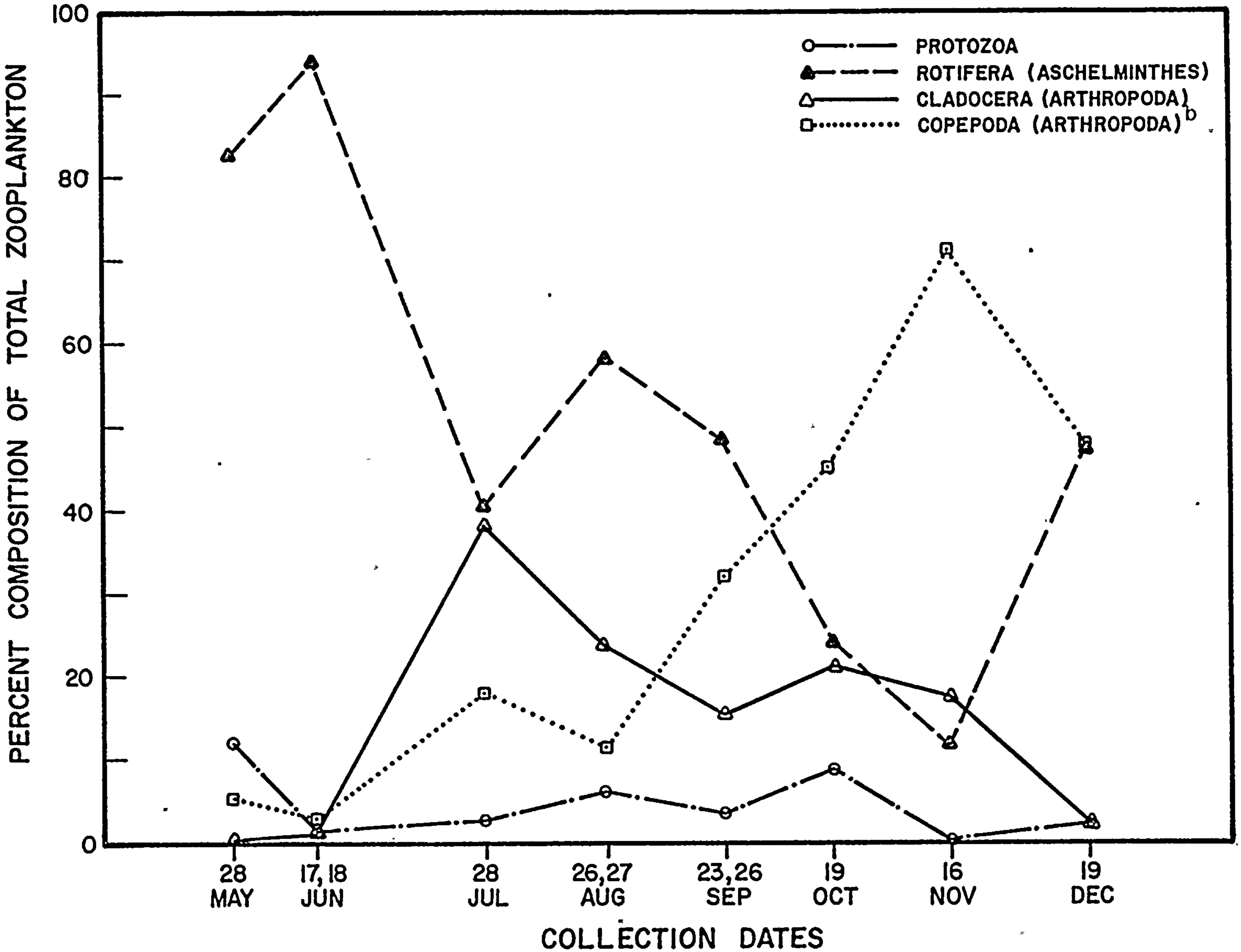
NINE MILE POINT VICINITY - 1976

TAXON	DATE							
	28 MAY	17,18 JUN	28 JUL	26,27 AUG	23,26 SEP	19 OCT	16 NOV	19 DEC
HEXARTHRIDAE								
HEXARTHRA SP.				X				
TESTUDINELLIDAE								
FILINIA LONGISETA	X	X	X	D	X	X	X	X
TESTUDINELLA SP.	X							
CONOCHILIDAE								
CONOCHILOIDES SP.				X				
CONOCHILUS UNICORNIS	X	X	X	D	X	X		
COLLOTHECACEAE								
COLLOTHECA MUTABILIS	X	X	X	X	X	X	X	X
CLADOCERA (ARTHROPODA)								
HOLOPEDIDAE								
HOLOPEDIUM GIBBERUM				X				
DAPHNIDAE								
CERIODAPHNIA LACUSTRIS			X	X	X	X	X	X
DAPHNIA RETROCURVA			X	X	X	X	X	X
DAPHNIA PULEX							X	X
BOSMINIDAE								
BOSMINA COREGONI	X	X		X	X	X	X	X
BOSMINA LONGIROSTRIS	X	X	D	D	D	D	D	X
CHYDORIDAE								
ALONA AFFINIS	X			X				
CHYDORUS SPHAERICUS					X	X		X
COPEPODA (ARTHROPODA)								
COPEPODA NAUPLII	X	X	D	D	X	D	X	D
CALANOIDA JUVENILE	X	X	X	X	X	X	X	X
EURYTEMORA AFFINIS(adult)							X	[illegible]
DIAPTOMUS SP.(adult)							X	X
CYCLOPOIDA JUVENILE	X	X	D	X	D	D	D	D
ACANTHOCYCLOPS VERNALIS(adult)								X
DIACYCLOPS BICUSPIDATUS THOMASI(adult)			X	X	X	X	X	X
TROPOCYCLOPS PRASINUS MEXICANUS(adult)				X	X	X	X	X

X PRESENT AT ONE OR MORE STATIONS, MEAN OF R-1 AND R-2

D ABUNDANCE OF 15 PCT. OR MORE AT ONE OR MORE STATIONS PER DATE: MEAN OF R-1 AND R-2

SEASONAL CYCLE OF MAJOR ZOOPLANKTON TAXA[a]
NINE MILE POINT VICINITY – 1976



[a] Day collection; mean of two replicates; number of organisms/m^2
[b] Copepoda includes nauplii, calanoid and cyclopoid juveniles and adults

FIGURE IVD-1

increase in the cladoceran population in July, followed by dominance by copepods in October and November. Throughout the 1976 sampling period, the protozoans represented less than 9% of the zooplankton collected. The species composition by date for the Nine Mile Point vicinity during 1976 is presented in Table IVD-1.

- Copepoda

Watson and Carpenter (1974) reported that the mean concentration of copepods (adults and juveniles) in the upper 50 m of the water column in a 1970 lake-wide survey of Lake Ontario (33 stations) ranged from 1,311 organisms/m^3 in January to 27,633 organisms/m^3 in August. The peak concentrations from this study were reported from August through October.

In the Nine Mile Point vicinity during 1976, the mean concentration of juvenile copepods (calanoid and cyclopoid) in samples collected to the 18-m water depth only was approximately 1.7 to 4.5 times greater (LMS 1977, Appendices VB-1a and VB-1b) than that reported in the 1970 lake-wide survey, during which approximately 51% of the samples were collected at depths greater than 50 m. Concentrations ranged from 4,653 organisms/m^3 in December to 247,570 organisms/m^3 in November 1976. The peak concentration for both calanoid and cyclopoid juvenile copepods was reported in November; an earlier but minor peak occurred in July for cyclopoid copepods.

During the 1976 sampling period, the adult copepod population ranged from 0.3 to 9.6% (conclusion based on data presented in LMS 1977, Appendices VB-1a and VB-1d) and the nauplii ranged from 12.0 to 60.8% of the total copepods recorded per day (LMS 1977, Appendices VB-1c and VB-1d). The calanoid juvenile

population represented only 0.2-3.9% of the total copepods enumerated (LMS 1977, Appendices VB-1a and VB-1d). The cyclopoid juveniles comprised the majority of the copepods in June and from September through December (LMS 1977, Appendices VB-1b and VB-1d); this was coincident with the decrease in percent composition of the nauplii, which had been the dominant group in May and August (LMS 1977, Appendices VB-1c and VB-1d).

Nauwerck et al. (1972) reported that the densities of cyclopoid copepods were greater at inshore than at offshore sampling stations in the lake-wide survey in Lake Ontario, although no spatial differences in densities were observed for calanoid copepods. No consistent offshore-onshore spatial distribution pattern was observed for either group of copepods within the 18-m depth contour in the Nine Mile Point vicinity during the 1976 sampling period (LMS 1977, Appendices VB-1a and VB-1b).

- Cladocera

During a 1970 lake-wide survey in Lake Ontario, mean total cladoceran densities in the upper 50 m ranged from a low of 15 organisms/m^3 in January to a high of 27,106 organisms/m^3 reported in August (Watson and Carpenter 1974). Cladocerans increased in abundance during the summer months with peak densities observed in August and October. In the Nine Mile Point vicinity, the mean concentrations of cladocerans during 1976 ranged from 417 organisms/m^3 in December to 68,495 organisms/m^3 in September, with peak densities recorded in July and September (LMS 1977, Appendix VB-1e). The magnitude of difference in the ranges between these two studies is related to the difference in water depth sampled.

Cladocerans showed a trend of greater abundance at inshore stations (14-24-m depths) than in the upper 50 m at the offshore stations (>50 m) (Patalas 1969; Nauwerck et al. 1972). This trend was also observed within the 18-m depth contour in the Nine Mile Point vicinity from May through September; the cladocerans were more abundant at the 10 and 20-ft depth contours than at the 40 and 60-ft contours (LMS 1977, Appendix VB-1e). No consistent offshore-onshore trend was observed during the remainder of the 1976 sampling period.

b. 40-ft Contour - Nine Mile Point Vicinity

- Rotifera: Aschelminthes

The spatial-temporal distribution of rotifers at the 40-ft contour is presented in Figure IVD-2; no consistent spatial distribution among transects was observed and the FITZ-40-ft station values generally fell within the observed range at the other 40-ft stations.

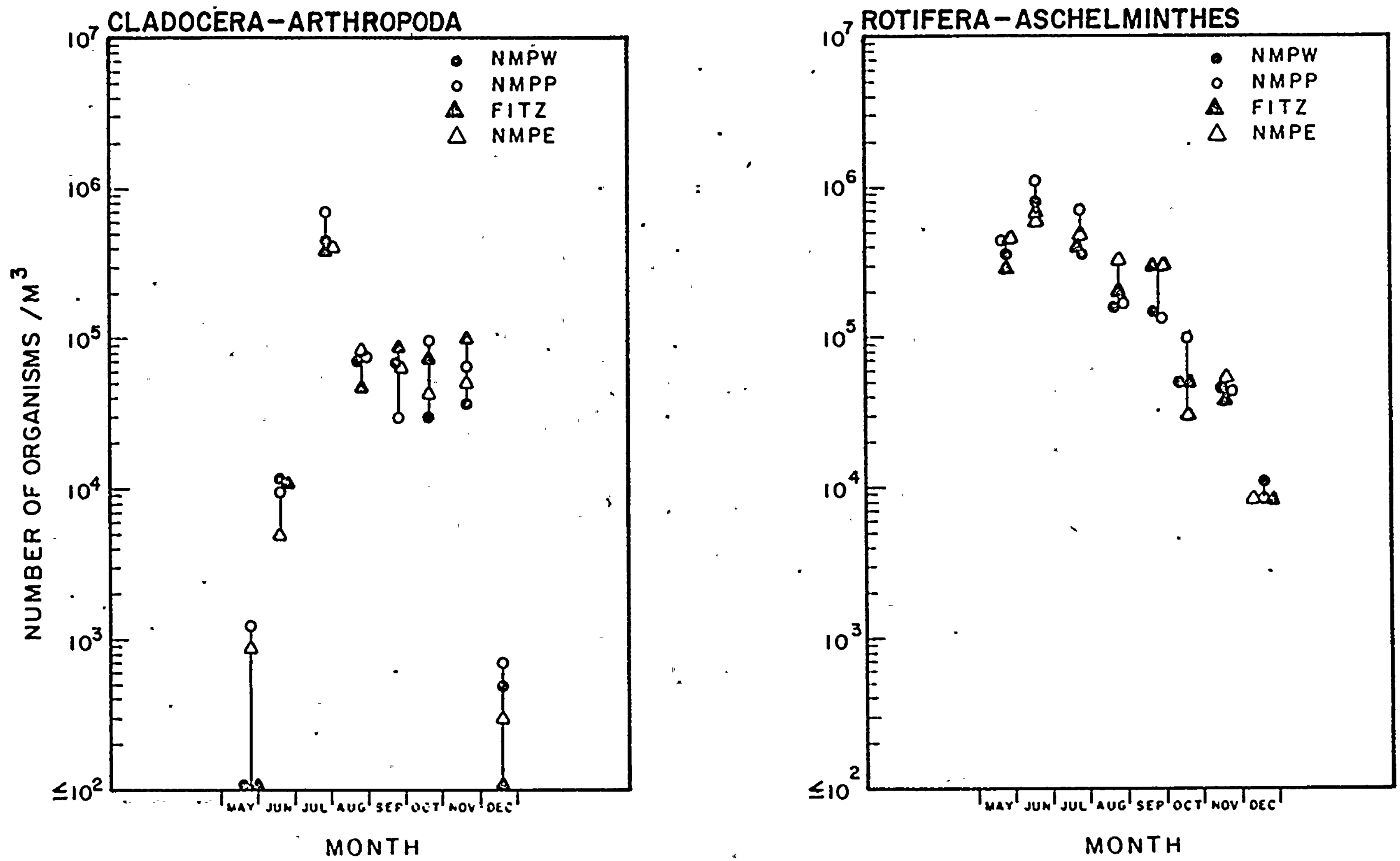
- Cladocera: Arthropoda

The spatial-temporal distribution of cladocerans at the 40-ft contour is presented in Figure IVD-2; no consistent spatial pattern among control and plant transects was observed. The difference in the cladoceran concentrations among transects in the May and December samples were within the limits of natural variability and thus were not attributable to a plant effect.

- Copepoda

The spatial-temporal distribution of calanoid and cyclopoid juvenile copepods is presented in Figure IVD-3. On all collection dates, the calanoid juveniles represented less than 5% of

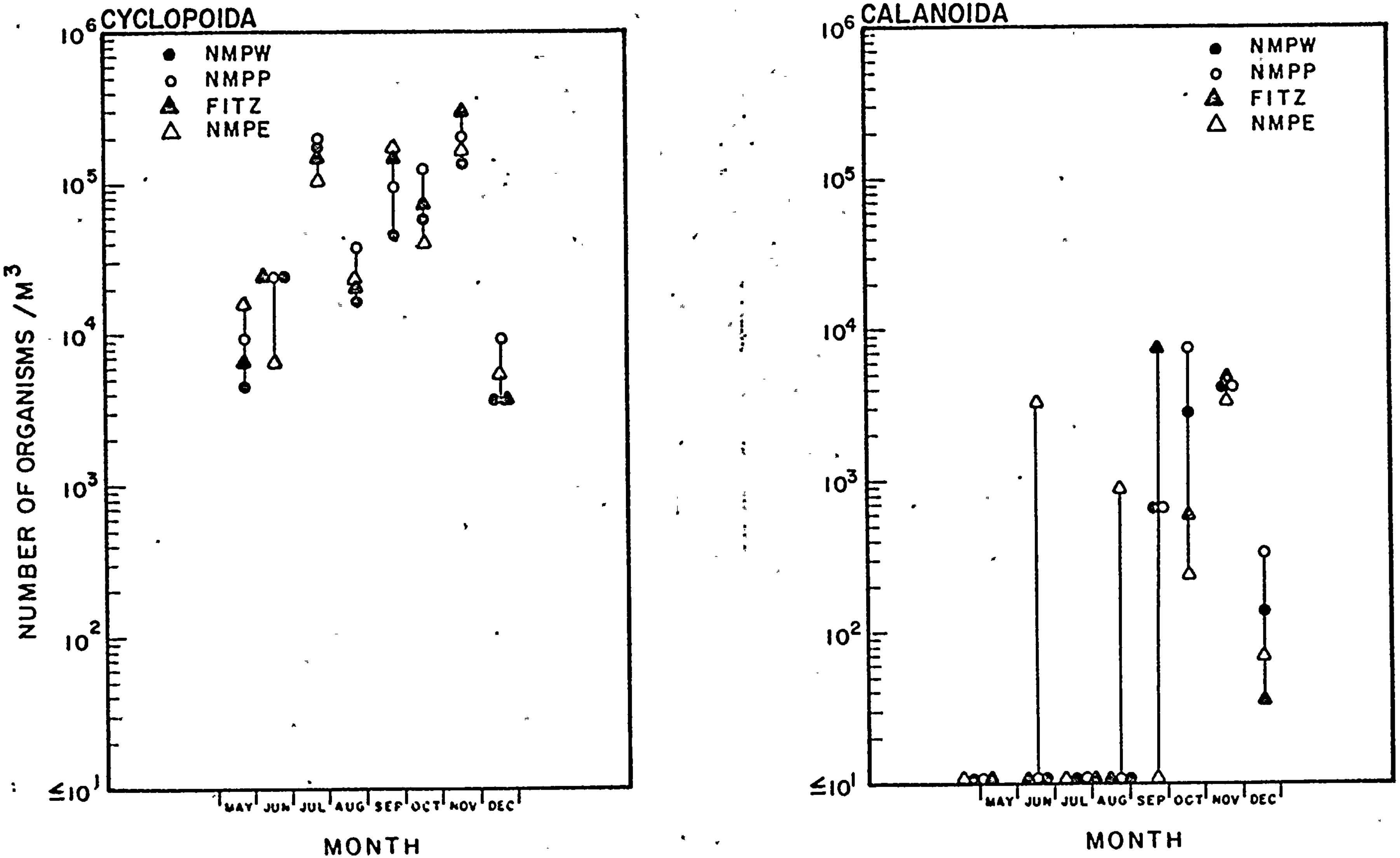
ABUNDANCE OF
CLADOCERA AND ROTIFERA*
40-FT DEPTH CONTOUR
NINE MILE POINT VICINITY – 1976



*ZOOPLANKTON COLLECTIONS, MEAN OF R-1 and R-2

FIGURE IVD-2

ABUNDANCE OF
CYCLOPOID AND CALANOID COPEPODS*
40-FT DEPTH CONTOUR
NINE MILE POINT VICINITY - 1976



*ZOOPLANKTON COLLECTIONS, MEAN OF R-1 and R-2 JUVENILE STAGE

FIGURE IVD-3

the copepod population and as such were not present in sufficient numbers for interpretation of plant effect.

No consistent spatial distribution among control and plant transects was observed for cyclopoid juveniles. The concentrations of cyclopoid juveniles at the 40-ft depth contour were representative of the seasonal trend reported for the Nine Mile Point vicinity.

In summary, there was no apparent effect of FitzPatrick plant operation on major zooplankton taxa as exemplified by analysis of copepods, cladocerans, and rotifers along the 40-ft depth contour. For the groups analyzed, the FITZ-40-ft station values generally fell within the range of natural variation observed at the other 40-ft stations with the FITZ-40-ft station consistently higher or lower values. The lack of a consistent spatial distribution among transects was in agreement with earlier findings based on 1975 data (LMS 1976).

2. Entrainment Studies

a. Description of Studies

Collections for the zooplankton entrainment viability studies were made during both day and night on two dates per month between April 1976 and March 1977. Samples were collected with a submersible pump from the intake and discharge bays and from the same two lake plume locations (3 and 2 F isotherms) as the phytoplankton plume samples. Viability analysis was also conducted on plume entrainment simulation samples to evaluate the effects of zooplankton entrainment into the plume. As in the phytoplankton program, all samples from the discharge bay were held at discharge temperature for a time period equivalent

to the time of travel between the collection point and the diffuser ports in the lake. The objectives of the zooplankton entrainment studies were to evaluate the effects of plant passage while the lake plume samples and in-plant temperature simulations were used to evaluate jet entrainment. The general procedure for the viability samples was to collect a sufficient sample volume to obtain 200 organisms per ml in the concentrated sample. A summary of the zooplankton entrainment program is given in Table IVD-2. Zooplankton viability studies were always conducted during periods of high plant load with a minimum observed temperature rise of 12.2 C. The majority of the values were between 13 and 16 C (LMS 1977, Table VIII-5).

Two temperature reduction procedures were used on the zooplankton discharge samples to simulate the reduction in temperature occurring in the plume after discharge to the lake. The first procedure (used from April through June) was to place the discharge sample into the incubation chamber at intake temperature, thus lowering the sample temperature. All samples were incubated for eight hours prior to analysis except 14 April collections which were analyzed immediately and after 24 hours. For the July 1976 through March 1977 period, a technique that more rapidly reduced the temperature was used to better simulate the actual conditions of the discharge to the lake. The discharge samples were serially diluted with filtered intake water in a time-series dilution that simulated the predicted dilution time in the near-field plume. After the temperature reduction, the samples were incubated at intake temperature for eight hours.

The effects of jet entrainment on zooplankton during May and June were evaluated by diluting discharge samples to a temperature rise of 2 or 3 F with intake water and then incubating them

TABLE IVD-2

ZOOPLANKTON[a] VIABILITY SAMPLING PROGRAM

JAMES A. FITZPATRICK NUCLEAR POWER PLANT AND VICINITY - 1976

SAMPLE TYPE	FREQUENCY[b]	DAY/NIGHT[c]	LOCATION OF SAMPLING	PROCEDURE OUTLINE
INTAKE	2/MON(Apr-Dec)	Day and night	INTAKE FOREBAY[e] (14 April Collection)	Pump through net for 5-15 minutes (~200 cells/counting chamber); immediate analysis and after 24 hr incubation period
			INTAKE FOREBAY[e] (28 April-December Collections)	Pump through net for 5-15 minutes (~200 cells/counting chamber); analysis after 8 hr incubation period
DISCHARGE	2/MON(Apr-Dec)	Day and night	DISCHARGE AFTBAY (14 April Collection)	Pump through net for 5-15 minutes; hold for travel time to diffuser; immediate analysis and after 24 hr incubation period
			DISCHARGE AFTBAY (28 April-June Collections)	Pump through net for 5-15 minutes; hold for travel time to diffuser; analysis after 8 hr incubation period
			DISCHARGE AFTBAY (July-December Collections)	Pump through net for 5-15 minutes; hold for travel time to diffuser; bring sample to 0.5 liters with filtered discharge water; dilute with filtered intake water to 2°F, time series dilution scheme; refilter through net; analysis after 8 hr incubation period
SIMULATION 3°F	1/MON(Apr-Dec) 2/MON(Apr-Dec)	Day Night	DISCHARGE AFTBAY (May & June Collections)	Pump through net for 5-15 minutes; hold for travel time to diffuser; instantaneous dilution with unfiltered (May-9June collections)/filtered (23,28 June collections) intake water following dilution ratios (Figure 1) appropriate for recorded ΔT; refilter and analyze after 8 hr incubation period
			INTAKE FOREBAY[e] (July-December Collections)	Pump through net for 1.5 times the collection time of the intake sample; add 12 liters of filtered intake water to intake sample; add resultant sample to 1 liter of filtered discharge water, time series dilution scheme; refilter and analyze after 8 hr incubation period
SIMULATION[d] 2°F	Same as 3°F simulation	Same as 3°F simulation	Same as 3°F simulation	Same as 3°F simulation
3°F PLUME ISOTHERM (LAKE)[b]	1/MON(Apr-Dec)	Day	VISIBLE BOIL (0.5 m below surface)	Pump; analyze after 8 hr incubation period
2°F PLUME ISOTHERM (LAKE)[b]	1/MON(Apr-Dec)	Day	1200-1500 ft FROM BOIL ALONG TRAJECTORY OF PLUME	Pump; analyze after 8 hr incubation period
LAKE(FITZ INTAKE)[b]	1/MON(Oct-Dec)	Day	VICINITY OF FITZ INTAKE STRUCTURE; 24 ft DEPTH CONTOUR, 1000 ft OFFSHORE, 500 ft BEHIND VISIBLE BOIL	Pump; analyze after 8 hr incubation period

[a]Zooplankton: >76μ but less than 571μ in size
[b]Frequency of lake collections contingent on weather conditions
[c]Day = 1030 hrs; Night = 2230 hrs
[d]Simulated studies for zooplankton are conducted whenever lake sampling is cancelled due to inclement weather
[e]Intake forebay sample taken on lake side of entrainment rack, prior to tempering

2/MON = Twice monthly

1/MON = Once monthly

for eight hours at intake temperatures. In this way, most organisms contained in these samples had been subjected to plant passage since discharge samples were composed of concentrated organisms while intake dilution water contained relatively few organisms at their natural density. From July through the remainder of the sampling program, the simulation technique was changed to better simulate jet entrainment. During that period, organisms collected from the intake were serially added, along with water at intake temperature, to a volume of filtered water at discharge temperature. The addition rate was designed to produce a time-temperature regime of twice the duration expected in the near-field plume. As a result, these simulation samples represent only organisms entrained at various points in the near-field plume out to the 2 and 3 F isotherms, with none of the organisms having been subjected to plant passage. Thus, the total mortality expected at the 2 or 3 F isotherm would be the combination of the observed plume entrainment and plant passage mortalities. The organisms have also been subjected to a longer duration temperature exposure than actual entrained organisms. The simulation samples were subsequently incubated at intake temperature for eight hours.

Following the incubation period, two 1.0 ml aliquots were withdrawn from each sample and examined for the number of live and dead organisms of each species. The numbers of dead and total organisms observed in the two aliquots were combined for each group of species analyzed (see below) and the mortality of each sample computed as the number of dead organisms divided by the total number observed. The mortalities of the temperature affected samples were plotted over the sampling period along with the intake mortality. The mortality of each group attributable to plant passage was computed as the difference between observed percent surviving at the intake and discharge divided

by the intake survival. This calculation removes the effects of sampling mortality by assuming equal sampling mortality at the two locations. Since the same sampling gear and procedures were used at both locations the assumption of equal sampling mortality is valid.

b. Results of Entrainment Studies

(i) Cladocera

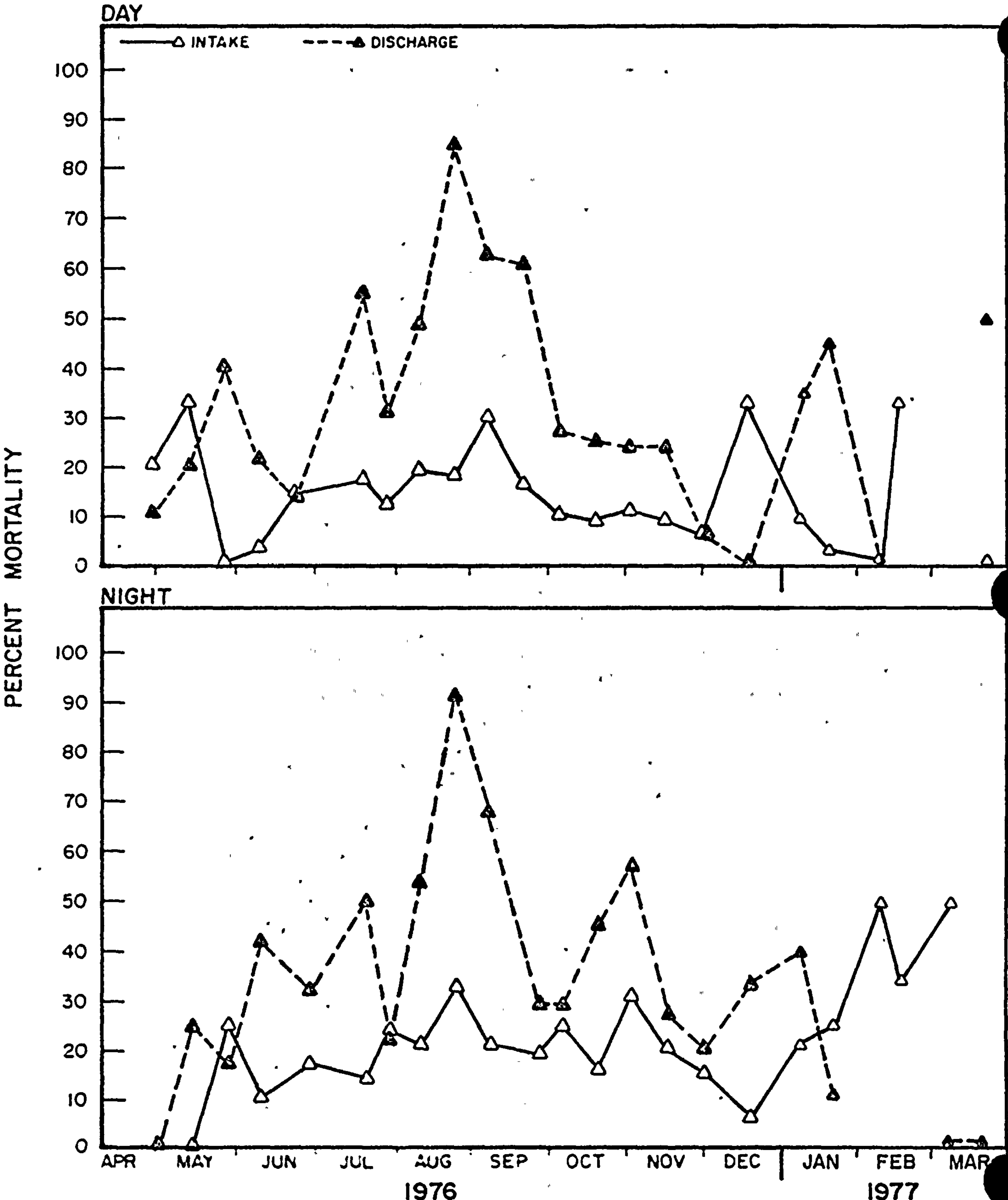
The temporal variation of intake and discharge mortality of cladocerans collected in day and night samples is shown on Figure IVD-4. Figure IVD-4 shows the day and night distributions of both intake and discharge mortalities to be similar with both showing a trend of high discharge mortality during periods of warmer lake temperatures. This period also corresponds to the periods of maximum lake abundance (Figure IVD-2) and maximum entrained abundance of cladocerans (LMS 1977, Appendix VIIIB-1). *Bosmina longirostris* was the dominant entrained cladoceran during the period of peak abundance (LMS 1977, Appendix VIIIB-1).

The mortality attributable to plant passage during the period July through September was 38.1% as compared to between 9 and 17% for the other periods of the year when abundances were much lower (Table IVD-3). Table IVD-3 also shows a very consistent intake survival for cladocerans of between 80 and 86% for the sampling year. This would indicate that the sampling mortality for cladocerans was both low (<20%) and consistent.

The observed mortalities in the 3 and 2 F simulation and lake samples (Figures IVD-5 and IVD-6) show generally close

CLADOCERA MORTALITY* IN INTAKE AND DISCHARGE SAMPLES

JAMES A. FITZPATRICK NUCLEAR POWER PLANT – 1976-1977



*Mean of two replicates; analysis after 8-hour incubation period.

TABLE IVD-3

MORTALITY OF ZOOPLANKTON DUE TO PLANT PASSAGE

JAMES A. FITZPATRICK NUCLEAR POWER PLANT - 1976-1977

TAXA	TIME PERIOD	% LIVE[b] INTAKE	% LIVE[b] DISCHARGE	% MORTALITY DUE TO PLANT PASSAGE[c]
CLADOCERA (ARTHROPODA)	APR-JUN	85.3	77.5	9.2
	JUL-SEP	80.5	49.9	38.1
	OCT-DEC	85.6	70.8	17.3
	JAN-MAR	83.8	69.6	16.9
COPEPODA[a] (ARTHROPODA)	APR-JUN	47.2	35.5	24.8
	JUL-SEP	63.8	34.9	45.3
	OCT-DEC	65.1	49.4	24.1
	JAN-MAR	56.6	55.2	2.4
TOTAL PROTOZOA	APR-JUN	53.6	32.2	40.0
	JUL-SEP	42.1	34.7	17.7
	OCT-DEC	33.5	40.3	-20.3
	JAN-MAR	56.1	44.3	20.3
ROTIFERA	APR-JUN	46.8	35.4	24.3
	JUL-SEP	45.6	34.0	25.4
	OCT-DEC	44.6	42.9	3.8
	JAN-MAR	37.0	27.8	24.8
TOTAL ZOOPLANKTON	APR-JUN	48.1	37.9	21.2
	JUL-SEP	60.5	38.3	36.7
	OCT-DEC	63.0	50.3	20.1
	JAN-MAR	52.2	50.6	3.1

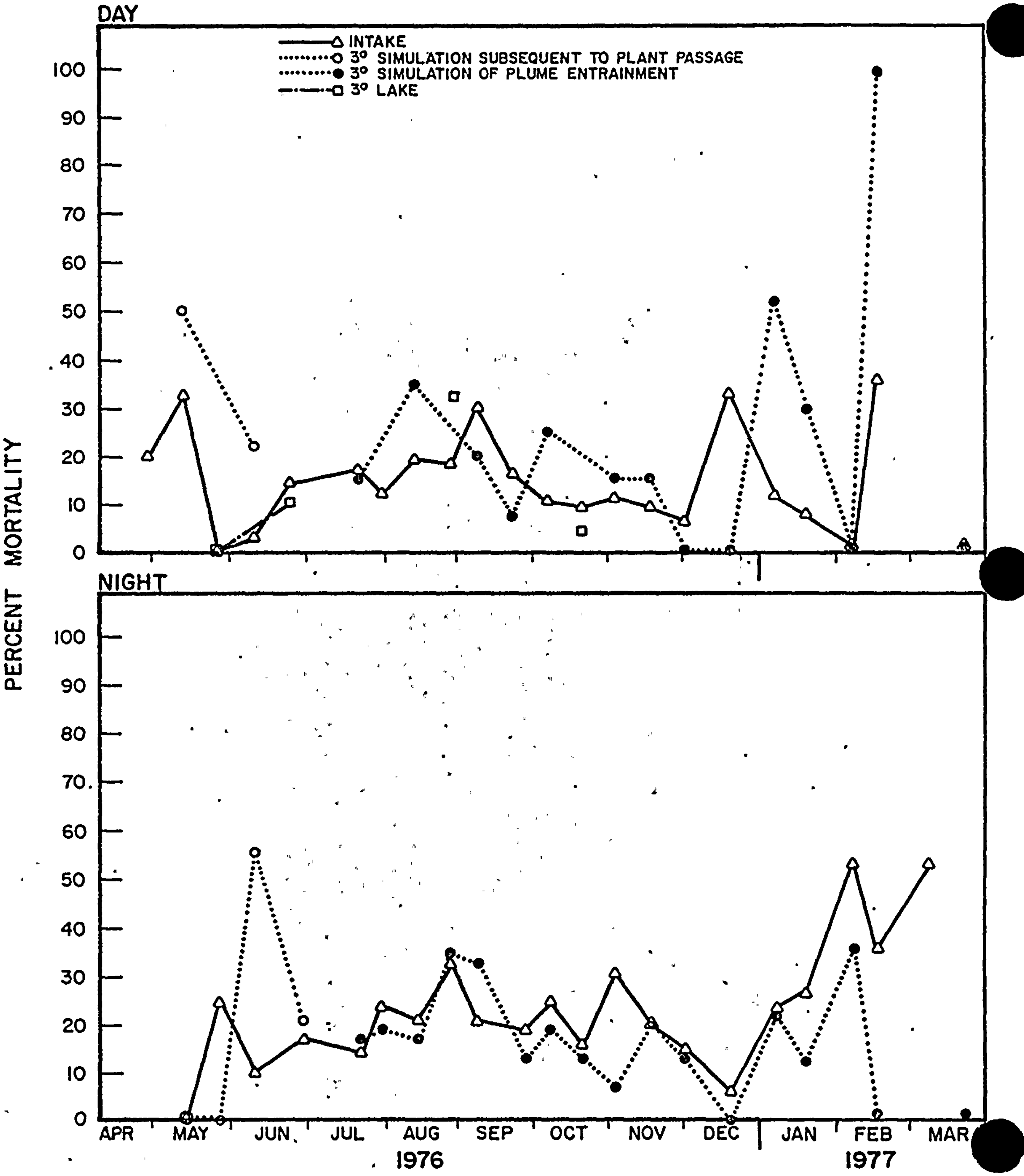
[a] Adults, juvenile, nauplii

[b] Number live divided by the total collected

[c] $\frac{\%\ \text{Live}_I - \%\ \text{Live}_D}{\%\ \text{Live}_I}$; I = Intake sample; D = Discharge sample

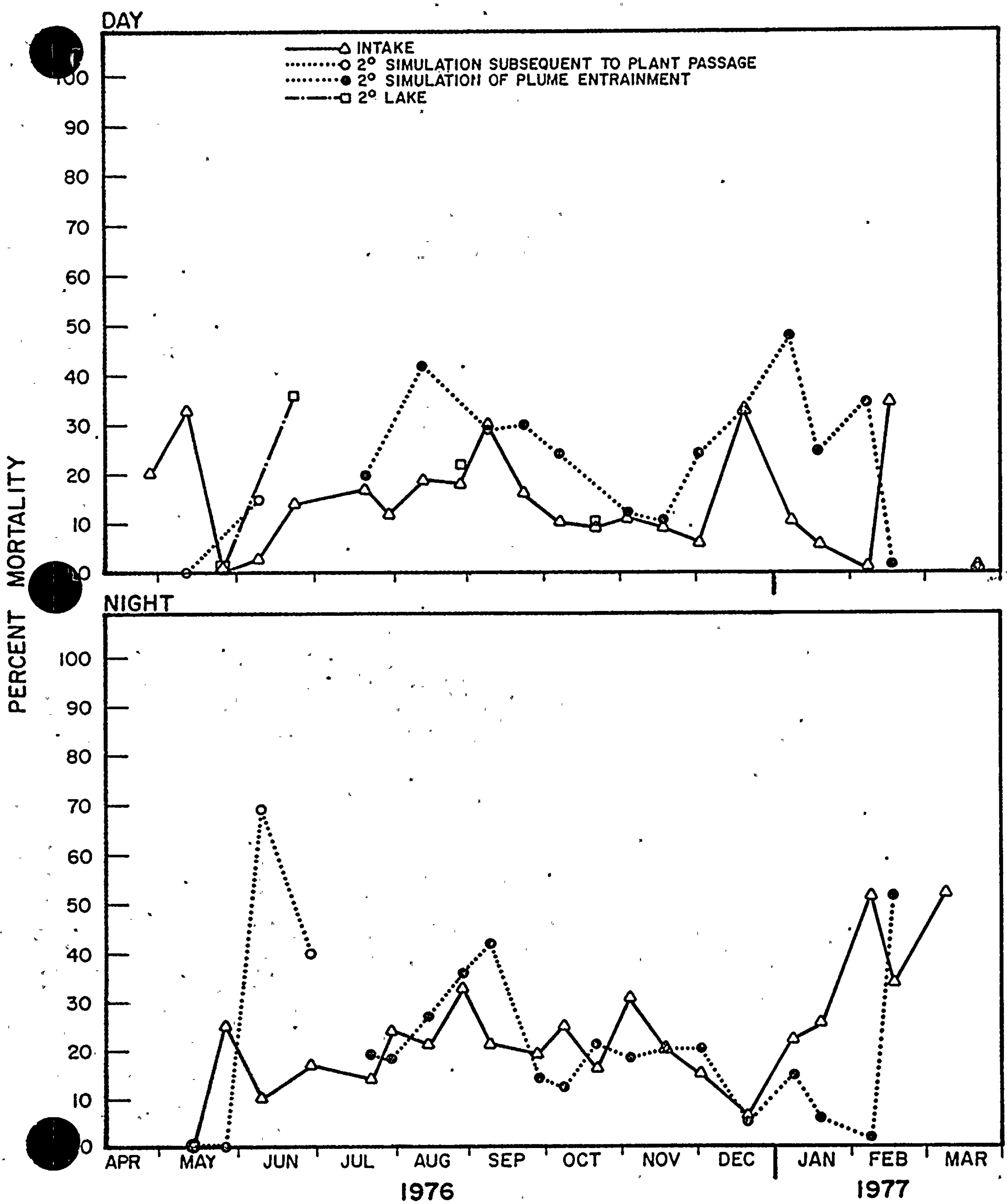
FIGURE IVD-5

CLADOCERA MORTALITY *
IN INTAKE AND 3° F DILUTION SAMPLES
JAMES A. FITZPATRICK NUCLEAR POWER PLANT – 1976-1977



*Mean of two replicates; analysis after 8-hour incubation period.

CLADOCERA MORTALITY* IN INTAKE AND 2° F DILUTION SAMPLES
JAMES A. FITZPATRICK NUCLEAR POWER PLANT — 1976-1977



*Mean of two replicates analysis after 8-hour incubation period.

agreement with those observed in the intake samples especially during the summer period of peak cladoceran abundance. The close agreement between observed mortalities in the jet entrainment samples (lake and simulations) and the intake mortalities indicates a negligible effect of plume entrainment on cladocerans.

(ii) Copepods

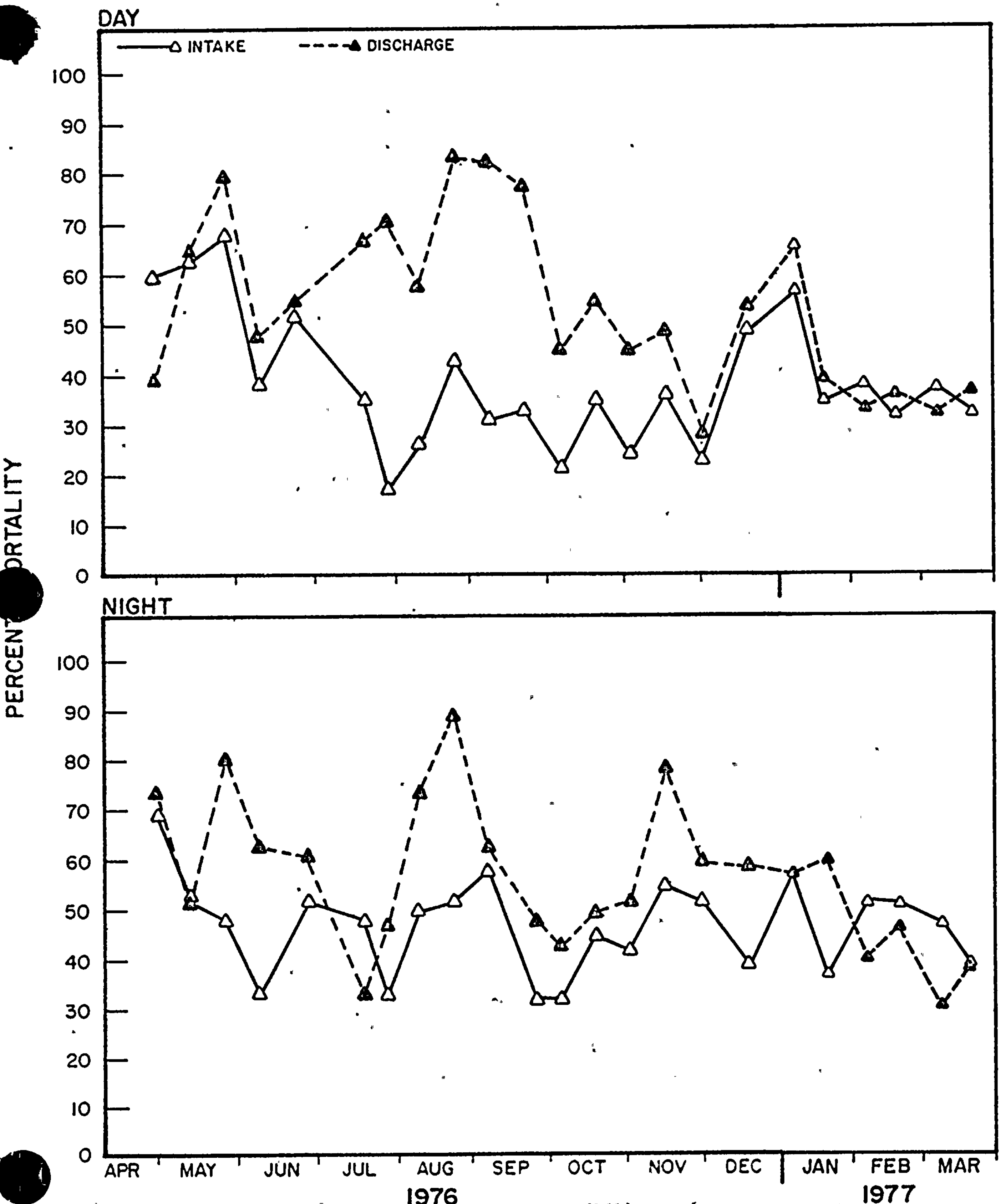
The trend in mortality of copepods observed in day intake and discharge samples (Figure IVD-7) is similar to that of cladocerans, i.e., increased discharge mortality during periods of warmer lake temperatures. The night data show a more variable trend with substantial differences between intake and discharge mortalities observed in the May-June and November-December periods, but for a shorter period during July-September than was observed in day samples. The variation between day and night results may have been due to variations in observed intake mortalities which may indicate a changing population at the intake between day and night due to diurnal vertical migrations.

The seasonal copepod mortalities attributable to plant passage given in Table IVD-3 indicate a higher plant-induced mortality for the July-September period (45.3%) than for the remainder of the year. Plant-induced mortality was lowest (2.4%) during the winter period (January-March) and similar during the spring and fall periods (24.8 and 24.1%, respectively).

While copepod abundances were high throughout the summer period, maximum abundances in both lake and entrainment collections were observed in November collections (LMS

COPEPODA MORTALITY* IN INTAKE AND DISCHARGE SAMPLES

JAMES A. FITZPATRICK NUCLEAR POWER PLANT — 1976-1977



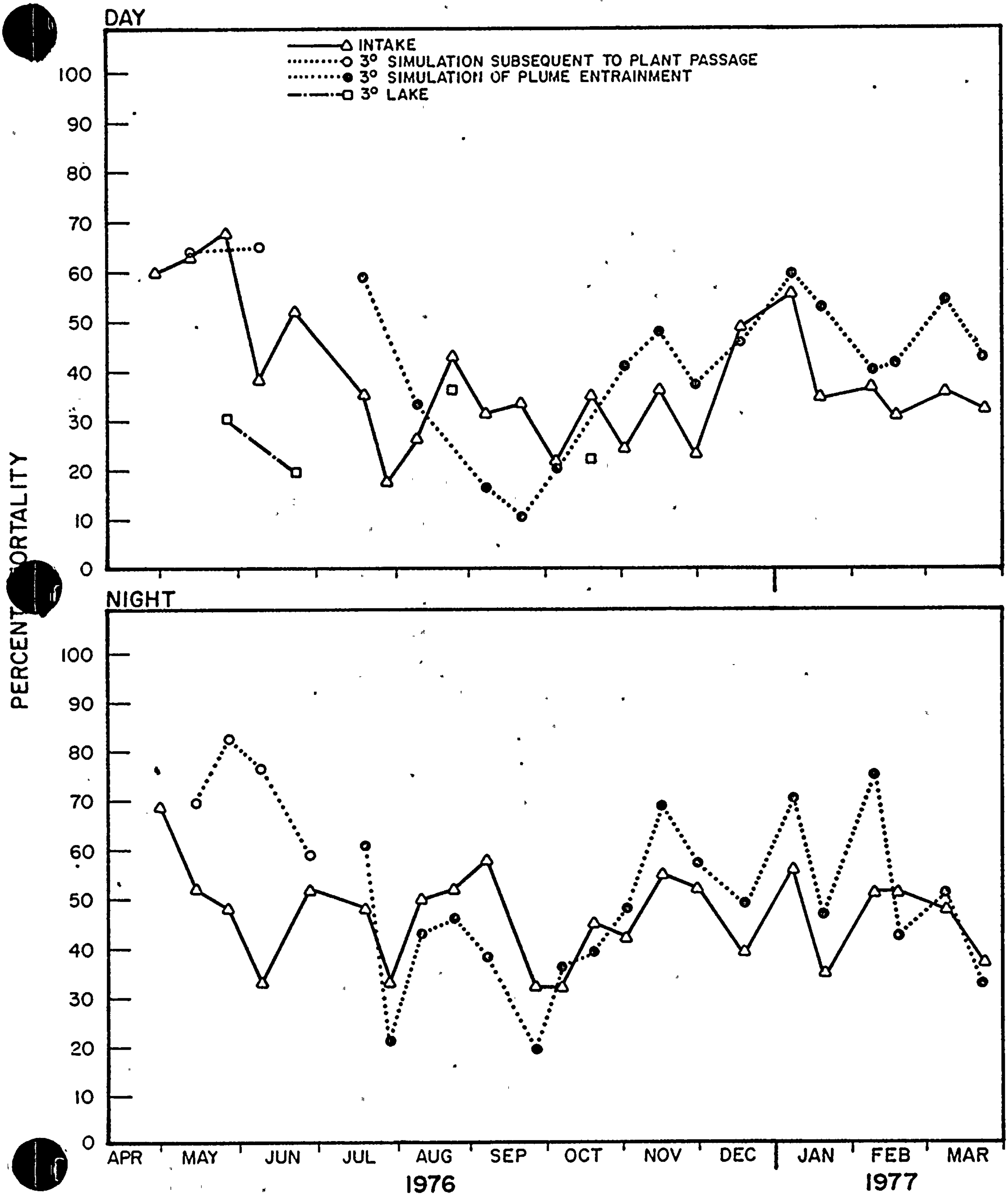
*Mean of two replicates; Adults, juvenile and nauplii copepods; analysis after 8-hour incubation period

1977, Appendices VB-1d and VIIIB-1). From June through August, copepod entrainment abundances were approximately equally dominated by nauplii and cyclopoid juveniles, while only the cyclopoid juveniles were more dominant in the November collections. The overall dominance of the copepod entrainment collections by cyclopoids paralleled the lake observations (see Section IVD-1). The combination during summer of a higher percentage of nauplii and higher ambient water temperatures may have contributed to the observed increase in across-the-plant mortality during the July-September period.

The results of the 3 and 2 F simulation samples (Figures IVD-8 and IVD-9) both show a similar trend of lower observed mortalities than were observed at the intake from August through October, followed by a period of generally higher than intake mortalities from November through March (the May and June simulations were done subsequent to plant passage and therefore are not representative of plume entrainment effects.). All but one of the four lake plume collections showed lower mortalities than the corresponding intake collections.

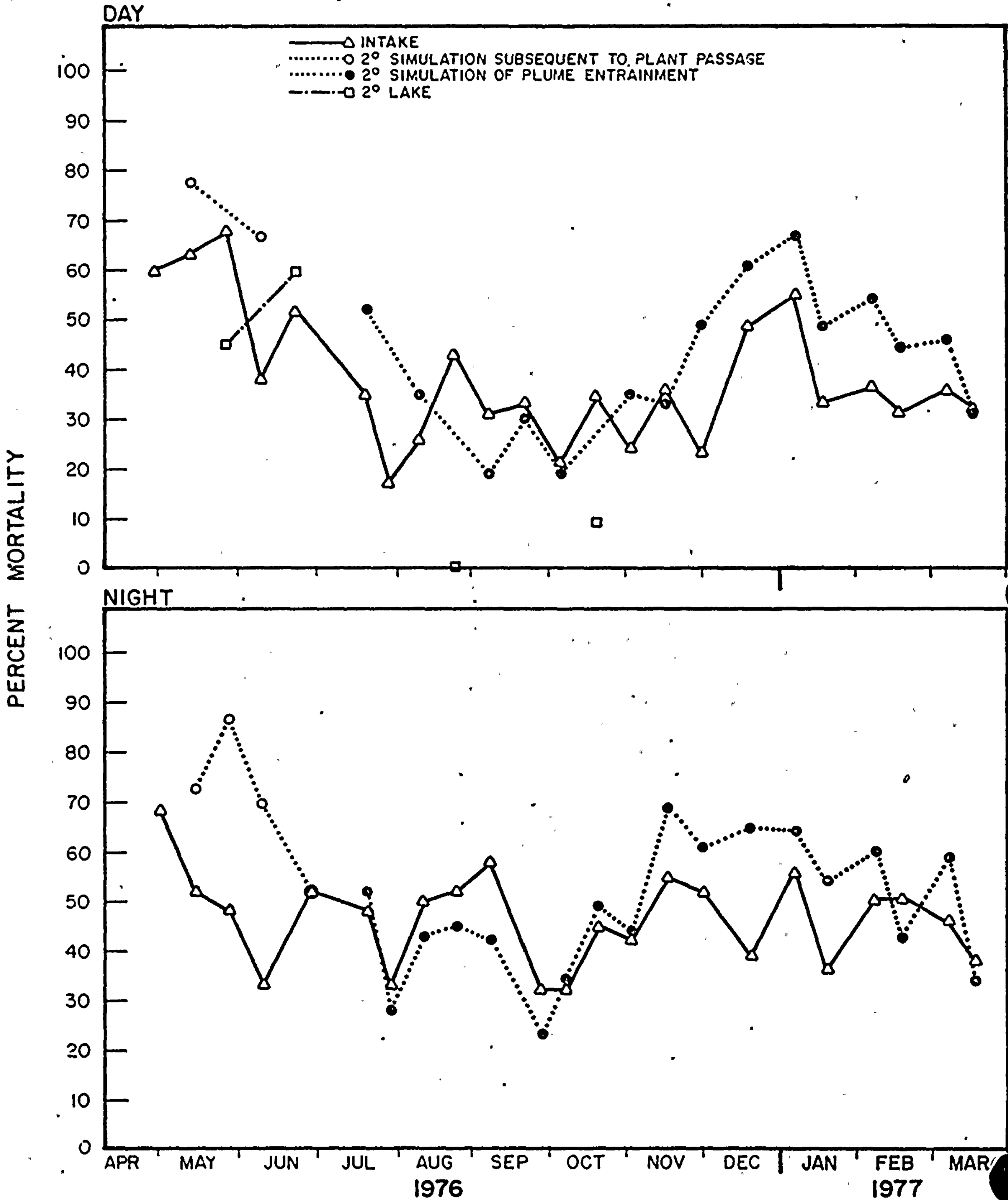
The lower than intake mortalities observed from August through October, a period of high copepod abundance, combined with the observed low differences between intake and simulation mortalities for the remainder of the year, indicate that plume entrainment had only a minor effect on copepod survival.

COPEPODA MORTALITY *
IN INTAKE AND 3° F DILUTION SAMPLES
JAMES A. FITZPATRICK NUCLEAR POWER PLANT — 1976-1977



*Mean of two replicates; Adults, juvenile and nauplii copepods; analysis after 8-hour incubation period

COPEPODA MORTALITY* IN INTAKE AND 2° F DILUTION SAMPLES
JAMES A. FITZPATRICK NUCLEAR POWER PLANT – 1976-1977



*Mean of two replicates; Adults, juvenile and nauplii copepods; analysis after 8-hour incubation period.

(iii) Protozoans

Both intake and discharge collections of protozoans yielded generally high mortalities throughout the year (Figure IVD-10), indicating high sampling mortality at both locations. Differences between intake and discharge mortalities were generally low with discharge mortalities frequently less than the corresponding intake value. The increase in variability in the data in the latter part of 1976 and the first three months of 1977 was due to a decrease in numbers of organisms observed due to decreased protozoan abundances (LMS 1977, Appendix VIIIB-1).

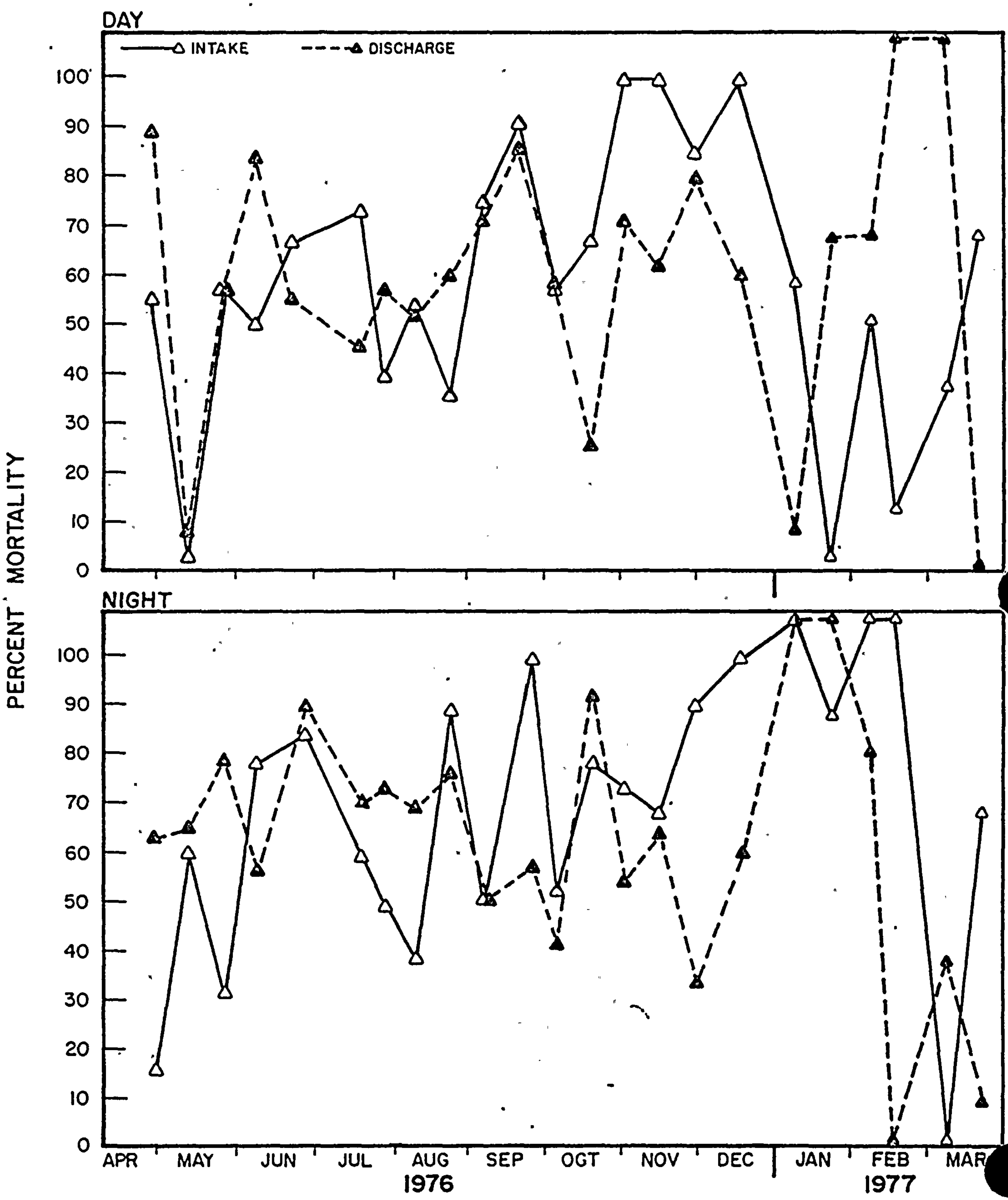
While generally low abundances of protozoans were observed throughout the year, maximum abundances were measured from July through September (LMS 1977; Appendix VIIIB-1). The relatively high sampling mortality coupled with the generally low abundances of protozoans precluded extensive interpretation of the data. The computed mortalities due to plant passage, given in Table IVD-3, show the effect of lower discharge than intake mortalities in that the October-December mortality is negative.

The results for protozoans of 3 and 2 F simulations (Figures IVD-11 and IVD-12) show the same high degree of variability and high intake mortality as the intake-discharge data and preclude any conclusive statement about the effects of plume entrainment on protozoans. The data show a tendency for simulation mortalities to be less than intake mortalities, which may indicate a negligible effect of plume entrainment.

TOTAL PROTOZOA MORTALITY* IN INTAKE AND DISCHARGE SAMPLES

FIGURE IVD-10

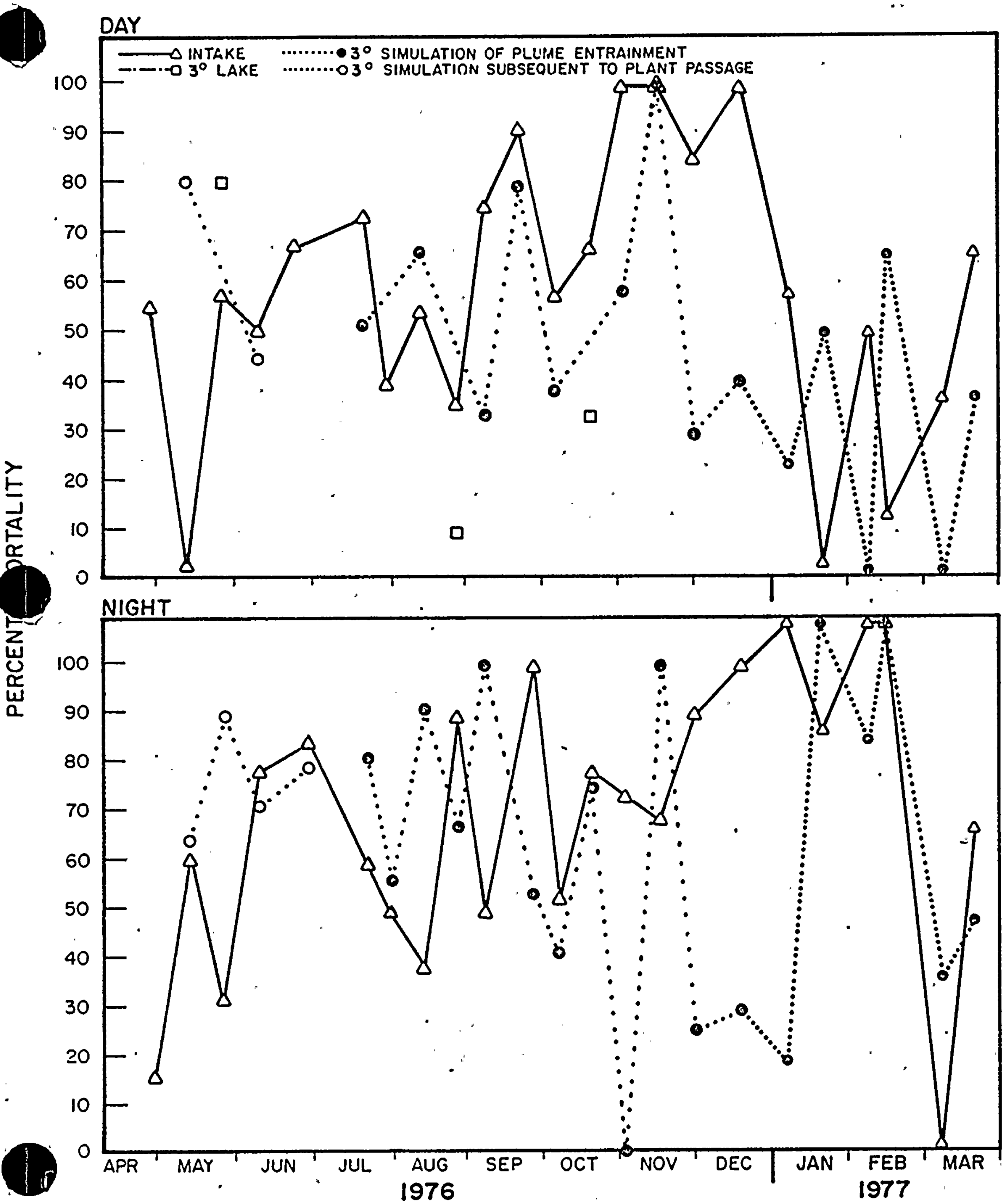
JAMES A. FITZPATRICK NUCLEAR POWER PLANT — 1976-1977



*Mean of two replicates; analysis after 8-hour incubation period.

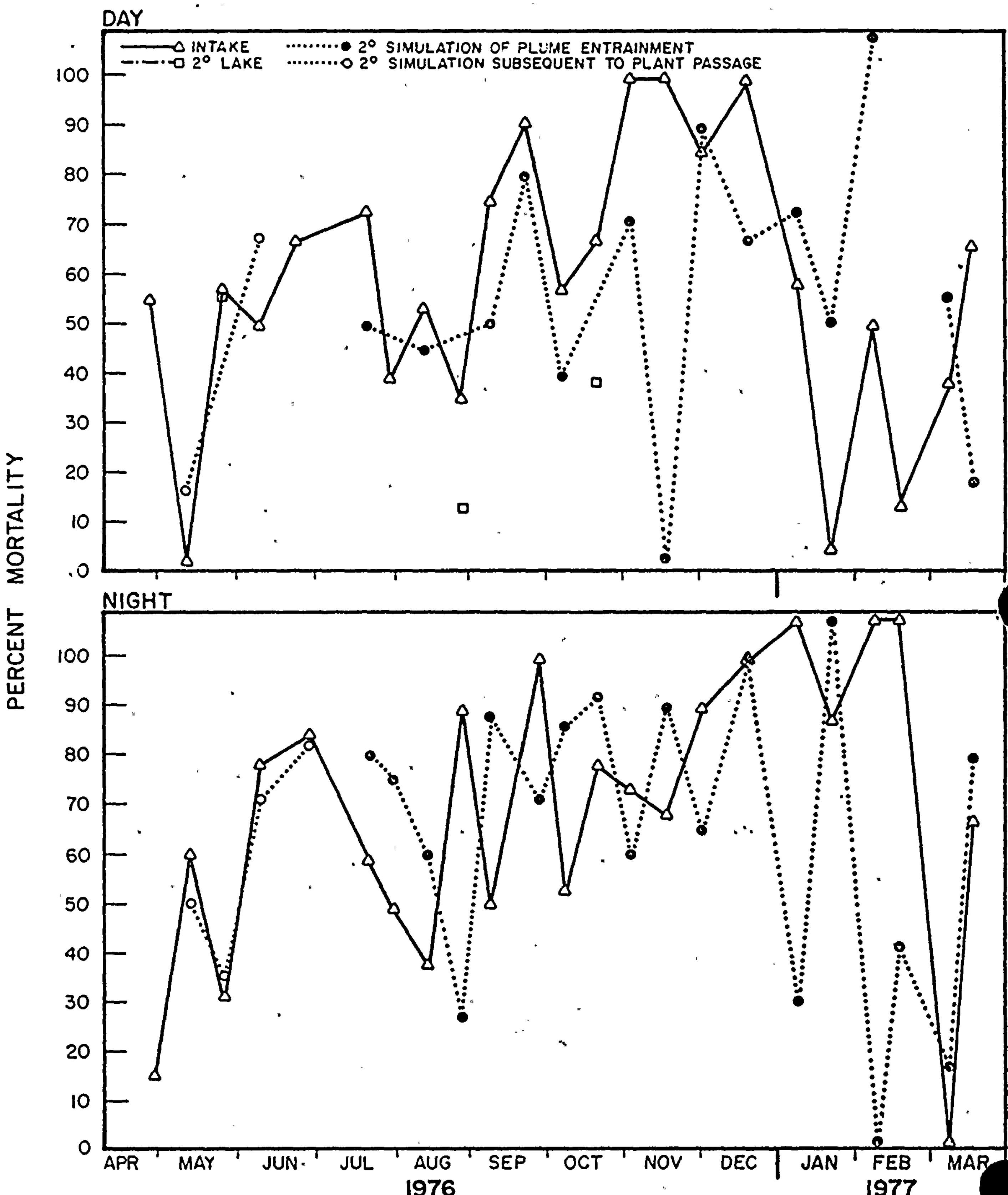
TOTAL PROTOZOA MORTALITY* IN INTAKE AND 3° F DILUTION SAMPLES
JAMES A. FITZPATRICK NUCLEAR POWER PLANT – 1976-1977

FIGURE IVD-11



*Mean of two replicates; analysis after 8-hour incubation period.

TOTAL PROTOZOA MORTALITY* IN INTAKE AND 2° F DILUTION SAMPLES
JAMES A. FITZPATRICK NUCLEAR POWER PLANT — 1976-1977



*Mean of two replicates; analysis after 8-hour incubation period.

(iv) Rotifers

The intake and discharge mortality data for rotifers (Figure IVD-13) do not indicate any seasonal or diel patterns. While discharge mortality generally exceeded intake values, differences between the two mortalities tended to be small throughout the year. The computed rotifer mortalities attributable to plant passage (Table IVD-3) were approximately 25% for the spring, summer, and winter periods, dropping to 3.8% during the fall. The failure of the rotifer population to exhibit an increase in observed mortality during the warmer summer months may have been due to changes in species composition through the year (LMS 1977, Appendix VIIIB-1).

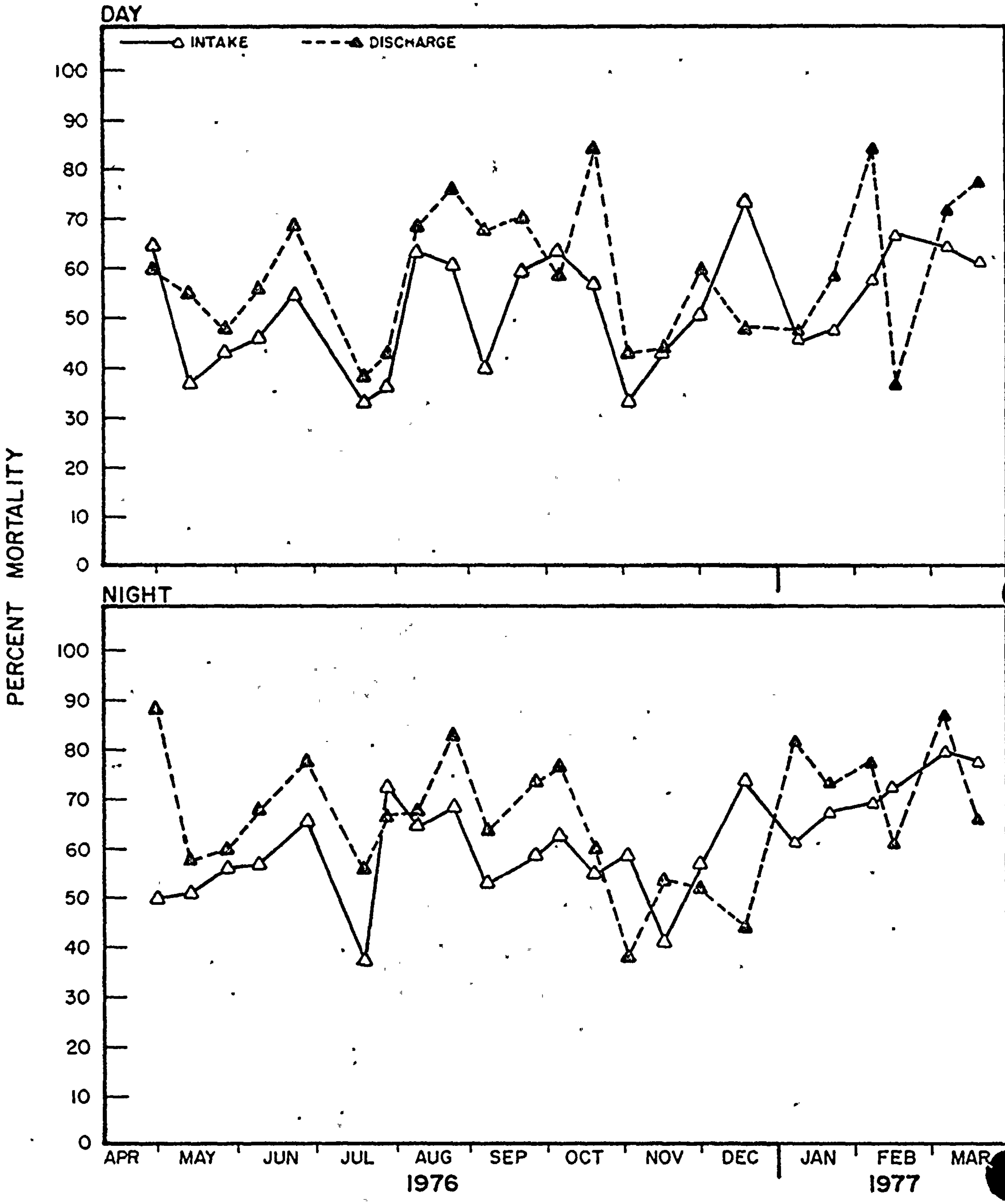
The 2 and 3 F results (Figures IVD-14 and IVD-15) show the same lack of any seasonal trend in observed mortalities, with mortalities observed in simulation and lake plume samples frequently being lower than corresponding intake values. The general agreement between intake and simulation mortalities indicate that plume entrainment effects on rotifer variability are negligible.

(v) Total Zooplankton

The combined results for all zooplankton at the intake and discharge (Figure IVD-16) show the same seasonal trend of increased discharge mortalities during the warmer months as was observed for the cladocerans and copepods. The inclusion of the rotifer data reduces the magnitude of the observed differences in mortalities from the two locations. The computed mortalities due to plant passage for all

ROTIFERA MORTALITY* IN INTAKE AND DISCHARGE SAMPLES

JAMES A. FITZPATRICK NUCLEAR POWER PLANT – 1976-1977

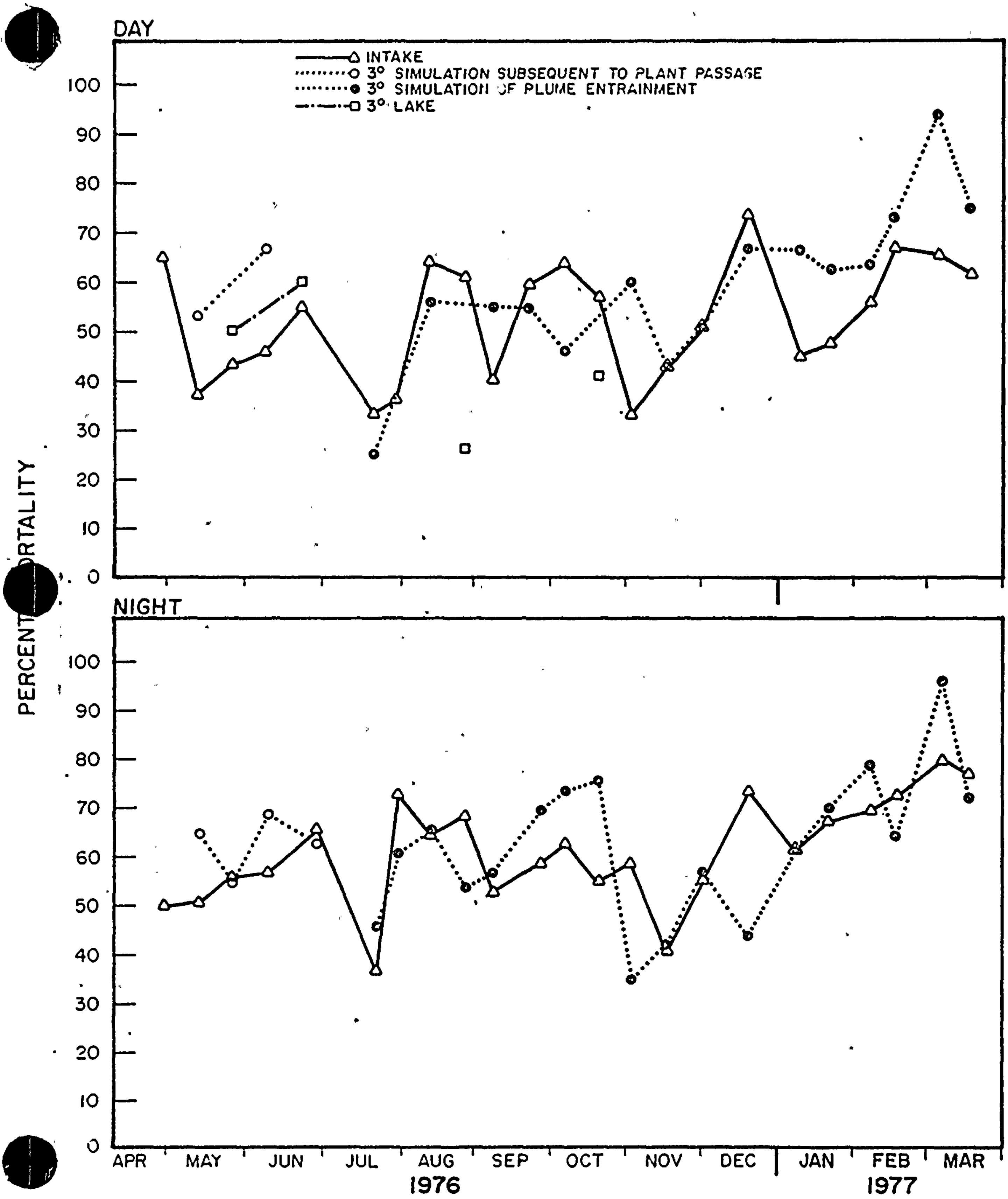


*Mean of two replicates; analysis after 8-hour incuoation period.

ROTIFERA MORTALITY* IN INTAKE AND 3° F DILUTION SAMPLES

JAMES A. FITZPATRICK NUCLEAR POWER PLANT – 1976-1977

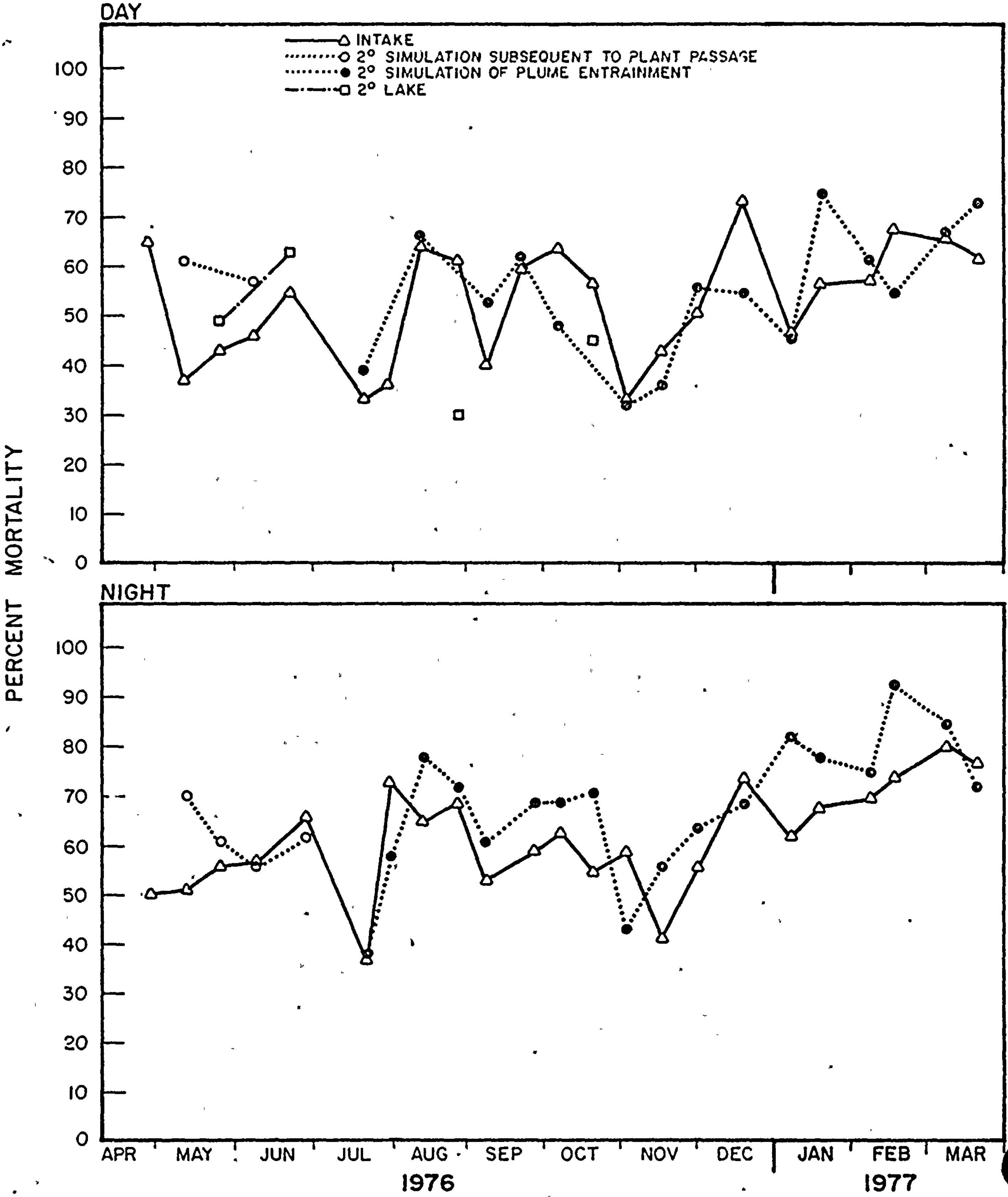
FIGURE IVD-14



*Mean of two replicates; analysis after 8-hour incubation period.

FIGURE IVD-15

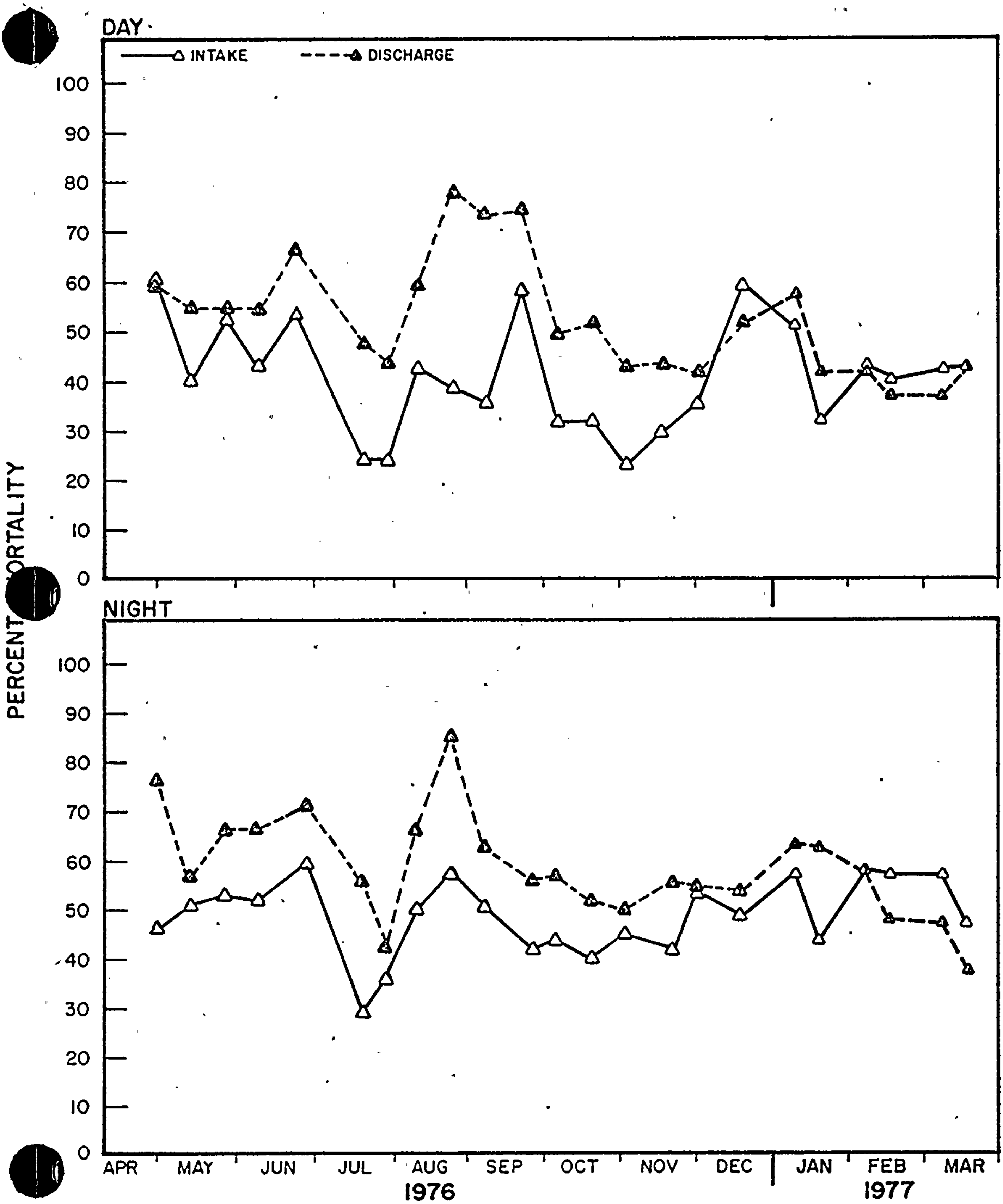
ROTIFERA MORTALITY*
IN INTAKE AND 2° F DILUTION SAMPLES
JAMES A. FITZPATRICK NUCLEAR POWER PLANT – 1976-1977



*Mean of two replicates; analysis after 8-hour incubation period.

TOTAL ZOOPLANKTON MORTALITY* IN INTAKE AND DISCHARGE SAMPLES

JAMES A. FITZPATRICK NUCLEAR POWER PLANT – 1976-1977



*Mean of two replicates; analysis after 8-hour incubation period.

zooplankton combined were generally low but do reflect the overall increased mortality during the summer (36.7%).

The combined results of the 3 and 2 F simulation and lake samples (Figures IVD-17 and IVD-18) show a lack of any substantial effect of plume entrainment on zooplankton survival. Summer mortality values of both the simulation and lake plume collections were generally lower than or equal to corresponding intake collections indicating no effect of plume entrainment on the zooplankton community when plant entrainment would be expected to result in highest mortalities due to high ambient temperatures and maximum discharge temperatures.

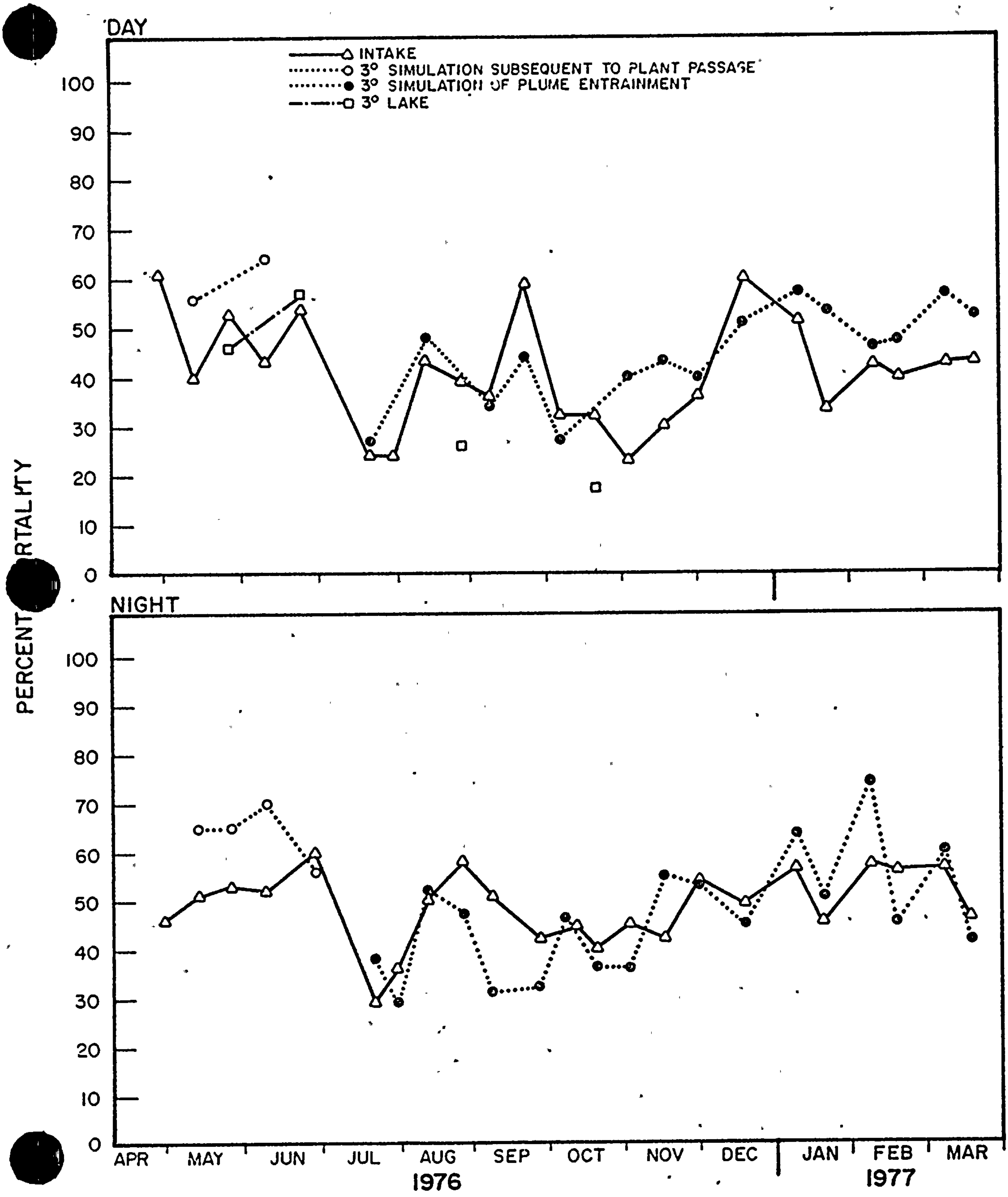
3. Conclusions

The results of the zooplankton sampling at stations both in the vicinity of the FitzPatrick plant and at control locations revealed no consistant spatial trends in abundance of zooplankters. This would indicate that any effect of the FitzPatrick plant on the zooplankton community is well within the range of natural variation in the area.

The zooplankton entrainment studies showed maximum seasonal plant induced mortalities of between 38 and 45% for the various zooplankton groups, usually during the summer months, with an average summer mortality of 36.7% for all zooplankton. The effect of plume entrainment on zooplankton survival was found to be small or nonexistent.

The small effects associated with plant and plume entrainment support the results of the lake monitoring program. It would not be possible to detect the small decrease in zooplankton abundance due

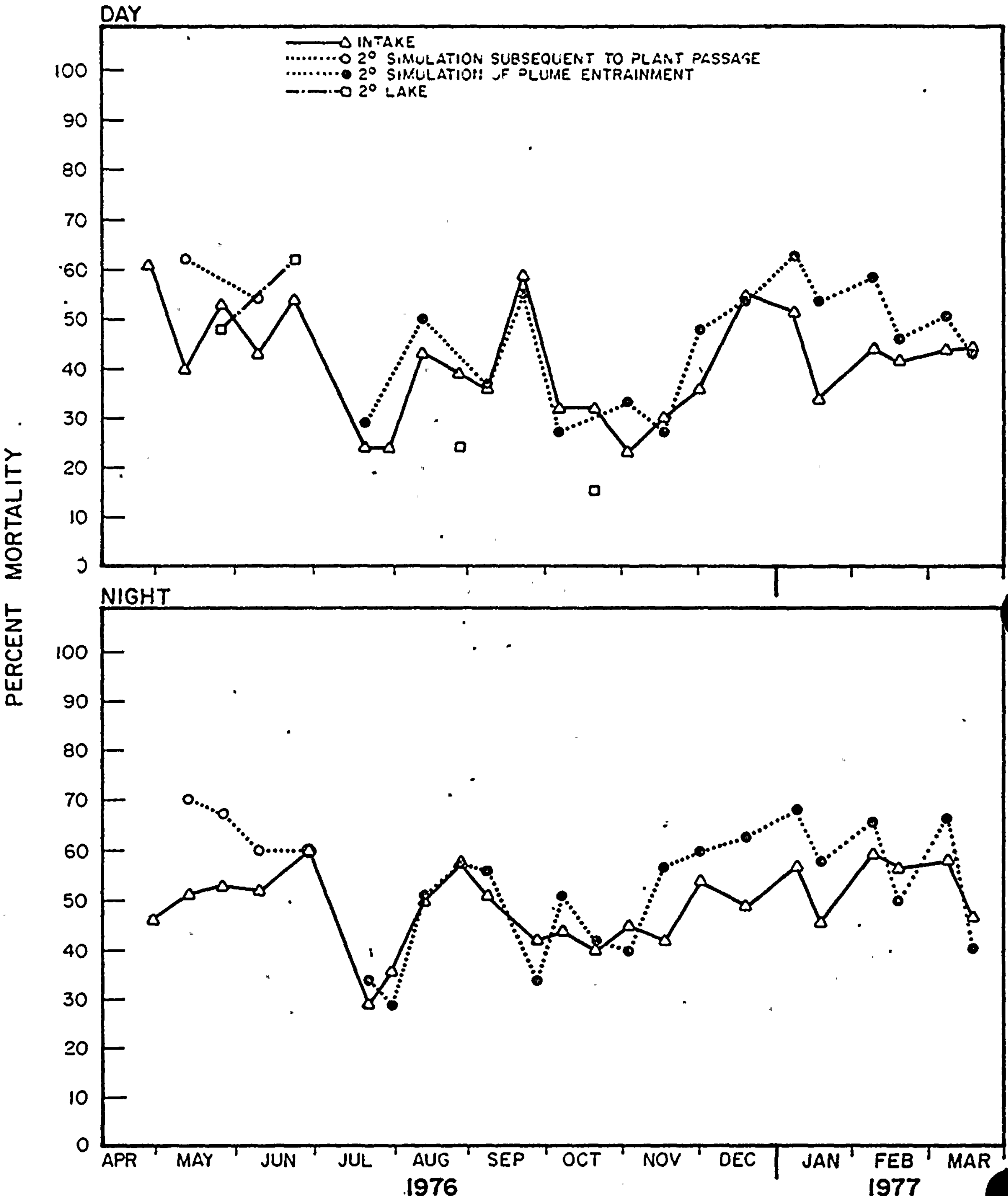
TOTAL ZOOPLANKTON MORTALITY*
IN INTAKE AND 3° F DILUTION SAMPLES
JAMES A. FITZPATRICK NUCLEAR POWER PLANT – 1976-1977



*Mean of two replicates; analysis after 8-hour incubation period.

TOTAL ZOOPLANKTON MORTALITY*
IN INTAKE AND 2° F DILUTION SAMPLES
JAMES A. FITZPATRICK NUCLEAR POWER PLANT – 1976-1977

FIGURE IVD-18



*Mean of two replicates; analysis after 8-hour incubation peirod.

to entrainment. Furthermore, the high reproductive rates of this trophic level will quickly affect the small losses. The lake monitoring program also demonstrates that plant operation has not resulted in any shifts in the major assemblages of the zooplankton community.

E. BENTHOS

1. Community Description: Lake Ontario and Nine Mile Point Vicinity

The benthic community is composed of infauna (i.e., organisms living in the bottom sediment), epifauna (i.e., organisms living upon the bottom sediment), and epiflora (i.e., plants attached to bottom sediment). In Lake Ontario, the major epiflora is the macrophyte Cladophora and the most abundant inshore macroinvertebrates are members of the family Tubificidae (Annelida, Oligochaeta), commonly called "sludgeworms" (LMS 1977a). The maximum habitat depth for many of the macroinvertebrates is between 48 and 90 m with the benthic fauna increasing in abundance and diversity with decreasing depth (Judd and Gemmel 1971). Stylodrilus heringianus, Pontoporeia affinis, and sphaeriids are the most abundant macrobenthic organisms in the nearshore zone (<42 m) (LMS 1977a).

Because it is a non-mobile community, the presence and relative abundance of organisms, both spatially and temporally, are dependent on several factors: water depth; water quality, including dissolved nitrates, orthophosphates, silica, light intensity, and oxygen saturation; sediment characteristics and sedimentation rates and organic content of the sediment; food supply; and hydrodynamic factors. Certain species of flora and fauna are strictly confined to well defined types of substrata and exist at only certain current velocities.

Observations were made of the benthic macrofauna community in the Nine Mile Point vicinity approximately every other month from April through December 1976. Macrofauna were collected at 20 stations ranging in water depth from 10 to 60 ft (Figure IVE-1). Macrofauna retained in a No. 40 U.S. Geological sieve (>420μ) were analyzed. In conjunction with these collections but at selected stations and at a variable frequency, sediment accumulation, organic carbon content, grain size distribution and sediment composition were monitored. Whenever possible, all samples were taken from a similar substrate type and all contained the filamentous green macrophyte Cladophora less than one inch thick throughout the 0.5-m sample area; this standardization among sample locations was necessary to eliminate the effect of sediment type and cover on the benthic species composition and abundance.

The species occurrence of macroinvertebrates in the Nine Mile Point vicinity during 1976 is presented by date in Table IVE-1. The following species represented ≥5% of the total benthos in one or more samples at one or more stations per collection date and for a minimum of three collections: the gastropods Valvata perdepressa, Amnicola integra, A. limnosa, and Goniobasis livescens; the polychaete Manayunkia speciosa; two tubificid oligochaetes, Potamothrix moldaviensis and P. vejdovskyi; and the amphipods Gammarus fasciatus and Pontoporeia affinis.

In general during 1976, concentrations of gastropods, bivalves (LMS 1977b, Appendix VIB-5f), ostracods (LMS 1977b, Appendix VIB-5b), and oligochaetes (LMS 1977b, Appendix VIB-5a) in the Nine Mile Point vicinity were consistently greater at the 60-ft depth contour (LMS 1977b, Appendix VIB-5a) polychaetes were more abundant primarily in water depths less than 30-ft with the majority of them reported from the 20-ft depth contour (LMS 1977b, Appendix VIB-5a); nematodes were

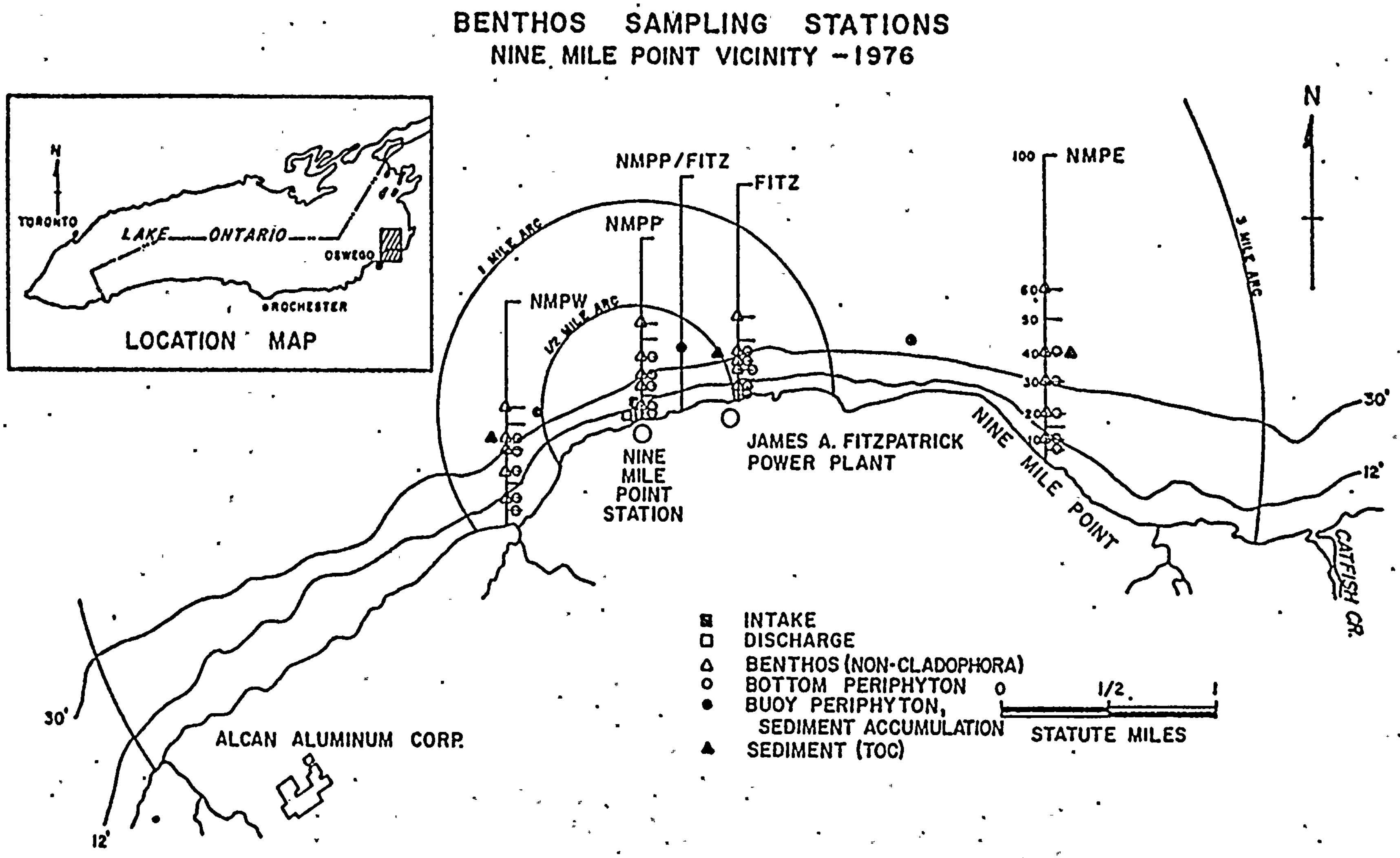

BENTHOS SAMPLING STATIONS
NINE MILE POINT VICINITY - 1976
LOCATION MAP
N
TORONTO
LAKE ONTARIO
OSWEGO
ROCHESTER
NMPP/FITZ
FITZ
NMPP
NMPW
NMPE
1 MILE ARC
1/2 MILE ARC
3 MILE ARC
100
60
50
40
30
20
10
N
30'
12'
NINE MILE POINT STATION
JAMES A. FITZPATRICK POWER PLANT
NINE MILE POINT
CATFISH CR.
ALCAN ALUMINUM CORP.
INTAKE
DISCHARGE
BENTHOS (NON-CLADOPHORA)
BOTTOM PERIPHYTON
BUOY PERIPHYTON, SEDIMENT ACCUMULATION
SEDIMENT (TOC)
0
1/2
1
STATUTE MILES

FIGURE IVE-1

TABLE IVE-1

OCCURRENCE OF MACROINVERTEBRATES IN BENTHIC COLLECTIONS BY DATE

NINE MILE POINT VICINITY - 1976

	19 APR 14 MAY	15-17 JUN	3, 4, 7 SEP	12, 13 OCT	14 DEC[a]
CNIDARIA (COELENTERATA)					
HYDROZOA	D	D	D	D	D
HYDROIDA - ATHECATA					
CLAVIDAE					
CORDYLOPHORA					
C. LACUSTRIS	X	D	D	D	
HYDRIDAE					
HYDRA					
H. AMERICANA	D	D	X	X	D
RHYNCHOCOELA	X	X	X	D	
PLATYHELMINTHES	D	X	X	D	
TURBELLARIA	X	X			
TRICLADIDA					
PLANARIIDAE	D	X	X	D	
ASCHELMINTHES					
NEMATODA	D	D	D	D	X
CHROMADOROIDEA					
PLECTIDAE					
ANONCHUS[b]	X			X	
ENOPLIDA					
ALAIMIDAE					
ALAIMUS	X	X	X	X	
DORYLAIMIDA					
DORYLAIMIDAE					
DORYLAIMUS	D	D	D	D	X
RHABDITIDA					
RHABDITIDEA					
BUTLERIUS	X	X			
MOLLUSCA					
GASTROPODA	D	D	D	D	D
PROSOBRANCHIA - MESOGASTROPODA					
VALVATIDAE	X				
VALVATA	X	X	X	X	
V. PERDEPRESSA	D	D	D	D	D
V. SINCERA				X	
V. PISCINALIS		X	X	X	
V. TRICARINATA PERCONFUSA				X	
BULIMIDAE (HYDROBIIDAE)	X			X	
AMNICOLA	X	X	D	D	X
A. INTEGRA	D	D	D	D	D
A. LIMOSA	X	D	D	D	X
AMNICOLA SP.		X			
A. LUSTRICA	X	X	D	D	
BITHINIA					
B. TENTACULATA	X	D	X	X	
PLEUROCERIDAE	X				
GONIOBASIS			X		
G. LIVESCENS	D	X	D	D	X

TABLE IVE-1 (Continued)

OCCURRENCE OF MACROINVERTEBRATES IN BENTHIC COLLECTIONS BY DATE

NINE MILE POINT VICINITY - 1976

	19 APR 14 MAY	15-17 JUN	3, 4, 7 SEP	12, 13 OCT	14 DEC[a]
MOLLUSCA (CONT)					
GASTROPODA (CONT)					
PULMONATA - BASOMMATOPHORA					
PHYSIDAE					
PHYSA	X	D	X	X	
P. INTEGRA	X	X	X	X	
P. SAYII	X	X			X
P. HETEROSTROPHA[b]		X			
P. ELLIPTICA[b]		X		X	
LYMNAEIDAE	X				
LYMNAEA	X	X	X	X	
L. CATASCOPIUM	X	X	X	X	X
L. EMARGINATA[b]				X	
PLANORBIDAE					
GYRAULUS					
G. PARVUS	X	X	X	X	
HELISOMA			X	X	
H. ANCEPS	X	X	X	X	
H. TRIVOLVIS				X	
ANCYLIDAE				X	
FERRISSIA	X				X
F. TARDA	X	X		X	
LAEVAPEX					
L. FUSCUS	X				
BIVALVIA (PELECYPODA)	D	D	D	D	D
EULAMELLIBRANCHIA					
MARGARITIFARIDAE					
ADADONTA					
A. GRANDIS				X	
UNIONIDAE	X		X	X	
HETERODONTIDA					
SPHAERIIDAE			X		
MUSCULIUM			X	X	
PISIDIUM	D	D	D	D	D
SPHAERIUM	D	D	D	D	D
ANNELIDA					
POLYCHAETA	D	D	D	D	
SABELLIDA					
SABELLIDAE					
MANAYUNKIA					
M. SPECIOSA	D	D	D	D	
OLIGOCHAETA	D	D	D	D	D
PROSOPORA					
LUMBRICULIDAE	X			X	
STYLODRILUS					
S. HERINGIANUS	D	X	X	X	
PLESIOPORA					
TUBIFICIDAE	D	D	D	D	D
AULODRILUS	X			X	
A. AMERICANUS	X	X	X		
A. LIMNOBIUS		X	X	X	X
A. PLURISETA	X	X	D	X	
A. PIQUETI	X	X	X	X	X
LIMNODRILUS					
L. HOFFMEISTERI	D	D	X	X	
L. UDEKEMIANUS	X	X			
L. CLAPAREDIANUS	X				
L. PROFUNDICOLA	X	X	X	X	
L. HOFFMEISTERI VARIANT		X	X		

TABLE IVE-1 (Continued)

OCCURRENCE OF MACROINVERTEBRATES IN BENTHIC COLLECTIONS BY DATE

NINE MILE POINT VICINITY - 1976

	19 APR 14 MAY	15-17 JUN	3, 4, 7 SEP	12, 13 OCT	14 DEC[a]
ANNELIDA (CONT)					
OLIGOCHAETA (CONT)					
PLESIOPORA (CONT)					
TUBIFICIDAE (CONT)					
ILYODRILUS					
I. TEMPLETONI		X			
PELOSCOLEX					
P. FREYI	X	X		X	
P. FEROX	X		X		
P. MULTISETOSUS MULTISETOSUS		X	X	X	
P. MULTISETOSUS LONGIDENTUS	X		X	X	
TUBIFEX					
T. IGNOTUS	X				
T. TUBIFEX	X	X			
UID TUBIFICIDAE		X			
POTAMOTHRIX				X	
P. MOLDAVIENSIS	D	D	D	X	X
P. VEJDOVSKYI	D	D	X	D	X
NAIDIDAE	X	X	X	X	
ARCTEONAIS					
A. LOMONDI		X			
NAIS		X			
N. BRETSCHERI	D	D	X	X	
N. ELINGUIS		X			
N. SIMPLEX	X	X			
PARANAIS					
P. SIMPLEX[b]	X	X			
PIGUETIELLA					
P. MICHIGANENSIS	X	X	X	X	
CHAETOGASTER					
C. DIASTROPHIS		X	X	X	
SPECARIA					
S. JOSINAE[b]		X			
STYLARIA					
S. LACUSTRIS	X	X		X	
UNICINAIS					
U. UNCINATA	X	X	X	X	
VEJKOVSKYELLA					
V. INTERMEDIA	X	X	X		
PRISTINA		X	X	X	
P. AEGUISETA[b]				X	
P. OSBORNII			X		
ENCHYTRAEIDAE	X	X	X	X	
HIRUDINEA			X	X	
RHYNCHOBDELLIDA					
GLOSSIPHONIIDAE					
HELOBDELLA					
H. STAGNALIS				X	
PISCICOLIDAE					
PISCICOLA			X		
ARTHROPODA					
ARACHNIDA					
ACARI	D	D	D	D	D
LIMNESIIDAE					
LIMNESIA	X	X	X	X	

TABLE IVE-1 (Continued)

OCCURRENCE OF MACROINVERTEBRATES IN BENTHIC COLLECTIONS BY DATE

NINE MILE POINT VICINITY - 1976

	19 APR 14 MAY	15-17 JUN	3, 4, 7 SEP	12, 13 OCT	14 DEC[a]
ARTHROPODA (CONT)					
ARACHNIDA (CONT)					
ACARI (CONT)					
HYGROBATIDAE					
HYGROBATES		X	X	X	
HYGROBATES SP. 1	D	D	D	D	X
HYGROBATES SP. 3	X	X		D	X
HYGROBATES SP. 4	X	X	X		
HYGROBATES SP. 5				X	
UNIONICOLIDAE					
NEUMANIA		X			
UNIONICOLA	X			X	
UNIONICOLA SP. 1	X	D	X	X	
UNIONICOLA SP. 2				X	
PIONIDAE					
FORELIA	X	D	X	X	
PIONA		X	X	X	
LEBERTIIDAE					
LEBERTIA	D	D	X	D	
TORRENTICOLIDAE					
TORRENTICOLA			X		
INSECTA					
EPHEMEROPTERA	X	X		X	
HEPTAGENIIDAE					
STENONEMA	X	X		X	
TRICHOPTERA	X	D	X	X	X
HYDROPTILIDAE		X			
AGRAYLEA	X	X			
LEPTOCERIDAE		X			
OECETIS	X	X	X	X	
ARTHRIPSODES	X	D	X	X	
LEPTOCERUS					
L. AMERICANUS				X	
HYDROPSYCHIDAE					
CHEUMATOPSYCHE SP.					X
DIPTERA	D	D	D	D	D
TENDIPEDIDAE (CHIRONOMIDAE)	D	X	X	X	
CHIRONOMUS	X	X	D	D	
CLADOTANYTARSUS		X	X		
COELOTANYPUS			X		
CRICOTOPUS	D	X	X	X	
CRYPTOCHIRONOMUS	D	X	X	X	D
DEMICRYPTOCHIRONOMUS	X	X	X	X	
DICROTENDIPES	X	X	X	X	
ENDOCHIRONOMUS			X		
GLYPTOTENDIPES		X	X		
CRYPTOCLADOPELMA (HARNISCHIA)		X			
HETEROTRISSOCLADIUS	X		X		
MICROSPECTRA	X	X	X		
MICROTENDIPES	X	X	X	X	
PARACLADOPELMA	X	X	X		
PARACHIRONOMUS	X	X	X		
PHAENOPSECTRA	X		X		
POLYPEDILUM	X	D		X	
PROCLADIUS	X	X	X	X	
PSEUDOCHIRONOMUS	X	X	D	X	
PSECTROCLADIUS SPP.	X	X	X		
PSECTROCLADIUS SP. III	X	X			
POTTHASTIA	X		X	X	X

TABLE IVE-1 (Continued)

OCCURRENCE OF MACROINVERTEBRATES IN BENTHIC COLLECTIONS BY DATE

NINE MILE POINT VICINITY - 1976

	19 APR 14 MAY	15-17 JUN	3, 4, 7 SEP	12, 13 OCT	14 DEC[a]
ARTHROPODA (CONT)					
INSECTA (CONT)					
DIPTERA (CONT)					
TENDIPEDIDAE (CHIRONOMIDAE) (CONT)					
RHEOTANYTARSUS	D	X	D	X	
STICTOCHIRONOMUS	X	X	X		
TRISSOCLADIUS	X				
XENOCHIRONOMUS	X				
EINFELDIA[b]		X			
TANYTARSUS (+MICROPSECTRA)	X	X	D		
PARATANYTARSUS		X			
CERATOPOGONIDAE		X			
EMPIDIDAE	X				
CRUSTACEA					
ISOPODA	X	X	X	X	
ASELLIDAE					
ASELLUS	X	X	X	X	
AMPHIPODA	D	D	D	D	D
GAMMARIDAE			X	D	D
GAMMARUS			X		
G. FASCIATUS	D	D	D	D	
CRANGONYX	X	X	X	X	
HAUSTORIIDAE					
PONTOPOREIA					
P. AFFINIS	D	D	D	D	D
TALITRIDAE					
HYALELLA					
H. AZTECA	X		X		
MYSIDACEA	X				
MYSIDAE					
MYSIS					
M. OCULATA RELICTA	X				
DECAPODA	X	X	X	X	
ASTACIDAE					
CAMBARUS					
C. BARTONI		X			
ORCONECTES					
O. PROPINQUUS PROPINQUUS	X	X	X		
OSTRACODA	D.	D	D	D	X
BRYOZOA	D	D	D	D	

X - Presence in one or more samples at one or more stations per collection period
D - Abundance of ≥5% of total benthos in one or more samples at one or more stations per collection period

[a]Collections made at only two stations (NMPE-20-ft [R-1] and NMPE-30-ft [R-1 and R-
[b]Identification pending

generally more abundant in water depths greater than 40 ft (LMS 1977b, Appendix VIB-5c); and hydroids were consistently more abundant along the 10-ft contour (LMS 1977b, Appendix VIB-5e). Depth-related differences in distribution were not evident in dipterans, amphipods, or Acari as a group (LMS 1977b, Appendix VIB-5b). These observations have the following limitations: each group consists of more than one species and the substrate type sampled throughout the study period was consistent at only the 40 and 60-ft contour along FITZ transect and the 30, 40, and 60-ft contour along NMPE transect. An analysis of major taxa along the 40-ft contour revealed no effect on the distribution and abundance due to plant operation (LMS 1977b,p. VI-14).

Gammarus fasciatus was chosen for further interpretation of spatial and temporal trends based on its designation as a representative important species and its numerical dominance in the benthic collections. *G. fasciatus*, an annual species (i.e., with a life cycle of one year), showed a peak concentration in the Nine Mile Point vicinity in August (September collection) and particularly at the 10-ft contour; high concentrations were still evident in the October collection but at both the 10 and 20-ft contours (LMS 1977b, Appendix VIB-6c). Based on the mean concentration of *G. fasciatus* from similar substrate types among all collections, the peak concentrations of this amphipod were reported as follows (LMS 1977b, Appendices VIB-3 and VIB-6c):

DEPTH CONTOUR (ft)	PREDOMINANT SUBSTRATE TYPE	PEAK PERIOD
10	bedrock with sand in crevices	August
20	bedrock with sand in crevices	August
30	sand and silt; bedrock with sand in crevices	August
40	sand and silt; bedrock with sand in crevices	June; October
60	sand and silt	October

Along the 40-ft contour, there was a general increase in *Gammarus* from NMPW to NMPE transect (Figure IVE-2). The FITZ transect had the greatest concentration of *G. fasciatus* in three of the eight samples and no sample collected at FITZ had the minimum concentration of *Gammarus*. A comparison of values at FITZ and NMPE transects, both consistently characterized by sand and silt, showed an increased abundance of *G. fasciatus* at FITZ in April (29.3 times greater than NMPE, collected on the same date), and August (1.1 times greater than NMPE transect, collection: 7 and 3 September, respectively), and increased abundances at NMPE in June (1.5 times greater than FITZ collected on the same date) and October (4.3 times greater than FITZ transect, collection: 13 and 12 October, respectively). The magnitude of the difference between FITZ and NMPE in the April collection is attributed to natural spatial variability, as one replicate was 28.5 times larger than the second replicate from the same location and also contained no *Cladophora*. Thus, the 1976 lake results indicate that *G. fasciatus* abundances in the vicinity of the FitzPatrick plant fall within the range of values observed at the control transects and that plant operation has no apparent effect on the benthic *Gammarus* population.

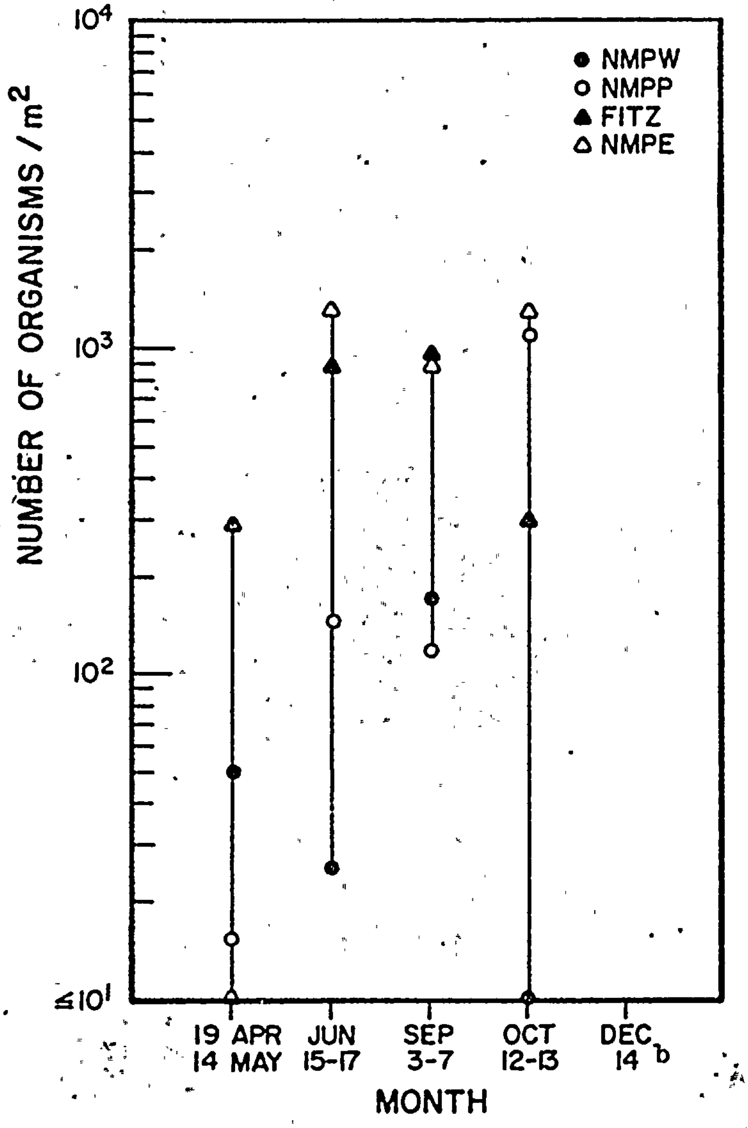
2. *Gammarus* sp. Entrainment and Viability Studies

a. Study Description

The *Gammarus* sp. entrainment program consisted of the collection of samples from the plant intake and discharge for viability analysis, with additional larger samples from the intake for abundance estimates of entrained organisms. For abundance determination, samples were collected for a 30-minute period from two depths in the intake (14 and 20 ft) four times per day (two collections corresponding to day and two collections

ABUNDANCE[a] OF GAMMARUS FASCIATUS

IN BENTHIC COLLECTIONS
40-FT DEPTH CONTOUR
NINE MILE POINT VICINITY-1976



[a]Number of organisms/m^2; mean of two replicates

[b]No sample collected in December at the 40 ft depth contour

corresponding to night) per month from January through September and two times per day (one day and one night collection) per month from October 1976 through March 1977. All intake samples were collected with 0.5-m plankton nets suspended in the intake flow on fixed frames. From April through June 1976, Gammarus sp. viability samples were collected twice daily (1100 and 2300 hours) from both the intake and discharge bays. From July 1976 through March 1977 samples were collected only once per day (2300 hours) since previous collections had shown that highest abundances were observed in night collections. Sampling during April took place on one day, May through September on two days per month, and then one day per month from October through March 1977. For each collection, a five-minute sample was obtained from each of the two intake depths and two five-minute pumped samples were collected from the discharge bay. Thus, during periods of twice-daily sampling, a total of four intake and four discharge samples were collected.

Additional samples were collected from the intake and discharge for 3 and 2 F plume entrainment simulation experiments from May 1976 through March 1977. Simulation samples were collected with the same frequency as the intake and discharge viability samples except on dates when lake plume samples were collected. In addition to the in-plant viability sampling, samples were also collected from the near-field discharge plume in the lake on one day in May and two days in June. Samples were collected by a surface tow with a 0.5-m net from the turbulent zone of jet surfacing out along the plume trajectory for five minutes. This tow was designed to sample both the 3 and 2 F plume isotherms.

As in other entrainment programs, all discharge bay samples were held at discharge temperature for the approximate travel time to the diffuser ports prior to analysis. The April discharge

samples were incubated for eight hours prior to analysis, the May through June collections were analyzed immediately after the travel time hold period, and the July 1976 through March 1977 discharge samples were diluted with filtered intake water in a time series of dilution to within 2 F of the intake temperature. The latter treatment was designed to subject plant-passed organisms to a temperature reduction similar to that occurring in the plume.

During May and June, the 3 and 2 F simulations consisted of samples collected in the discharge and then diluted with intake water to either 3 or 2 F above intake temperature with a single addition of intake water. Thus the simulation samples for this period represent organisms subject to plant passage. From July 1976 through March 1977 the simulation procedure was changed to more closely represent only those organisms entrained in the plume, not those subject to plant passage. Organisms collected from the intake were subjected to the full plant temperature rise for the 3 F simulation (one-half the plant temperature rise for the 2 F) and subsequently diluted with filtered intake water in a time series of dilutions designed to simulate the temperature reductions occurring in the plume. Thus the 3 F simulation samples represent the worst case of plume entrainment, i.e., entrainment into the plume immediately at the point of discharge and subsequent travel out to the 3 F isotherm. The 2 F simulation samples represent organisms entrained at the point of 2:1 dilution in the plume and subsequent travel to the 2 F isotherm.

b. Results of *Gammarus fasciatus* Entrainment Studies

Except for the January 1976 collections, the monthly abundance data for entrained *Gammarus* (Table IVE-2) showed no consistent

TABLE IVE-2

MEAN* ABUNDANCE OF *GAMMARUS FASCIATUS*

IN ENTRAINMENT COLLECTIONS

JAMES A. FITZPATRICK NUCLEAR POWER PLANT - 1976-1977

DATE	ABUNDANCE (NO./1000 m^3)
14 JAN 1976	9675
18 FEB	541
17 MAR	264
14 APR	357
12 MAY	153
16 JUN	330
14 JUL	246
18 AUG	377
8 SEP	147
6 OCT	287
3 NOV	301
15 DEC	252
1 JAN 1977	281
2 FEB	465
7 MAR	194

*Mean of four daily intake collections taken at two depths from January through September 1976 and mean of two daily intake collections taken at two depths from October 1976 through March 1977.

due to the simulation. The increased mortalities observed in 1977 winter samples may indicate an increased sensitivity to plume entrainment during times of colder ambient temperatures.

The results of the lake samples indicate low mortalities (less than or equal to 5%) on all dates except 23 June (54%).

Both the plume entrainment simulation results and the lake plume sampling results indicate generally low mortalities attributable to plume entrainment during the summer and fall periods, with increased sensitivity during the winter.

3. Assessment of Entrainment Impact on *Gammarus fasciatus* Standing Stocks

In order to assess the impact of plant entrainment on the *Gammarus fasciatus* community in the vicinity of the FitzPatrick plant, estimates were made of the total number of this taxon killed by passage through the plant. These estimates were compared to the calculated standing stock of *Gammarus* in the lake in the vicinity of the plant.

The total number of *Gammarus* entrained by the plant was calculated from the monthly entrainment abundances and plant circulating water flow data. Two-month totals for the number of *Gammarus* entrained were computed (except three months from January to March 1977) to coincide with the standing stock estimates (see below). The observed discharge mortalities were used to calculate the total number of the entrained organisms killed by passage through the plant. The observed discharge mortality is a conservative estimate of the plant-induced mortality in that the observed discharge mortality

includes some mortality attributable to sampling (discharge samples were collected with a pump) and some naturally occurring percentage of dead organisms. Since the assumption of identical sampling methodologies at the intake and discharge was not valid in the *Gammarus* program, a cropping rate calculation which removes sampling mortality, similar to the procedure followed for zooplankton, could not be used. The above calculations of total entrained and total killed during the two-month periods were done for both actual and maximum plant flow conditions. The maximum flow results represent a "worst case" condition of the plant pumping at its maximum rate every day of the period.

In order to evaluate the effects of entrainment damage on the *Gammarus* community, estimates were made of the number of *Gammarus* present in the lake during the entrainment studies. Results of both the macrozooplankton lake collections (planktonic *Gammarus*)(LMS 1977b, Appendix VC-1a and VC-1b) and the benthos collection (benthic *Gammarus*)(LMS 1977b, Appendix VIB-6c) were examined for use in estimating the standing stock. Since both data sets showed maximum *Gammarus* abundances in August 1976, August data was selected for a comparison of the number of *Gammarus* in the water column to those found on the benthos. The maximum observed water column abundance of *Gammarus* during 1976 was 9221 organisms/1000 m^3 in a bottom night collection on 18 August (LMS 1977b, Appendix VC-1b) along the 20-ft contour. The mean benthic abundance of *Gammarus* observed along the 20-ft contour in August collections was 2999 organisms/m^2 of bottom area (LMS 1977b, Appendix VIB-6c). If the entire planktonic community of *Gammarus* above one m^2 of bottom were to settle to the bottom, this would result in a benthic abundance of 56 organisms/m^2, or approximately 1.9% of the observed mean benthic community. These evaluations indicate that the main portion of the *Gammarus* community is benthic, and therefore all standing stock

estimates were made from the benthic abundance data. The estimates are conservatively low in that they do not include the percentage of the population that are in the water column.

The estimates of standing stock were made for each seasonal set of benthic collections and for purposes of impact assessment, each population was assumed to be independent in terms of the effect of entrainment cropping during each period (see Table IVE-4). That is, it was assumed that the population does not undergo extensive immigration or emigration and that natural reproductive cycles take place during this period. Since no benthic collections were made outside the April to October period, November-December standing stocks were estimated from the October data and both 1976 and 1977 winter (January-February 1976 and January-March 1977) estimates were taken as the mean of the early spring and late fall estimates.

Standing stock was estimated for the area bounded by the benthic collections in the longshore direction (approximately 3.5 miles) and to the 65-ft depth in the lake. The total benthic area contained in the segment is approximately 6800×10^3 m^2 (1680 acres).

Table 1VE-4 gives the results of two cropping calculations for each of the plant flow conditions evaluated. The estimated percent cropping is the percentage of the number of Gammarus in the waterbody segment removed by entrainment mortality. The estimated effective cropping is the computed equivalent number of acres of benthic area that would be completely cropped, based on the mean benthic abundance in the segment.

As can be seen from Table 1VE-4, estimated percent cropping during either actual or maximum plant flow conditions was less than one-half of 1% of the population throughout each sampling period,

TABLE IVE-4

MORTALITY OF *GAMMARUS FACIATUS* DUE TO PLANT PASSAGE

JAMES A. FITZPATRICK NUCLEAR POWER PLANT AND NINE MILE POINT VICINITY - 1976-1977

SAMPLING PERIOD	ESTIMATED TOTAL ENTRAINED		PERCENT MORTALITY	ESTIMATED TOTAL IN LAKE	WEIGHTED MEAN No./m^2	ESTIMATED ENTRAINMENT MORTALITY		ESTIMATED PER-CENT CROPPING		ESTIMATED EFFECTIVE CROPPING	
	ACTUAL FLOW	MAXIMUM FLOW				ACTUAL FLOW	MAXIMUM FLOW	ACTUAL FLOW	MAXIMUM FLOW	ACTUAL FLOW	MAXIMUM FLOW
JAN-FEB	32.06×10^7	70.88×10^7	30.26	864.88×10^7	1272	9.70×10^7	21.45×10^7	1.12	2.48	18.8	41.7
MAR-APR	3.05×10^7	4.39×10^7	30.26	269.84×10^7	397	0.92×10^7	1.33×10^7	0.34	0.49	5.7	8.3
MAY-JUN	2.98×10^7	3.41×10^7	21.56	601.20×10^7	884	0.64×10^7	0.74×10^7	0.11	0.12	1.8	2.1
JUL-AUG	3.88×10^7	4.47×10^7	53.09	1840.50×10^7	2707	2.06×10^7	2.37×10^7	0.11	0.13	1.9	2.2
SEP-OCT	2.36×10^7	2.73×10^7	40.82	1459.92×10^7	2147	0.96×10^7	1.11×10^7	0.07	0.08	1.1	1.3
NOV-DEC	3.19×10^7	3.90×10^7	9.09	1459.92×10^7	2147	0.29×10^7	0.35×10^7	0.02	0.02	0.3	0.4
JAN-MAR	5.31×10^7	6.52×10^7	56.25	864.88×10^7	1272	2.99×10^7	3.66×10^7	0.35	0.42	5.8	7.1

TABLE [illegible]1

ESTIMATED TOTAL ENTRAINED, TOTAL IN WATERBODY SEGMENT AND PERCENT CROPPING OF ALEWIFE LARVAE

NINE MILE POINT UNIT 1 - 1976

SAMPLING WEEK	NO. OF CIRC. WATER PUMPS	ESTIMATED TOTAL ENTRAINED		ESTIMATED TOTAL IN WATERBODY SEGMENT*	WEIGHTED MEAN (NO./m^3)	ESTIMATED PERCENT CROPPING	
		ACTUAL FLOW	MAXIMUM FLOW			ACTUAL FLOW	MAXIMUM FLOW
13-19 JUN	2	0	0	13.80 X 10^4	0.0004	0	0
20-26 JUN	2	0	0	85.34 X 10^4	0.0023	0	0
27 JUN-3 JUL	2	4.19 X 10^4	4.47 X 10^4	360.70 X 10^4	0.0095	1.16	1.24
4-10 JUL	2	13.19 X 10^4	14.07 X 10^4	1453.93 X 10^4	0.0383	0.91	0.97
11-17 JUL	2	54.70 X 10^4	58.36 X 10^4	1756.79 X 10^4	0.0463	3.11	3.32
18-24 JUL	2	8.69 X 10^4	9.27 X 10^4	3273.71 X 10^4	0.0863	0.27	0.28
25-31 JUL	2	14.72 X 10^4	15.71 X 10^4	3038.43 X 10^4	0.0801	0.48	0.52
1- 7 AUG	2	475.20 X 10^4	524.54 X 10^4	32064.21 X 10^4	0.8454	1.48	1.64
8-14 AUG	2	113.24 X 10^4	125.00 X 10^4	13383.67 X 10^4	0.3529	0.87	0.93
15-21 AUG	2	367.50 X 10^4	405.65 X 10^4	16090.29 X 10^4	0.4242	2.28	2.52
22-28 AUG	2	133.50 X 10^4	147.36 X 10^4	3658.70 X 10^4	0.0965	3.65	4.03
29 AUG-4 SEP	2	114.88 X 10^4	126.53 X 10^4	6077.16 X 10^4	0.1602	1.89	2.08
5-11 SEP	2	3.97 X 10^4	4.36 X 10^4	118.40 X 10^4	0.0031	3.35	3.68
12-18 SEP	-	-	-	703.25 X 10^4	0.0185	-	-
19-25 SEP	2	11.90 X 10^4	13.09 X 10^4	-	-	-	-
26 SEP-2 OCT	-	-	-	-	-	-	-
3- 9 OCT	2	0.99 X 10^4	1.09 X 10^4	-	-	-	-
10-16 OCT	-	-	-	-	-	-	-
17-23 OCT	2	0.99 X 10^4	1.09 X 10^4	-	-	-	-
TOTAL		1317.66 X 10^4	1450.59 X 10^4	8207.38 X 10^4			

*See text for definition of waterbody segment.

except during January-February 1976. At this time the slightly increased cropping value resulted from the abnormally high January entrainment abundances. Since similarly high abundances were not seen during either summer periods of high lake abundance or the following winter period, it is probable that the January 1976 estimate was not representative of actual entrainment abundances during the month. It should be noted that the calculation of total numbers entrained did not take into account the reduction in intake flow during winter months, when up to 30% of the plant flow may be recirculated as tempering flow. Since no quantitative data were available on tempering flows, full flow values were used. If 30% tempering was occurring during the winter months of both 1976 and 1977, the cropping percentages and areas would also be reduced by 30%.

The effective cropping areas given in Table IVE-4 also show the effect of the high January 1977 entrainment estimates, with the remaining results all showing cropping of less than nine of the 1680 acres in the segment.

The results of the *Gammarus* entrainment cropping analysis clearly indicate that the numbers of *Gammarus* suffering entrainment mortality represent an extremely small percentage of the local population and that such mortalities would have a negligible effect if any on the community. It is of interest to note that the analysis of benthic vs. planktonic *Gammarus* abundances also would indicate that only a small percentage of the population is vulnerable to entrainment by being in the water column, the main portion of the population being benthic.

4. Conclusions

The results of the lake benthos monitoring program showed no discernible spatial or temporal distributions attributable to the

operation of the FitzPatrick plant. Distribution of Gammarus, a representative important species, along the 40-ft contour showed no effect of plant operation. Entrainment viability and abundance studies coupled with standing stock estimates for the Nine Mile Point area indicate a negligible cropping of Gammarus by entrainment into the cooling water flows.

F. ICHTHYOPLANKTON

1. Community Description

a. Nine Mile Point Vicinity

During 1976, fish eggs and larvae were monitored at 15 stations, ranging in depth from 20 to 100 ft (Figure IVC-1). Collections were made approximately weekly during daylight hours in April and May and from mid-September through December and approximately weekly during day and night from June through mid-September. Eighty-six percent of the lake samples were collected when the daily discharge temperature rise at FitzPatrick plant exceeded 50% of the maximum design value. Collections were made with one-meter plankton nets of #0 (571) mesh towed concurrently at the surface, mid-depth, and bottom for approximately five minutes at each station. All fish larvae were enumerated and identified and a random subsample of up to 60 larvae per species per sample were measured and the life stage (i.e., pro-larvae, larvae, or juvenile) recorded. Fish eggs were subsampled for enumeration and identification.

Fifteen taxa (including 12 species) of fish larvae and six species of fish eggs were identified from ichthyoplankton collections in the Nine Mile Point vicinity during 1976 (Table

IVF-1). Eggs of *Catostomus* sp. and johnny darter were also collected in the Nine Mile Point vicinity during 1976; these were identified from the benthic collections (LMS 1977, Table VIB-2). All species identified in the 1976 larval collections had also been identified during the 1975 lake program (Table IVF-1). Of the representative important species only alewife, rainbow smelt, threespine stickleback and yellow perch were collected, in both 1975 and 1976, while coho salmon, brown trout, and smallmouth bass, also representative important species, were not identified in the Nine Mile Point vicinity in either year.

The occurrence of ichthyoplankton and fish eggs by date is presented in Table IVF-2. Eggs were collected in the Nine Mile Point vicinity from 21 April (rainbow smelt) through 18 August (alewife). Larvae, defined as pro-larvae, larvae, and/or juveniles, were collected in the lake from 7 April (burbot) through 13 October (alewife). The greatest number of identifiable taxa in any monthly collection occurred in June and July, and are as follows.

JUNE		JULY	
EGGS AND LARVAE	LARVAE	EGGS AND LARVAE	LARVAE
Alewife	Burbot	Alewife	Johnny darter
Carp	Emerald shiner	Carp	*Lepomis* sp.
Rainbow smelt	Johnny darter		Mottled sculpin
White perch	*Lepomis* sp.		*Notropis* sp.
	Mottled sculpin		Rainbow smelt
	Notropis sp.		Threespine stickleback
			Trout-perch
			White perch
			Yellow perch

TABLE IVF-1

ICHTHYOPLANKTON AND FISH EGGS SPECIES INVENTORY FROM LAKE COLLECTIONS[a]

NINE MILE POINT VICINITY - 1975 and 1976

			DEVELOPMENTAL STAGE			
			1975		1976	
FAMILY	SCIENTIFIC NAME	COMMON NAME	LARVAE[b] AND/OR EGGS	EGGS	LARVAE[b]	EGGS
Centrarchidae	Lepomis sp.	UID sunfish	*		*	
	L. macrochirus	-				
	UID Centrarchidae	-	*			
Clupeidae	Alosa pseudoharengus	Alewife	*		*	*
	Dorosoma cepedianum	Gizzard shad		*		*
Cottidae	Cottus bairdi	Mottled sculpin	*		*	
Cyprinidae	Cyprinus carpio	Carp	*		*	*
	Notropis sp.	UID shiner	*		*	
	N. atherinoides	Emerald shiner	*		*	
	N. cornutus	Common shiner		*		
	N. hudsonius	Spottail shiner	*			
	Pimephales notatus	Bluntnose minnow	*			
	P. promelas	Fathead minnow	*			
	UID Cyprinidae	-	*		*	
Gadidae	Lota lota	Burbot	*		*	
Gasterosteidae	Gasterosteus aculeatus	Threespine stickleback	*		*	
Osmeridae	Osmerus mordax	Rainbow smelt	*		*	*
Percichthyidae	Morone americana	White perch	*		*	*
Percidae	Etheostoma sp.	-	*			
	E. nigrum	Johnny darter	*			*
	Perca flavescens	Yellow perch	*			*
Percopsidae	Percopsis omiscomaycus	Trout-perch	*		*	
Salmonidae	Coregonus sp.	-			*	
	C. artedii	Cisco or Lake herring	*		*	*

[a]Lake collections: surface, mid-depth and bottom tows
[b]Larvae = pro-larvae, larva, and juvenile

TABLE IVF - 2

ICHTHYOPLANKTON AND FISH EGGS SPECIES OCCURRENCE BY DATE*

JAMES A. FITZPATRICK NUCLEAR POWER PLANT AND VICINITY - FEBRUARY-JUNE 1976

SPECIES	LOCATION	FEB	MAR	APR					MAY						JUN						
		4	17	7	14	21	28	29	5	12	13	19	22	26	2	9	10	16	17	23	30
ALEWIFE	FITZ									L		L		L				E		EL	EL
	LAKE D															E		EL	L	EL	EL
	N																E	EL		EL	
BURBOT	FITZ		E		L		L					L									
	LAKE D			L	L	L		L					L	L							
	N														L						
CARP	FITZ																	L			L
	LAKE D																	L		L	
	N																	L		EL	
EMERALD SHINER	LAKE D																				
	N																	L			
JOHNNY DARTER	FITZ											L				EL				L	L
	LAKE D																				
	N																L	L		L	
LAKE HERRING (CISCO)	FITZ								E												
	LAKE D							L			E										
LEPOMIS SP. (UID)	LAKE D														L			L			
	N														L		L				
MINNOWS AND CARPS (UID)	LAKE N																			L	
MOTTLED SCULPIN	FITZ															L		L		L	
	LAKE D																				
	N																L	L		L	
NOTROPIS SP.	FITZ																				L
	LAKE N																	L		L	
RAINBOW SMELT	FITZ				L		E		E	EL		L		EL	EL	L		L			
	LAKE D					E		E			EL		EL	EL	L	L		L	L	L	L
	N														EL	L	L	L		L	

TABLE IVF - 2 (Continued)

ICHTHYOPLANKTON AND FISH EGGS SPECIES OCCURRENCE BY DATE* (Continued)

JAMES A. FITZPATRICK NUCLEAR POWER PLANT AND VICINITY - FEBRUARY-JUNE 1976

SPECIES	LOCATION	FEB 4	MAR 17	APR 7	APR 14	APR 21	APR 28	APR 29	MAY 5	MAY 12	MAY 13	MAY 19	MAY 22	MAY 26	JUN 2	JUN 9	JUN 10	JUN 16	JUN 17	JUN 23	JUN 30
THREESPINE STICKLEBACK	LAKE N																				
TROUT PERCH	FITZ																				
	LAKE N																				
WALLEYE	FITZ						E			E		E		E							
WHITE BASS	FITZ									L											
WHITE PERCH	FITZ								E			E		E	EL	L		L		L	
	LAKE D										E			L	EL	L		EL	L	L	L
	N														L	L	L	EL		L	
YELLOW PERCH	FITZ						L			L		L									
	LAKE D							L					L								
	N																				
UID	FITZ	E	E				E			E		EL		E	E	E		EL		E	EL
	LAKE D							EL			E		EL	L	L	EL		L	L	EL	
	N														E		EL	EL		EL	

*Dates listed when larvae and/or eggs collected; ichthyoplankton includes pro-larvae, larva, and juvenile life stages.

D = Day collection
N = Night collection

E = Fish eggs
L = Fish larvae

UID = Unidentified organism

FITZ = James A. FitzPatrick Nuclear Power Plant entrainment program

LAKE = Lake ichthyoplankton collections

TABLE IVF - 2 (Continued)

ICHTHYOPLANKTON AND FISH EGGS SPECIES OCCURRENCE BY DATE*

JAMES A. FITZPATRICK NUCLEAR POWER PLANT AND VICINITY - JULY-DECEMBER 1976

SPECIES	LOCATION	JUL 1	JUL 7	JUL 14	JUL 15	JUL 21	JUL 28	AUG 4	AUG 11	AUG 18	AUG 25	SEP 1	SEP 2	SEP 3	SEP 8	SEP 15	SEP 22	SEP 26	SEP 30	OCT 6	OCT 13	OCT 20	NOV 3	NOV 17	DEC 1	DEC 15
ALEWIFE	FITZ		EL	EL		EL	EL	EL	EL	L	L	L			L		L			L		L	L	L		
	LAKE D		EL		EL	EL	EL	EL	EL	EL	L	L			L	L		L	L		L					
	N	EL	EL		EL	EL	EL	EL	EL	L	L		L	L	L	L										
BURBOT	FITZ																									
	LAKE D																									
	N																									
CARP	FITZ		L				L	L																		
	LAKE D				L		L	L																		
	N	L	EL		L	L	L	L	L		L															
EMERALD SHINER	LAKE D								L	L																
	N																									
JOHNNY DARTER	FITZ		L	L		L	L		L								L									
	LAKE D		L		L																					
	N	L	L		L	L	L	L	L		L		L													
LAKE HERRING (CISCO)	FITZ																									
	LAKE D																									
LEPOMIS SP. (UID)	LAKE D									L																
	N	L	L		L	L							L													
MINNOWS AND CARPS (UID)	LAKE N																									
MOTTLED SCULPIN	FITZ																									
	LAKE D						L	L																		
	N	L	L		L	L	L	L		L																
NOTROPIS SP.	FITZ																									
	LAKE N	L	L			L																				

TABLE IVF - 2 (Continued)

ICHTHYOPLANKTON AND FISH EGGS SPECIES OCCURRENCE BY DATE* (Continued)

JAMES A. FITZPATRICK NUCLEAR POWER PLANT AND VICINITY - JULY-DECEMBER 1976

		JUL						AUG				SEP								OCT			NOV		DEC	
SPECIES	LOCATION	1	7	14	15	21	28	4	11	18	25	1	2	3	8	15	22	26	30	6	13	20	3	17	1	15
RAINBOW SMELT	FITZ		L	L		L			L	L		L					L								L	L
	LAKE D		L								L															
	N	L	L		L	L	L	L	L	L	L		L	L		L										
THREESPINE STICKLEBACK	LAKE N						L																			
TROUT-PERCH	FITZ			L																						
	LAKE N				L										L											
WALLEYE	FITZ																									
WHITE BASS	FITZ																									
WHITE PERCH	FITZ		L	L		L	L	L	L	L							L									
	LAKE D		L		L	L	L	L	L	L	L															
	N	L	L		L	L	L	L	L	L	L		L													
YELLOW PERCH	FITZ																									
	LAKE D																									
	N					L																				
UID	FITZ		E	E			E	E	E	E																
	LAKE D		EL		EL	EL	EL	EL	EL	EL	L	L														
	N	EL	EL		EL	E	EL	EL	EL																	

*Dates listed when larvae and/or eggs collected; ichthyoplankton includes pro-larvae, larva, and juvenile life stages.

D = Day collection
N = Night collection

E = Fish eggs
L = Fish larvae

UID = Unidentified organism

FITZ = James A. FitzPatrick Nuclear Power Plant entrainment program

LAKE = Lake ichthyoplankton collections

The 1976 spatial/temporal distribution of the representative important species and those occurring in the viability program (johnny darter, mottled sculpin, and white perch) are discussed below.

(i) Alewife (*Alosa pseudoharengus*)

Alewife eggs were collected in the Nine Mile Point vicinity from 9 June to 18 August with the greatest numbers collected at night on 7 and 15 July; the grand mean over all stations was 13,434 eggs/1000 m^3 and 15,827 eggs/1000 m^3 for both dates, respectively (LMS 1977, Appendix VC-2c). The greatest concentration of eggs (117,127 eggs/1000 m^3) was reported at the 0.5-NMPE-20-ft station, in the bottom night sample on 15 July. Between 23 June and 4 August, egg concentrations in night collections were greater than those in day samples in 95% of the paired collections. This suggests that spawning activity tends to be greater at night, an observation which has been previously reported for Lake Erie (Detroit Edison 1976).

The spatial distribution determined from night collections showed that egg concentrations were more dense at the 20-ft contour than the 40-ft contour with further reduction offshore to the 100-ft contour. The eggs, which are demersal and essentially nonadhesive, were collected in greater abundance in the bottom samples than in the surface or mid-depth samples.

Alewife larvae were first collected on 16 June and persisted in the lake collections in the Nine Mile Point vicinity until 13 October (Table IVF-2). The seasonal maxima occurred on 4 and 18 August for both day and night collections

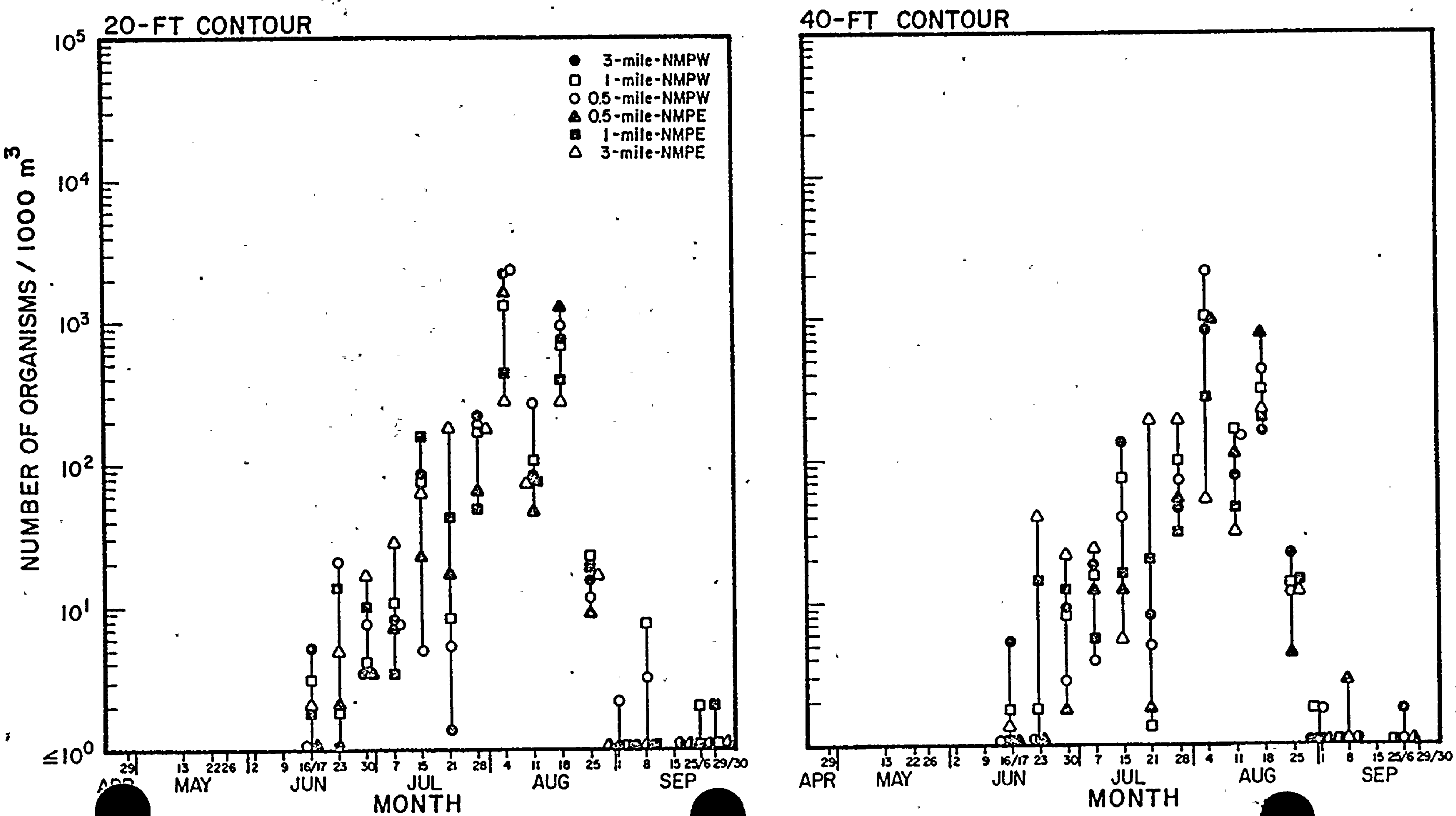
(LMS 1977, Appendices VC-2a and VC-2b); the grand mean over all stations from night collections on these dates was 1,820 larvae/1000 m^3 and 875 larvae/1000 m^3, respectively. Concentrations at night were greater than those observed during the daytime in 73% of the collections at the 20-ft contour and 86% of the collections at the 40-ft contour. The magnitude of the ratio between night and day collections during the period of seasonal maxima ranged from 1.3 to 8.1 at the 20-ft contour and from 1.5 to 49.4 at the 40-ft contour.

The onshore/offshore spatial distribution of alewife larvae, determined from night collections, showed a trend of decreasing alewife larvae abundances further offshore. This is based on the mean concentration of larvae both over all dates for stations along the NMPP transect and over all sample depths and stations per collection date for the 20 and 40-ft contours. Larvae were more abundant in surface collections on 8 of 11 collection dates which showed a grand mean over all stations of more than 10 larvae/1000 m^3. This trend was less pronounced at the 20-ft contour where only 5 of 11 collection dates yielded greater concentrations in the surface samples. These findings parallel those reported in Lake Erie (Detroit Edison 1976).

The longshore spatial distribution of alewife larvae was investigated in view of the proximity of 0.5-NMPE and 1-NMPE-20-ft and 40-ft sampling stations to the FitzPatrick intake and discharge structures (Figure IVC-1). The greatest abundances of larvae along both the 20 and 40-ft contours, based on the grand mean over all dates and sample depths for day collections, were reported at 0.5-NMPW and

ABUNDANCE* OF ALEWIFE LARVAE IN DAY COLLECTIONS

NINE MILE POINT VICINITY – 1976



*MEAN OF SURFACE, MID-DEPTH, AND BOTTOM COLLECTIONS; NONE COLLECTED IN THE REMAINING COLLECTIONS

FIGURE IVF-1

the lowest at either 1-NMPE or 3-NMPE radii (LMS 1977, Appendix VC-2a). Only on 18 August were larvae collected in the greatest abundance at 0.5-NMPE radius and at both the 20 and 40-ft contours (Figure IVF-1). During the remaining collection dates, larval abundances reported at this station were within the range reported for all stations (LMS 1977, Appendices VC-2a and VC-2b).

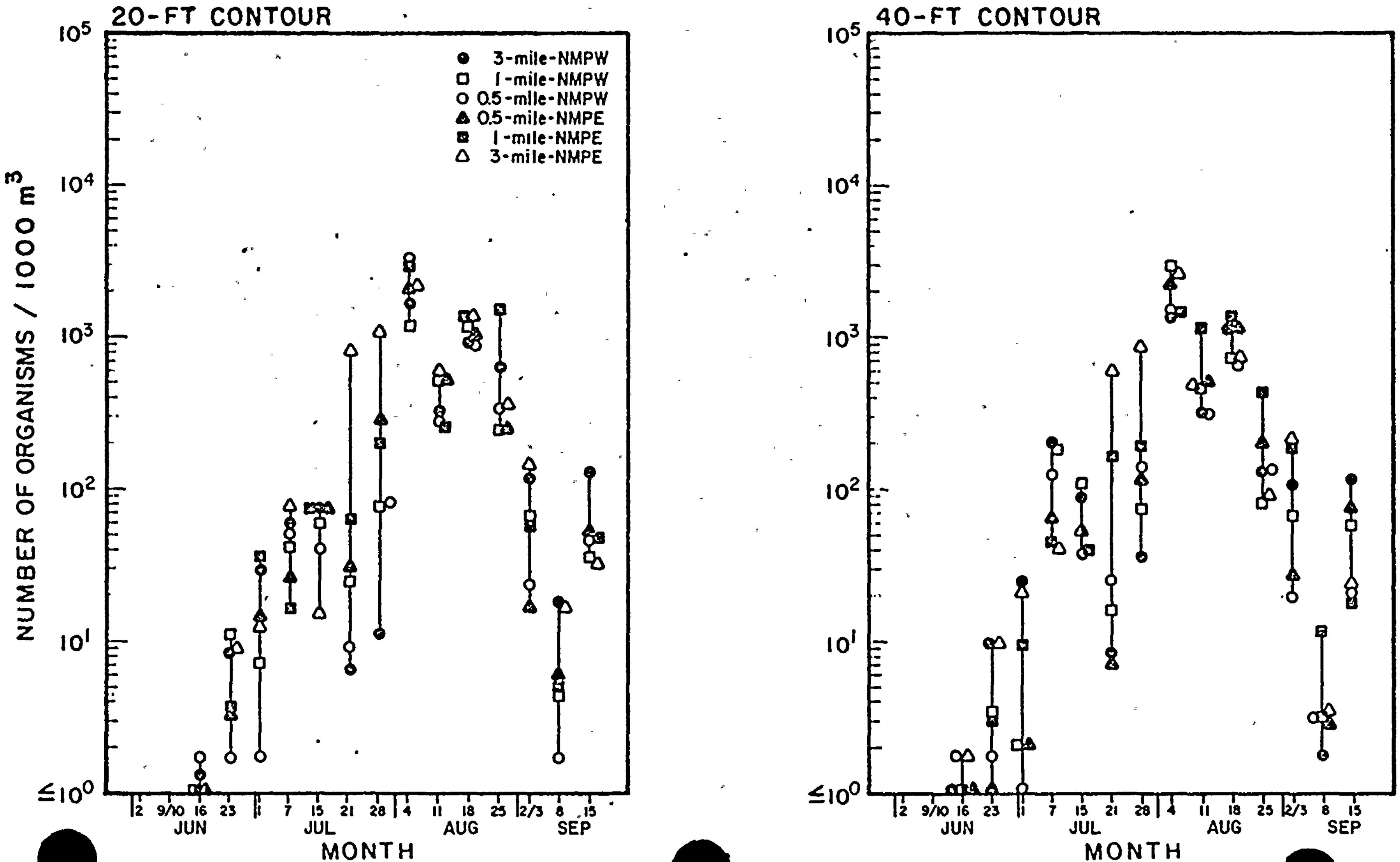
The greatest abundances of larvae over all dates and sample depths in night collections were reported at 3-NMPE and 1-NMPE radii, respectively for both the 20 and 40-ft contours (LMS 1977, Appendix VC-2b). Larval abundances were greatest at 1-NMPE radius on only 3 of 10 collections at the 40-ft contour and only 4 of 11 collections at the 20-ft contour. On no date were maximum larval abundances reported at 0.5-NMPE radius for either the 20 or 40-ft contours based on the mean of surface, mid-depth and bottom samples for all dates having a mean concentration over all stations of greater than 10 larvae/1000 m^3. During August, the period of peak larval abundances, no consistent spatial trend was observed among the stations along either the 20 or 40-ft contours (Figure IVF-2).

(ii) Rainbow Smelt (Osmerus mordax)

Rainbow smelt eggs were collected in the Nine Mile Point vicinity from 21 April through 20 May in day collections and only on 2 June in night collections. The greatest numbers were collected on 29 April, when the concentrations per sample ranged from 3 to 521 eggs/1000 m^3 (LMS 1977, Appendix VC-2c). The majority of the eggs were collected in the

ABUNDANCE* OF ALEWIFE LARVAE IN NIGHT COLLECTIONS

NINE MILE POINT VICINITY - 1976



*MEAN OF SURFACE, MID-DEPTH, AND BOTTOM COLLEC[...]S, NONE COLLECTED IN THE REMAINING COLLECTION[...]

FIGURE IVF-2

seasonal trend, but contained values ranging between 147 and 541 organisms/1000 m^3. The extremely high January 1976 abundance value (9,675 organisms/1000 m^3) relative to results from the rest of the sampling period is unexplained and is not considered representative of a monthly average. An examination of the day and night abundance collections (LMS 1977b, Appendix VIIIC-1) shows the night abundances to be generally higher than day measurements, possibly because of the increased susceptibility of Gammarus to entrainment at night due to its upward vertical migration.

The results of the Gammarus viability studies are given in Table IVE-3 (1976 data summarized from LMS 1977b, Appendix VIIIC-2). Observed intake mortalities were generally low with only 3 of the 22 results exceeding 20% mortality. Except on 20 October, mortalities after 20 June did not exceed 5%. Observed discharge mortalities showed a trend of increased mortality during the warmer summer months of July, August, and early September. Four of the five (out of a total of 19) mortalities in excess of 50% were observed during this period of relatively warm ambient water temperatures. Observed mortalities for the remainder of the sampling period were generally less than 40%.

The in-plant simulation samples collected prior to 20 July represent organisms subject to full plant passage and thus are not representative of plume-entrained organisms. This would explain the relatively high mortalities observed during this period (Table IVE-3). The 3 and 2 F simulation samples collected after June, representing plume-entrained organisms, showed low mortalities (less than 20%). Negative mortalities are a product of the calculation that removed sampling mortality (i.e., intake mortality) from the simulation mortality, and should be considered as representing essentially zero mortality

TABLE IVE-3

MORTALITY OF GAMMARUS FASCIATUS IN ENTRAINMENT COLLECTIONS[a]

JAMES A. FITZPATRICK NUCLEAR POWER PLANT - 1976-1977

DATE	PHOTOPERIOD	INTAKE MORTALITY (%)	DISCHARGE MORTALITY (%)	3 F SIMULATION MORTALITY[b] (%)	2 F SIMULATION MORTALITY[b] (%)
28 APR 1976	D	25	19	NO SAMPLE	NO SAMPLE
	N	2	38	NO SAMPLE	NO SAMPLE
12 MAY	D	22	12	31	9
	N	7	27	22	28
26 MAY	D	12	20	LAKE SAMPLE[c]	0[d]
	N	0	27	9	83
9 JUN	D	8	32	LAKE SAMPLE[c]	0[d]
	N	12	30	LAKE SAMPLE[c]	5[d]
23 JUN	D	18	17	LAKE SAMPLE[c]	54[d]
28 JUN	N	0	16	LAKE SAMPLE[c]	1[d]
20 JUL	N	5	100	-5	-5
29 JUL	N	0	57	1	0
11 AUG	N	0.5	61	-0.5	1
25 AUG	N	0.4	44	-0.4	-0.4
8 SEP	N	0	67	0	0
27 SEP	N	0	33	0	0
20 OCT	N	43	31	-4	-68
17 NOV	N	0	-	0	0
19 DEC	N	0	9	0	0
1 JAN 1977	N	0	-	11	8
2 FEB	N	0	56	13	7
7 FEB	N	0	-	20	0

[a]April-December 1976 data summarized from LMS (1977b, Appendix VIIIC-2).
[b]For in-plant simulations mortality due to collection removed from simulation mortality.
[c]When lake sample collected no in-plant simulations - lake results given in 2 F column.
[d]Lake sample results

- Not applicable, no organisms collected

surface samples at the western stations (1- and 3-NMPW-20-ft and 40-ft) (LMS 1977, Appendix VC-2c). This observation is not in agreement with the demersal and adhesive character of the eggs. Day/night comparisons could not be investigated due to the limited data base.

Rainbow smelt larvae were collected in all day collections from 13 May through 7 July and on 25 August, and in all night collections from 2 June through 15 September (Table IVF-2). The seasonal maxima occurred on 9 June for day collections and on 2 June for night collections; the grand mean over all stations and sample depths was 20.5 larvae/1000 m^3 and 18.7 larvae/1000 m^3, respectively (LMS 1977, Appendices VC-2a and VC-2b). Concentrations at night were greater than those observed during day collections in 73% of the collections at the 20-ft contour and in 76% of the collections at the 40-ft contour. On 2 June, larval concentrations were greater at night than in 83% of the day samples taken at the combined 20 and 40-ft contour stations, on 9 June, on the other hand, concentrations were greater in day collections than at night in 69% of the samples.

For those dates when mean larval abundance at each depth contour exceeded 5 larvae/1000 m^3, rainbow smelt larvae were more frequently observed in higher concentrations in night collections at the 20-ft contour than at the 40-ft contour; however, for all dates combined for stations along the NMPP transect, this onshore/offshore trend was not substantiated (LMS 1977, Appendix VC-2b). There was a slight trend of more larvae collected in the bottom samples than the surface and mid-depth samples based on a comparison among dates. Larvae were observed to remain close to the bottom in Lake Erie (Detroit Edison 1976).

The longshore spatial distribution of rainbow smelt larvae was investigated from night collections (LMS 1977, Appendix VC-2b) because of the low numbers of larvae collected during the day (LMS 1977, Appendix VC-2a). Larvae were most abundant at 3-NMPE and 1-NMPE along the 20-ft contour; no apparent difference in grand mean concentrations over dates and sample depths was observed between all stations along the 40-ft contour. On two of five night collections, rainbow smelt larvae were most abundant at the 1-NMPE-20-ft station (Figure IVF-3). During the remaining collections, the abundances at this station and at 0.5-NMPE-20-ft station fell within the range of abundances reported for all stations (LMS 1977, Appendix IVF-2b).

(iii) Threespine Stickleback (Gasterosteus aculeatus)

Threespine stickleback larvae were collected on 28 July only, and at only one station (3-NMPW-20-ft) (LMS 1977, Appendix VC-2b). No eggs were collected.

(iv) Yellow Perch (Perca flavescens)

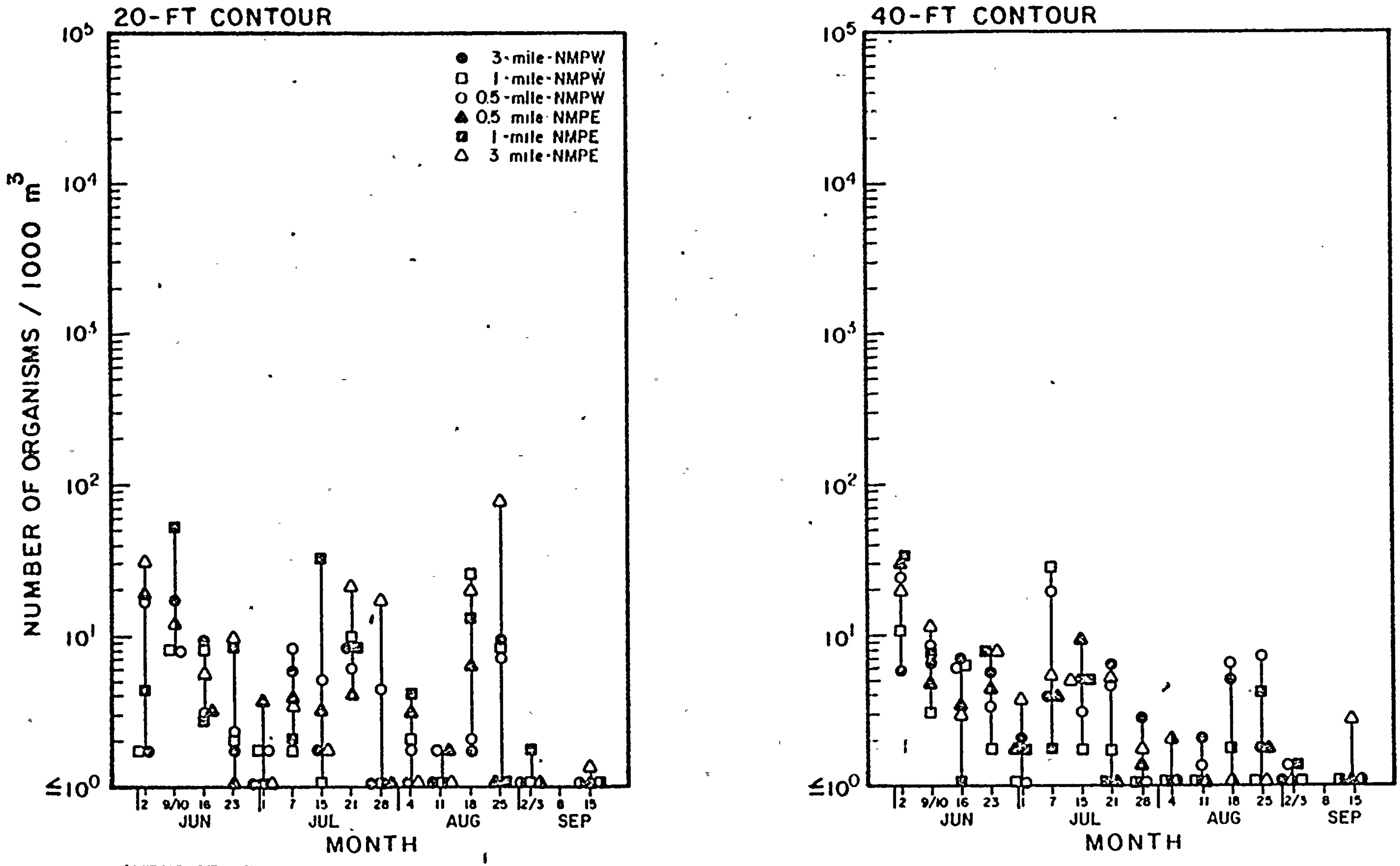
Larvae were collected on three dates (29 April, 22 May, and 21 July) with a maximum on 29 April, a day collection (LMS 1977, Appendix VC-2a). The greatest abundance of larvae (128 larvae/1000 m^3) was reported at 1-NMPE-20-ft station. No eggs were collected.

(v) Johnny Darter (Etheostoma nigrum)

Johnny darter larvae were collected in the Nine Mile Point vicinity only on 7 and 15 July in day collections, but from

ABUNDANCE* OF RAINBOW SMELT LARVAE IN NIGHT COLLECTIONS

NINE MILE POINT VICINITY - 1976



*MEAN OF SURFACE, MID-DEPTH, AND BOTTOM COLLECTIONS, NONE COLLECTED IN THE REMAINING COLLECTIONS

FIGURE IVF-3

9/10 June through 2/3 September in night collections (Table IVF-2). The greatest number of larvae collected in a day collection was 10 larvae/1000 m^3 (LMS 1977, Appendix VC-2a), whereas in night collections the grand mean over all stations and sample depths reached a maximum of 53.6 larvae/1000 m^3 (LMS 1977, Appendix VC-2b). The maximum recorded in night collections at any station was 1,120 larvae/1000 m^3 and this was at 3-NMPE-40-ft station. In general, the number of larvae decreased further offshore based on a mean of the three sample depths; greater numbers of larvae were reported from the bottom samples at the 20-ft depth contour. Vertical spatial distribution was not apparent at the 40-ft contour or beyond.

No eggs were collected in the lake collections in the Nine Mile Point vicinity during 1976 (Table IVF-2).

(vi) Mottled Sculpin (Cottus bairdi)

Mottled sculpin larvae were collected in the Nine Mile Point vicinity from 9/10 June through 10 August in night samples and 28 July and 4 August in day collections (Table IVF-2). Larvae were more frequently collected in night collections than day collections and generally in higher numbers (LMS 1977, Appendices VC-2a and VC-2b). The maximum number of larvae reported from a day collection was 7 larvae/1000 m^3; whereas in night collections the maximum concentration was 97 larvae/1000 m^3 reported in the NMPP-60-ft bottom sample. The seasonal maxima determined from night collections occurred on 16 and 23 July, a period when larval abundances also increased from onshore to offshore along the NMPP transect. Abundances were generally greater in the

bottom samples than in the surface and mid-depth samples; however, it should be stressed that the data base was limited for interpretation of spatial distribution.

(vii) White Perch (Morone americana)

White perch eggs were collected in the Nine Mile Point vicinity in day collections on 13 May, 2 and 16 June, and in night collections on 16 June (Table IVF-2). Eggs were collected only at the 20 and 40-ft contours along 1-NMPE and at 0.5-NMPE-40-ft station; the maximum concentration was 5 eggs/1000 m^3 (LMS 1977, Appendix VC-2c).

White perch larvae were identified in day collections on 26 May, in day and night collections from 2 June through 25 August, and in day collections on 2 September (Table IVF-2). The greatest concentrations of larvae collected were 38 and 40 larvae/1000 m^3 for day and night collections, respectively (LMS 1977, Appendices VC-2a and VC-2b). On the average, more larvae were found in night collections than in the corresponding day collection. Based on a mean of all stations and sample depths per date, more larvae were collected at the 20-ft contour than the 40-ft contour. Vertically, there was a trend of greater concentrations of larvae at the surface at night and in mid-depth and bottom samples in day collections.

2. Species Composition, Abundance and Spatial and Temporal Trends in Entrained Ichthyoplankton

Samples for estimating species composition and abundance of entrained ichthyoplankton were collected from the intake bay of the Nine Mile Point and FitzPatrick plants. Samples were collected both

day and night twice a month from January through April and from 22 September through December 1976, and weekly from May through 8 September. Two samples were collected four times per day spaced approximately six hours apart on each sampling date from January through 8 September and two samples twelve hours apart were collected twice per day approximately on each date from 22 September through December 1976. Intake samples were obtained with 0.5-m nets equipped with 571 mesh. The nets were suspended in the intake bays at 14 and 20 ft below the water surface at FitzPatrick and at 2 and 13 ft at Nine Mile Point. Discharge aftbay samples were also obtained at FitzPatrick, however, this sample was part of the viability program similar to that described for Gammarus (See Section IVE-2b). The collection method and sampling schedule was distinct from the regular entrainment program. Due to the low numbers of ichthyoplankton collected in the viability program these studies did not provide useful information.

A total of 14 taxa, including three representative important species, were identified in 1976 collections from JAF in-plant sampling (Table IVF-3). Unidentified eggs and larvae might have increased the species list slightly if they could have been identified. Entrainment sampling data were summarized for the representative important species, the other species were not collected in sufficiently large numbers for interpretation. Of the representative important species, impact assessment is restricted to alewife and rainbow smelt; yellow perch larvae were only identified from three samples ranging in concentration from 4 to 31 larvae/1000 m^3 (LMS 1977, Appendix VIIID-2a) and thus no assessment could be undertaken due to the low numbers.

TABLE IVF-3

ICHTHYOPLANKTON AND FISH EGGS SPECIES INVENTORY[a]

NINE MILE POINT NUCLEAR STATION UNIT 1 AND JAMES A. FITZPATRICK NUCLEAR POWER PLANT.- 1976

SCIENTIFIC NAME[b]	COMMON NAME	FITZPATRICK LARVAE	FITZPATRICK EGGS	NINE MILE POINT LARVAE	NINE MILE POINT EGGS
Family Clupeidae					
Alosa pseudoharengus	Alewife ✓	X	X	X	X
Dorosoma cepedianum	Gizzard shad				X
Family Salmonidae					
Coregonus artelii	Cisco or Lake herring		X		X
Family Osmeridae					
Osmerus mordax	Rainbow smelt ✓	X	X	X	X
Family Cyprinidae					
Cyprinus carpio	Carp	X		X	
Notropis sp.	UID shiner	X			
Family Percopsidae					
Percopsis omiscomaycus	Trout perch	X		X	
Family Gadidae					
Lota lota	Burbot	X	X	X	
Family Cottidae					
Cottus bairdi	Mottled sculpin	X		X	X
Family Percichthyidae					
Morone americana	White perch	X	X	X	X
M. chrysops	White bass	X			
Family Percidae					
Etheostoma nigrum	Johnny darter	X	X	X	X
Perca flavescens	Yellow perch ✓	X		X	X
Stizostedion vitreum	Walleye		X		X
UID Species		X	X	X	X

[a] Species from regular entrainment program; larvae are pro-larvae, larva and/or juvenile stage
[b] According to A List of Common and Scientific Names of Fishes from the United States and Canada. Amer. Fish. Soc. Spec. Publ. 6. 3rd ed.

✓Representative important species

a. Alewife

Alewife eggs were present in entrainment samples from 16 June to 11 August 1976 (Table IVF-4). There were two periods in which eggs were collected in substantial abundance: from 23 June through 21 July, when abundances ranged from approximately 1400 to 9800 organisms/1000 m^3, and on 4 and 11 August, when abundances were approximately 870 and 560 organisms/1000 m^3, respectively.

Alewife larvae were present in entrainment samples from 23 June to 6 October 1976. Substantial numbers of larvae were collected from 14 July through 25 August with a peak in abundance observed on 4 August (Table IVF-4). The bulk of the larvae collected were early life stages and relatively few individuals greater than 15 mm were collected. Mansueti and Hardy (1967) defined the larval stage as 5-16 mm and a prejuvenile stage from 17 to approximately 27 mm. Except on 18 August and 1 September, life stages beyond larvae made up a very small proportion of the collections. The low abundance of prejuveniles and juveniles may be the result of a movement of these stages away from the intake area, active avoidance of the intake, or avoidance of collecting gear in the plant.

The length frequency of alewife larvae collected from the lake on 4 and 18 August shows good agreement with the length frequency for plant collections on the same date (Figure IVF-4). The lake collections of 4 August were dominated by early life stages with few larvae greater than 12 mm, a pattern which is similar to the length distribution observed in plant collections. On 18 August early larvae still predominated, but substantial numbers of older larvae were collected, as they were

TABLE IVF-4

MEAN ABUNDANCE* OF EGGS AND LARVAE FOR RAINBOW SMELT, ALEWIFE, AND YELLOW PERCH IN ENTRAINMENT COLLECTIONS

JAMES A. FITZPATRICK NUCLEAR POWER PLANT - 1976

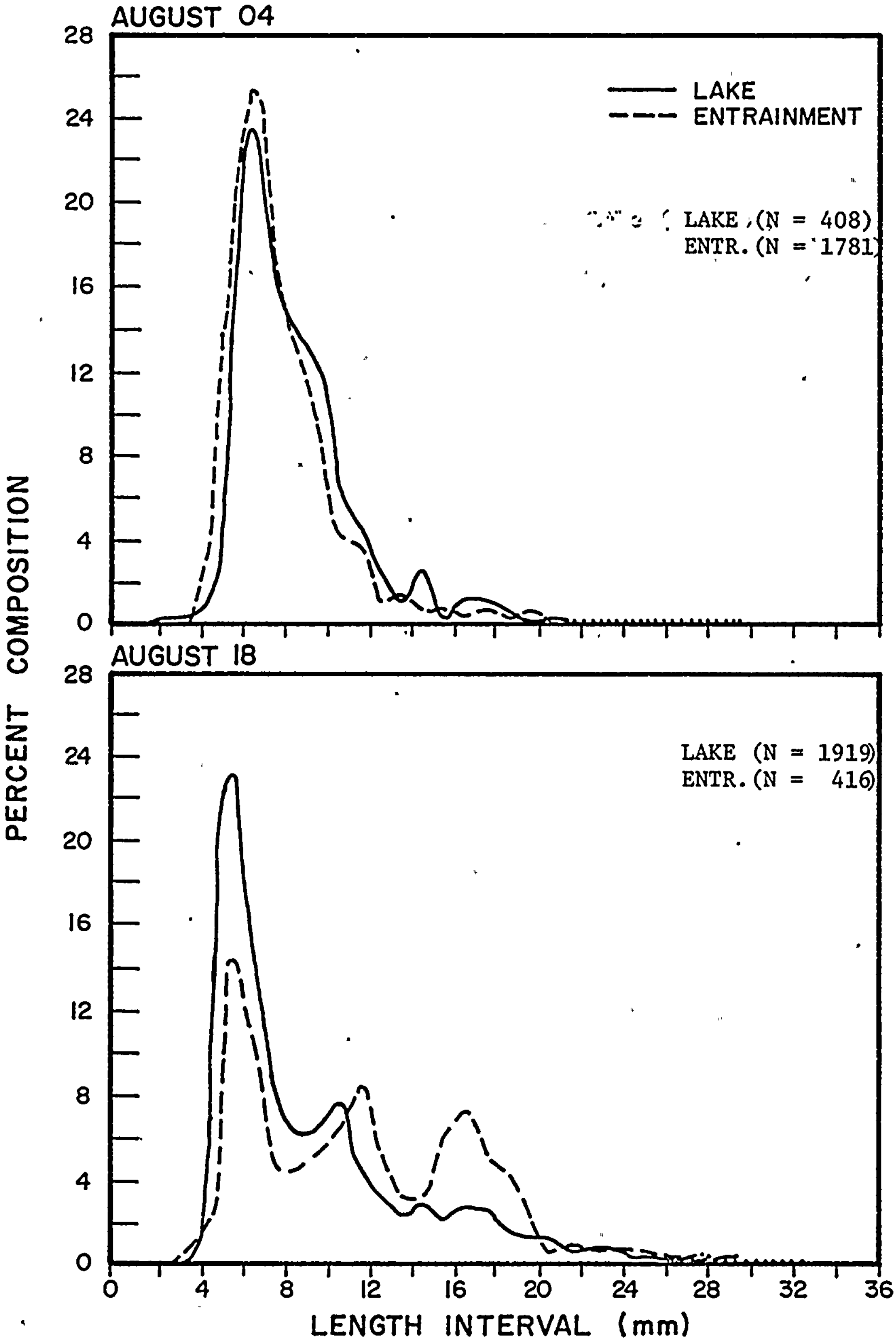
DATE	EGGS		LARVAE		
	RAINBOW SMELT	ALEWIFE	RAINBOW SMELT	ALEWIFE	YELLOW PERCH
14 APR					
28 APR	834				4
5 MAY	177				
12 MAY	41		1		1
19 MAY			6		1
26 MAY	9		4		
2 JUN	2		6	6	
9 JUN			21		
16 JUN		9	5		
23 JUN		3060		6	
30 JUN		8057		7	
7 JUL		9807	1	15	
[illegible]4 JUL		3786	7	137	
[illegible]1 JUL		1435	2	20	
28 JUL		80		300	
4 AUG		867		2524	
11 AUG		562	1	527	
18 AUG			1	612	
25 AUG				438	
1 SEP			1	32	
8 SEP				2	
22 SEP			1	9	
6 OCT				3	
20 OCT					
3 NOV					
17 NOV					
1 DEC			35		
15 DEC			4		

*Mean of all samples on each sampling date; number of organisms/1000 m^3

FIGURE IVF-4

LENGTH FREQUENCY OF ALEWIFE LARVAE IN LAKE AND ENTRAINMENT COLLECTIONS

JAMES A. FITZPATRICK NUCLEAR POWER PLANT AND VICINITY-1976



in the plant collections on this date. In addition, both lake and plant sampling began to capture larvae in the 3-5 mm size range. These data indicate that the lake and plant collections sampled the early life stages in a similar manner.

b. Rainbow Smelt

Rainbow smelt eggs were present in plant collections from 28 April to 2 June, with the peak abundance on 28 April and diminishing abundance thereafter (Table IVF-4) (LMS 1977, Appendix VIID-1b). Smelt larvae were present from 12 May to 15 December (Table IVF-4). Rainbow smelt have a prolonged period of development, and therefore, the specimens collected during fall are classified as larvae, because individuals 50 mm or more have the physical appearance of larvae. Concentrations of smelt larvae were very low compared to alewife, but a peak of abundance may have occurred on 9 June.

c. Yellow Perch

Yellow perch larvae were present from 28 April to 19 May in very low abundance (Table IVF-4).

3. Estimated Entrainment of Representative Important Species

a. Alewife

The estimated total numbers of alewife and rainbow smelt eggs and larvae entrained at the FitzPatrick plant were computed from the day/night abundance data from the regular entrainment sampling program (Tables IVF-5 through IVF-8). The concentrations of eggs and larvae collected at the intake forebay for

TABLE IVF-5

ESTIMATED TOTAL ENTRAINED, TOTAL IN WATERBODY SEGMENT AND PERCENT CROPPING OF ALEWIFE EGGS

JAMES A. FITZPATRICK NUCLEAR POWER PLANT - 1976

SAMPLING WEEK	NO. OF CIRC. WATER PUMPS	ESTIMATED TOTAL ENTRAINED		ESTIMATED TOTAL IN WATERBODY SEGMENT*	WEIGHTED MEAN (NO./m^3)	ESTIMATED PERCENT CROPPING	
		ACTUAL FLOW	MAXIMUM FLOW			ACTUAL FLOW	MAXIMUM FLOW
6-12 JUN	2/3	0	0	909.30 X 10^4	0.0001	0	0
13-19 JUN	3	11.98 x 10^4	13.92 X 10^4	19081.40 X 10^4	0.0022	0.06	0.07
20-26 JUN	3/2	4245.16 x 10^4	4953.68 X 10^4	2394386.05 X 10^4	0.27	0.18	0.21
27 JUN-3 JUL	2	11273.64 X 10^4	13042.21 X 10^4	910013.95 X 10^4	0.10	1.24	1.43
4-10 JUL	3	14816.31 X 10^4	15874.37 X 10^4	19726751.16 X 10^4	2.24	0.08	0.08
11-17 JUL	2	4739.06 X 10^4	6128.40 X 10^4	33255239.53 X 10^4	3.37	0.01	0.02
18-24 JUL	3/2	1841.02 X 10^4	2322.90 X 10^4	14980034.88 X 10^4	1.70	0.01	0.02
25-31 JUL	2	97.80 X 10^4	129.66 X 10^4	6264620.93 X 10^4	0.71	0.002	0.002
1-7 AUG	3	1310.36 X 10^4	1403.94 X 10^4	1031776.74 X 10^4	0.12	0.13	0.14
8-14 AUG	3	849.89 X 10^4	910.06 X 10^4	44344.19 X 10^4	0.0050	1.92	2.05
TOTAL		39185.22 X 10^4	44779.14 X 10^4	78627158.13 X 10^4		0.05	0.06

*See text for definition of waterbody segment.

TABLE [illegible]-6

ESTIMATED TOTAL ENTRAINED, TOTAL IN WATERBODY SEGMENT AND PERCENT CROPPING OF ALEWIFE LARVAE

JAMES A. FITZPATRICK NUCLEAR POWER PLANT - 1976

SAMPLING WEEK	NO. OF CIRC. WATER PUMPS	ESTIMATED TOTAL ENTRAINED		ESTIMATED TOTAL IN WATERBODY SEGMENT*	WEIGHTED MEAN ($NO./m^3$)	ESTIMATED PERCENT CROPPING	
		ACTUAL FLOW	MAXIMUM FLOW			ACTUAL FLOW	MAXIMUM FLOW
13-19 JUN	3/2	0	0	13.80×10^4	0.0004	0	0
20-26 JUN	3/2	8.60×10^4	10.04×10^4	85.34×10^4	0.002	10.08	11.76
27 JUN-3 JUL	2	99.49×10^4	115.09×10^4	360.70×10^4	0.01	27.58	31.91
4-10 JUL	3	22.51×10^4	24.12×10^4	1453.93×10^4	0.04	1.55	1.66
11-17 JUL	2	171.37×10^4	221.61×10^4	1756.79×10^4	0.05	9.75	12.61
18-24 JUL	3/2	25.02×10^4	31.57×10^4	3273.71×10^4	0.09	0.76	0.96
25-31 JUL	2	365.66×10^4	484.81×10^4	3038.43×10^4	0.08	12.03	15.96
1-7 AUG	3	3813.09×10^4	4085.38×10^4	32064.21×10^4	0.85	11.89	12.74
8-14 AUG	3	795.92×10^4	852.27×10^4	13383.67×10^4	0.35	5.95	6.37
15-21 AUG	3	924.94×10^4	990.99×10^4	16090.29×10^4	0.42	5.75	6.16
22-28 AUG	3	661.60×10^4	708.85×10^4	3658.70×10^4	0.10	18.08	19.37
29 AUG-4 SEP	3	44.44×10^4	51.48×10^4	6077.16×10^4	0.16	0.73	0.85
5-11 SEP	3	3.63×10^4	3.88×10^4	118.40×10^4	0.003	3.07	3.28
12-18 SEP	-	-	-	703.25×10^4	0.02	-	-
19-25 SEP	3	13.60×10^4	14.57×10^4	-	-	-	-
26 SEP-2 OCT	-	-	-	-	-	-	-
3-9 OCT	3	3.58×10^4	4.05×10^4	-	-	-	-
TOTAL		6953.45×10^4	7598.71×10^4				

*See text for definition of waterbody segment.

TABLE IVF-7

ESTIMATED TOTAL ENTRAINED, TOTAL IN WATERBODY SEGMENT AND PERCENT CROPPING OF RAINBOW SMELT EGGS

JAMES A. FITZPATRICK NUCLEAR POWER PLANT - 1976

SAMPLING WEEK	NO. OF CIRC. WATER PUMPS	ESTIMATED TOTAL ENTRAINED		ESTIMATED TOTAL IN WATERBODY SEGMENT*	WEIGHTED MEAN (NO./m^3)	ESTIMATED PERCENT CROPPING	
		ACTUAL FLOW	MAXIMUM FLOW			ACTUAL FLOW	MAXIMUM FLOW
18-24 APR	3	-	-	2997.67×10^4	0.00034	-	-
25 APR-1 MAY	3	1203.35×10^4	1350.68×10^4	22860.47×10^4	0.00259	5.26	5.91
2-8 MAY	3	255.84×10^4	287.16×10^4	0	0	-	-
9-15 MAY	3	54.91×10^4	65.56×10^4	1739.53×10^4	0.00020	3.16	3.77
16-22 JUN	3	0	0	7427.91×10^4	0.00084	0	0
23-29 MAY	3	12.99×10^4	13.92×10^4	332.56×10^4	0.00004	3.91	4.19
30 MAY-5 JUN	3	2.17×10^4	2.43×10^4	0	0	-	-
TOTAL		1529.26×10^4	1719.75×10^4	35358.14×10^4			

*See text for definition of waterbody segment.

TABLE IVF-8

ESTIMATED TOTAL ENTRAINED, TOTAL IN WATERBODY SEGMENT AND PERCENT CROPPING OF RAINBOW SMELT LARVAE

JAMES A. FITZPATRICK NUCLEAR POWER PLANT - 1976

SAMPLING WEEK	NO. OF CIRC. WATER PUMPS	ESTIMATED TOTAL ENTRAINED		ESTIMATED TOTAL IN WATERBODY SEGMENT*	WEIGHTED MEAN (NO./m^3)	ESTIMATED PERCENT CROPPING	
		ACTUAL FLOW	MAXIMUM FLOW			ACTUAL FLOW	MAXIMUM FLOW
18-24 APR	3	0	0	-	-	-	-
25 APR-1 MAY	3	0	0	-	-	-	-
2- 8 MAY	3	0	0	-	-	-	-
9-15 MAY	3	1.36 X 10^4	1.62 X 10^4	-	-	-	-
16-22 JUN	3	8.33 X 10^4	9.71 X 10^4	-	-	-	-
23-29 MAY	3	5.29 X 10^4	5.67 X 10^4	-	-	-	-
30 MAY-5 JUN	3	8.96 X 10^4	10.04 X 10^4	945.87 X 10^4	0.0249	0.95	1.06
6-12 JUN	3	29.52 X 10^4	34.64 X 10^4	222.52 X 10^4	0.0059	13.27	15.57
13-19 JUN	3	6.41 X 10^4	7.44 X 10^4	303.84 X 10^4	0.0080	2.11	2.45
20-26 JUN	3/2	0	0	283.52 X 10^4	0.0075	0	0
27 JUN-3 JUL	2	0	0	34.74 X 10^4	0.0009	0	0
4-10 JUL	3	1.66 X 10^4	1.78 X 10^4	229.69 X 10^4	0.0061	0.72	0.77
11-17 JUL	2	8.89 X 10^4	11.49 X 10^4	299.71 X 10^4	0.0079	2.97	3.83
18-24 JUL	3/2	2.44 X 10^4	3.08 X 10^4	112.17 X 10^4	0.0030	2.18	2.75
25-31 JUL	2	0	0	11.03 X 10^4	0.0003	0	0
1- 7 AUG	3	0	0	96.98 X 10^4	0.0026	0	0
8-14 AUG	3	1.51 X 10^4	1.62	53.68 X 10^4	0.0014	2.81	3.02
15-21 AUG	3	1.66 X 10^4	1.78	44.89 X 10^4	0.0012	3.70	3.97
22-28 AUG	3	0	0	42.10 X 10^4	0.0011	0	0
29 AUG-4 SEP	3	1.54 X 10^4	1.78 X 10^4	13.08 X 10^4	0.0003	11.77	13.61
5-11 SEP	3	0	0	0	0	-	-
12-18 SEP	-	-	-	43.05 X 10^4	0.0011	-	-
19-25 SEP	3	1.81 X 10^4	1.94 X 10^4	-	-	-	-
26 SEP-2 OCT	-	-	-	-	-	-	-
3- 9 OCT	3	0	0	-	-	-	-
10-16 OCT	-	-	-	-	-	-	-
17-23 OCT	2	0	0	-	-	-	-
24-30 OCT	-	-	-	-	-	-	-
31 OCT-6 NOV	3	0	0	-	-	-	-
7-13 NOV	-	-	-	-	-	-	-
14-20 NOV	3	0	0	-	-	-	-
21-27 NOV	-	-	-	-	-	-	-
28 NOV-4 DEC	3	50.19 X 10^4	56.33 X 10^4	-	-	-	-
5-11 DEC	-	-	-	-	-	-	-
12-18 DEC	3/2	4.25 X 10^4	6.15 X 10^4	-	-	-	-
TOTAL		133.82 X 10^4	153.29 X 10^4				

*See text for definition of waterbody segment.

individual depths and times were averaged to give a mean concentration per sample date. This mean concentration by date was considered representative of weekly abundance and multiplied by weekly plant flows to produce a weekly entrainment total. A total estimate was obtained for both the actual flow conditions in 1976 and the full flow condition to provide a "worst case" estimate.

(i) Eggs

The total number of alewife eggs entrained ranged from approximately 12 to 14,800 x 10^4/week for actual flow conditions and 14 to 15,800 x 10^4/week for full flow conditions (Table IVF-5). The peak of egg abundance occurred in the plant during the week of 4-10 July, while the peak in lake abundance occurred during the week of 11-17 July.

(ii) Larvae

The total numer of alewife larvae entrained per week ranged from approximately 4 x 10^4 to 3800 x 10^4 for actual flow conditions and from 4 x 10^4 to 4100 x 10^4 for full flow conditions (Table IVF-6). The peak weekly abundance of larvae in the lake occurred during the week of 1-7 August, concurrent with peak abundance in entrainment collections.

b. <u>Rainbow Smelt</u>

(i) Eggs

An estimated total of 1200 x 10^4 rainbow smelt eggs were entrained under actual flow conditions during the week of

25 April to 1 May, which was the peak in abundance for 1976 (Table IVF-7). The weekly total dropped to zero during 16-22 May and was at a low level for the two following weeks.

(ii) Larvae

The estimated total number of larvae entrained per week under actual flow conditions was less than 10×10^4 except for the weeks of 6-12 June and 28 November to 4 December (Table IVF-8). The peak in lake abundance of larvae was observed during the week of 30 May to 5 June, with an estimated total of 946×10^4 larvae.

4. Cropping Rates and Assessment of Entrainment Impact

The estimation of cropping rates and impact assessment is restricted to alewife and rainbow smelt because other species, including the other representative important species, were entrained in very low numbers or were not found in the entrainment program. In addition, lake sampling for ichthyoplankton indicated low abundance of the early life stages of all species except alewife and rainbow smelt (See Section IVF.1). The Nine Mile Point area does not appear to be an important spawning and nursery area for most species.

For the purpose of estimating cropping rates and assessing impact, a plant mortality rate of 100% for both eggs and larvae of alewife and rainbow smelt is used in subsequent calculations. This approach is conservative in that the survival studies, which were inadequate to provide a reliable estimate of percent mortality, did indicate some survival after plant passage (LMS 1977, Appendix VIIID-2a). With the assumption of 100% mortality, the estimated total number of eggs

and larvae entrained presented in Tables IVF-5 through IVF-8 represent the estimated total weekly mortality of these life stages.

a. Cropping Estimates for Eggs

The estimated total number of alewife and rainbow smelt eggs entrained per week under actual and full flow conditions was compared with the estimated total present in the lake during the same week. The area of the lake chosen for comparison was a water body segment bounded by the extent of sampling (i.e., larval tows). This segment covers approximately 3.5 miles of shoreline and extends outward to the 110-ft depth contour, which is approximately one mile offshore. Sampling actually stopped at the 100-ft depth contour but the computation of standing crops extended the area to 110 ft because of the stratified nature of the calculation.

The total number of eggs present in the water body segment was computed by multiplying the mean concentration (number/1000 m^3) from day (rainbow smelt) or night (alewife) collections for each depth contour range (e.g., 0-30, 30-50, 50-70, 70-90, and 90-110 ft) by the volume for that depth range in the segment. The totals for each depth range were summed to produce a water body segment total from the stratified estimates.

Incubation time for alewife eggs is approximately six days at the water temperature in Lake Ontario during peak spawning activity (See Section IVF.1). Weekly cropping estimates can therefore be viewed as independent losses to the annual egg production. Rainbow smelt egg incubation time was reported to be 19 days at 9-10 C (48-50 F) for a population in the Miramichi River, New Brunswick (Scott and Crossman 1973). Thus, weekly

cropping estimates for rainbow smelt do not provide independent estimates of losses of eggs. However, only three weekly estimates, each two weeks apart, could be calculated (Table IVF-7). The weekly cropping estimates presented may approach independent estimates.

The estimate of lake standing crop was based on the collections made with towed plankton nets, and therefore represents the abundance of eggs in the water column at the time of sampling. Alewife and rainbow smelt eggs are demersal and can be sampled by plankton nets only for a short time immediately after being spawned in the water column. The vast majority of eggs present in the area of interest at any given time would be on the bottom, and therefore estimates based on towed net samples would grossly underestimate the total present.

Studies in Lake Michigan in the vicinity of the Zion and Waukegan Generating Stations included both net sampling and benthic sampling of alewife eggs using a suction pump (Cima et al. 1975, Methods p.7). Two transects were sampled intensively with the pump during the period of peak alewife spawning and revealed very large numbers of eggs present on the bottom. The Lake Michigan data (Cima et al. 1975, Tables 18 and 19; Appendix Table C-38) were used to compute a ratio of water column abundance to benthic abundance for a date which had data for both the water column and benthos. A water column total was obtained for each depth contour sampled by multiplying the mean concentration (number/m^3) by the depth of the water column in meters. For the two transects combined, the water column totals for each depth contour were summed and divided by the sum of the total benthic eggs at each depth contour. The ratio of water column egg abundance to benthic egg abundance was 0.0043. This

factor was applied to the water column abundances for both alewife and rainbow smelt in the Nine Mile Point vicinity to provide an estimate of the total number of eggs present. Since rainbow smelt eggs are demersal and adhesive, application of the ratio for alewife eggs is a reasonable approach for this species. The weekly lake abundances of eggs presented in Tables IVF-5 and IVF-7 were developed using the above procedure.

Extremely low percentages of the weekly standing crops of alewife eggs were lost to entrainment (Table IVF-5). The overall seasonal cropping rates under actual and full flow conditions were 0.05 and 0.06%, respectively. The weekly cropping of rainbow smelt eggs was on the order of 3-5% for actual flow conditions and 4-6% for maximum flow (Table IVF-7). The annual cropping rates for these two flow conditions were 4.33 and 4.86%, respectively for rainbow smelt eggs.

b. Egg Cropping Equivalents in Spawning Adults

The estimated total number of alewife and rainbow smelt eggs entrained was compared with the average fecundity of these species in Lake Ontario as determined during the 1976 study program. The comparison provides perspective on the loss of eggs (assuming 100% mortality) by expressing the loss in terms of adult fish.

The average total number of eggs per female by size group is presented in Tables IVF-9 and IVF-10. The fecundity data for the control and experimental sites and for the different size groups were combined to produce a mean total number of eggs per female for each species. For alewife the mean total number of eggs was 26,272 and for rainbow smelt, 24,288.

TABLE IVF-9

FECUNDITY OF ALEWIFE

NINE MILE POINT VICINITY - JUNE-JULY 1976

I. CONTROL SITE[a]

AGE	NUMBER OF FISH	TOTAL LENGTH (mm) MEAN	TOTAL LENGTH (mm) RANGE	TOTAL EGGS/OVARY MEAN	TOTAL EGGS/OVARY STANDARD DEVIATION	MATURE EGGS/OVARY MEAN	MATURE EGGS/OVARY STANDARD DEVIATION
II	15	156	145 - 170	23435	7309	12052	3243
III	15	157	129 - 179	28779	8199	14329	3776
IV	15	170	157 - 181	27211	6713	15333	2905
V	6	168	156 - 180	26914	6662	13750	3114

II. EXPERIMENTAL SITE[b]

AGE	NUMBER OF FISH	TOTAL LENGTH (mm) MEAN	TOTAL LENGTH (mm) RANGE	TOTAL EGGS/OVARY MEAN	TOTAL EGGS/OVARY STANDARD DEVIATION	MATURE EGGS/OVARY MEAN	MATURE EGGS/OVARY STANDARD DEVIATION
II	15	157	129 - 168	21756	5889	11763	2840
III	15	152	130 - 172	24653	8253	13547	4216
IV	15	166	137 - 180	27333	8367	14740	3917
V	11	167	137 - 184	30097	9144	16429	4469

[a]Bottom Gill Net: NMPW-15', NMPW-30', NMPE-15', NMPE-30', NMPE-40'
Surface Gill Net: NMPW-40', NMPE-40'

[b]Bottom Gill Net: NMPP-15', NMPP-30', NMPP-40', FITZ-15', FITZ-30', FITZ-40'
Surface Gill Net: NMPP-40', FITZ-40'

TABLE IVF-10

FECUNDITY OF RAINBOW SMELT

NINE MILE POINT VICINITY - APRIL-MAY 1976

I. CONTROL SITE[a]

AGE	NUMBER OF FISH	TOTAL LENGTH (mm)		TOTAL EGGS/OVARY	
		MEAN	RANGE	MEAN	STANDARD DEVIATION
II	7	144	137 - 154	9041	1688
III	15	153	142 - 172	11764	3558
IV	14	168	145 - 209	16261	6398
V	12	207	163 - 248	36895	20105
VI	5	231	211 - 264	55477	20241

II. EXPERIMENTAL SITE[b]

AGE	NUMBER OF FISH	TOTAL LENGTH (mm)		TOTAL EGGS/OVARY	
		MEAN	RANGE	MEAN	STANDARD DEVIATION
II	10	145	133 - 162	10049	1876
III	15	157	137 - 215	13949	7092
IV	16	165	146 - 193	15614	4408
V	15	209	158 - 250	33490	15030
VI	3	224	222 - 228	40344	4885

[a]Bottom Gill Net: NMPW-15', NMPW-30', NMPW-40', NMPE-15', NMPE-30', NMPE-40'
Surface Gill Net: NMPW-40', NMPE-40'
Bottom Trawl: NMPW-20', NMPW-40', NMPE-40'

[b]Bottom Gill Net: NMPP-15', NMPP-30', NMPP-40'
Surface Gill Net: NMPP-40', FITZ-40'
Bottom Trawl: NMPP/FITZ-20', NMPP/FITZ-40'

TABLE [illegible]-11

ESTIMATED TOTAL ENTRAINED, TOTAL IN WATERBODY SEGMENT AND PERCENT CROPPING OF ALEWIFE LARVAE

NINE MILE POINT UNIT 1 - 1976

SAMPLING WEEK	NO. OF CIRC. WATER PUMPS	ESTIMATED TOTAL ENTRAINED		ESTIMATED TOTAL IN WATERBODY SEGMENT*	WEIGHTED MEAN (NO./m^3)	ESTIMATED PERCENT CROPPING	
		ACTUAL FLOW	MAXIMUM FLOW			ACTUAL FLOW	MAXIMUM FLOW
13-19 JUN	2	0	0	13.80 X 10^4	0.0004	0	0
20-26 JUN	2	0	0	85.34 X 10^4	0.0023	0	0
27 JUN-3 JUL	2	4.19 X 10^4	4.47 X 10^4	360.70 X 10^4	0.0095	1.16	1.24
4-10 JUL	2	13.19 X 10^4	14.07 X 10^4	1453.93 X 10^4	0.0383	0.91	0.97
11-17 JUL	2	54.70 X 10^4	58.36 X 10^4	1756.79 X 10^4	0.0463	3.11	3.32
18-24 JUL	2	8.69 X 10^4	9.27 X 10^4	3273.71 X 10^4	0.0863	0.27	0.28
25-31 JUL	2	14.72 X 10^4	15.71 X 10^4	3038.43 X 10^4	0.0801	0.48	0.52
1- 7 AUG	2	475.20 X 10^4	524.54 X 10^4	32064.21 X 10^4	0.8454	1.48	1.64
8-14 AUG	2	113.24 X 10^4	125.00 X 10^4	13383.67 X 10^4	0.3529	0.87	0.93
15-21 AUG	2	367.50 X 10^4	405.65 X 10^4	16090.29 X 10^4	0.4242	2.28	2.52
22-28 AUG	2	133.50 X 10^4	147.36 X 10^4	3658.70 X 10^4	0.0965	3.65	4.03
29 AUG-4 SEP	2	114.88 X 10^4	126.53 X 10^4	6077.16 X 10^4	0.1602	1.89	2.08
5-11 SEP	2	3.97 X 10^4	4.36 X 10^4	118.40 X 10^4	0.0031	3.35	3.68
12-18 SEP	-	-	-	703.25 X 10^4	0.0185	-	-
19-25 SEP	2	11.90 X 10^4	13.09 X 10^4	-	-	-	-
26 SEP-2 OCT	-	-	-	-	-	-	-
3- 9 OCT	2	0.99 X 10^4	1.09 X 10^4	-	-	-	-
10-16 OCT	-	-	-	-	-	-	-
17-23 OCT	2	0.99 X 10^4	1.09 X 10^4	-	-	-	-
TOTAL		1317.66 X 10^4	1450.59 X 10^4	8207.38 X 10^4			

*See text for definition of waterbody segment.

TABLE IVF-12

ESTIMATED TOTAL ENTRAINED, TOTAL IN WATERBODY SEGMENT AND PERCENT CROPPING OF RAINBOW SMELT EGGS

NINE MILE POINT UNIT 1 - 1976

SAMPLING WEEK	NO. OF CIRC. WATER PUMPS	ESTIMATED TOTAL ENTRAINED		ESTIMATED TOTAL IN WATERBODY SEGMENT*	WEIGHTED MEAN (NO./m^3)	ESTIMATED PERCENT CROPPING	
		ACTUAL FLOW	MAXIMUM FLOW			ACTUAL FLOW	MAXIMUM FLOW
18-24 APR	-	-	-	2997.67×10^4	0.00034	-	-
25 APR-1 MAY	2	146.94×10^4	158.27×10^4	22860.47×10^4	0.00259	0.64	0.69
2-8 MAY	2	51.02×10^4	54.43×10^4	0	-	-	-
9-15 MAY	2	25.87×10^4	27.60×10^4	1739.53×10^4	0.0020	1.49	1.59
16-22 MAY	2	0.92×10^4	0.98×10^4	7427.91×10^4	0.00084	0.01	0.01
23-29 MAY	2	4.60×10^4	4.91×10^4	332.56×10^4	0.00004	1.38	1.48
30 MAY-5 JUN	2	7.26×10^4	7.74×10^4	0	0	-	-
6-12 JUN	2	38.85×10^4	41.45×10^4	0	0	-	-
TOTAL		275.46×10^4	295.38×10^4	35358.14×10^4		0.78	0.84

*See text for definition of waterbody segment.

TABLE IVF-13

ESTIMATED LAKEWIDE CROPPING OF ALEWIFE AND RAINBOW SMELT LARVAE

JAMES A. FITZPATRICK POWER PLANT AND NINE MILE POINT UNIT 1 - 1976

I. ALEWIFE

TOTAL NUMBER ENTRAINED X 10^4					PERCENTAGE CROPPED			
FITZ		FITZ AND NMP			FITZ		FITZ AND NMP	
ACTUAL FLOW	MAXIMUM FLOW	ACTUAL FLOW	MAXIMUM FLOW	LAKEWIDE TOTAL X 10^4	ACTUAL FLOW	MAXIMUM FLOW	ACTUAL FLOW	MAXIMUM FLOW
6953	7599	8270	9050	3490479	0.20	0.22	0.24	0.26

I. RAINBOW SMELT

134	153	191	215	81149	0.17	0.19	0.24	0.26

The estimated total number of eggs entrained for each species was divided by the mean total number of eggs per female to determine the average number of females required to produce the total eggs lost to entrainment. The entrainment of 39,185 x 10^4 (actual flow conditions) alewife eggs is equivalent to the spawning of 14,915 average female alewives. Under conditions of maximum flow the egg loss is equivalent to the spawning of 17,044 average females. The values for actual and maximum flow conditions for rainbow smelt are 630 and 708 average females, respectively. These numbers represent extremely small percentages of the stock estimates for these species given in a later section (Table IVG-15). Assuming that only 25% of the standing stock are mature females the above numbers would represent 0.0055 and 0.0026% of the alewife and rainbow smelt mature females in the Oswego Sector (Table IVG-15) based on the adjusted stock estimates. The assumption of 25% mature females is believed to be conservative since the standing stock estimates are composed of primarily older fish (see Section IVG).

c. Cropping Estimates for Larvae

Plant cropping estimates for alewife and rainbow smelt larvae were based on the water body segment described in Section IVF.4a and on an estimate of the lake-wide larval standing crops of these species from night collections. A lake-wide cropping estimate was developed because alewife and rainbow smelt are distributed throughout the lake and apparently use the entire shoreline for spawning. Fishery and impingement sampling at widely spaced locations on Lake Ontario on both the United States and Canadian sides has shown the alewife and rainbow smelt to be abundant at all locations. CDM/Limnetics (1977) summarized entrainment and impingement studies at power plants

on Lake Michigan and found all life stages of alewife and rainbow smelt to be widely distributed in that lake. Wells (1974) studied the distribution of fish fry along the shores of central and southern Lake Michigan and found alewife larvae distributed throughout this area (approximately 2/3 of Lake Michigan). Alewife larvae were more abundant on the east shore than the west shore, but this difference was probably due to upwellings on the west shore which carried larvae out of the study area. Rainbow smelt larvae were less abundant than alewife larvae, but they were also distributed throughout the study area.

Because the duration of the larval stage is more than one week, weekly cropping estimates cannot be summed to produce an estimate of total cropping. For this analysis, total entrainment will be compared with an average lake standing crop during the peak of larval abundance. This approach is conservative because the actual total present in the water body segment thoughout the larval period would have been greater than the average during peak abundance. The mean concentration of alewife larvae was 57 larvae/1000 m^3 at the 100-ft contour for all samples combined (LMS 1977, Appendix VC-2b) indicating that larvae were present beyond the water body segment boundary. Rainbow smelt larvae were also found at the 100-ft contour but in much lower concentration than alewife larvae (LMS 1977, Appendix VC-2a). However, rainbow smelt larval abundance demonstrated no real onshore-offshore trends (page IV-67). These larvae were not accounted for in the computation of cropping rate, thereby, adding an additional conservative factor to the estimate.

The standing crops of larvae in the water body segment were calculated in the same manner as described for eggs except that only night collections were used. As described for eggs, the

sampling extended to the 100-ft depth contour, but the computation of the water body segment extended the area to the 110-ft contour.

d. Water Body Segment Cropping

The weekly cropping estimates for alewife larvae in the water body segment of interest ranged from less than 1% to approximately 28% for actual flow and from less than 1% to 32% for maximum flow conditions (Table IVF-6). Weekly cropping estimates for rainbow smelt larvae ranged from 0 to 13% for actual flow and from 0 to 16% for maximum flow conditions (Table IVF-8). While these estimates cannot be summed to produce a seasonal cropping percentage, they do indicate the rate of loss of larvae for weekly time units in the vicinity of the FitzPatrick plant.

During their period of maximum abundance in the vicinity of Nine Mile Point (1 August to 4 September), alewife larvae had a mean weekly abundance of $14,255 \times 10^4$. Cropping percentages based on total alewife larvae entrained in 1976 were 49% for actual flow and 53% for maximum flow (Table IVF-6). Rainbow smelt larvae had a mean weekly abundance of 331×10^4 during the period of peak abundance (30 May to 17 July) in the vicinity of Nine Mile Point. Annual cropping percentages of 40% for actual flow and 46% for maximum were obtained from the estimated total entrained during 1976. The conservative nature of this calculation should be emphasized in that the standing stock estimates do not account for the natural offshore movement of larvae by upwellings and offshore drift.

e. Lake-wide Cropping

A lake-wide standing crop of alewife larvae was computed from the mean abundance of larvae during the period of peak abundance ($14,255 \times 10^4$) at Nine Mile Point and the ratio of the water body segment shoreline length (3.5 miles) to the total shoreline length for Lake Ontario (857 miles; Hutchinson 1957).

An estimated total of $3,490,479 \times 10^4$ alewife larvae were present in Lake Ontario in an area around the entire perimeter of the lake and extending outward to the 110-ft depth contour. Lake-wide cropping estimates were based on the total number entrained at the FitzPatrick plant and for the total entrained at FitzPatrick and Nine Mile Point Unit 1 combined. The lake-wide cropping estimates were restricted to FitzPatrick and Nine Mile Point because entrainment estimates for other plants on Lake Ontario were not available. Entrainment estimates for alewife larvae at the Nine Mile Point plant are presented in Table IVF-11. A similar calculation was performed for rainbow smelt larvae and a lake-wide estimate of $81,149 \times 10^4$ larvae was obtained (see Table IVF-12 for total rainbow smelt entrainment at Nine Mile Point Unit 1).

Lake-wide cropping estimates for larvae of alewife and rainbow smelt were very low for both FitzPatrick alone and FitzPatrick and Nine Mile Point plants combined (Table IVF-13). The Nine Mile Point plant entrains few alewife larvae compared to the FitzPatrick plant, and therefore, makes a small contribution to the combined lake-wide cropping estimate. Nine Mile Point's contribution to the combined cropping estimate for rainbow smelt was greater than for alewife.

5. Impact of Egg and Larvae Cropping

When egg abundance data were corrected for undersampling of benthic eggs, the water body segment cropping percentages were extremely low for both alewife and rainbow smelt. Considering the demersal nature of the eggs of both species, a low percentage cropping of eggs is indicated. The egg cropping, in terms of the number of average mature females required to produce the eggs lost (page IV-79), indicates that this loss represents a very small fraction of the spawning potential of these populations, which certainly have the ability to offset the small egg losses.

Water body segment cropping of larvae based on an average maximum standing crop produced percentages which would be considered serious if the conservative nature of the calculations were not considered. The most important factor that would reduce the cropping percentage substantially is the larvae which were not accounted for in the average standing crop. The total actually present would certainly be greater than the average. In addition, only those larvae inside the 110-ft depth contour were included. The assumption of 100% plant mortality increases the estimated cropping over that which actually occurs.

The projection of plant cropping on a lake-wide larval population basis is a very rough estimate, being based on an average standing crop for only a very small portion of the total potential spawning area. The actual larval population density would be expected to vary significantly from place to place along the shoreline. However, the lake-wide cropping estimates provide a rough estimate for the lake as whole, which is an important perspective for impact assessment. The lake-wide cropping estimates are very low, and are conservative because the same factors which affected the standing crop estimate for the water body segment apply to the lake-wide estimate.

In the following section (IV.G) the lake-wide abundance of alewife, as determined from Yankee trawl data, was given as 26.63×10^9 (adjusted for undersampling). When this is compared to the lake-wide abundance of larvae estimated in this section (34.90×10^9), it appears that the number of larvae in the lake is grossly underestimated. One would except that if the lake-wide abundance of older age groups is reasonably accurate, a much greater number of larvae would be produced. If larval abundance has been underestimated as suggested here, the larval cropping percentages would actually be much lower.

The combined cropping of eggs and larvae of alewife and rainbow smelt would remove an extremely small percentage of the reproductive potential of these populations. This small loss will not have an adverse impact on these populations, because, as discussed in the following section, they undoubtedly have the compensatory potential to offset these minimal losses.

G. FISH

1. Lake Monitoring Program

Fish communities in the Oswego and Nine Mile Point area of Lake Ontario were sampled intermittently by Storr with gill nets and trap nets from 1969 to 1972 (Storr 1973). From 1973 through 1976 intensive sampling has been conducted with gill nets, trawls, and beach seines. Gill net collections from 1973 through 1975 have been done along four transets (Figure IVG-1) twice per month (spring, summer and fall) with surface and bottom nets set at the 15, 30, 40, and 60-ft depth contours. Nets were set and retrieved once every 12-hours for 48 consecutive hours. During 1976, sets were made along the same four transects at the 15, 30, and 60-ft contour on the bottom both day and night, and night surface and day bottom gill

FISH SAMPLING STATIONS

NINE MILE POINT VICINITY

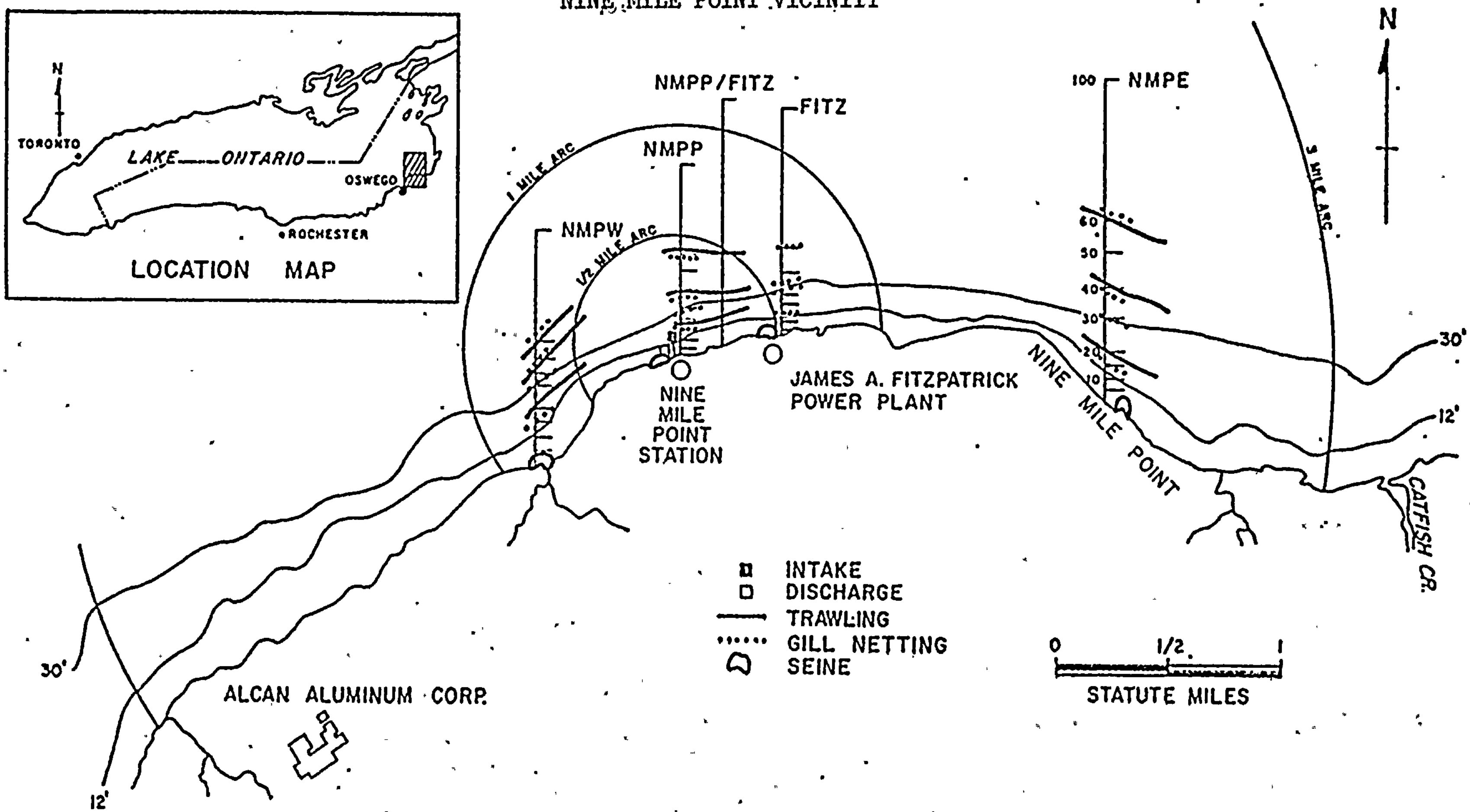


FIGURE IVG-1

nets were set at the 40-ft contour; also twice per month. Trawls were conducted along the eastern and western most transects and along the NMPP/FITZ transect twice monthly at the 20, 40, and 60-ft depth contours. Beach seines were used at the foot of each transect once per month. Gill net catches were converted to catch/12-hr, trawl catches to catch/15 minutes and seines to catch/haul.

Annual average catch/effort data for each gear type are presented in Tables IVG-1 through IVG-3 for 1974, 1975, and 1976, respectively to illustrate the fish community success over these years.

The 1975 and 1976 gill net catch/effort data for nets set at similar locations and for similar time periods over the two years are presented in Table IVG-4. Comparable catches were observed for preoperational and postoperational periods.

During the 1974 and 1975 FitzPatrick studies, an otter trawl was used for trawling, yielding relatively few fish compared to trawling conducted by the New York State Department of Environmental Conservation (NYSDEC) which used a standard Yankee trawl. During 1976 a standard Yankee trawl, similar to that used by state and federal agencies, was employed for the collection of forage fish species, such as the alewife, rainbow smelt, johnny darter, and spottail shiner, in the Nine Mile Point area. However, this gear was restricted to only two sample locations in the study area by bottom topography. The limited sampling precluded comparison of the catch per unit effort with those obtained by NYSDEC.

TABLE IVG-1

FISH COLLECTED BY SEINES, TRAWLS, AND GILL NETS

NINE MILE POINT - 1974

Common Name	Seines	Surface Trawl		Bottom Trawl		Total Trawls		Surface Gill Nets		Bottom Gill Nets		Total Gill Nets		TOTAL	
	#	#	#/effort	#	#/effort	#	#/effort	#	#/effort	#	#/effort	#	#/effort	#	% Comp.
Alewife	3351	679	2.35	2514	8.67	3193	5.41	36,917	41.97	31,113	30.74	68,030	35.57	74526	74.60
Rainbow smelt	2	67	0.23	109	0.39	176	0.31	5,622	4.32	5902.	3.63	11,524	3.93	11702	11.71
Spottail shiner	14	4	0.01	13	0.04	17	0.03	50	0.04	5,377	3.98	5,427	2.29	5458	5.60
Emerald shiner	77	23	0.08	7	0.02	30	0.05	1	< .01	1	< .01	2	< .01	109	0.15
Mottled sculpin		1	< .01	5	0.02	6	0.01			17	0.01	17	0.01	23	0.02
Threespine stickleback	6	16	0.05	5	0.02	21	0.03			2	< .01	2	< .01	29	0.03
Trout perch				5	0.02	5	0.01	3	< .01	512	0.49	515	0.28	520	0.53
Yellow perch	1							10	0.01	1,558	1.52	1,568	0.87	1569	1.50
White perch	108	3	0.01	4	0.02	7	0.01	100	0.11	3,023	3.01	3,123	1.77	3238	3.24
White sucker										660	0.57	660	0.32	660	0.68
White bass								25	0.03	29	0.03	54	0.03	54	0.06
Rock bass				2	0.01	2	< .01	1	< .01	211	0.21	212	0.12	214	0.22
Smallmouth bass	7							3	< .01	261	0.27	264	0.16	271	0.28
Gizzard shad	2			3	0.02	3	0.01	573	0.54	427	0.37	1,000	0.45	1005	1.03
Johnny darter	1			5	0.02	5	0.01			2	0.01	.2	< .01	8	0.01
Brown bullhead	2							4	< .01	58	0.07	62	0.04	64	0.07
Lake chub								1	< .01	167	0.14	168	0.08	168	0.17
American eel		1	.0.01	1	< .01	2	< .01	1	< .01	2	< .01	3	< .01	5	0.01
Sea lamprey								4	< .01	2	< .01	6	< .01	6	0.01
Pumpkinseed	3									12	0.01	12	.01	15	0.02
Carp										1	< .01	1	< .01	1	< 0.01
Black crappie										1	< .01	1	< .01	1	< 0.01
Longnose dace	1													1	< 0.01
Brown trout								60	0.08	15	0.02	75	0.04	75	0.08
Stonecat										85	0.05	85	0.03	85	0.09
Chinook salmon		1	< .01			1	< .01	16	0.02	15	0.02	31	0.02	32	0.03
Yellow bass										1	< .01	1	< .01	1	< 0.01
Golden shiner	4							1	< .01			1	< .01	5	0.01
Gar				1	< .01	1	< .01	2	< .01	1	< .01	3	< .01	4	< 0.01
Freshwater drum										3	< .01	3	< .01	3	< 0.01
Burbot										1	< .01	1	< .01	1	< 0.01
Walleye										3	< .01	3	< .01	3	< 0.01
Brook silverside	1													1	< 0.01
Redfin pickerel	1													1	< 0.01
Lake trout										4	< .01	4	< .01	4	< 0.01
Rainbow trout								21	0.03	4	0.01	25	0.02	25	0.03
Coho salmon								10	0.01	3	< .01	13	0.01	13	0.01
Northern hogsucker										2	< .01	2	< .01	2	< 0.01
Shallow water cisco										1	< .01	1	< .01	1	< 0.01
Bowfin								1	< .01			1	< .01	1	< 0.01
Channel catfish										3	< .01	3	< .01	3	< 0.01
Northern pike								1	< .01	4	< .01	5	< .01	5	0.01
U[illegible]	1							1	< .01			1	< .01	2	< 0.01

GRAND TOTAL [illegible],917

TABLE IVG-2

TOTAL FISH ABUNDANCE COLLECTED BY SEINES, TRAWLS AND GILL NETS

NINE MILE POINT VICINITY - 1975

	SEINE	SURFACE TRAWL		BOTTOM TRAWL		TOTAL TRAWLS		SURFACE GILL NETS		BOTTOM GILL NETS		TOTAL GILL NETS		TOTAL *	
COMMON NAME	NO. (TRANSECTS)	NO.	CATCH/ EFFORT	NO.	CATCH/ EFFORT	NO.	CATCH/ EFFORT	NO.	CATCH/ EFFORT	NO.	CATCH/ EFFORT	NO.	CATCH/ EFFORT	NO.	%
Alewife	7055	1981	6.47	1684	5.50	3665	5.99	35462	43.73	14146	12.63	49608	25.69	60328	75.09
Spottail shiner	51			43	0.14	43	0.07	147	0.18	8652	7.73	8799	4.56	8893	11.07
White perch	15	3	0.01	38	0.12	41	0.07	115	0.14	3715	3.32	3830	1.98	3886	4.84
Rainbow smelt	1	58	0.19	175	0.57	233	0.38	860	1.06	893	0.80	1753	0.91	1987	2.47
Yellow perch	22							13	0.02	1005	0.90	1018	0.53	1040	1.29
Gizzard shad	8	3	0.01	18	0.06	21	0.03	398	0.49	451	0.40	849	0.44	878	1.09
Trout-perch		1	<0.01	21	0.07	22	0.04	2	<0.01	657	0.59	659	0.34	681	0.85
White sucker	7							9	0.01	636	0.57	645	0.33	652	0.81
Smallmouth bass	4							15	0.02	413	0.37	428	0.22	432	0.54
Rock bass				2	0.01	2	<0.01	5	0.01	289	0.26	294	0.15	296	0.37
Brown trout								116	0.14	66	0.06	182	0.09	182	0.23
Threespine stickleback	65	46	0.15	48	0.16	94	0.15			1	<0.01	1	<0.01	160	0.20
Lake chub	2							6	0.01	125	0.11	131	0.07	133	0.17
White bass		1	<0.01			1	<0.01	23	0.03	73	0.07	96	0.05	97	0.12
Brown bullhead								3	<0.01	89	0.08	92	0.05	92	0.11
Johnny darter				88	0.29	88	0.14							88	0.11
Mottled sculpin				68	0.22	68	0.11			10	0.01	10	0.01	78	0.10
Stonecat								1	<0.01	77	0.07	78	0.04	78	0.10
Emerald shiner	53	9	0.03	5	0.02	14	0.02							67	0.08
Coho salmon	12							31	0.04	14	0.01	45	0.02	57	0.07
Golden shiner	39									1	<0.01	1	<0.01	40	0.05
Chinook salmon	7							11	<0.01	11	0.01	22	0.01	29	0.04
Lake trout								1	<0.01	27	0.02	28	0.01	28	0.03
Rainbow trout								14	0.02	4	<0.01	18	0.01	18	0.02
Pumpkinseed	2							1	<0.01	14	0.01	15	0.01	17	0.02
Carp	4							2	<0.01	8	0.01	10	0.01	14	0.02
American eel		3	0.01	5	0.02	8	0.01			5	<0.01	5	<0.01	13	0.02
Largemouth bass	12													12	0.01
Freshwater drum								1	<0.01	10	0.01	11	0.01	11	0.01
Burbot								1	<0.01	8	0.01	9	<0.01	9	0.01
Longnose dace	6													6	0.01
Longnose gar								4	<0.01	1	<0.01	5	<0.01	5	0.01

TABLE IVG-2 (CONT)

TOTAL FISH ABUNDANCE COLLECTED BY SEINES, TRAWLS, AND GILL NETS

NINE MILE POINT VICINITY - 1975

COMMON NAME	SEINE	SURFACE TRAWL		BOTTOM TRAWL		TOTAL TRAWLS		SURFACE GILL NETS		BOTTOM GILL NETS		TOTAL GILL NETS		TOTAL *	
	NO. (TRANSECTS)	NO.	CATCH/ EFFORT	NO.	CATCH/ EFFORT	NO.	CATCH/ EFFORT	NO.	CATCH/ EFFORT	NO.	CATCH/ EFFORT	NO.	CATCH/ EFFORT	NO.	%
Brook stickleback	3			1	<0.01	1	<0.01							4	<0.01
Sea lamprey								1	<0.01	3	<0.01	4	<0.01	4	<0.01
Northern pike										3	<0.01	3	<0.01	3	<0.01
Walleye										3	<0.01	3	<0.01	3	<0.01
Black crappie	1									1	<0.01	1	<0.01	2	<0.01
Northern hogsucker										2	<0.01	2	<0.01	2	<0.01
Splake trout								1	<0.01	1	<0.01	2	<0.01	2	<0.01
Banded killifish	1													1	<0.01
Bluegill sunfish										1	<0.01	1	<0.01	1	<0.01
Bowfin	1													1	<0.01
Brook trout								1	<0.01			1	<0.01	1	<0.01
Channel catfish										1	<0.01	1	<0.01	1	<0.01
Cisco or Lake herring										1	<0.01	1	<0.01	1	<0.01
Fathead minnow	1													1	<0.01
Goldfish										1	<0.01	1	<0.01	1	<0.01
Longnose sucker										1	<0.01	1	<0.01	1	<0.01
Redfin pickerel										1	<0.01	1	<0.01	1	<0.01
Silvery minnow														-	-
Tadpole madtom														-	-
Logperch														-	-
Bridle shiner														-	-
Lake chubsucker														-	-

* Experimental seines not included in total number and percent

- Not applicable

TABLE [illegible]3

TOTAL FISH COLLECTED BY SEINES, TRAWLS, AND GILL NETS

NINE MILE POINT VICINITY - 1976

SPECIES	SEINE		DAY TRAWL*		NIGHT TRAWL*		TOTAL TRAWLS*		BOTTOM GILL NETS		SURFACE GILL NETS		TOTAL GILL NETS		TOTAL (ALL GEARS)	
	TOTAL CATCH	CATCH/ HAUL	TOTAL CATCH	CATCH/ 15 MIN EFFORT	TOTAL CATCH	CATCH/ 15 MIN EFFORT	TOTAL CATCH	CATCH/ 15 MIN EFFORT	TOTAL CATCH	CATCH/ 12 HR. EFFORT	TOTAL CATCH	CATCH/ 12 HR EFFORT	TOTAL CATCH	CATCH/ 12 HR EFFORT	TOTAL CATCH	%
ALEWIFE	12659	186.16	6051	39.42	3131	20.87	9182	30.30	13308	14.10	11412	84.45	24720	21.94	46561	56.7
RAINBOW SMELT	15	0.22	5871	38.37	2124	14.16	7995	26.39	1559	1.78	427	3.01	1986	1.92	9996	12.2
SPOTTAIL SHINER	30	0.44	838	5.48	526	3.51	1364	4.50	8112	7.89	17	0.15	8129	7.03	9523	11.6
JOHNNY DARTER			478	3.12	3069	20.46	3547	11.71	1	<0.01			1	<0.01	3548	4.3
WHITE PERCH	65	0.96	39	0.25	171	1.14	210	0.69	2741	2.52	20	0.14	2761	2.26	3036	3.7
TROUT-PERCH			936	6.12	646	4.31	1582	5.22	830	0.83	1	0.01	831	0.74	2413	2.9
GIZZARD SHAD	1632	24.00	2	0.01	4	0.03	6	0.02	306	0.24	99	0.73	405	0.30	2043	2.5
YELLOW PERCH	28	0.41	22	0.14	38	0.25	60	0.20	1785	1.77	1	0.01	1786	1.57	1874	2.3
THREESPINE STICKLEBACK	446	6.56	199	1.30	14	0.09	213	0.70							659	0.8
WHITE SUCKER			1	0.01	17	0.11	18	0.06	625	0.53	3	<0.01	628	0.47	646	0.8
EMERALD SHINER	534	7.85	27	0.18	1	0.01	28	0.09	1	<0.01			1	<0.01	563	0.7
ROCK BASS			1	0.01	3	0.02	4	0.01	183	0.17	1	<0.01	184	0.15	188	0.2
SMALLMOUTH BASS					2	0.01	2	0.01	169	0.19			169	0.17	171	0.2
WHITE BASS	91	1.34	5	0.03	9	0.06	14	0.05	38	0.03	7	0.05	45	0.04	150	0.2
GOLDEN SHINER	140	2.06							2	<0.01			2	<0.01	142	0.2
BROWN TROUT	5	0.07	1	0.01			1	<0.01	113	0.11	19	0.15	132	0.11	138	0.2
LAKE CHUB									109	0.09			109	0.08	109	0.1
MOTTLED SCULPIN			4	0.03	72	0.51	76	0.25	6	0.01			6	0.01	82	0.1
SPLAKE (Hybrid Trout)			1	0.01	1	0.01	2	0.01	79	0.08	1	<0.01	80	0.07	82	0.1
BROWN BULLHEAD			1	0.01			1	<0.01	59	0.05			59	0.05	60	0.1
STONECAT									42	0.02			42	0.02	42	0.1
COHO SALMON	20	0.29							13	0.01	8	0.06	21	0.02	41	<0.1
CHINOOK SALMON	2	0.03							7	<0.01	6	0.05	13	0.01	15	<0.1
LAKE TROUT									8	0.01			8	0.01	8	<0.1
RAINBOW TROUT									8	0.01	6	0.02	14	0.01	14	<0.1
PUMPKINSEED									5	0.01			5	0.01	5	<0.1
CARP	5	0.07							9	0.01			9	0.01	14	<0.1
AMERICAN EEL					1	0.01	1	<0.01	4	<0.01			4	<0.01	5	<0.1
LARGEMOUTH BASS									1	<0.01			1	<0.01	1	<0.1
FRESHWATER DRUM					1	0.01	1	<0.01	4	<0.01			4	<0.01	5	<0.1
BURBOT									10	0.01			10	0.01	10	<0.1
LONGNOSE DACE	1	0.01													1	<0.1
LONGNOSE GAR									1	<0.01			1	<0.01	1	<0.1
BROOK STICKLEBACK	3	0.04													3	<0.1
SEA LAMPREY									4	<0.01			4	<0.01	4	<0.1
NORTHERN PIKE									3	<0.01			3	<0.01	3	<0.1
NORTHERN HOG SUCKER									4	<0.01			4	<0.01	4	<0.1
BLUEGILL									1	<0.01			1	<0.01	1	<0.1
BOWFIN									2	<0.01			2	<0.01	2	<0.1
BROOK TROUT									1	<0.01			1	<0.01	1	<0.1
CHANNEL CATFISH			1	0.01			1	<0.01							1	<0.1
CISCO OR LAKE HERRING									1	<0.01			1	<0.01	1	<0.1
GOLDFISH									1	<0.01			1	<0.01	1	<0.1
LOGPERCH			1	0.01			1	<0.01							1	<0.1
SALVELINUS SP.									7	0.01			7	0.01	7	<0.1
BLUNTNOSE MINNOW	1	0.01													1	<0.1
UID *SALMONIDAE*	4	0.06													4	<0.1
TOTAL (ALL SPECIES)	15681		14479		9830		24309		30162		12028		42190		82180	

*Regular Trawl Program

TABLE IVG-4

MEAN MONTHLY CATCH/12-HOUR EFFORT* OF FISH IN GILL NET COLLECTIONS

NINE MILE POINT VICINITY - 1975-1976

I. 1975

SPECIES	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Alewife	33.46	53.25	32.06	68.76	7.01	13.82	8.02	16.79	10.94
Brown trout	0.27	0.06	0.18	0.05	0.00	0.00	0.07	0.07	0.32
Chinook salmon	0.01	0.01	0.00	0.01	0.00	0.02	0.01	0.00	0.00
Coho salmon	0.20	0.06	0.00	0.00	0.00	0.00	0.00	0.00	0.02
Lake trout	0.00	0.02	0.01	0.00	0.00	0.00	0.04	0.04	0.04
Rainbow smelt	6.39	0.61	0.18	0.20	0.00	0.24	0.75	1.58	0.36
Rainbow trout	0.05	0.01	0.01	0.00	0.00	0.01	0.00	0.00	0.10
Smallmouth bass	0.14	0.10	0.90	0.49	1.88	1.32	0.03	0.04	0.00
Yellow perch	0.41	0.44	1.38	1.12	1.16	0.94	0.64	0.22	0.09

II. 1976

SPECIES	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Alewife	61.30	56.81	8.14	44.52	35.39	12.60	6.40	8.66	0.02
Brown trout	0.07	0.10	0.38	0.16	0.05	0.03	0.04	0.06	0.01
Chinook salmon	0.01	0.05	0.04	0.00	0.00	0.01	0.02	0.00	0.00
Coho salmon	0.05	0.07	0.06	0.01	0.00	0.00	0.00	0.00	0.00
Lake trout	0.00	0.06	0.01	0.00	0.00	0.00	0.00	0.00	0.01
Rainbow smelt	10.74	4.56	0.38	0.08	0.02	0.01	0.78	1.16	0.26
Rainbow trout	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.01
Smallmouth bass	0.29	0.12	0.04	0.12	0.17	0.52	0.13	0.08	0.01
Yellow perch	0.29	0.84	1.46	3.63	2.24	1.90	1.43	0.16	0.12

$$* - \sum \frac{\text{catch/12-hr effort per net}}{\text{No. nets per month}}$$

Mean of all fish collected in 15 ft bottom gill net, 30 ft bottom gill net, 60 ft bottom gill net; 40 ft night surface gill net; 40 ft day bottom gill net; day net, set later than 0500 hrs and for a maximum of 18 hours; night set, set not earlier than 1300 hrs and for a maximum of 18 hours

a. Alewife (Alosa pseudoharengus)

(i) Abundance and Percent Composition

The average catch/effort for alewives in 1974, 1975, and 1976 are presented in Tables IVG-1, IVG-2, and IVG-3, respectively. During each year, the alewife was the most frequently collected fish, representing 75% of the total fish catch during both 1974 and 1975 and 57% in 1976. The lower percent composition of alewife during 1976 is attributed to the reduction in surface gill netting effort during 1976 since the largest percentage of alewife were collected in surface gill nets in previous years.

Because of the program changes in 1976 the average catch/12 hours was calculated for locations and times fished in common during 1975 and 1976 (Table IVG-4). These data are presented to demonstate the continued success of the alewife through the comparison of preoperational catch/effort to postoperational catch/effort.

During 1975 and 1976 the April, May, June, and July catch/effort were high in comparison to the rest of the year; this time period corresponds to the period of onshore spawning migration by the alewife. Although differences in magnitude of monthly catch/effort existed between the years, a similar abundance trend over months existed (Table IVG-4) for both years. Also the yearly averages are similar (27.12 and 25.98 for 1975 and 1976, respectively) indicating no substantial change in the alewife population between years.

(ii) Length Frequency Distribution

The monthly length frequency distribution of alewives collected with gill nets during 1976 is given in Figure IVG-2. These data are presented to demonstrate the probable length frequency distribution of alewives in the vicinity of the plant so that a comparison between impingement and the lake length frequency can be made later in this submission.

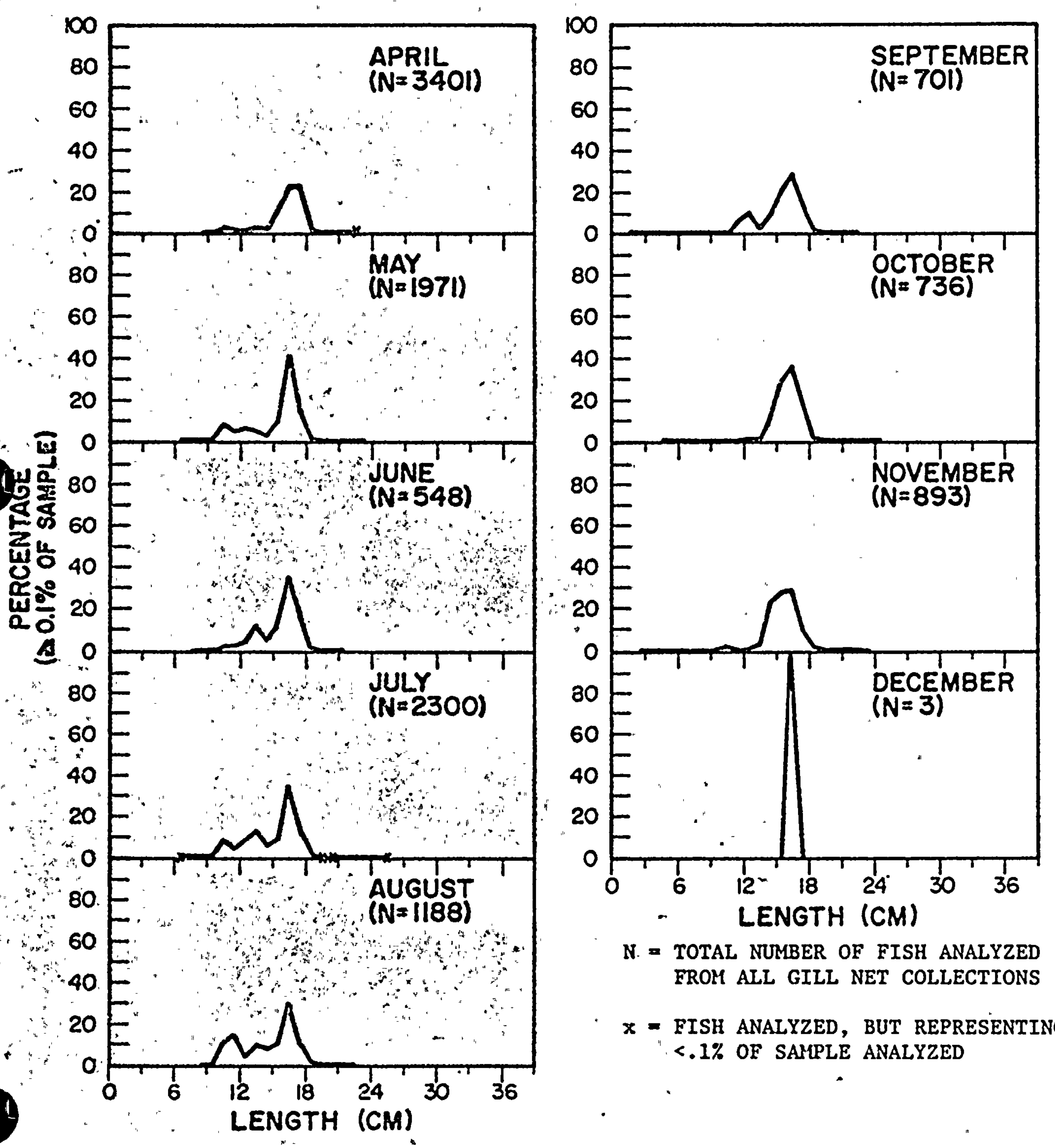
During April, two dominant size categories were observed: yearlings (i.e., fish spawned the previous summer), and fish two years old and older. The percent composition of yearling fish increased from May to August. This increase in recruitment of yearlings reflects the increasing susceptibility of these growing fish to the gill net or an increase in relative abundance due to the onshore movement of yearling fish.

The dominant peak in length frequency distribution during each month represents older fish collected by one or two mesh sizes.

Length frequency distributions for alewives collected with the Yankee trawl along the 40 and 60-ft depth contour at NMPE are presented in Figures IVG-3 and IVG-4, respectively. In June along both depth contours the distribution was bimodal, the first peak representing yearlings and the second older fish. In July and August the trawl catches were dominated by fish 12 cm and longer while in September the recruitment of young-of-the-year is indicated by the presence of a peak of approximately 6 cm. From September through November, young-of-the-year fish represented a

LENGTH FREQUENCY DISTRIBUTION FOR ALEWIFE

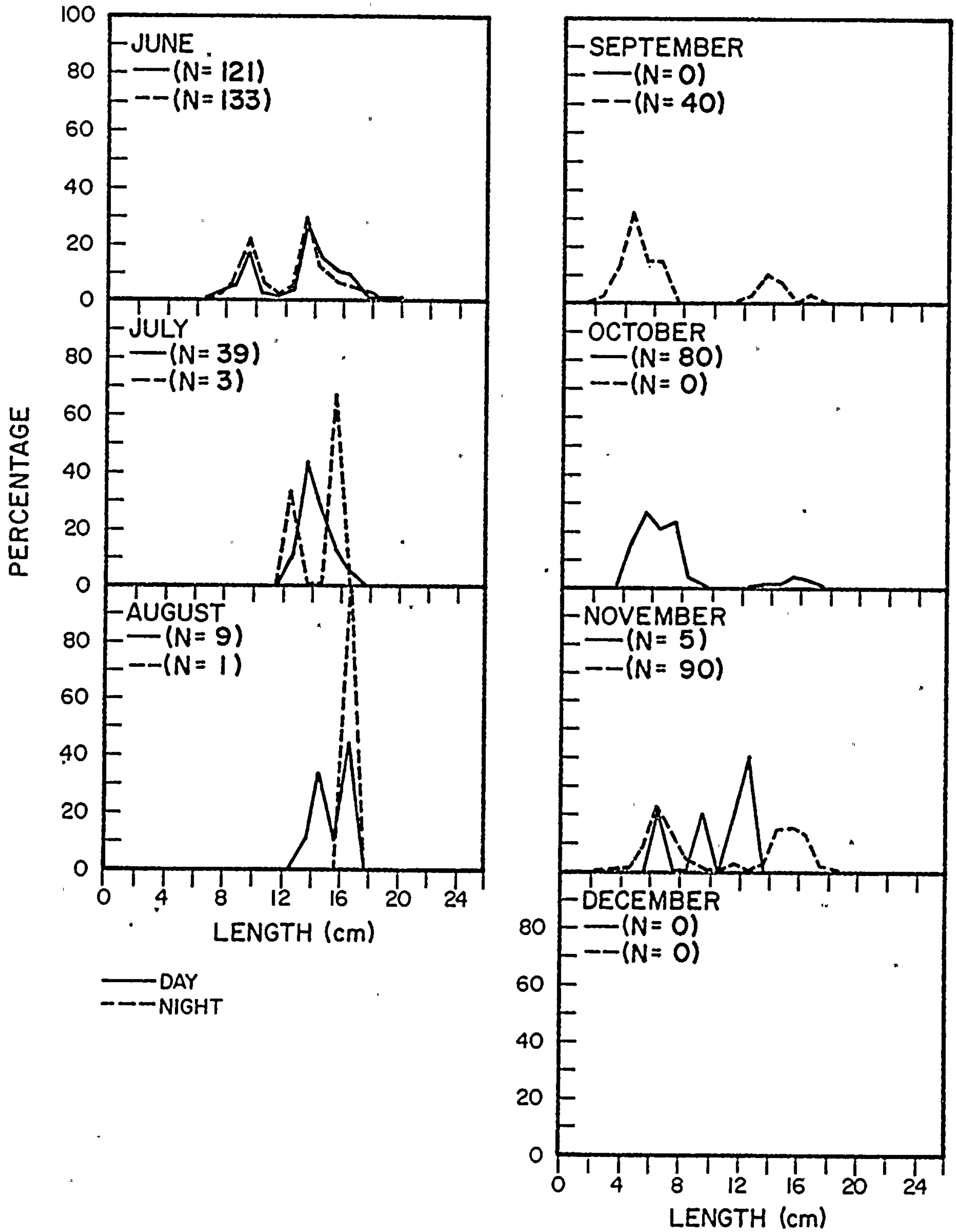
NINE MILE POINT VICINITY — APRIL-DECEMBER, 1976



N = TOTAL NUMBER OF FISH ANALYZED FROM ALL GILL NET COLLECTIONS

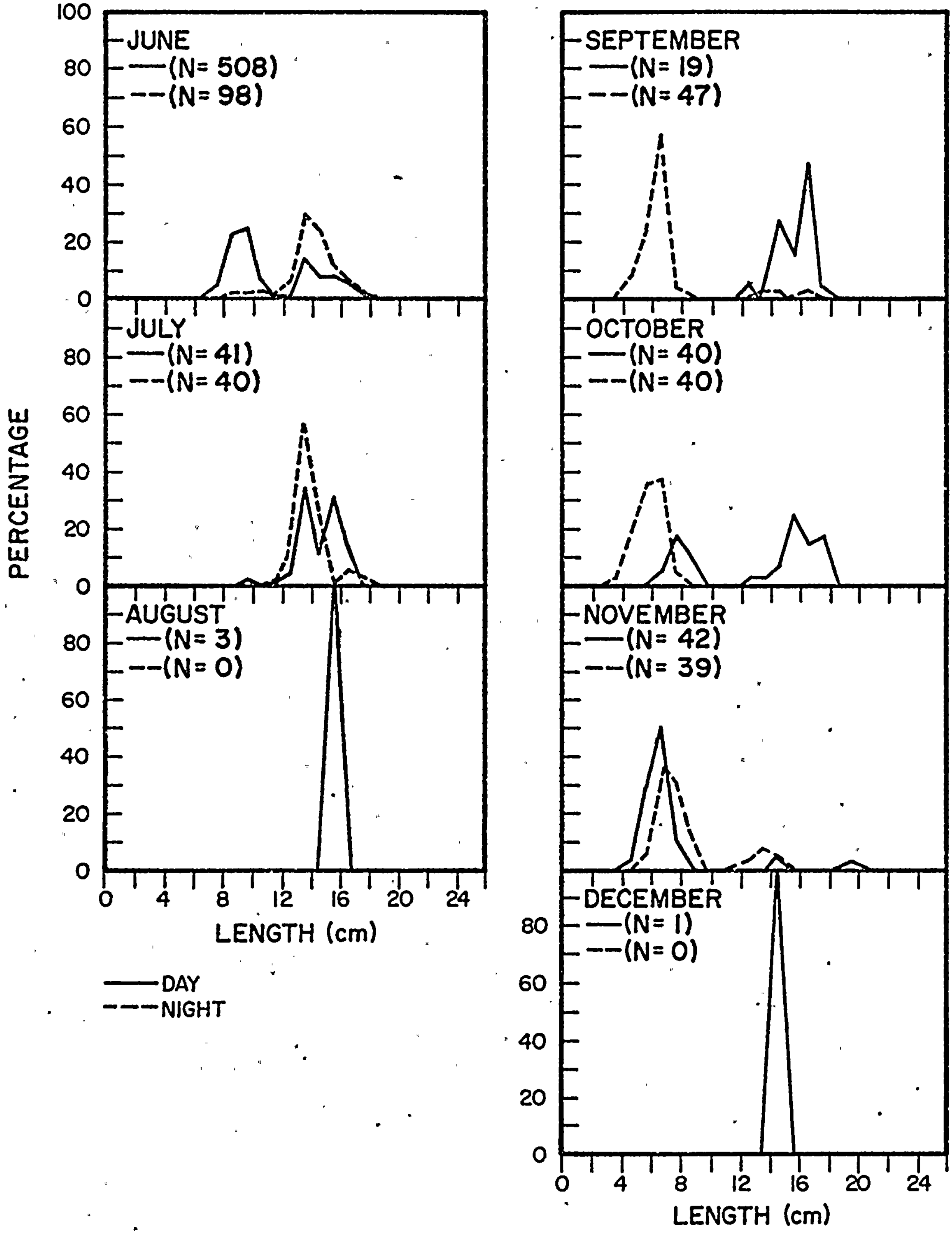
x = FISH ANALYZED, BUT REPRESENTING <.1% OF SAMPLE ANALYZED

LENGTH FREQUENCY DISTRIBUTION
FOR ALEWIFE
IN 40-FT YANKEE TRAWL COLLECTIONS
NINE MILE POINT VICINITY – 1976



LENGTH FREQUENCY DISTRIBUTION FOR ALEWIFE IN 60-FT YANKEE TRAWL COLLECTIONS

NINE MILE POINT VICINITY – 1976



majority of fish collected with the Yankee trawl. A comparison of the trawl and gill net length frequencies indicates that yearling fish are more susceptible to the trawl than the gill nets.

b. Rainbow Smelt (*Osmerus mordax*)

(i) Abundance and Percent Composition

The rainbow smelt catch/effort for common gill net fishing locations and times fished during 1975 and 1976 are presented in Table IVG-4. These data show that the 1976 catch/effort during April and May was higher than during 1975 while similar values were observed for the other months. The annual average catch/effort for 1976 (2.0 fish/effort) was greater than for 1975 (1.2 fish/effort). These data suggest that the rainbow smelt population has increased in the Nine Mile Point area since the start up of the FitzPatrick plant in 1975.

The rainbow smelt percent composition of all fish collected with all gear types suggests that during 1975 rainbow smelt represented a small percentage of the fish community (2.5%); however, during 1974 (11.7%) and 1976 (12.2%) the species was relatively more abundant (Tables IVG-1 through IVG-3). The total numbers collected also support this observation with 11,702 collected in 1974, 1987 in 1975, and 9996 in 1976. Thus, the rainbow smelt appears to be undergoing annual fluctuations in catchable fish of approximately 80%. This degree of fluctuation in catchable fish becomes important when compared to the estimated population and then to impingement cropping. This species apparently has a

tremendous ability to compensate for large population reductions. Van Oosteen (1944) reported that after a major smelt die-off in the 1940's in all the Great Lakes due to some unknown disease this species population levels quickly returned to normal.

(ii) Length Frequency Distribution

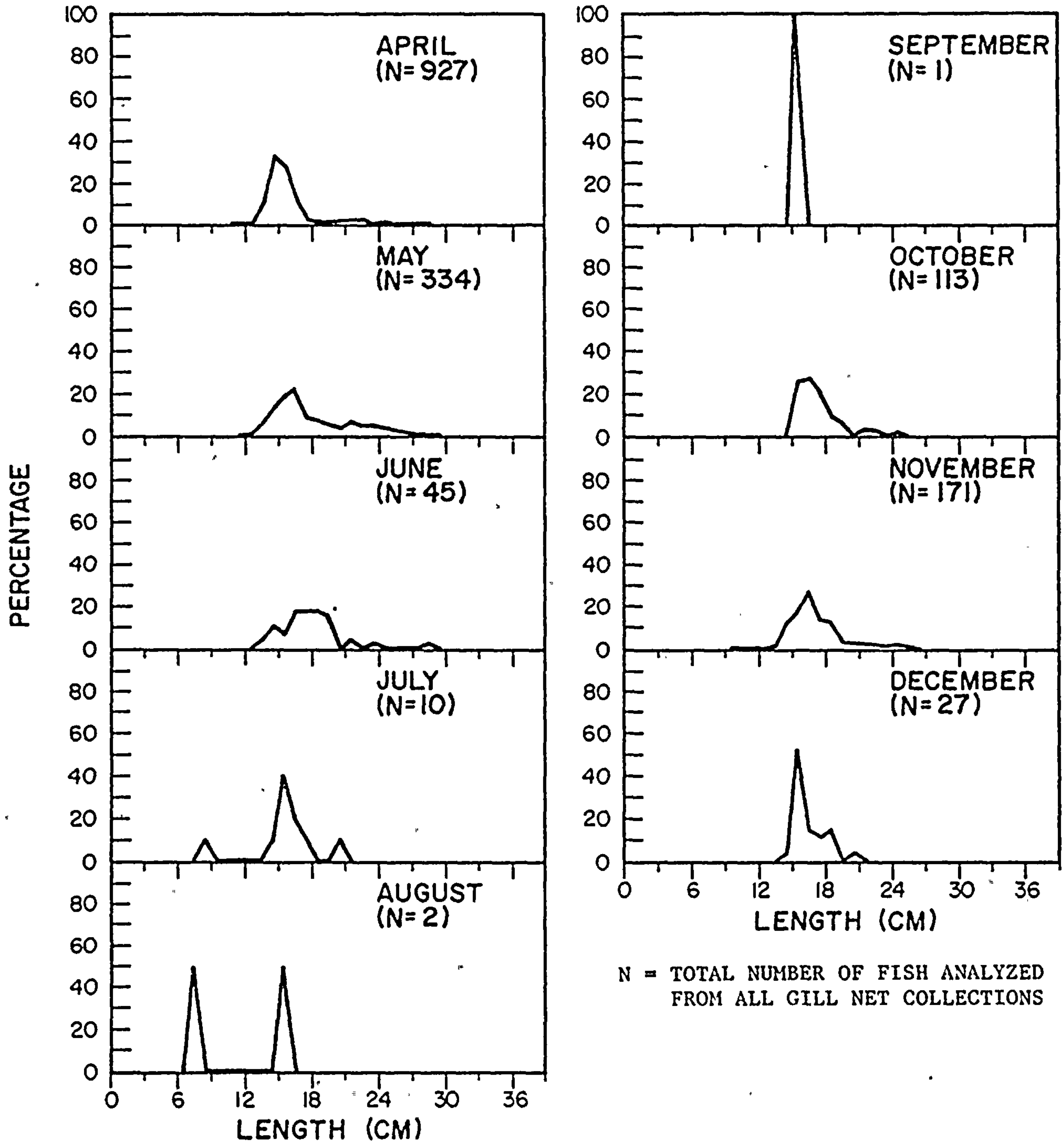
Monthly length frequency distributions for rainbow smelt collected with gill nets from April to December 1976 in the vicinity of Nine Mile Point are presented in Figure IVG-5.

The majority of rainbow smelt collected were 12-19 cm in length. Fish within the 20-26 cm range (age group VI and VII) were occasionally collected in April, May, and June. The recruitment of young-of-the-year rainbow smelt to the gear occurred during July. The low numbers of fish collected from June to September reflects the post-spawning offshore movement of the smelt.

Length frequency distributions for rainbow smelt collected with the Yankee trawl along the 40 and 60-ft depth contour are presented in Figures IVG-6 and IVG-7, respectively. Yearlings and young-of-the-year fish dominated the trawl catch at both the 40 and 60-ft depth contour, however, a greater percentage of larger fish were collected along the 60-ft depth contour than along the 40-ft depth contour. Both the numbers of fish collected and the length frequency plots indicate that young-of-the-year smelt are more susceptible to the Yankee trawl than the gill nets.

LENGTH FREQUENCY DISTRIBUTION FOR RAINBOW SMELT

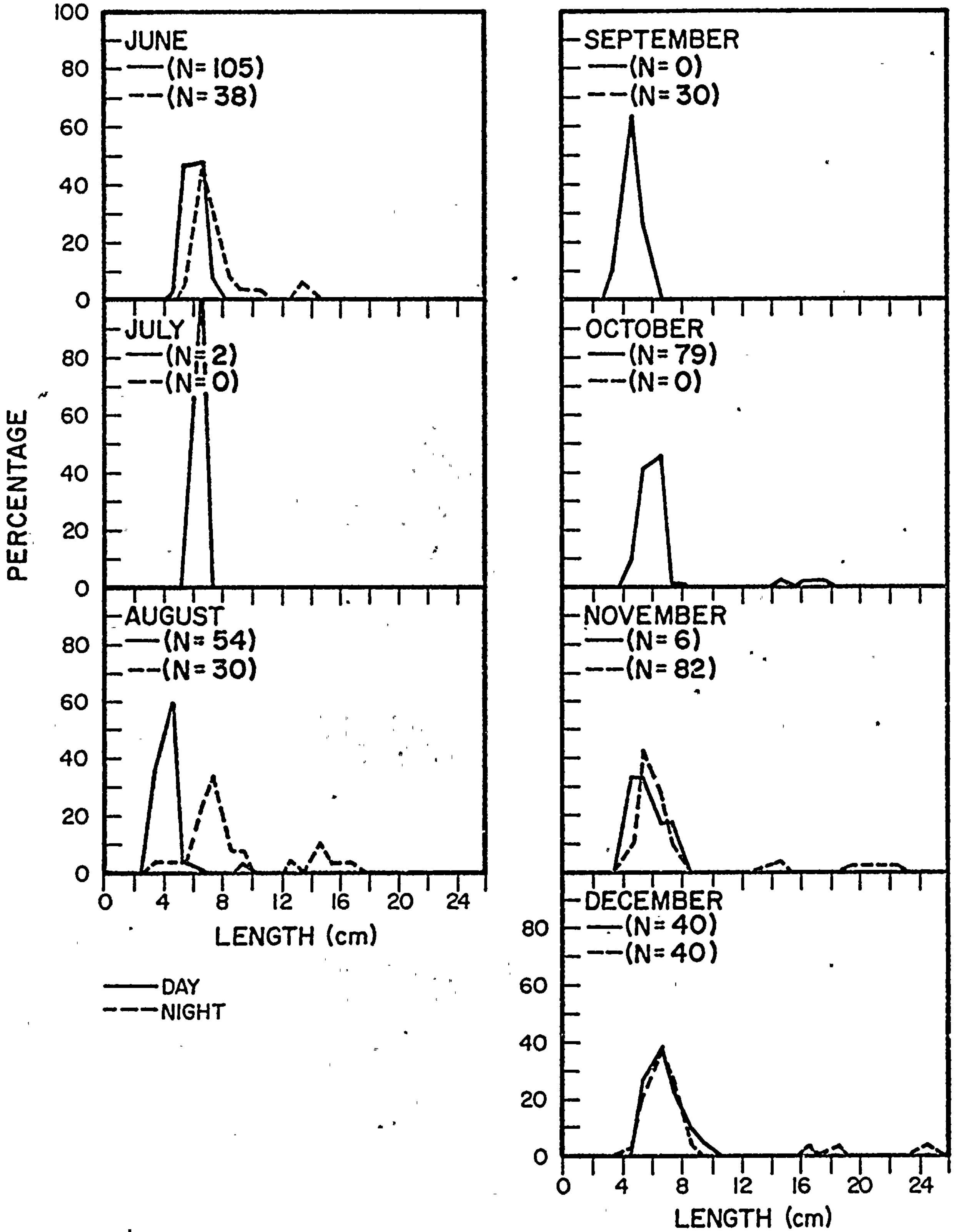
NINE MILE POINT VICINITY — APRIL-DECEMBER, 1976



N = TOTAL NUMBER OF FISH ANALYZED FROM ALL GILL NET COLLECTIONS

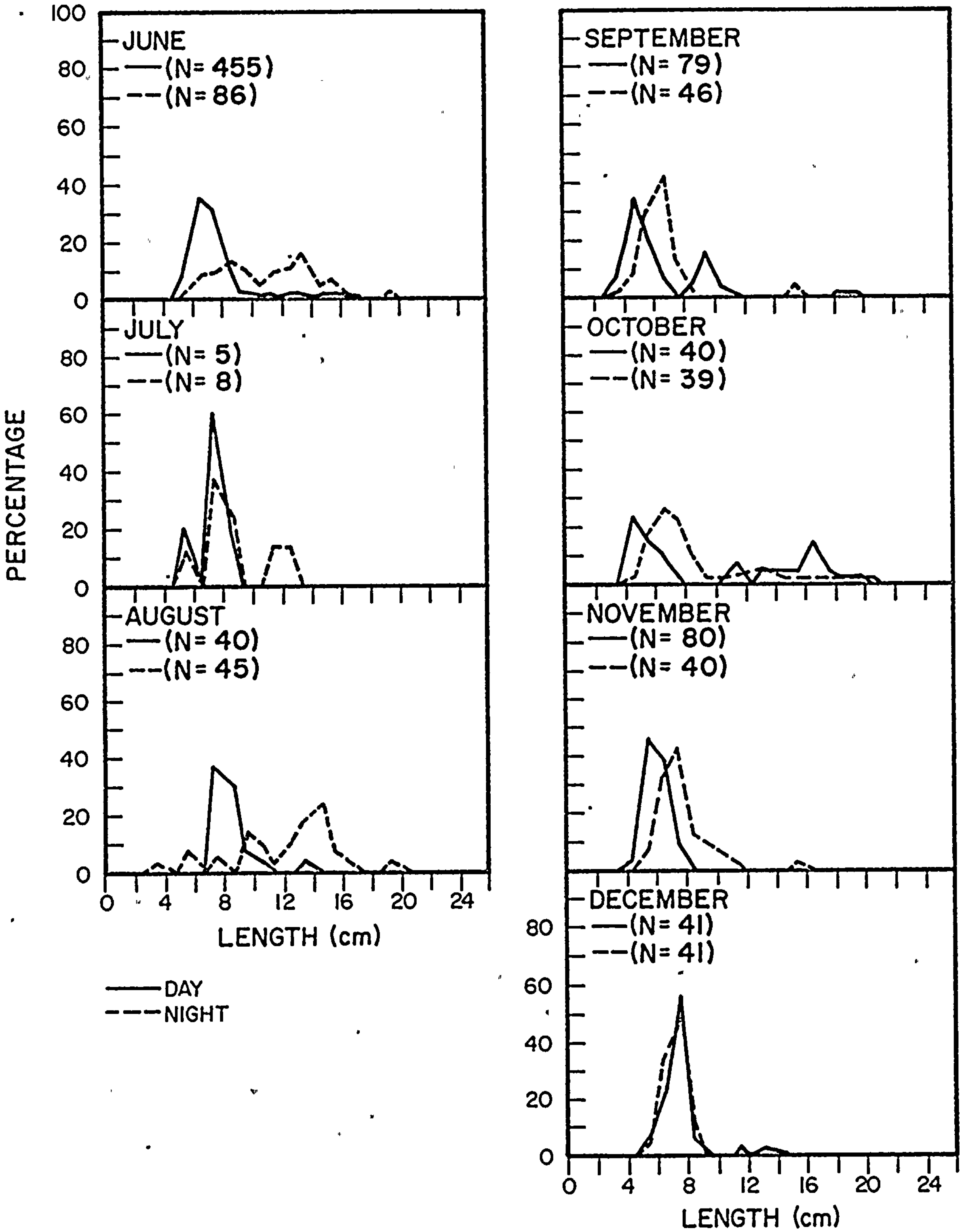
LENGTH FREQUENCY DISTRIBUTION FOR RAINBOW SMELT IN 40-FT YANKEE TRAWL COLLECTIONS

NINE MILE POINT VICINITY – 1976



LENGTH FREQUENCY DISTRIBUTION FOR RAINBOW SMELT IN 60-FT YANKEE TRAWL COLLECTIONS

NINE MILE POINT VICINITY – 1976



c. <u>Yellow Perch</u> (<u>Perca flavescens</u>)

(i) Abundance and Percent Composition

From 1974 to 1976, yellow perch were not successfully collected with trawls or beach seines; gill nets appear to have been the most successful sampling gear (Tables IVG-1 through IVG-3). During these three years, the majority of yellow perch were collected with bottom gill nets. The catch/effort from bottom gill nets indicates a fluctuating population size with an average annual catch/effort in 1974 of 1.52 fish/12-hour effort, dropping to 0.90 fish/12-hour effort in 1975, and then rising to 1.57 fish/12-hour effort in 1976. The total numbers of fish collected over years reveal a similar trend, with 1569 fish collected in 1974, 1040 in 1975, and 1874 during 1976 (Tables IVG-1 through IVG-3). The catch/effort for nets fished at similar sites (Table IVG-4) and for similar durations also illustrated that the yellow perch population has increased from 1975 to 1976. This increase suggests that the operation of Fitz-Patrick has not affected the success of yellow perch in the area.

(ii) Length Frequency Distribution

Monthly length frequency data for yellow perch collected with gill nets during 1976 are presented in Table IVG-5. In April, a trimodal distribution was evident, representing yearling (median length 11.1 to 12.0 cm), age group three and four (median length 20.1 to 21.0 cm) and age group five and six (median length 26.1 to 27.0 cm) (LMS 1975, Table VII-34). This trimodal trend continued until July when

TABLE IVG-5

LENGTH FREQUENCY FOR YELLOW PERCH[a]

NINE MILE POINT VICINITY - APRIL - JUNE, 1976

LENGTH INTERVAL (CM)	JAN[b] NO.	JAN[b] PCNT	FEB[b] NO.	FEB[b] PCNT	MAR[b] NO.	MAR[b] PCNT	APR NO.	APR PCNT	MAY NO.	MAY PCNT	JUN NO.	JUN PCNT
.1- 1.0	0	.0	0	.0	0	.0	0	.0	0	.0	0	.0
1.1- 2.0	0	.0	0	.0	0	.0	0	.0	0	.0	0	.0
2.1- 3.0	0	.0	0	.0	0	.0	0	.0	0	.0	0	.0
3.1- 4.0	0	.0	0	.0	0	.0	0	.0	0	.0	0	.0
4.1- 5.0	0	.0	0	.0	0	.0	0	.0	0	.0	0	.0
5.1- 6.0	0	.0	0	.0	0	.0	0	.0	0	.0	0	.0
6.1- 7.0	0	.0	0	.0	0	.0	0	.0	0	.0	0	.0
7.1- 8.0	0	.0	0	.0	0	.0	0	.0	0	.0	0	.0
8.1- 9.0	0	.0	0	.0	0	.0	0	.0	0	.0	0	.0
9.1- 10.0	0	.0	0	.0	0	.0	0	.0	1	.8	4	2.1
10.1- 11.0	0	.0	0	.0	0	.0	2	4.8	11	8.4	25	13.0
11.1- 12.0	0	.0	0	.0	0	.0	5	11.9	18	13.7	30	15.6
12.1- 13.0	0	.0	0	.0	0	.0	0	.0	0	.0	5	2.6
13.1- 14.0	0	.0	0	.0	0	.0	2	4.8	3	2.3	8	4.2
14.1- 15.0	0	.0	0	.0	0	.0	1	2.4	17	13.0	12	6.3
15.1- 16.0	0	.0	0	.0	0	.0	2	4.8	8	6.1	10	5.2
16.1- 17.0	0	.0	0	.0	0	.0	1	2.4	8	6.1	8	4.2
17.1- 18.0	0	.0	0	.0	0	.0	1	2.4	8	6.1	7	3.6
18.1- 19.0	0	.0	0	.0	0	.0	5	11.9	10	7.6	9	4.7
19.1- 20.0	0	.0	0	.0	0	.0	7	16.7	8	6.1	15	7.8
20.1- 21.0	0	.0	0	.0	0	.0	1	2.4	5	3.8	9	4.7
21.1- 22.0	0	.0	0	.0	0	.0	2	4.8	7	5.3	2	1.0
22.1- 23.0	0	.0	0	.0	0	.0	1	2.4	2	1.5	8	4.2
23.1- 24.0	0	.0	0	.0	0	.0	1	2.4	3	2.3	3	1.6
24.1- 25.0	0	.0	0	.0	0	.0	0	.0	5	3.8	4	2.1
25.1- 26.0	0	.0	0	.0	0	.0	3	7.1	4	3.1	10	5.2
26.1- 27.0	0	.0	0	.0	0	.0	5	11.9	3	2.3	14	7.3
27.1- 28.0	0	.0	0	.0	0	.0	1	2.4	5	3.8	3	1.6
28.1- 29.0	0	.0	0	.0	0	.0	1	2.4	2	1.5	4	2.1
29.1- 30.0	0	.0	0	.0	0	.0	1	2.4	2	1.5	0	.0
30.1- 31.0	0	.0	0	.0	0	.0	0	.0	0	.0	1	.5
31.1- 32.0	0	.0	0	.0	0	.0	0	.0	1	.8	0	.0
32.1- 33.0	0	.0	0	.0	0	.0	0	.0	0	.0	1	.5
TOTAL COLLECTED	0		0		0		42		132		205	
TOTAL ANALYZED	0		0		0		42		131		192	
MEAN LENGTH							19.5		17.7		17.4	
VARIANCE							30.93		29.62		34.66	

NUMBER OF FISH

[a]All gill net collections
[b]No collections scheduled

LENGTH FREQUENCY FOR YELLOW PERCH[a]

NINE MILE POINT VICINITY - [illegible] - DECEMBER, 1976

LENGTH INTERVAL (CM)	NUMBER OF FISH JUL NO.	PCNT	AUG NO.	PCNT	SEP NO.	PCNT	OCT NO.	PCNT	NOV NO.	PCNT	DEC NO.	PCNT
.1- 1.0	0	.0	0	.0	0	.0	0	.0	0	.0	0	.0
1.1- 2.0	0	.0	0	.0	0	.0	0	.0	0	.0	0	.0
2.1- 3.0	0	.0	0	.0	0	.0	0	.0	0	.0	0	.0
3.1- 4.0	0	.0	0	.0	0	.0	0	.0	0	.0	0	.0
4.1- 5.0	0	.0	0	.0	0	.0	0	.0	0	.0	0	.0
5.1- 6.0	0	.0	0	.0	0	.0	0	.0	0	.0	0	.0
6.1- 7.0	0	.0	0	.0	0	.0	0	.0	0	.0	0	.0
7.1- 8.0	0	.0	0	.0	0	.0	0	.0	0	.0	0	.0
8.1- 9.0	8	2.2	0	.0	0	.0	0	.0	0	.0	0	.0
9.1- 10.0	67	18.3	20	7.1	2	.6	0	.0	0	.0	0	.0
10.1- 11.0	49	13.4	78	27.6	13	4.1	0	.0	0	.0	0	.0
11.1- 12.0	28	7.6	54	19.1	25	8.0	4	1.3	0	.0	0	.0
12.1- 13.0	26	7.1	20	7.1	31	9.9	11	3.7	0	.0	0	.0
13.1- 14.0	47	12.8	21	7.4	44	14.0	13	4.3	3	11.1	1	7.7
14.1- 15.0	27	7.4	22	7.8	38	12.1	62	20.7	7	25.9	1	7.7
15.1- 16.0	20	5.4	14	4.9	36	11.5	60	20.0	3	11.1	2	15.4
16.1- 17.0	18	4.9	8	2.8	20	6.4	25	8.3	5	18.5	1	7.7
17.1- 18.0	17	4.6	9	3.2	29	9.2	27	9.0	2	7.4	2	15.4
18.1- 19.0	13	3.5	6	2.1	24	7.6	22	7.3	0	.0	1	7.7
19.1- 20.0	6	1.6	6	2.1	13	4.1	25	8.3	1	3.7	0	.0
20.1- 21.0	2	.5	2	.7	10	3.2	16	5.3	1	3.7	1	7.7
21.1- 22.0	2	.5	4	1.4	7	2.2	6	2.0	2	7.4	1	7.7
22.1- 23.0	5	1.4	4	1.4	5	1.6	2	.7	0	.0	0	.0
23.1- 24.0	1	.3	1	.4	2	.6	3	1.0	1	3.7	0	.0
24.1- 25.0	3	.8	2	.7	3	1.0	4	1.3	0	.0	0	.0
25.1- 26.0	9	2.5	2	.7	5	1.6	5	1.7	0	.0	1	7.7
26.1- 27.0	9	2.5	5	1.8	1	.3	4	1.3	0	.0	0	.0
27.1- 28.0	3	.8	4	1.4	3	1.0	4	1.3	1	3.7	1	7.7
28.1- 29.0	3	.8	0	.0	2	.6	3	1.0	0	.0	0	.0
29.1- 30.0	2	.5	1	.4	0	.0	3	1.0	1	3.7	1	7.7
30.1- 31.0	1	.3	0	.0	0	.0	1	.3	0	.0	0	.0
31.1- 32.0	1	.3	0	.0	1	.3	0	.0	0	.0	0	.0
32.1- 33.0	0	.0	0	.0	0	.0	0	.0	0	.0	0	.0
TOTAL COLLECTED	397		301		352		317		27		14	
TOTAL ANALYZED	367		283		314		300		27		13	
MEAN LENGTH	14.2		13.6		15.9		17.3		17.5		19.4	
VARIANCE	24.75		18.12		14.69		13.97		17.28		26.53	

[a]All gill net collections

recruitment of young-of-the-year occurred. From July to December, growth of the young-of-the-year is evident and these fish dominate the length frequency data, with the fish reaching a median size of 14.1-15.0 cm by November.

d. <u>White Perch</u> (<u>Morone americana</u>)

(i) Abundance and Percent Composition

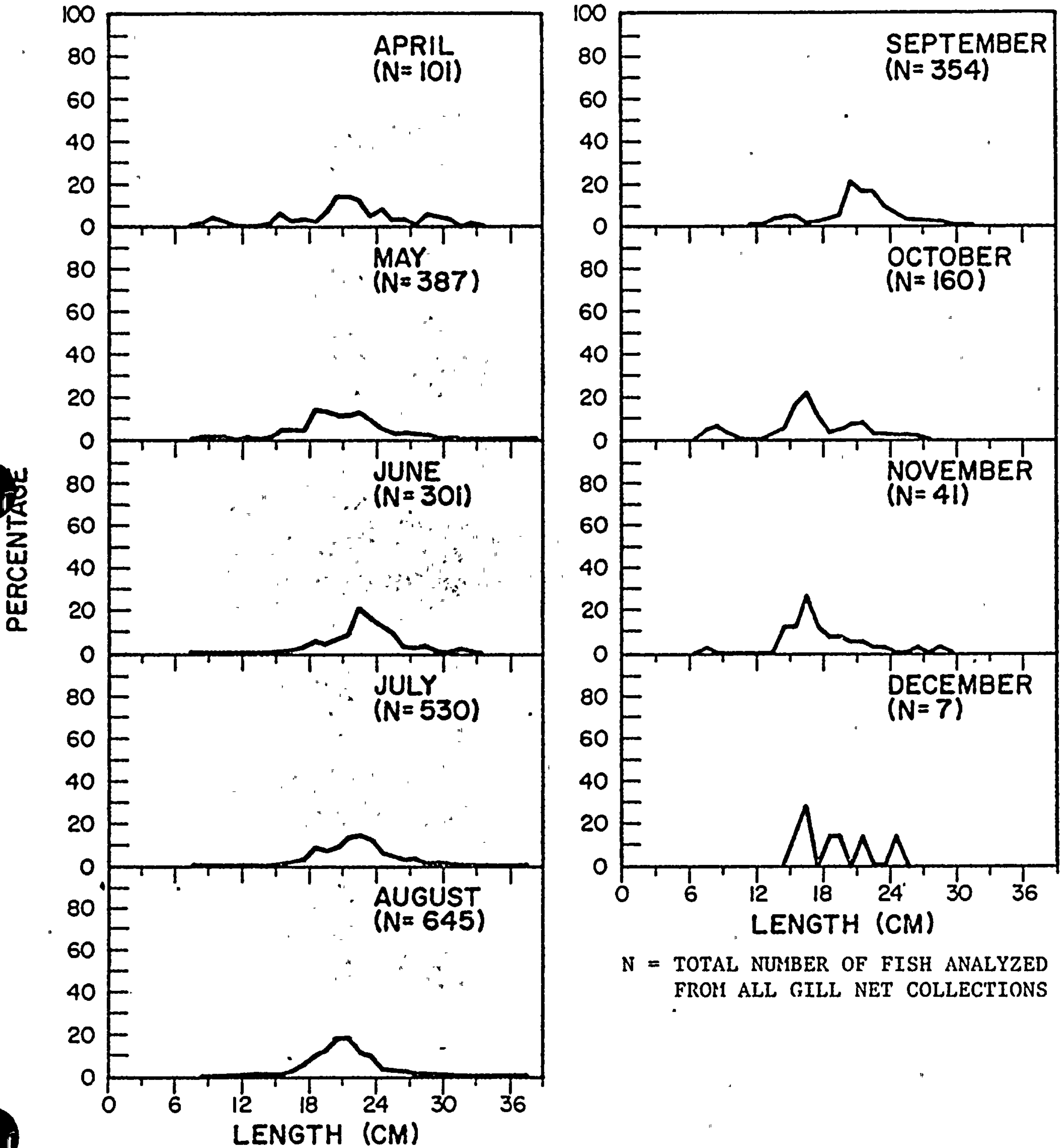
During 1974, 1975, and 1976, the majority of white perch were collected with bottom gill nets. For this reason, the bottom gill net collections offer the most reliable method for monitoring white perch abundance.

The mean annual white perch catch/12-hour effort was 3.01, 3.32, and 2.52 fish from 1974 through 1976, respectively. The percent composition of white perch during the three-year study period remained relatively constant with 3.2% in 1974, 4.8% in 1975, and 3.7% in 1976 (Tables IVG-1 through IVG-3).

(ii) Length Frequency Distribution

Monthly length frequency distributions for white perch collected in the vicinity of Nine Mile Point during 1976 are presented in Figure IVG-8. From April to September, larger (older) fish dominated the collections, with yearling fish representing a minority of the catch. In October, under yearlings became the dominant age group in the gill net collections, coinciding with the recruitment of young-of-the-year fish to the gear.

LENGTH FREQUENCY DISTRIBUTION
FOR WHITE PERCH
NINE MILE POINT VICINITY — APRIL-DECEMBER, 1976



N = TOTAL NUMBER OF FISH ANALYZED FROM ALL GILL NET COLLECTIONS

e. Smallmouth Bass (*Micropterus dolomieui*)

(i) Abundance and Percent Composition

Bottom gill net collections at Nine Mile Point have collected a relatively large number of smallmouth bass and these collections are used to characterize the resident population.

The average catch/12-hour bottom gill net effort was 0.27 (261 fish) in 1974, 0.37 (413 fish) in 1975, and 0.19 (169 fish) in 1976 (Tables IVG-1 through IVG-3). The annual average catch/effort for similar collection sites and fishing durations also show that the 1975 catch was higher than the 1976 catch (Table IVG-4).

The percent composition of smallmouth bass collected with all gear types was 0.28% in 1974, 0.57% in 1975, and 0.21% in 1976.

(ii) Length Frequency Distribution

Length frequency data for smallmouth bass collected with gill nets during 1976 are presented in Table IVG-6. During April, May, and June, the majority of smallmouth bass were between 34 and 41 cm in length. The median for April was 38.1-39.0 cm, which represents fish most probably from 7 to 9 years old. In July, August, and September, smaller fish were present in the collections, representing fish of age class I. Recruitment of young-of-the-year fish was not evident during 1976.

TABLE IVG-6

LENGTH-FREQUENCY OF SMALLMOUTH BASS[a]

NINE MILE POINT VICINITY - APRIL - JUNE, 1976

LENGTH INTERVAL (CM)	NUMBER OF FISH JAN[b] NO.	PCNT	FEB[b] NO.	PCNT	MAR[b] NO.	PCNT	APR NO.	PCNT	MAY NO.	PCNT	JUN NO.	PCNT
.1- 1.0	0	.0	0	.0	0	.0	0	.0	0	.0	0	.0
1.1- 2.0	0	.0	0	.0	0	.0	0	.0	0	.0	0	.0
2.1- 3.0	0	.0	0	.0	0	.0	0	.0	0	.0	0	.0
3.1- 4.0	0	.0	0	.0	0	.0	0	.0	0	.0	0	.0
4.1- 5.0	0	.0	0	.0	0	.0	0	.0	0	.0	0	.0
5.1- 6.0	0	.0	0	.0	0	.0	0	.0	0	.0	0	.0
6.1- 7.0	0	.0	0	.0	0	.0	0	.0	0	.0	0	.0
7.1- 8.0	0	.0	0	.0	0	.0	0	.0	0	.0	0	.0
8.1- 9.0	0	.0	0	.0	0	.0	0	.0	0	.0	0	.0
9.1- 10.0	0	.0	0	.0	0	.0	0	.0	0	.0	0	.0
10.1- 11.0	0	.0	0	.0	0	.0	0	.0	0	.0	0	.0
11.1- 12.0	0	.0	0	.0	0	.0	0	.0	0	.0	0	.0
12.1- 13.0	0	.0	0	.0	0	.0	0	.0	0	.0	0	.0
13.1- 14.0	0	.0	0	.0	0	.0	0	.0	0	.0	0	.0
14.1- 15.0	0	.0	0	.0	0	.0	0	.0	0	.0	0	.0
15.1- 16.0	0	.0	0	.0	0	.0	0	.0	0	.0	0	.0
16.1- 17.0	0	.0	0	.0	0	.0	0	.0	0	.0	0	.0
17.1- 18.0	0	.0	0	.0	0	.0	0	.0	0	.0	0	.0
18.1- 19.0	0	.0	0	.0	0	.0	0	.0	0	.0	0	.0
19.1- 20.0	0	.0	0	.0	0	.0	0	.0	0	.0	0	.0
20.1- 21.0	0	.0	0	.0	0	.0	0	.0	0	.0	0	.0
21.1- 22.0	0	.0	0	.0	0	.0	0	.0	0	.0	0	.0
22.1- 23.0	0	.0	0	.0	0	.0	0	.0	0	.0	0	.0
23.1- 24.0	0	.0	0	.0	0	.0	0	.0	0	.0	0	.0
24.1- 25.0	0	.0	0	.0	0	.0	0	.0	0	.0	0	.0
25.1- 26.0	0	.0	0	.0	0	.0	0	.0	0	.0	0	.0
26.1- 27.0	0	.0	0	.0	0	.0	0	.0	0	.0	0	.0
27.1- 28.0	0	.0	0	.0	0	.0	0	.0	0	.0	0	.0
28.1- 29.0	0	.0	0	.0	0	.0	0	.0	0	.0	0	.0
29.1- 30.0	0	.0	0	.0	0	.0	0	.0	0	.0	0	.0
30.1- 31.0	0	.0	0	.0	0	.0	0	.0	0	.0	0	.0
31.1- 32.0	0	.0	0	.0	0	.0	0	.0	0	.0	1	16.7
32.1- 33.0	0	.0	0	.0	0	.0	1	3.1	1	6.7	0	.0
33.1- 34.0	0	.0	0	.0	0	.0	1	3.1	0	.0	0	.0
34.1- 35.0	0	.0	0	.0	0	.0	0	.0	2	13.3	0	.0
35.1- 36.0	0	.0	0	.0	0	.0	3	9.4	1	6.7	0	.0
36.1- 37.0	0	.0	0	.0	0	.0	2	6.3	1	6.7	2	33.3
37.1- 38.0	0	.0	0	.0	0	.0	4	12.5	3	20.0	1	16.7
38.1- 39.0	0	.0	0	.0	0	.0	10	31.3	3	20.0	0	.0
39.1- 40.0	0	.0	0	.0	0	.0	7	21.9	2	13.3	1	16.7
40.1- 41.0	0	.0	0	.0	0	.0	4	12.5	2	13.3	0	.0
41.1- 42.0	0	.0	0	.0	0	.0	0	.0	0	.0	1	16.7
42.1- 43.0	0	.0	0	.0	0	.0	0	.0	0	.0	0	.0
43.1- 44.0	0	.0	0	.0	0	.0	0	.0	0	.0	0	.0
44.1- 45.0	0	.0	0	.0	0	.0	0	.0	0	.0	0	.0
TOTAL COLLECTED	0		0		0		32		15		6	
TOTAL ANALYZED	0		0		0		32		15		6	
MEAN LENGTH							38.2		37.4		37.1	
VARIANCE							3.92		5.57		12.59	

[a]All gill net collections
[b]No collections scheduled

TABLE IVG-6 (Continued)

LENGTH-FREQUENCY OF SMALLMOUTH BASS[a]

NINE MILE POINT VICINITY - JULY - DECEMBER, 1976

LENGTH INTERVAL (CM)	NUMBER OF FISH											
	JUL		AUG		SEP		OCT		NOV		DEC	
	NO.	PCNT	NO.	PCNT	NO.	PCNT	NO.	PCNT	NO.	PCNT	NO.	PCNT
.1- 1.0	0	.0	0	.0	0	.0	0	.0	0	.0	0	.0
1.1- 2.0	0	.0	0	.0	0	.0	0	.0	0	.0	0	.0
2.1- 3.0	0	.0	0	.0	0	.0	0	.0	0	.0	0	.0
3.1- 4.0	0	.0	0	.0	0	.0	0	.0	0	.0	0	.0
4.1- 5.0	0	.0	0	.0	0	.0	0	.0	0	.0	0	.0
5.1- 6.0	0	.0	0	.0	0	.0	0	.0	0	.0	0	.0
6.1- 7.0	0	.0	0	.0	0	.0	0	.0	0	.0	0	.0
7.1- 8.0	0	.0	0	.0	0	.0	0	.0	0	.0	0	.0
8.1- 9.0	0	.0	0	.0	0	.0	0	.0	0	.0	0	.0
9.1- 10.0	0	.0	0	.0	0	.0	0	.0	0	.0	0	.0
10.1- 11.0	0	.0	0	.0	0	.0	0	.0	0	.0	0	.0
11.1- 12.0	0	.0	0	.0	0	.0	0	.0	0	.0	0	.0
12.1- 13.0	0	.0	0	.0	0	.0	0	.0	0	.0	0	.0
13.1- 14.0	2	11.1	1	4.0	0	.0	0	.0	0	.0	0	.0
14.1- 15.0	0	.0	0	.0	1	2.0	0	.0	0	.0	0	.0
15.1- 16.0	0	.0	0	.0	1	2.0	0	.0	0	.0	0	.0
16.1- 17.0	0	.0	0	.0	0	.0	0	.0	0	.0	0	.0
17.1- 18.0	0	.0	0	.0	0	.0	0	.0	0	.0	0	.0
18.1- 19.0	0	.0	0	.0	0	.0	1	5.9	0	.0	0	.0
19.1- 20.0	0	.0	0	.0	0	.0	0	.0	0	.0	0	.0
20.1- 21.0	0	.0	0	.0	0	.0	0	.0	0	.0	0	.0
21.1- 22.0	0	.0	0	.0	0	.0	0	.0	0	.0	0	.0
22.1- 23.0	0	.0	0	.0	0	.0	0	.0	0	.0	0	.0
23.1- 24.0	0	.0	0	.0	0	.0	0	.0	0	.0	0	.0
24.1- 25.0	0	.0	0	.0	0	.0	0	.0	0	.0	0	.0
25.1- 26.0	3	16.7	2	8.0	4	8.2	2	11.8	0	.0	0	.0
26.1- 27.0	1	5.6	0	.0	1	2.0	0	.0	0	.0	0	.0
27.1- 28.0	0	.0	0	.0	3	6.1	1	5.9	0	.0	0	.0
28.1- 29.0	0	.0	0	.0	1	2.0	0	.0	0	.0	0	.0
29.1- 30.0	0	.0	1	4.0	0	.0	1	5.9	1	20.0	0	.0
30.1- 31.0	0	.0	0	.0	0	.0	0	.0	1	20.0	0	.0
31.1- 32.0	0	.0	0	.0	3	6.1	1	5.9	0	.0	0	.0
32.1- 33.0	0	.0	0	.0	0	.0	1	5.9	0	.0	0	.0
33.1- 34.0	2	11.1	1	4.0	2	4.1	0	.0	0	.0	0	.0
34.1- 35.0	0	.0	1	4.0	2	4.1	1	5.9	0	.0	1	100.0
35.1- 36.0	2	11.1	1	4.0	6	12.2	0	.0	0	.0	0	.0
36.1- 37.0	0	.0	1	4.0	3	6.1	2	11.8	0	.0	0	.0
37.1- 38.0	0	.0	7	28.0	3	6.1	0	.0	0	.0	0	.0
38.1- 39.0	4	22.2	4	16.0	7	14.3	1	5.9	0	.0	0	.0
39.1- 40.0	2	11.1	4	16.0	3	6.1	4	23.5	2	40.0	0	.0
40.1- 41.0	0	.0	0	.0	5	10.2	2	11.8	1	20.0	0	.0
41.1- 42.0	0	.0	0	.0	2	4.1	0	.0	0	.0	0	.0
42.1- 43.0	2	11.1	0	.0	1	2.0	0	.0	0	.0	0	.0
43.1- 44.0	0	.0	1	4.0	0	.0	0	.0	0	.0	0	.0
44.1- 45.0	0	.0	1	4.0	1	2.0	0	.0	0	.0	0	.0
TOTAL COLLECTED	19		25		49		17		5		1	
TOTAL ANALYZED	18		25		49		17		5		1	
MEAN LENGTH	32.6		35.9		34.6[illegible]		33.8		35.9		34.9	
VARIANCE	89.41		40.58		41.[illegible]		43.40		31.60			

[a]All gill net collections

f. <u>Threespine Stickleback</u> (*Gasterosteus aculeatus*)

(i) Abundance and Percent Composition

Threespine sticklebacks were difficult to collect with either gill nets or trawls as evidenced by the low catches from 1974 through 1976 (Tables IVG-1 through IVG-3). Seines, however, suggest an increase in the numbers collected, from 6 in 1974 to 65 in 1975 and 446 in 1976. However, most of those collected in 1976 were collected in only 4 of the 28 seine hauls and the data are too variable to permit any definite statements.

An alternative monitor of the population is the impingement collections of fish at Nine Mile Point throughout this time period. The number of threespine sticklebacks impinged per month was plotted and revealed a trend similar to that observed with beach seines, i.e., an increase in abundance of fish over the past four years (Figure IVG-9). The trend in percent composition of threespine sticklebacks agrees with the beach seine and impingement abundance trends, with sticklebacks representing 0.03% of the total catch in 1974, 0.20% in 1975, and 0.80% in 1976. These data suggest that the threespine stickleback population has increased in the vicinity of Nine Mile Point since Fitz-Patrick start up occurred in 1975 indicating that plant operation has not adversely affected the threespine population.

(ii) Length Frequency Distribution

Length frequency data for threespine stickleback collected in the lake were not tabulated due to the low numbers collected.

ABUNDANCE OF THREESPINE STICKLEBACK
IN IMPINGEMENT COLLECTIONS
NINE MILE POINT VICINITY—1973-1977.

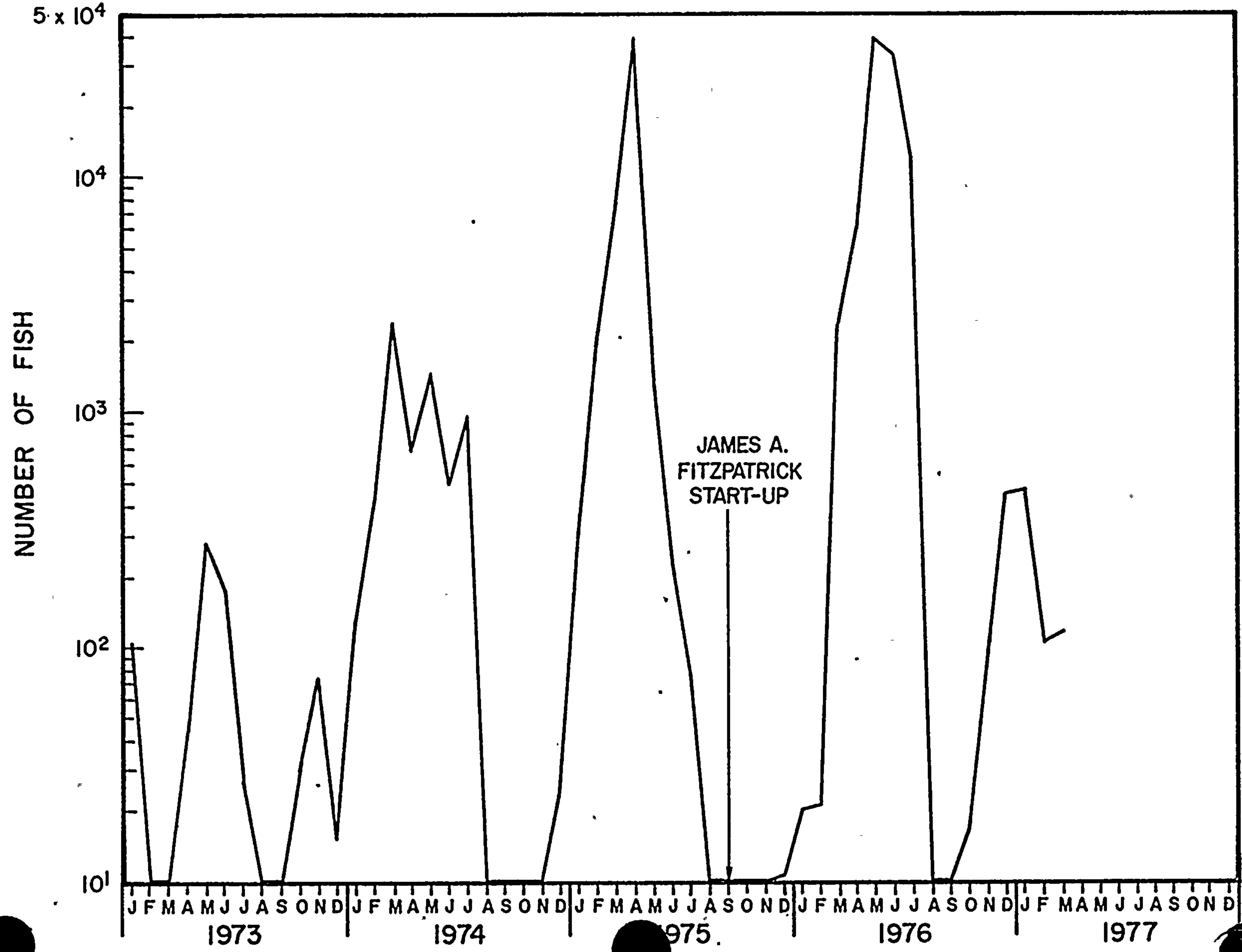


FIGURE ·IVG-9

g. Brown Trout (Salmo trutta)

The annual average catch/effort for bottom gill nets during 1974 was 0.02 fish/12-hour effort, 0.06 fish in 1975, and 0.11 fish in 1976, a fivefold increase since 1974. The numbers of brown trout stocked by the NYSDEC increased from 60,300 in 1973, to 123,400 in 1974, 214,604 in 1975, and 310,750 in 1976, also equaling a fivefold increase (Schneider 1977; Jolliff and Bouton 1977). Thus the increased numbers of brown trout netted mirrors the increased stocking effort.

h. Coho Salmon (Oncorhynchus kisutch)

Bottom gill net data indicate a slight increase in the catch of coho salmon from 0.01 fish/12-hour effort in 1974 to 0.02 in both 1975 and 1976. The NYSDEC stocked approximately 813,000 coho in 1975 and only 177,575 in 1976 (Jolliff and Bouton 1977).

2. Estimated Impingement at James A. FitzPatrick Nuclear Power Plant

a. Species Inventory

Impingement sampling at the JAF traveling screens from September 1975 to March 1977 has resulted in the collection of 50 species representing 19 families of fish (Table IVG-7). The Cyprinidae was the most frequently represented family with 13 species, followed by the Salmonidae with seven species, one of which was the hybrid splake. No rare or endangered fish were collected during the 19 months of impingement monitoring at the Fitz-Patrick plant.

TABLE IVG-7

SPECIES INVENTORY OF FISHES IN IMPINGEMENT COLLECTIONS[a]

JAMES A. FITZPATRICK NUCLEAR POWER PLANT - SEPTEMBER 1975-MARCH 1977

SCIENTIFIC NAME[b]	COMMON NAME
Family Petromyzontidae	
Petromyzon marinus	Sea lamprey
Family Lepisosteidae	
Lepisosteus osseus	Longnose gar
Family Amiidae	
Amia calva	Bowfin
Family Anguillidae	
Anguilla rostrata	American eel
Family Clupeidae	
Alosa pseudoharengus	Alewife
Dorosoma cepedianum	Gizzard shad
Family Salmonidae	
Coregonus artedii	Cisco or Lake herring
Oncorhynchus sp.	
Oncorhynchus kisutch	Coho salmon
O. tshawytscha	Chinook salmon
Salmo gairdnerii	Rainbow trout
S. trutta	Brown trout
Salvelinus sp.	
Salvelinus namaycush	Lake trout
S. namaycush x *fontinalis*	Splake trout
Family Osmeridae	
Osmerus mordax	Rainbow smelt
Family Umbridae	
Umbra limi	Central madminnow
Family Esocidae	
Esox americanus americanus	Redfin pickerel
E. lucius	Northern pike
Family Cyprinidae	
Carassius auratus	Goldfish
Couesius plumbeus	Lake chub
Cyprinus carpio	Carp
Hybognathus nuchalis	Silvery minnow
Notemigonus crysoleucas	Golden shiner
Notropis atherinoides	Emerald shiner

TABLE IVG-7 (Continued)

SPECIES INVENTORY OF FISHES IN IMPINGEMENT COLLECTIONS[a]

SCIENTIFIC NAME [b]	COMMON NAME
Family Cyprinidae (continued)	
N. emiliae	Pugnose minnow
N. hudsonius	Spottail shiner
Pimephales notatus	Bluntnose minnow
P. promelas	Fathead minnow
Rhinichthys cataractae	Longnose dace
Semotilus sp.	
Semotilus atromaculatus	Creek chub
S. margarita	Pearl dace
Family Catostomidae	
Catostomus commersoni	White sucker
Hypentelium nigricans	Northern hog sucker
Family Ictaluridae	
Ictalurus nebulosus	Brown bullhead
I. punctatus	Channel catfish
Noturus flavus	Stonecat
N. gyrinus	Tadpole madtom
Family Percopsidae	
Percopsis omiscomaycus	Trout-perch
Family Gadidae	
Lota lota	Burbot
Family Cyprinodontidae	
Fundulus diaphanus	Banded killifish
Family Gasterosteidae	
Culaea inconstans	Brook stickleback
Gasterosteus aculeatus	Threespine stickleback
Family Percichthyidae	
Morone americana	White perch
M. chrysops	White bass
Family Centrarchidae	
Ambloplites rupestris	Rock bass
Lepomis gibbosus	Pumpkinseed
L. macrochirus	Bluegill
Micropterus dolomieui	Smallmouth bass
M. salmoides	Largemouth bass
Pomoxis annularis	White crappie
P. nigromaculatus	Black crappie

TABLE IVG-7 (Continued)

SPECIES INVENTORY OF FISHES IN IMPINGEMENT COLLECTIONS[a]

SCIENTIFIC NAME[b]	COMMON NAME
Family Percidae	
Etheostoma nigrum	Johnny darter
Perca flavescens	Yellow perch
Percina caprodes	Logperch
Stizostedion vitreum vitreum	Walleye
Family Sciaenidae	
Aplodinotus grunniens	Freshwater drum
Family Cottidae	
Cottus bairdi	Mottled sculpin

[a]Traveling screen (LMS 1977, Table IX-5)

[b]According to A List of Common and Scientific Names of Fishes from the United States and Canada. Amer. Fish. Soc. Spec. Publ. No. 6. 3rd ed.

b. Abundance of Fish in Impingement Collections

Collections of impinged fish from the traveling screens and trash racks in the intake forebay of the FitzPatrick plant have been made three times per week since 10 September 1975. Impingement results reported in this section represent sampling conducted from September 1975 to March 1977, a total of 19 months. During the 19 months of this study, a total of 2,553,713 fish were collected from the traveling screens at the FitzPatrick plant (Table IVG-8).

From September 1975 through January 1976, the alewife was the most abundant fish collected (26,425 fish); the rainbow smelt was the second most frequently collected fish during these months (5453 fish), except for December when the gizzard shad ranked second (2577 fish)(Table IVG-8). During February, 1976 the gizzard shad was the most frequently collected fish and in March 1976 the rainbow smelt ranked first. The high impingement of rainbow smelt during March coincides with the time of their onshore migration (Wells 1968). From April to November 1976, the alewife was again the most frequently collected fish. Peak alewife impingement occurred during May when 1,634,284 were collected and April with 382,944 fish; April and May are the months when alewife onshore migration reaches its peak (Smith 1968; Richkus 1974).

Rainbow smelt dominated the impingement collections during December 1976, and January and February 1977 (Table IVG-8). . In March 1977, alewives again became dominant. Thus, impingement collections at the FitzPatrick plant can be characterized as mirroring the onshore migration of the alewife from April until late in the year when this species moves to deeper waters, and

TABLE IVG-8

ABUNDANCE AND PERCENT COMPOSITION OF FISH IN IMPINGEMENT COLLECTIONS

JAMES A. FITZPATRICK NUCLEAR POWER PLANT - 10 SEPTEMBER - DECEMBER 1975[a]

	SEP		OCT		NOV		DEC		TOTAL	
SPECIES	NO.	%	NO.	%	NO.	%	NO.	%	NO.	%
Alewife	2567	92.6	6541	69.5	6874	77.5	7594	60.6	23576	70.2
American eel	1	<0.1	4	<0.1	1	<0.1			6	<0.1
Black crappie			6	0.1	3	<0.1			9	<0.1
Bluegill sunfish	7	0.3	458	4.9	74	0.8	37	0.3	576	1.7
Bowfin			1	<0.1	1	<0.1			2	<0.1
Brown bullhead	3	0.1	1	<0.1	1	<0.1	6	<0.1	11	<0.1
Brown trout	1	<0.1							1	<0.1
Carp			1	<0.1					1	<0.1
Channel catfish			1	<0.1			4	<0.1	5	<0.1
Creek chub					1	<0.1			1	<0.1
Emerald shiner			5	0.1	3	<0.1	4	<0.1	12	<0.1
Freshwater drum			3	<0.1	3	<0.1	1	<0.1	7	<0.1
Gizzard shad	2	0.1	293	3.1	545	6.1	2577	20.6	3417	10.2
Johnny darter	4	0.1	42	0.4	25	0.3	5	<0.1	76	0.2
Lake chub							2	<0.1	2	<0.1
Lake trout			2	<0.1	2	<0.1	4	<0.1	8	<0.1
Largemouth bass			4	<0.1					4	<0.1
Longnose dace			3	<0.1			2	<0.1	5	<0.1
Mottled sculpin	15	0.5	80	0.8	169	1.9	91	0.7	355	1.1
Mudminnow			5	0.1	6	0.1	3	<0.1	14	<0.1
Pumpkinseed			8	0.1	2	<0.1	2	<0.1	12	<0.1
Rainbow smelt	89	3.2	1635	17.4	858	9.7	1834	14.6	4416	13.2
Rock bass	5	0.2	16	0.2	7	0.1	29	0.2	57	0.2
Sea lamprey			1	<0.1	1	<0.1			2	<0.1
Smallmouth bass	3	0.1	6	0.1	12	0.1	5	<0.1	26	0.1
Splake (hybrid Lake trout)					1	<0.1	1	<0.1	2	<0.1
Spottail shiner	50	1.8	158	1.7	125	1.4	92	0.7	425	1.3
Stonecat	7	0.3	45	0.5	27	0.3	6	<0.1	85	0.3
Threespine stickleback			1	<0.1	27	0.3	20	0.2	48	0.1
Trout-perch	4	0.1	6	0.1	8	0.1	14	0.1	32	0.1
Walleye							1	<0.1	1	<0.1
White bass					16	0.2	110	0.9	126	0.4
White perch	1	<0.1	46	0.5	43	0.5	46	0.4	136	0.4
White sucker	3	0.1	4	<0.1	3	<0.1	2	<0.1	12	<0.1
Yellow perch	10	0.4	41	0.4	26	0.3	39	0.3	116	0.3
TOTAL	2773	-	9417	-	8864	-	12531	-	33584	-
NO. HRS. SAMPLED	216		336		288		239			
AVG. NO. FISH/HR	12.8		25.1		30.8		52.4			

[a]Traveling screen collections

TABLE IVG-8(Continued)

ABUNDANCE* AND PERCENT COMPOSITION OF FISH IN IMPINGEMENT COLLECTIONS

JAMES A. FITZPATRICK NUCLEAR POWER PLANT - JANUARY - JUNE, 1976[b]

SPECIES	JAN NO.	JAN %	FEB NO.	FEB %	MAR NO.	MAR %	APR NO.	APR %	MAY NO.	MAY %	JUN NO.	JUN %
Alewife	2849	55.62	2	0.37	4743	20.99	382944	92.53	1634284	93.38	112425	85.32
American eel							2	<0.01	22	<0.01	2	<0.01
Black crappie	1	0.02			1	<0.01	1	<0.01	1	<0.01		
Bluegill	1	0.02			1	<0.01	5	<0.01	9	<0.01	1	<0.01
Bluntnose minnow							3	<0.01				
Bowfin												
Brook stickleback					76	0.34	36	0.01	18	<0.01	1	<0.01
Brown bullhead	6	0.12			5	0.02	6	<0.01	1	<0.01		
Brown trout					1	<0.01	1	<0.01			2	<0.01
Burbot												
Carp												
Channel catfish	20	0.39	3	0.56	8	0.04	1	<0.01				
Cisco or Lake herring												
Coho salmon											1	<0.01
Creek chub	2	0.04					2	<0.01				
Cyprinidae							2	<0.01				
Emerald shiner	49	0.96	14	2.60	107	0.47	63	0.02	60	<0.01	7	0.01
Esox sp.												
Fathead minnow					2	0.01	4	<0.01				
Freshwater drum	25	0.49	2	0.37	6	0.03	2	<0.01			1	<0.01
Gizzard shad	356	6.95	189	35.13	4963	21.97	941	0.23	87	<0.01	3	<0.01
Golden shiner	5	0.10	1	0.19	3	0.01	3	<0.01	23	<0.01		
Goldfish	1	0.02			1	<0.01						
Johnny darter	5	0.10	2	0.37	4	0.02	62	0.02	2241	0.13	338	0.27
Lake chub	1	0.02			5	0.02	4	<0.01	18	<0.01	6	<0.01
Lake trout	2	0.04			2	0.01			1	<0.01	1	<0.01
Largemouth bass												
Lepomis sp.											1	<0.01
Logperch							1	<0.01				
Longnose dace	6	0.12	4	0.74	22	0.10	1	<0.01				
Longnose gar	1	0.02										
Mottled sculpin	88	1.72	21	3.90	100	0.44	1072	0.26	1803	0.10	349	0.26
Mudminnow	2	0.04	2	0.37	60	0.27	33	0.01	28	<0.01	3	<0.01
Northern hog sucker												
Northern pike					1	<0.01			1	<0.01		
Pearl dace	1	0.02										
Pimephales sp.									14	<0.01		
Pugnose minnow							4	<0.01				
Pumpkinseed	6	0.12			1	<0.01	9	<0.01	36	<0.01	3	<0.01
Rainbow smelt	1047	20.44	179	33.27	9090	40.23	20417	4.93	78033	4.46	1772	1.34
Rainbow trout												
Rock bass	52	1.02	9	1.67	49	0.22	41	0.01	100	0.01	7	0.01
Salmonidae							1	<0.01	5	<0.01	1	<0.01
Salvelinus sp.									7	<0.01	6	<0.01
Sea lamprey	2	0.04			1	<0.01	6	<0.01	1	<0.01		
Silvery minnow					1	<0.01						
Smallmouth bass	92	1.80	5	0.93	18	0.08	11	<0.01	65	<0.01	5	<0.01
Splake (hybrid lake trout)							3	<0.01				
Spottail shiner	207	4.04	28	5.20	161	0.71	333	0.08	1586	0.09	1014	0.77
Stonecat	1	0.02			2	0.01	7	<0.01	12	<0.01	7	0.01
Tadpole madtom												
Threespine stickleback	9	0.18	9	1.67	1112	4.92	3763	0.91	24643	1.41	14876	11.29
Trout-perch	3	0.06	1	0.19	37	0.16	1569	0.38	3996	0.23	721	0.55
Walleye	1	0.02					1	<0.01				
White bass	87	1.70	58	10.78	1558	6.90	876	0.21	875	0.05	73	0.06
White fish									1	<0.01		
White perch	109	2.13	7	1.30	407	1.80	1430	0.35	1479	0.08	71	0.05
White sucker	4	0.08			1	<0.01	4	<0.01	25	<0.01	15	0.01
Yellow perch	81	1.58	2	0.37	46	0.20	179	0.04	679	0.04	57	0.04
UID							11	<0.01	8	<0.01		
UID chub												
UID sucker												
TOTAL	5122		538		22595		413854		1750162		131769	

[b]Traveling screen collections ; field counts and identification

TABLE IV.G-8 (Continued)

<u>ABUNDANCE* AND PERCENT COMPOSITION OF FISH IN IMPINGEMENT COLLECTIONS</u> (Continued)

JAMES A. FITZPATRICK NUCLEAR POWER PLANT - JULY - DECEMBER, 1976[b]

SPECIES	JUL		AUG		SEP		OCT		NOV		DEC		TOTAL	
	NO.	%	NO.	%	NO.	%	NO.	%	NO.	%	NO.	%	NO.	%
Alewife	58477	86.96	1438	66.64	2032	71.88	1681	49.12	68070*	77.42	1329	8.11	2270274	90.67
American eel	6	0.01	4	0.19	8	0.28	4	0.12	2	<0.01	1	<0.01	51	<0.01
Black crappie					1	0.04			1	<0.01	1	<0.01	6	<0.01
Bluegill					1	0.04	3	0.09	1	<0.01			22	<0.01
Bluntnose minnow													3	<0.01
Bowfin					1	0.04	1	0.03	3	<0.01			5	<0.01
Brook stickleback													131	<0.01
Brown bullhead			2	0.09	5	0.18	38	1.11	22	0.02	17	0.10	102	<0.01
Brown trout			1	0.05			1	0.03			2	0.01	8	<0.01
Burbot	1	<0.01	2	0.09			2	0.06			10	0.06	15	<0.01
Carp									3	<0.01	1	<0.01	4	<0.01
Channel catfish									23	0.03	3	0.02	58	<0.01
Cisco or Lake herring											1	<0.01	1	<0.01
Coho salmon	1	<0.01											2	<0.01
Creek chub													4	<0.01
Cyprinidae									1	<0.01			3	<0.01
Emerald shiner	1	<0.01	5	0.23	4	0.14	47	1.37	5	0.01	90	0.55	452	0.02
<u>Esox</u> sp.	3	<0.01											3	<0.01
Fathead minnow													6	<0.01
Freshwater drum									2	<0.01	1	<0.01	39	<0.01
Gizzard shad	2	<0.01	2	0.09	1	0.04	247	7.22	580	0.66	392	2.39	7763	0.31
Golden shiner			1	0.05	1	0.04	1	0.03	1	<0.01	1	<0.01	40	<0.01
Goldfish											1	<0.01	3	<0.01
Johnny darter	664	0.99	119	5.51	100	3.54	9	0.26	2	<0.01	6	0.04	3552	0.14
Lake chub	7	0.01	5	0.23	2	0.07	1	0.03	1	<0.01			50	<0.01
Lake trout							1	0.03	1	<0.01			8	<0.01
Largemouth bass					1	0.04							1	<0.01
<u>Lepomis</u> sp.	4	0.01											5	<0.01
Logperch	1	<0.01											2	<0.01
Longnose dace	2	<0.01									1	<0.01	36	<0.01
Longnose gar													1	<0.01
Mottled sculpin	154	0.23	30	1.39	87	3.08	33	0.96	89	0.10	167	1.02	3993	0.16
Mudminnow	1	<0.01							3	<0.01			132	0.01
Northern hog sucker	1	<0.01	1	0.05									2	<0.01
Northern pike			2	0.09							3	0.02	7	<0.01
Pearl dace													1	<0.01
<u>Pimephales</u> sp.													14	<0.01
Pugnose minnow													4	<0.01
Pumpkinseed	1	<0.01	4	0.19	5	0.18	6	0.18	11	0.01	8	0.05	90	<0.01
Rainbow smelt	226	0.34	170	7.88	82	2.90	1032	30.16	17797	20.24	13394	81.78	143239	5.72
Rainbow trout					1	0.04							1	<0.01
Rock bass	19	0.03	27	1.25	41	1.45	30	0.88	36	0.04	94	0.57	505	0.02
Salmonidae	6	0.01	6	0.23									19	<0.01
<u>Salvelinus</u> sp.	10	0.01	2	0.09					1	<0.01			26	<0.01
Sea lamprey	1	<0.01							1	<0.01	7	0.04	19	<0.01
Silvery minnow													1	<0.01
Smallmouth bass	5	0.01	1	0.05	9	0.32	4	0.12	6	0.01	19	0.12	240	0.01
Splake (hybrid lake trout)			1	0.05					6	0.01	10	0.06	20	<0.01
Spottail shiner	1901	2.83	168	7.73	73	2.58	24	0.70	18	0.02	30	0.18	5543	0.22
Stonecat	15	0.02	2	0.09	5	0.18	9	0.26	3	<0.01	15	0.09	78	<0.01
Tadpole madtom							1	0.03					1	<0.01
Threespine stickleback	5004	7.44	2	0.09			7	0.20	47	0.05	210	1.28	49682	1.98
Trout-perch	489	0.73	36	1.67	7	0.25	6	0.18	4	<0.01	2	0.01	6871	0.27
Walleye													2	<0.01
White bass	10	0.01			1	0.04	13	0.38	928	1.06	276	1.69	4755	0.19
White fish													1	<0.01
White perch	65	0.10	20	0.93	160	5.66	106	3.10	97	0.11	73	0.45	4024	0.16
White sucker	40	0.06	20	0.93	41	1.45	20	0.58	3	<0.01	2	0.01	175	0.01
Yellow perch	105	0.16	84	3.89	158	5.59	95	2.78	160	0.18	212	1.29	1859	0.07
UID	2	<0.01											21	<0.01
UID chub	24	0.04	2	0.09									26	<0.01
UID sucker	1	<0.01	1	0.05									2	<0.01
TOTAL	67249		2158		2827		3422		87928		16378		2504002	

[b]Traveling screen collections; field counts and identification

Revised

TABLE IVG-8 (Continued)

ABUNDANCE AND PERCENT COMPOSITION OF FISH IN IMPINGEMENT COLLECTIONS

JAMES A. FITZPATRICK NUCLEAR POWER PLANT - JANUARY-MARCH, 1977

	JANUARY		FEBRUARY		MARCH		TOTAL	
SPECIES	NO.	%	NO.	%	NO.	%	NO.	%
Alewife	23	0.28	5	0.23	3075	53.07	3103	19.24
American eel	0	0.00	0	0.00	3	0.05	3	0.02
Banded killifish	0	0.00	0	0.00	0	0.00	0	0.00
Black crappie	0	0.00	0	0.00	0	0.00	0	0.00
Bluegill	0	0.00	0	0.00	1	0.02	1	<0.01
Bluntnose minnow	0	0.00	0	0.00	0	0.00	0	0.00
Bowfin	0	0.00	0	0.00	0	0.00	0	0.00
Brook stickleback	0	0.00	0	0.00	106	1.83	106	0.66
Brown bullhead	0	0.00	0	0.00	8	0.14	8	0.04
Brown trout	1	0.01	1	0.05	0	0.00	2	0.01
Burbot	9	0.11	4	0.18	1	0.02	14	0.09
Carp	0	0.00	2	0.09	0	0.00	2	0.04
Central mudminnow (Mudminnow)	0	0.00	0	0.00	23	0.04	23	0.14
Channel catfish	2	0.02	0	0.00	1	0.02	3	0.02
Coho salmon	1	0.01	0	0.00	1	0.02	2	0.01
Chub - UID	0	0.00	0	0.00	0	0.00	0	0.00
Creek chub	0	0.00	0	0.00	2	0.03	2	0.01
Emerald shiner	266	3.25	23	1.06	77	1.33	366	2.27
Fathead minnow	0	0.00	0	0.00	0	0.00	0	0.00
Freshwater drum	0	0.00	0	0.00	0	0.00	0	0.00
Gizzard shad	191	2.33	317	14.59	78	1.35	586	3.63
Golden shiner	2	0.02	0	0.00	6	0.10	8	0.04
Goldfish	1	0.01	2	0.09	2	0.03	5	0.03
Johnny darter	5	0.06	0	0.00	0	0.00	5	0.03
Lake chub	7	0.09	7	0.32	3	0.05	17	0.11
Lake herring	0	0.00	0	0.00	0	0.00	0	0.00
Lake trout	0	0.00	0	0.00	0	0.00	0	0.00
Logperch	0	0.00	0	0.00	0	0.00	0	0.00
Longnose dace	0	0.00	3	0.14	1	0.02	4	0.02
Longnose gar	0	0.00	0	0.00	0	0.00	0	0.00
Minnows and Carps	0	0.00	0	0.00	0	0.00	0	0.00
Mottled sculpin	462	5.64	107	4.93	45	0.78	614	3.81
Northern hog sucker	0	0.00	0	0.00	0	0.00	0	0.00
Northern pike	0	0.00	0	0.00	0	0.00	0	0.00
Oncorhynchus sp. (Salmonidae)	0	0.00	0	0.00	0	0.00	0	0.00
Pearl dace	0	0.00	0	0.00	0	0.00	0	0.00
Pugnose minnow	0	0.00	0	0.00	0	0.00	0	0.00
Pumpkinseed	2	0.02	3	0.14	4	0.07	9	0.06
Rainbow smelt	6032	73.66	987	45.44	1855	32.02	8874	55.00
Rainbow trout	0	0.00	0	0.00	0	0.00	0	0.00
Redfin pickerel	0	0.00	0	0.00	0	0.00	0	0.00
Rock bass	126	1.54	27	1.24	40	0.69	193	1.20
Salvelinus sp. (Salmonidae)	4	0.05	1	0.05	0	0.00	5	0.03
Sea lamprey	4	0.05	3	0.14	0	0.00	7	0.04
Semotilus sp. (Cyprinidae)	0	0.00	0	0.00	0	0.00	0	0.00
Silvery minnow	0	0.00	0	0.00	0	0.00	0	0.00
Smallmouth bass	23	0.28	84	3.87	38	0.66	145	0.90
Splake trout	6	0.07	0	0.00	3	0.05	9	0.06
Spottail shiner	73	0.89	5	0.23	22	0.38	100	0.62
Stonecat	4	0.05	3	0.14	3	0.05	10	0.06
Tadpole madtom	0	0.00	0	0.00	0	0.00	0	0.00
Threespine stickleback	478	5.84	107	4.93	120	2.07	705	4.37
Trout perch	20	0.24	3	0.14	24	0.41	47	0.29
Trouts (Salmonidae)	0	0.00	0	0.00	0	0.00	0	0.00
Unidentified	1	0.01	1	0.05	1	0.02	3	0.02
Walleye	1	0.01	0	0.00	0	0.00	1	<0.01
White bass	241	2.94	43	1.98	23	0.40	307	1.90
White crappie	0	0.00	0	0.00	0	0.00	0	0.00
White perch	86	1.05	398	18.32	174	3.00	658	4.08
White sucker	3	0.04	2	0.09	1	0.02	6	0.04
Yellow perch	104	1.27	24	1.10	53	0.91	181	1.12
Largemouth bass	0	0.00	1	0.05	0	0.00	1	<0.01
Chinook salmon	0	0.00	1	0.05	0	0.00	1	<0.01
TOTAL	8189		2164		5794		16136	

of rainbow smelt from December to March. Occasionally during the winter gizzard shad may dominate monthly collections.

c. Length Frequency and Age Class Distribution of Impinged Fish

Length frequency and age distribution of eight impinged species, including all the representative important species are discussed in this section so that these characteristics may be compared to those fish collected from the lake by LMS and New York State Department of Environmental Conservation (NYSDEC) to determine if impingement is selective of certain age classes or sizes.

(i) Alewife

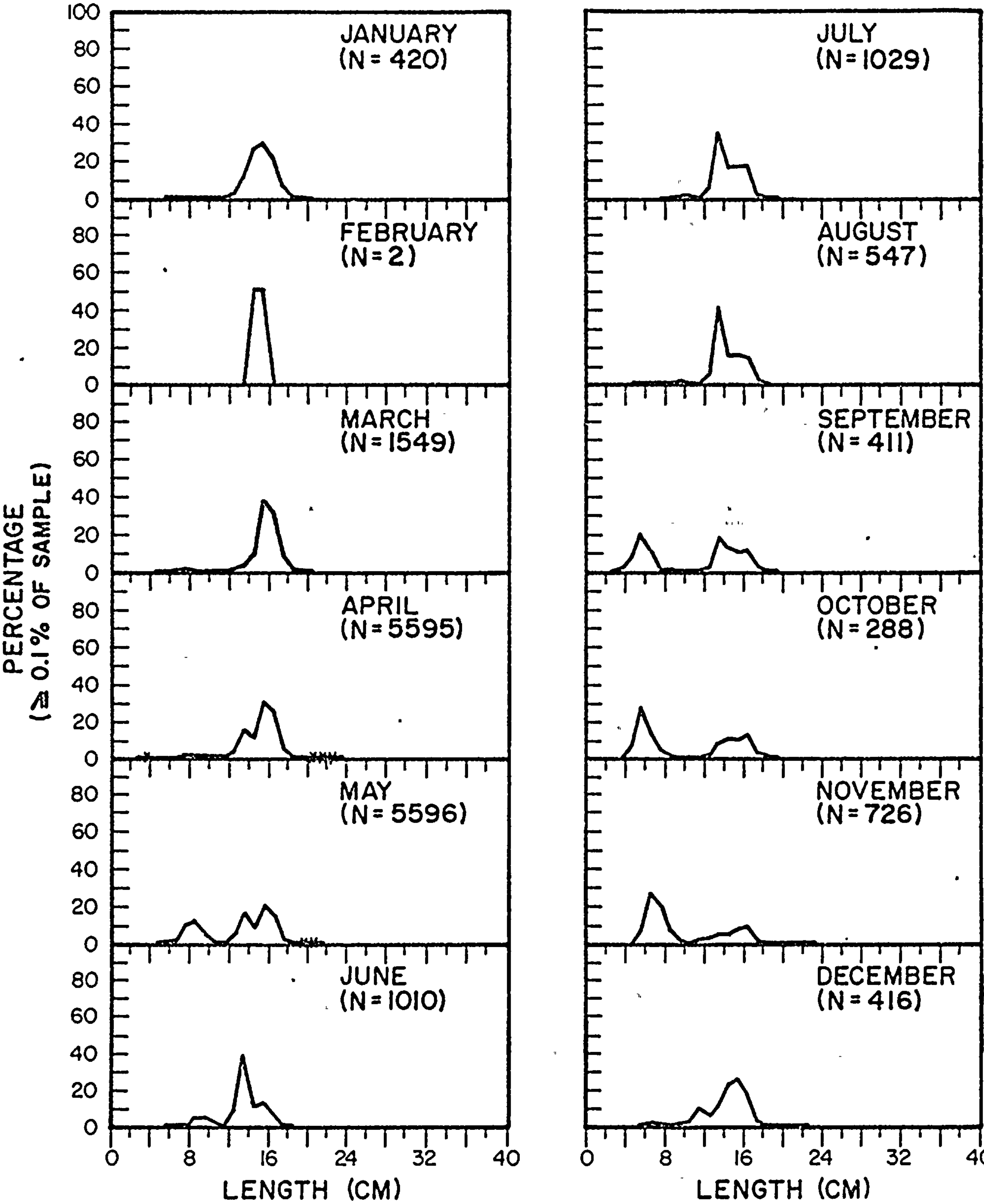
The monthly length frequency distribution for alewife collected from the traveling screens at the FitzPatrick plant during 1976 is presented in Figure IVG-10 and age data in Table IVG-9. From January to March, the length frequency distribution was unimodal; when viewed in relation to age data this suggests that the alewives impinged during January-March were age III or older.

During April, the length frequency distribution was bimodal, indicating the presence of two-year-old fish in addition to three-year-olds and older. A small number of yearlings were also collected from January through April (excluding February). In May, a larger percentage of yearlings were collected than during other months and fish age II or older made up the remainder of the catch.

From April through June, 73 male and 112 female alewives were randomly selected from the FitzPatrick impingement

LENGTH FREQUENCY DISTRIBUTION FOR ALEWIFE

JAMES A. FITZPATRICK NUCLEAR POWER PLANT - 1976



N = TOTAL NUMBER OF FISH ANALYZED FROM TRAVELING SCREEN COLLECTIONS ON SCHEDULED IMPINGEMENT DAYS

x = FISH ANALYZED, BUT REPRESENTING <.1% OF SAMPLE ANALYZED

TABLE IVG-9

AGE CLASS DISTRIBUTION OF ALEWIFE FROM IMPINGEMENT COLLECTIONS

JAMES A. FITZPATRICK NUCLEAR POWER PLANT - 1976

I. WINTER (15 JAN - 31 MAR)

AGE CLASS	MALES[a] (N = 2)			FEMALES[b] (N = 2)		
	% FREQUENCY	TOTAL LENGTH (cm)		% FREQUENCY	TOTAL LENGTH (cm)	
		MEAN	RANGE		MEAN	RANGE
I	0	-	-	0	-	-
II	0	-	-	0	-	-
III	50.0	16.40	-	100.0	15.90	15.2 - 16.6
II	0	-	-	0	-	-
V	50.0	15.40	-	0	-	-

[a]Collected 31 Mar

[b]Collected 15 Jan - 25 Mar

- = Not applicable

II. SPRING (11 APR - 31 JUN)

AGE CLASS	MALES[a] (N = 73)			FEMALES[b] (N = 112)		
	% FREQUENCY	TOTAL LENGTH (cm)		% FREQUENCY	TOTAL LENGTH (cm)	
		MEAN	RANGE		MEAN	RANGE
I	0	-	-	0	-	-
II	6.8	14.76	12.5 - 15.7	1.8	13.65	12.5 - 14.8
III	52.1	14.24	12.5 - 16.4	54.5	14.67	12.8 - 17.9
IV	31.5	15.34	13.7 - 16.5	23.2	16.01	13.6 - 17.4
V	9.6	16.21	15.1 - 16.6	18.7	16.50	15.5 - 17.4
VI	0	-	-	1.8	16.75	16.5 - 17.0

[a]Collected 14 Apr - 16 Jun

[b]Collected 11 Apr - 30 Jun

- = Not applicable

III. SUMMER (7 JUL - 8 SEP)

AGE CLASS	MALES[a] (N = 105)			FEMALES[b] (N = 91)		
	% FREQUENCY	TOTAL LENGTH (cm)		% FREQUENCY	TOTAL LENGTH (cm)	
		MEAN	RANGE		MEAN	RANGE
I	1.0	13.60	-	1.1	10.50	-
II	26.7	14.48	12.6 - 16.7	30.8	14.52	12.9 - 16.4
III	50.5	14.44	12.6 - 16.8	27.5	14.69	13.3 - 17.1
IV	19.0	15.85	13.5 - 17.3	33.0	16.38	13.3 - 17.9
V	1.9	15.45	15.0 - 15.9	6.6	16.12	15.7 - 16.5
VI	1.0	17.70	-	1.1	15.80	-

[a]Collected 7 Jul - 8 Sep

[b]Collected 7 Jul - 18 Aug

- = Not applicable

IV. FALL (29 SEP - 22 DEC)

AGE CLASS	MALES[a] (N = 50)			FEMALES[b] (N = 69)		
	% FREQUENCY	TOTAL LENGTH (cm)		% FREQUENCY	TOTAL LENGTH (cm)	
		MEAN	RANGE		MEAN	RANGE
I	12.0	14.40	13.1 - 15.5	2.9	13.05	12.8 - 13.3
II	40.0	14.74	13.3 - 16.7	37.7	15.36	12.5 - 17.2
III	46.0	15.27	13.7 - 17.3	53.6	15.60	13.5 - 17.3
IV	2.0	16.20	-	5.8	16.45	15.3 - 17.4

[a]Collected 29 Sep - 15 Dec

[b]Collected 29 Sep - 22 Dec

- = Not applicable

catch and analyzed for age. Age III fish accounted for the highest percentages impinged of both sexes, with 52.1% of the males and 54.5% of the females. Male alewife collected with bottom gill nets during the same period showed a slightly different age composition, with age III fish accounting for only about 44% of the male alewife collected from the lake (LMS 1977, Table VII-9).

This difference in age structure between impinged fish and those collected with gill nets during the spring is more pronounced for females than for males. Gillnetted age III females represented only about 27% of the females collected from the lake with 64.5% older than age III fish (LMS 1977, Table VII-9), whereas impingement collections contained 54.5% three-year-old females and only 43.7% older than age III fish. This may be due to either the inability of the gill nets to collect age III females or the selective impingement of younger fish. The Yankee trawl collections contained a high percentage (21%) of yearlings in June (Figures IVG-3 and IVG-4).

During the summer, the age class distribution of impinged fish changed only slightly from that observed during the spring. Female age class distribution showed either fewer older individuals (age III-V) or more younger fish (age II). During the fall, the greatest percentage of male alewife impinged (86%) were age II and III fish, while 91.3% of the females were in these age classes (Table IVG-9). The recruitment of young-of-the-year fish occurred during September, October, and November (Figure IVG-10). Recruitment of young-of-the-year to the Yankee trawl collections also occurred from September to November (Figures IVG-3 and IVG-4).

(ii) Rainbow Smelt

Age class distribution for rainbow smelt collected in impingement during 1976 is presented in Table IVG-10 and length frequency in Figure IVG-11. Yearling rainbow smelt (4-7 cm) dominated the smelt collections from January to June (Figure IVG-11), although the age data suggest older fish were dominant (Table IVG-10). The discrepancy is probably due to the low numbers of fish for which age was calculated.

During the spring, 65.0% of the males collected were three-year-olds while 20.4% were four and 3.8% were five-year-olds. The age class distribution for females during this time was more evenly divided, with age III fish accounting for 43.2%, four-year-olds accounting for 28.4%, age V fish accounting for 21.3%, and age VI and VII accounting for 5.1% (Table IVG-10).

The age class distribution for rainbow smelt in impingement collections differed from the distribution of ages for fish from gill net collections (LMS 1977, Table VII-10). The gillnetted male rainbow smelt were dominated by age class III which represented between 85 and 88% of lake collections (LMS 1977, Table VII-10), whereas age III males accounted for only 65% of impingement collections. Gillnetted female rainbow smelt showed a bimodal age class distribution in collections with 59% age III, 9.4% age IV, and 23.9% age V fish. Gill nets apparently sample older individuals more effectively, whereas impingement age distribution is more heavily dominated by younger fish.

TABLE IVG-10

AGE CLASS DISTRIBUTION OF RAINBOW SMELT FROM IMPINGEMENT COLLECTIONS

JAMES A. FITZPATRICK NUCLEAR POWER PLANT - 1976

I. WINTER (14 JAN - 18 MAR)

AGE CLASS	MALES[a] (N = 5)			FEMALES[b] (N = 3)		
	% FREQUENCY	TOTAL LENGTH (cm)		% FREQUENCY	TOTAL LENGTH (cm)	
		MEAN	RANGE		MEAN	RANGE
I	20.0	12.8	-	0	-	-
II	60.0	14.0	12.3 - 15.3	33.3	13.0	-
III	20.0	15.2	-	33.3	14.3	-
IV	0	-	-	0	-	-
V	0	-	-	33.3	21.8	-

[a]Collected 17-18 Mar
[b]Collected 14 Jan - 10 Mar
- = Not applicable

II. SPRING (22 APR - 30 JUN)

AGE CLASS	MALES[a] (N = 157)			FEMALES[b] (N = 155)		
	% FREQUENCY	TOTAL LENGTH (cm)		% FREQUENCY	TOTAL LENGTH (cm)	
		MEAN	RANGE		MEAN	RANGE
II	10.2	13.65	11.3 - 16.1	1.9	14.73	13.1 - 17.5
III	65.0	14.65	11.1 - 19.8	43.2	15.17	12.5 - 21.3
IV	20.4	15.60	13.2 - 23.6	28.4	17.24	12.9 - 20.6
V	3.8	18.90	17.3 - 20.5	21.3	20.24	15.2 - 26.5
VI	0.6	17.40	-	3.2	20.58	17.3 - 24.5
VII	0	-	-	1.9	21.60	18.4 - 23.9

[a]Collected 22 Apr - 13 May
[b]Collected 22 Apr - 30 Jun
- = Not applicable

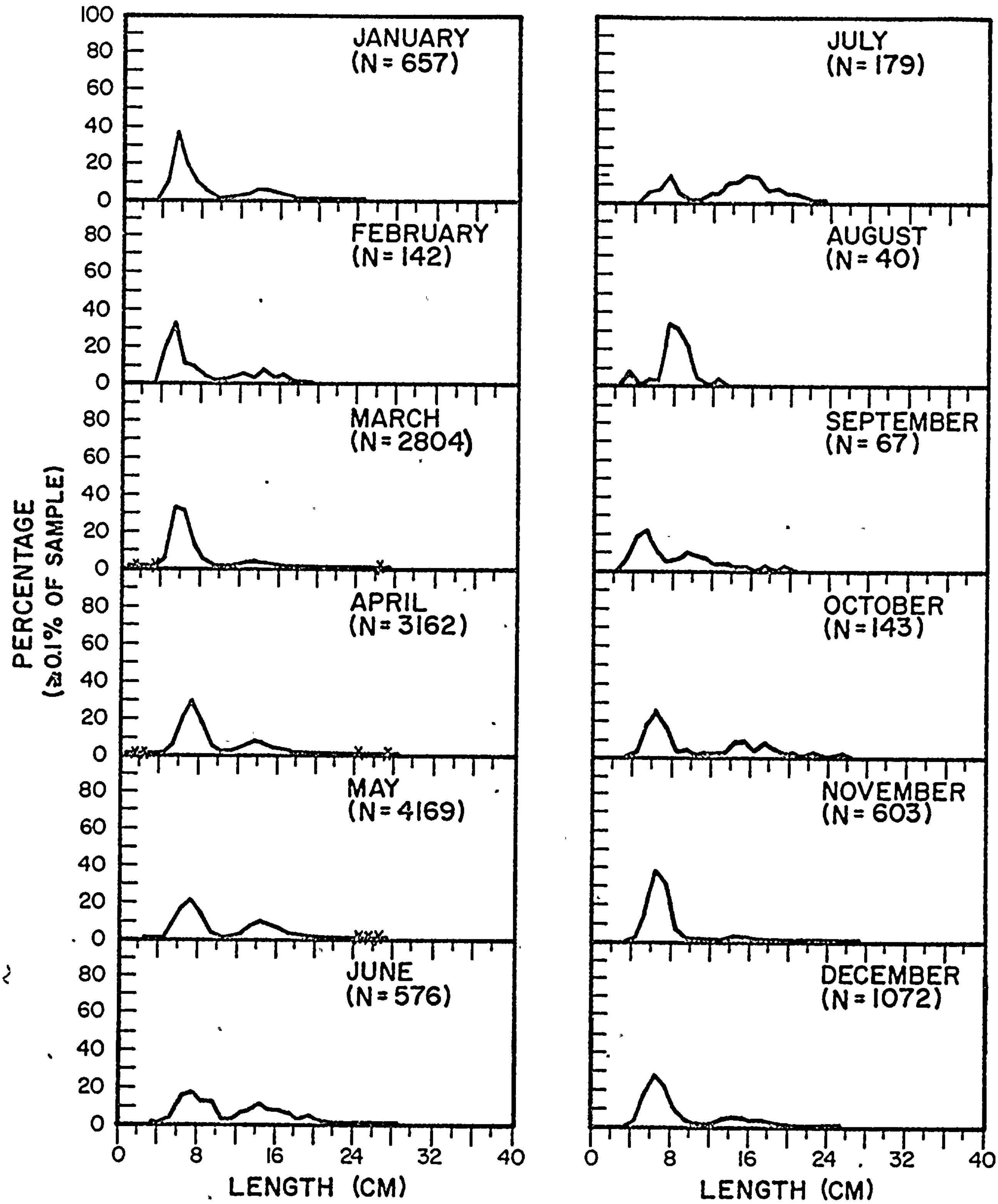
III. FALL (27 OCT - 29 DEC)

AGE CLASS	MALES[a] (N = 26)			FEMALES[b] (N = 42)		
	% FREQUENCY	TOTAL LENGTH (cm)		% FREQUENCY	TOTAL LENGTH (cm)	
		MEAN	RANGE		MEAN	RANGE
I	30.8	15.13	13.7 - 17.0	21.4	14.54	13.1 - 16.0
II	23.1	15.82	14.9 - 17.3	35.7	15.99	14.4 - 17.7
III	34.6	16.71	15.7 - 18.1	31.0	17.62	14.6 - 19.9
IV	11.5	17.43	16.7 - 17.9	11.9	21.36	19.3 - 22.7

[a]Collected 27 Oct - 29 Dec
[b]Collected 27 Oct - 29 Dec

LENGTH FREQUENCY DISTRIBUTION FOR RAINBOW SMELT

JAMES A. FITZPATRICK NUCLEAR POWER PLANT - 1976



N = TOTAL NUMBER OF FISH ANALYZED FROM TRAVELING SCREEN COLLECTIONS ON SCHEDULED IMPINGEMENT DAYS

X = FISH ANALYZED, BUT REPRESENTING <.1% OF SAMPLE ANALYZED

LMS Yankee trawl collections, however, were also dominated by younger fish (Figures IVG-3 and IVG-4) as were impingement collections.

During the fall the percentage of one-year-old rainbow smelt in impingement increased to 30.8% for males and 21.4% for females. The recruitment of young-of-the-year fish to impingement collections occurred in August and they dominated the collections from September to December (Figure IVG-11). Generally the majority of impinged rainbow smelt were young fish, ranging from young-of-the-year to age class II.

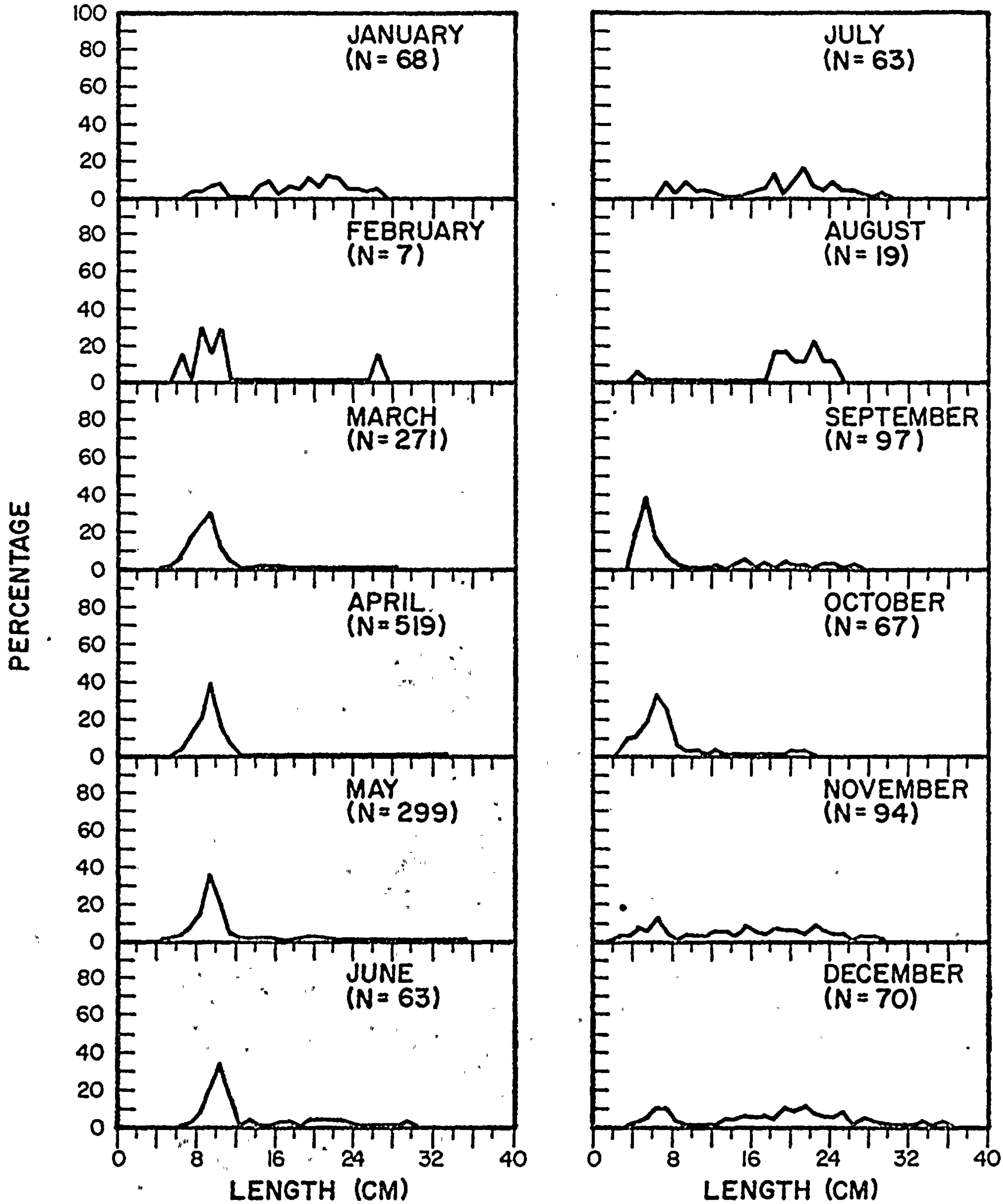
(iii) White Perch

Age was not calculated for white perch collected from the traveling screens at FitzPatrick; however, a length frequency distribution by month was constructed (Figure IVG-12). During January, the impingement collections contained fish in a range of sizes representing various ages. From February through June, yearling white perch dominated the impingement catch, while recruitment of young-of-the-year into the impingement collections began in September and young-of-the-year dominated the catch from September until November. In December, fish in a wide range of sizes were collected.

The length frequency distribution for white perch collected from the lake (Figure IVG-8) when compared to the impinged length frequency (Figure IVG-12) demonstrate that impingement collections consist mainly of younger fish while field collections consist mainly of older fish. Generally, as with the rainbow smelt, younger white perch represented the majority of impinged fish.

LENGTH FREQUENCY DISTRIBUTION FOR WHITE PERCH

JAMES A. FITZPATRICK NUCLEAR POWER PLANT - 1976



N = TOTAL NUMBER OF FISH ANALYZED FROM TRAVELING SCREEN COLLECTIONS ON SCHEDULED IMPINGEMENT DAYS

(iv) Yellow Perch

Age was not calculated for yellow perch collected from the traveling screens at FitzPatrick; however, length frequency data were tabulated (Table IVG-11). Yearling yellow perch (6-9 cm) dominated the impingement collections from January through July, while from March through August a small percentage of larger fish were collected. Fish 12-16 cm represented the majority of the impingement collections from September through December. Recruitment of young-of-the-year yellow perch to impingement occurred during October through December (Table IVG-11).

The length frequency data for fish collected in the lake (Table IVG-5) when compared to the impingment length frequency suggest that yellow perch impingement samples approximately the same age distribution of fish as do the gill nets.

(v) Smallmouth Bass

Age was not calculated for smallmouth bass collected from the traveling screens at FitzPatrick; however, length frequency data are presented in Table IVG-12. From January to May the majority of smallmouth impinged were young fish (yearlings = 7.6 to 13.10 cm; LMS 1975, Table VII-34). Later in the year, from June to December, the length frequency data are based on few fish and reveal no particular trend. Older (larger) fish predominated the lake collections (Table IVG-6), suggesting that impingement is selective for younger fish.

TABLE IVG-II

LENGTH-FREQUENCY *OF YELLOW PERCH

JAMES A. FITZPATRICK NUCLEAR POWER PLANT - JANUARY - JUNE, 1976

LENGTH INTERVAL (CM)	NUMBER OF FISH											
	JAN		FEB		MAR		APR		MAY		JUN	
	NO.	PCNT	NO.	PCNT	NO.	PCNT	NO.	PCNT	NO.	PCNT	NO.	PCNT
.1- 1.0	0	.0	0	.0	0	.0	0	.0	0	.0	0	.0
1.1- 2.0	0	.0	0	.0	0	.0	0	.0	0	.0	0	.0
2.1- 3.0	0	.0	0	.0	0	.0	0	.0	0	.0	0	.0
3.1- 4.0	0	.0	0	.0	0	.0	0	.0	0	.0	0	.0
4.1- 5.0	0	.0	0	.0	0	.0	0	.0	0	.0	0	.0
5.1- 6.0	1	1.3	0	.0	1	2.2	0	.0	0	.0	0	.0
6.1- 7.0	3	3.8	0	.0	3	6.5	6	7.7	21	13.5	11	21.2
7.1- 8.0	7	8.9	0	.0	10	21.7	12	15.4	21	13.5	9	17.3
8.1- 9.0	13	16.5	1	50.0	4	8.7	4	5.1	9	5.8	5	9.6
9.1- 10.0	23	29.1	0	.0	2	4.3	6	7.7	5	3.2	0	.0
10.1- 11.0	7	8.9	0	.0	4	8.7	8	10.3	17	10.9	6	11.5
11.1- 12.0	9	11.4	0	.0	2	4.3	2	2.6	20	12.8	7	13.5
12.1- 13.0	0	.0	0	.0	0	.0	2	2.6	9	5.8	0	.0
13.1- 14.0	1	1.3	0	.0	0	.0	2	2.6	7	4.5	0	.0
14.1- 15.0	0	.0	0	.0	1	2.2	1	1.3	4	2.6	0	.0
15.1- 16.0	0	.0	0	.0	0	.0	1	1.3	3	1.9	2	3.8
16.1- 17.0	0	.0	0	.0	1	2.2	2	2.6	5	3.2	1	1.9
17.1- 18.0	1	1.3	0	.0	0	.0	2	2.6	5	3.2	0	.0
18.1- 19.0	3	3.8	0	.0	5	10.9	3	3.8	5	3.2	2	3.8
19.1- 20.0	2	2.5	0	.0	0	.0	3	3.8	6	3.8	2	3.8
20.1- 21.0	1	1.3	0	.0	2	4.3	1	1.3	6	3.8	1	1.9
21.1- 22.0	1	1.3	0	.0	1	2.2	6	7.7	0	.0	2	3.8
22.1- 23.0	2	2.5	1	50.0	5	10.9	6	7.7	3	1.9	0	.0
23.1- 24.0	2	2.5	0	.0	0	.0	4	5.1	1	.6	1	1.9
24.1- 25.0	0	.0	0	.0	3	6.5	1	1.3	4	2.6	3	5.8
25.1- 26.0	1	1.3	0	.0	1	2.2	3	3.8	1	.6	0	.0
26.1- 27.0	1	1.3	0	.0	1	2.2	1	1.3	2	1.3	0	.0
27.1- 28.0	0	.0	0	.0	0	.0	0	.0	1	.6	0	.0
28.1- 29.0	0	.0	0	.0	0	.0	1	1.3	0	.0	0	.0
29.1- 30.0	1	1.3	0	.0	0	.0	0	.0	1	.6	0	.0
30.1- 31.0	0	.0	0	.0	0	.0	1	1.3	0	.0	0	.0
TOTAL COLLECTED	81		2		46		179		680		57	
TOTAL ANALYZED	79		2		46		78		156		52	
MEAN LENGTH	11.8		15.8		14.0		14.9		12.7		11.8	
VARIANCE	28.17		93.03		47.30		47.67		30.32		32.73	

* Traveling screen collections on scheduled impingement days

TABLE IVG-11 (Continued)

LENGTH-FREQUENCY* OF YELLOW PERCH

JAMES A. FITZPATRICK NUCLEAR POWER PLANT - JULY - DECEMBER, 1976

LENGTH INTERVAL (CM)	NUMBER OF FISH JUL NO.	JUL PCNT	AUG NO.	AUG PCNT	SEP NO.	SEP PCNT	OCT NO.	OCT PCNT	NOV NO.	NOV PCNT	DEC NO.	DEC PCNT
.1- 1.0	0	.0	0	.0	0	.0	0	.0	0	.0	0	.0
1.1- 2.0	0	.0	0	.0	0	.0	0	.0	0	.0	0	.0
2.1- 3.0	0	.0	0	.0	0	.0	0	.0	0	.0	0	.0
3.1- 4.0	0	.0	0	.0	0	.0	0	.0	0	.0	0	.0
4.1- 5.0	0	.0	0	.0	0	.0	0	.0	1	.7	1	.5
5.1- 6.0	0	.0	0	.0	1	.7	0	.0	2	1.4	0	.0
6.1- 7.0	2	2.0	0	.0	1	.7	1	1.1	19	12.8	25	12.0
7.1- 8.0	6	6.0	0	.0	0	.0	1	1.1	13	8.8	18	8.7
8.1- 9.0	16	16.0	0	.0	0	.0	2	2.2	11	7.4	6	2.9
9.1- 10.0	13	13.0	5	6.3	1	.7	0	.0	1	.7	5	2.4
10.1- 11.0	8	8.0	7	8.9	2	1.4	0	.0	0	.0	1	.5
11.1- 12.0	5	5.0	8	10.1	9	6.4	2	2.2	12	8.1	12	5.8
12.1- 13.0	3	3.0	7	8.9	11	7.9	5	5.4	15	10.1	29	13.9
13.1- 14.0	2	2.0	6	7.6	16	11.4	24	25.8	22	14.9	41	19.7
14.1- 15.0	4	4.0	7	8.9	21	15.0	18	19.4	21	14.2	28	13.5
15.1- 16.0	2	2.0	5	6.3	14	10.0	13	14.0	13	8.8	21	10.1
16.1- 17.0	6	6.0	4	5.1	8	5.7	7	7.5	5	3.4	7	3.4
17.1- 18.0	2	2.0	6	7.6	10	7.1	6	6.5	3	2.0	4	1.9
18.1- 19.0	3	3.0	5	6.3	14	10.0	5	5.4	5	3.4	3	1.4
19.1- 20.0	3	3.0	1	1.3	9	6.4	1	1.1	2	1.4	1	.5
20.1- 21.0	0	.0	1	1.3	4	2.9	2	2.2	0	.0	0	.0
21.1- 22.0	8	8.0	5	6.3	6	4.3	1	1.1	2	1.4	1	.5
22.1- 23.0	6	6.0	4	5.1	5	3.6	0	.0	0	.0	0	.0
23.1- 24.0	5	5.0	2	2.5	3	2.1	0	.0	0	.0	3	1.4
24.1- 25.0	1	1.0	2	2.5	0	.0	0	.0	0	.0	1	.5
25.1- 26.0	0	.0	3	3.8	4	2.9	0	.0	0	.0	0	.0
26.1- 27.0	0	.0	0	.0	0	.0	2	2.2	1	.7	0	.0
27.1- 28.0	2	2.0	0	.0	0	.0	2	2.2	0	.0	0	.0
28.1- 29.0	0	.0	0	.0	1	.7	0	.0	0	.0	1	.5
29.1- 30.0	2	2.0	1	1.3	0	.0	1	1.1	0	.0	0	.0
30.1- 31.0	1	1.0	0	.0	0	.0	0	.0	0	.0	0	.0
TOTAL COLLECTED	105		84		158		95		160		212	
TOTAL ANALYZED	100		79		140		93		148		208	
MEAN LENGTH	14.6		16.0		16.4		15.5		12.3		12.6	
VARIANCE	45.40		23.32		15.16		14.55		16.30		14.93	

*Traveling screen collections on scheduled impingement days

TABLE IVG-12

LENGTH-FREQUENCY* OF SMALLMOUTH BASS

NINE MILE POINT NUCLEAR STATION UNIT 1 - JANUARY - JUNE, 1976

LENGTH INTERVAL (CM)	NUMBER OF FISH JAN NO.	JAN PCNT	FEB NO.	FEB PCNT	MAR NO.	MAR PCNT	APR NO.	APR PCNT	MAY NO.	MAY PCNT	JUN NO.	JUN PCNT
.1- 1.0	0	.0	0	.0	0	.0	0	.0	0	.0	0	.0
1.1- 2.0	0	.0	0	.0	0	.0	0	.0	0	.0	0	.0
2.1- 3.0	0	.0	0	.0	0	.0	0	.0	0	.0	0	.0
3.1- 4.0	0	.0	0	.0	0	.0	0	.0	0	.0	0	.0
4.1- 5.0	0	.0	0	.0	0	.0	0	.0	0	.0	0	.0
5.1- 6.0	0	.0	0	.0	0	.0	0	.0	0	.0	0	.0
6.1- 7.0	1	1.1	0	.0	0	.0	0	.0	1	4.3	0	.0
7.1- 8.0	0	.0	0	.0	1	5.9	0	.0	1	4.3	0	.0
8.1- 9.0	6	6.8	0	.0	1	5.9	1	12.5	7	30.4	0	.0
9.1- 10.0	20	22.7	0	.0	4	23.5	1	12.5	4	17.4	0	.0
10.1- 11.0	13	14.8	2	66.7	4	23.5	2	25.0	2	8.7	0	.0
11.1- 12.0	20	22.7	0	.0	2	11.8	0	.0	6	26.1	1	33.3
12.1- 13.0	10	11.4	1	33.3	0	.0	0	.0	1	4.3	0	.0
13.1- 14.0	3	3.4	0	.0	0	.0	1	12.5	0	.0	0	.0
14.1- 15.0	0	.0	0	.0	0	.0	0	.0	0	.0	0	.0
15.1- 16.0	0	.0	0	.0	0	.0	0	.0	0	.0	0	.0
16.1- 17.0	0	.0	0	.0	0	.0	0	.0	0	.0	0	.0
17.1- 18.0	0	.0	0	.0	0	.0	0	.0	0	.0	0	.0
18.1- 19.0	0	.0	0	.0	0	.0	0	.0	1	4.3	0	.0
19.1- 20.0	0	.0	0	.0	0	.0	0	.0	0	.0	0	.0
20.1- 21.0	0	.0	0	.0	0	.0	0	.0	0	.0	0	.0
21.1- 22.0	3	3.4	0	.0	1	5.9	0	.0	0	.0	0	.0
22.1- 23.0	2	2.3	0	.0	0	.0	0	.0	0	.0	0	.0
23.1- 24.0	1	1.1	0	.0	0	.0	0	.0	0	.0	0	.0
24.1- 25.0	1	1.1	0	.0	0	.0	0	.0	0	.0	0	.0
25.1- 26.0	1	1.1	0	.0	0	.0	0	.0	0	.0	0	.0
26.1- 27.0	0	.0	0	.0	0	.0	0	.0	0	.0	0	.0
27.1- 28.0	0	.0	0	.0	0	.0	0	.0	0	.0	0	.0
28.1- 29.0	1	1.1	0	.0	0	.0	0	.0	0	.0	0	.0
29.1- 30.0	0	.0	0	.0	0	.0	0	.0	0	.0	0	.0
30.1- 31.0	0	.0	0	.0	0	.0	0	.0	0	.0	0	.0
31.1- 32.0	0	.0	0	.0	0	.0	0	.0	0	.0	0	.0
32.1- 33.0	0	.0	0	.0	0	.0	0	.0	0	.0	0	.0
33.1- 34.0	0	.0	0	.0	0	.0	0	.0	0	.0	0	.0
34.1- 35.0	0	.0	0	.0	0	.0	0	.0	0	.0	0	.0
35.1- 36.0	0	.0	0	.0	2	11.8	0	.0	0	.0	0	.0
36.1- 37.0	3	3.4	0	.0	0	.0	0	.0	0	.0	1	33.3
37.1- 38.0	2	2.3	0	.0	2	11.8	0	.0	0	.0	1	33.3
38.1- 39.0	0	.0	0	.0	0	.0	2	25.0	0	.0	0	.0
39.1- 40.0	0	.0	0	.0	0	.0	0	.0	0	.0	0	.0
40.1- 41.0	1	1.1	0	.0	0	.0	1	12.5	0	.0	0	.0
41.1- 42.0	0	.0	0	.0	0	.0	0	.0	0	.0	0	.0
TOTAL COLLECTED	92		5		18		11		66		5	
TOTAL ANALYZED	88		3		17		8		23		3	
MEAN LENGTH	13.9		10.8		17.0		21.2		10.2		28.4	
VARIANCE	59.17		1.28		131.65		218.12		5.63		209.60	

*Traveling screen collections on scheduled impingement days

TABLE IVG-12 (Continued)

LENGTH-FREQUENCY* OF SMALLMOUTH BASS

NINE MILE POINT NUCLEAR STATION UNIT 1 - JULY - DECEMBER, 1976

LENGTH INTERVAL (CM)	NUMBER OF FISH JUL NO.	PCNT	AUG NO.	PCNT	SEP NO.	PCNT	OCT NO.	PCNT	NOV NO.	PCNT	DEC NO.	PCNT
.1- 1.0	0	.0	0	.0	0	.0	0	.0	0	.0	0	.0
1.1- 2.0	0	.0	0	.0	0	.0	0	.0	0	.0	0	.0
2.1- 3.0	0	.0	0	.0	0	.0	0	.0	0	.0	0	.0
3.1- 4.0	0	.0	0	.0	0	.0	0	.0	0	.0	0	.0
4.1- 5.0	0	.0	0	.0	0	.0	0	.0	0	.0	0	.0
5.1- 6.0	0	.0	0	.0	0	.0	0	.0	0	.0	0	.0
6.1- 7.0	0	.0	0	.0	0	.0	0	.0	0	.0	0	.0
7.1- 8.0	0	.0	0	.0	0	.0	0	.0	0	.0	1	5.9
8.1- 9.0	2	40.0	0	.0	1	11.1	0	.0	0	.0	0	.0
9.1- 10.0	0	.0	0	.0	0	.0	0	.0	0	.0	0	.0
10.1- 11.0	0	.0	0	.0	0	.0	0	.0	0	.0	0	.0
11.1- 12.0	1	20.0	0	.0	0	.0	1	25.0	0	.0	0	.0
12.1- 13.0	1	20.0	0	.0	1	11.1	0	.0	0	.0	0	.0
13.1- 14.0	0	.0	0	.0	0	.0	0	.0	1	25.0	1	5.9
14.1- 15.0	0	.0	0	.0	0	.0	0	.0	0	.0	2	11.8
15.1- 16.0	0	.0	0	.0	0	.0	0	.0	1	25.0	3	17.6
16.1- 17.0	0	.0	0	.0	0	.0	0	.0	1	25.0	0	.0
17.1- 18.0	0	.0	0	.0	0	.0	0	.0	0	.0	1	5.9
18.1- 19.0	0	.0	0	.0	0	.0	0	.0	0	.0	0	.0
19.1- 20.0	0	.0	0	.0	0	.0	0	.0	0	.0	0	.0
20.1- 21.0	0	.0	0	.0	0	.0	0	.0	0	.0	0	.0
21.1- 22.0	0	.0	0	.0	0	.0	0	.0	0	.0	0	.0
22.1- 23.0	0	.0	0	.0	0	.0	0	.0	0	.0	0	.0
23.1- 24.0	0	.0	0	.0	0	.0	0	.0	0	.0	1	5.9
24.1- 25.0	0	.0	0	.0	0	.0	0	.0	0	.0	0	.0
25.1- 26.0	0	.0	0	.0	1	11.1	0	.0	0	.0	0	.0
26.1- 27.0	0	.0	0	.0	0	.0	0	.0	0	.0	0	.0
27.1- 28.0	0	.0	0	.0	0	.0	0	.0	0	.0	0	.0
28.1- 29.0	0	.0	0	.0	0	.0	0	.0	0	.0	0	.0
29.1- 30.0	0	.0	0	.0	0	.0	0	.0	0	.0	0	.0
30.1- 31.0	0	.0	0	.0	0	.0	0	.0	0	.0	0	.0
31.1- 32.0	0	.0	0	.0	0	.0	0	.0	0	.0	0	.0
32.1- 33.0	0	.0	0	.0	0	.0	0	.0	0	.0	0	.0
33.1- 34.0	0	.0	0	.0	1	11.1	0	.0	0	.0	0	.0
34.1- 35.0	0	.0	1	100.0	0	.0	0	.0	0	.0	0	.0
35.1- 36.0	0	.0	0	.0	0	.0	0	.0	0	.0	2	11.8
36.1- 37.0	0	.0	0	.0	0	.0	2	50.0	1	25.0	3	17.6
37.1- 38.0	0	.0	0	.0	1	11.1	1	25.0	0	.0	1	5.9
38.1- 39.0	0	.0	0	.0	3	33.3	0	.0	0	.0	2	11.8
39.1- 40.0	0	.0	0	.0	0	.0	0	.0	0	.0	0	.0
40.1- 41.0	0	.0	0	.0	0	.0	0	.0	0	.0	0	.0
41.1- 42.0	1	20.0	0	.0	1	11.1	0	.0	0	.0	0	.0
TOTAL COLLECTED	5		1		10		4		6		19	
TOTAL ANALYZED	5		1		9		4		4		17	
MEAN LENGTH	16.4		34.2		30.5		30.5		20.6		25.5	
VARIANCE	195.41				150.94		159.27		109.16		131.35	

* Traveling screen collections on scheduled impingement days

(vi) Threespine Stickleback

It was not possible to analyze age directly for the threespine sticklebacks collected from the traveling screens of the FitzPatrick plant. Length frequency distribution revealed that the majority of the threespine stickleback analyzed from impingement collections were 5.5 cm long (Figure IVG-13), which probably represents fish in age class II. Similar lengths have been reported for two-year-old threespine stickleback by Greenbank and Nelson (1958) and Brian and Power (1973), both from northern North America.

(vii) Other Species

Insufficient numbers of brown trout (eight) and coho salmon (four) were collected from impingement collections to warrant an analysis of length frequency.

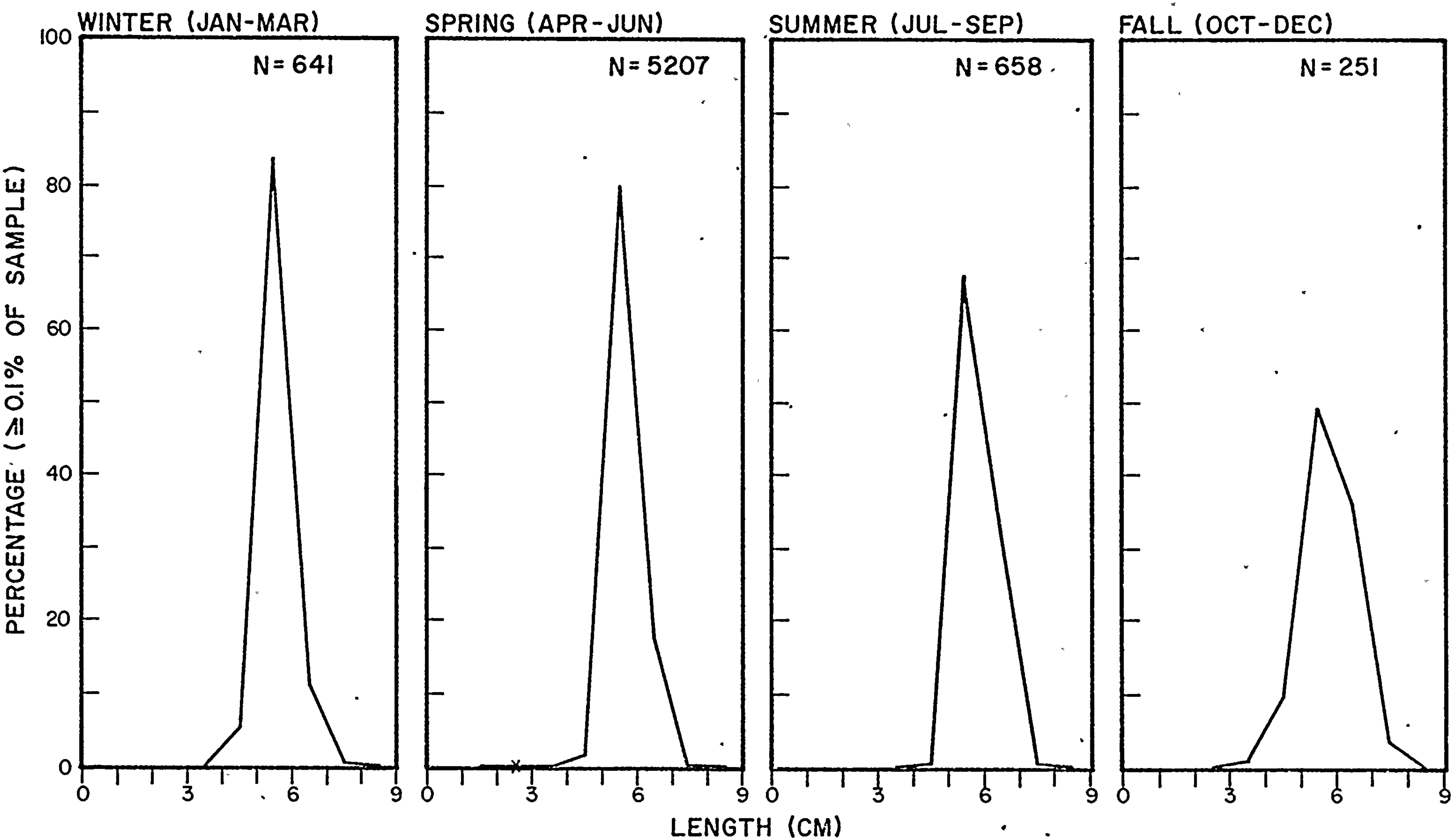
3. Estimated Impingement at FitzPatrick

The annual estimate of impingement at the FitzPatrick plant was derived as follows. Impingement data were extrapolated to obtain an estimated monthly total by multiplying the mean number of all fish collected per hour in each month (adjusted for non-operating screens) by the percentage of each species impinged during that month times the number of hours in the month. These values were totaled for the months in each year during which sampling was conducted.

An estimated 87,786 fish were impinged from September to December 1975, 4,313,562 from January to December 1976, and 38,441 from January to March 1977. This is a total of 4,439,789 fish for the 19-month study (Table IVG-13).

LENGTH FREQUENCY DISTRIBUTION
FOR THREESPINE STICKLEBACK

JAMES A. FITZPATRICK NUCLEAR POWER PLANT - 1976



N = TOTAL NUMBER OF FISH ANALYZED FROM TRAVELING SCREEN COLLECTIONS ON SCHEDULED IMPINGEMENT DAYS
X = FISH ANALYZED, BUT REPRESENTING <.1% OF SAMPLE ANALYZED

FIGURE IVG-13

TABLE IVG-13

ABUNDANCE AND PERCENT COMPOSITION OF FISH IN IMPINGEMENT COLLECTIONS[a]

JAMES A. FITZPATRICK NUCLEAR POWER PLANT - 10 SEPTEMBER - DECEMBER 1975

SPECIES	SEP NO.	SEP %	OCT NO.	OCT %	NOV NO.	NOV %	DEC NO.	DEC %	TOTAL NO.	TOTAL %
Alewife	8534	92.6	12978	69.5	17876	77.5	22863	60.6	61561	70.1
American eel	3	<0.1	7	<0.1	2	<0.1	0	0.0	12	<0.1
Black crappie	0	0.0	19	0.1	7	<0.1	0	0.0	26	<0.1
Bluegill sunfish	28	0.2	915	4.9	177	0.8	113	0.3	1233	1.4
Bowfin	0	0.0	2	<0.1	2	<0.1	0	0.0	4	<0.1
Brown bullhead	9	0.1	2	<0.1	2	<0.1	19	<0.1	32	<0.1
Brown trout	3	<0.1	0	0.0	0	0.0	0	0.0	3	<0.1
Carp	0	0.0	2	<0.1	0	0.0	0	0.0	2	<0.1
Channel catfish	0	0.0	2	<0.1	0	0.0	11	<0.1	13	<0.1
Creek chub	0	0.0	0	0.0	2	<0.1	0	0.0	2	<0.1
Emerald shiner	0	0.0	19	0.1	7	<0.1	11	<0.1	37	<0.1
Freshwater drum	0	0.0	6	<0.1	7	<0.1	4	<0.1	17	<0.1
Gizzard shad	9	0.1	579	3.1	1353	6.1	7772	20.6	9713	11.1
Johnny darter	9	0.1	75	0.4	67	0.3	15	<0.1	166	0.2
Lake chub	0	0.0	0	0.0	0	0.0	8	<0.1	8	<0.1
Lake trout	0	0.0	4	<0.1	4	<0.1	11	<0.1	19	<0.1
Largemouth bass	0	0.0	7	<0.1	0	0.0	0	0.0	7	<0.1
Longnose dace	0	0.0	6	<0.1	0	0.0	8	<0.1	14	<0.1
Mottled sculpin	46	0.5	149	0.8	421	1.9	264	0.7	880	1.0
Mudminnow	0	0.0	0	0.0	22	0.1	8	<0.1	30	<0.1
Pumpkinseed	0	0.0	0	0.0	4	<0.1	8	<0.1	12	<0.1
Rainbow smelt	295	3.2	3249	17.4	2151	9.7	5508	14.6	11203	12.8
Rock bass	18	0.2	37	0.2	22	0.1	75	0.2	152	0.2
Sea lamprey	0	0.0	2	<0.1	2	<0.1	0	0.0	4	<0.1
Smallmouth bass	9	0.1	19	0.1	22	0.1	15	<0.1	65	0.1
Splake (hybrid Lake trout)	0	0.0	0	0.0	2	<0.1	4	<0.1	6	<0.1
Spottail shiner	166	1.8	317	1.7	310	1.4	264	0.7	1057	1.2
Stonecat	28	0.2	93	0.5	67	0.3	19	<0.1	207	0.2
Threespine stickleback	0	0.0	2	<0.1	67	0.3	75	0.2	144	0.2
Trout perch	9	0.1	19	0.1	22	0.1	38	0.1	88	0.1
Walleye	0	0.0	0	0.0	0	0.0	4	<0.1	4	<0.1
White bass	0	0.0	0	0.0	44	0.2	340	0.9	384	0.4
White perch	3	<0.1	93	0.5	111	0.5	151	0.4	358	0.4
White sucker	9	0.1	7	<0.1	7	<0.1	8	<0.1	31	<0.1
Yellow perch	37	0.4	75	0.4	67	0.3	113	0.3	292	0.3
TOTAL	9215		18685		22157		37729		87786	
NO. HRS. SAMPLED	216		336		288		239			
AVG. NO. FISH/HR	12.8		25.1		30.8		52.4			

[a]Estimated

TABLE IVG-13 (Continudd)

ABUNDANCE AND PERCENT COMPOSITION OF IMPINGEMENT COLLECTIONS
JAMES A. FITZPATRICK NUCLEAR POWER PLANT - JANUARY - APRIL, 1976

	JAN		FEB		MAR		APR	
SPECIES	NO.	PCNT	NO.	PCNT	NO.	PCNT	NO.	PCNT
ALEWIFE	6792	55.6	5	0.4	10504	21.0	637897	92.5
AMERICAN EEL	0	0.0	0	0.0	0	0.0	3	*
BANDED KILLIFISH	0	0.0	0	0.0	0	0.0	0	0.0
BLACK CRAPPIE	2	*	0	0.0	2	*	3	*
BLUEGILL	2	*	0	0.0	2	*	8	*
BLUNTNOSE MINNOW	0	0.0	0	0.0	0	0.0	5	*
BOWFIN	0	0.0	0	0.0	0	0.0	0	0.0
BROOK STICKLEBACK	0	0.0	0	0.0	168	0.3	60	*
BROWN BULLHEAD	14	0.1	0	0.0	11	*	7	*
BROWN TROUT	0	0.0	0	0.0	2	*	2	*
BURBOT	0	0.0	0	0.0	0	0.0	0	0.0
CARP	0	0.0	0	0.0	0	0.0	0	0.0
CENTRAL MUDMINNOW (MUDMINNOW)	5	*	5	0.4	133	0.3	52	*
CHANNEL CATFISH	48	0.4	7	0.5	18	*	2	*
COHO SALMON	0	0.0	0	0.0	0	0.0	0	0.0
CHUB - UID	0	0.0	0	0.0	0	0.0	0	0.0
CREEK CHUB	5	*	0	0.0	0	0.0	2	*
EMERALD SHINER	117	1.0	34	2.6	237	0.5	112	*
FATHEAD MINNOW	0	0.0	0	0.0	4	*	22	*
FRESHWATER DRUM	60	0.5	5	0.4	13	*	3	*
GIZZARD SHAD	849	7.0	456	35.1	10991	22.0	1571	0.2
GOLDEN SHINER	12	0.1	2	0.2	7	*	8	*
GOLDFISH	2	*	0	0.0	2	*	2	*
JOHNNY DARTER	12	0.1	5	0.4	9	*	103	*
LAKE CHUB	2	*	0	0.0	11	*	10	*
LAKE HERRING	0	0.0	0	0.0	0	0.0	0	0.0
LAKE TROUT	5	*	0	0.0	4	*	0	0.0
LOGPERCH	0	0.0	0	0.0	0	0.0	2	*
LONGNOSE DACE	14	0.1	10	0.8	49	0.1	2	*
LONGNOSE GAR	2	*	0	0.0	0	0.0	0	0.0
MINNOWS & CARPS	0	0.0	0	0.0	0	0.0	2	*
MOTTLED SCULPIN	210	1.7	51	3.9	221	0.4	1792	0.3
NORTHERN HOG SUCKER	0	0.0	0	0.0	0	0.0	0	0.0
NORTHERN PIKE	0	0.0	0	0.0	2	*	0	0.0
ONCORHYNCHUS SP (SALMONIDAE)	0	0.0	0	0.0	0	0.0	2	*
PEARL DACE	2	*	0	0.0	0	0.0	0	0.0
PUGNOSE MINNOW	0	0.0	0	0.0	0	0.0	8	*
PUMPKINSEED	14	0.1	0	0.0	2	*	15	*
RAINBOW SMELT	2496	20.4	432	33.2	20131	40.2	34045	4.9
RAINBOW TROUT	0	0.0	0	0.0	0	0.0	0	0.0
REDFIN PICKEREL	0	0.0	0	0.0	2	*	0	0.0
ROCK BASS	124	1.0	22	1.7	109	0.2	68	*
SALVELINUS SP (SALMONIDAE)	0	0.0	0	0.0	0	0.0	0	0.0
SEA LAMPREY	5	*	0	0.0	2	*	10	*
SEMOTILUS SP (CYPRINIDAE)	0	0.0	0	0.0	0	0.0	0	0.0
SILVERY MINNOW	0	0.0	0	0.0	2	*	0	0.0
SMALLMOUTH BASS	219	1.8	12	0.9	40	0.1	18	*
SPLAKE TROUT	0	0.0	0	0.0	0	0.0	5	*
SPOTTAIL SHINER	493	4.0	68	5.2	357	0.7	551	0.1
STONECAT	2	*	0	0.0	4	*	20	*
TADPOLE MADTOM	0	0.0	0	0.0	0	0.0	0	0.0
THREESPINE STICKLEBACK	21	0.2	22	1.7	2463	4.9	6287	0.9
TROUT PERCH	7	0.1	2	0.2	82	0.2	2615	0.4
TROUTS (SALMONIDAE)	0	0.0	0	0.0	0	0.0	0	0.0
UNIDENTIFIED	0	0.0	0	0.0	0	0.0	0	0.0
WALLEYE	2	*	0	0.0	0	0.0	2	*
WHITE BASS	207	1.7	140	10.8	3450	6.9	1458	0.2
WHITE CRAPPIE	0	0.0	0	0.0	0	0.0	0	0.0
WHITE PERCH	260	2.1	17	1.3	901	1.8	2387	0.3
WHITE SUCKER	10	0.1	0	0.0	0	0.0	7	*
YELLOW PERCH	193	1.6	5	0.4	102	0.2	293	*
TOTAL	12208	99.7	1300	100.1	50037	99.8	689466	99.8
TOTAL MONTHLY FLOW SAMPLED (MG)	4147		2070		3982		9349	
TOTAL HOURS SAMPLED	312.08		288.40		335.95		432.23	

* LESS THAN 0.1 PERCENT
(MG) MILLION GALLONS, ALL UNITS COMBINED

TABLE IVG-13 (Continued)

ABUNDANCE AND PERCENT COMPOSITION OF IMPINGEMENT COLLECTIONS (CONTINUED)
JAMES A. FITZPATRICK NUCLEAR POWER PLANT - MAY - AUGUST, 1976

SPECIES	MAY NO.	MAY PCNT	JUN NO.	JUN PCNT	JUL NO.	JUL PCNT	AUG NO.	AUG PCNT
ALEWIFE	2662084	93.4	259442	85.3	139445	86.9	3429	66.6
AMERICAN EEL	36	*	5	*	14	*	10	0.2
BANDED KILLIFISH	2	*	0	0.0	0	0.0	0	0.0
BLACK CRAPPIE	2	*	0	0.0	0	0.0	0	0.0
BLUEGILL	11	*	2	*	12	*	0	0.0
BLUNTNOSE MINNOW	0	0.0	0	0.0	0	0.0	0	0.0
BOWFIN	0	0.0	0	0.0	0	0.0	0	0.0
BROOK STICKLEBACK	31	*	2	*	0	0.0	0	0.0
BROWN BULLHEAD	2	*	0	0.0	0	0.0	5	0.1
BROWN TROUT	0	0.0	5	*	0	0.0	5	0.1
BURBOT	0	0.0	0	0.0	2	*	7	0.1
CARP	0	0.0	0	0.0	0	0.0	0	0.0
CENTRAL MUDMINNOW	46	*	7	*	2	*	0	0.0
CHANNEL CATFISH	0	0.0	0	0.0	0	0.0	0	0.0
COHO SALMON	0	0.0	2	*	0	0.0	0	0.0
CHUB - UID	0	0.0	0	0.0	5	*	0	0.0
CREEK CHUB	0	0.0	0	0.0	0	0.0	0	0.0
EMERALD SHINER	108	*	16	*	2	*	12	0.2
FATHEAD MINNOW	24	*	0	0.0	0	0.0	0	0.0
FRESHWATER DRUM	0	0.0	2	*	0	0.0	0	0.0
GIZZARD SHAD	143	*	7	*	5	*	5	0.1
GOLDEN SHINER	41	*	0	0.0	0	0.0	2	*
GOLDFISH	0	0.0	0	0.0	0	0.0	0	0.0
JOHNNY DARTER	3657	0.1	782	0.3	1586	1.0	284	5.5
LAKE CHUB	29	*	14	*	64	*	17	0.3
LAKE HERRING	2	*	0	0.0	0	0.0	0	0.0
LAKE TROUT	0	0.0	0	0.0	0	0.0	0	0.0
LOGPERCH	2	*	0	0.0	2	*	0	0.0
LONGNOSE DACE	0	0.0	0	0.0	5	*	0	0.0
LONGNOSE GAR	0	0.0	0	0.0	0	0.0	0	0.0
MINNOWS & CARPS	0	0.0	0	0.0	0	0.0	2	*
MOTTLED SCULPIN	2942	0.1	805	0.3	367	0.2	72	1.4
NORTHERN HOG SUCKER	0	0.0	2	*	0	0.0	2	*
NORTHERN PIKE	2	*	0	0.0	7	*	5	0.1
ONCORHYNCHUS SP (SALMONIDAE)	0	0.0	0	0.0	0	0.0	0	0.0
~~PEARL DACE~~	0	0.0	0	0.0	0	0.0	0	0.0
PUGNOSE MINNOW	0	0.0	2	*	0	0.0	0	0.0
PUMPKINSEED	67	*	9	*	5	*	10	0.2
RAINBOW SMELT	127127	4.5	4098	1.3	544	0.3	405	7.9
RAINBOW TROUT	8	*	0	0.0	2	*	0	0.0
REDFIN PICKEREL	0	0.0	0	0.0	0	0.0	0	0.0
ROCK BASS	165	*	16	*	50	*	64	1.2
SALVELINUS SP (SALMONIDAE)	3	*	5	*	0	0.0	0	0.0
~~SEA LAMPREY~~	2	*	0	0.0	2	*	0	0.0
SEMOTILUS SP (CYPRINIDAE)	0	0.0	0	0.0	2	*	0	0.0
~~SILVERY MINNOW~~	0	0.0	0	0.0	0	0.0	0	0.0
SMALLMOUTH BASS	108	*	12	*	12	*	2	*
SPLAKE TROUT	10	*	12	*	38	*	12	0.2
SPOTTAIL SHINER	2603	0.1	2365	0.8	4531	2.8	398	7.7
STONECAT	20	*	16	*	36	*	5	0.1
TADPOLE MADTOM	0	0.0	0	0.0	0	0.0	0	0.0
THREESPINE STICKLEBACK	40157	1.4	34408	11.3	11937	7.4	5	0.1
TROUT PERCH	6511	0.2	1666	0.5	1171	0.7	86	1.7
TROUTS	0	0.0	2	*	0	0.0	0	0.0
UNIDENTIFIED	0	0.0	0	0.0	2	*	2	*
WALLEYE	0	0.0	0	0.0	0	0.0	5	0.1
WHITE BASS	1422	*	171	0.1	24	*	0	0.0
WHITE CRAPPIE	2	*	0	0.0	0	0.0	0	0.0
WHITE PERCH	2417	0.1	162	0.1	155	0.1	48	0.9
WHITE SUCKER	41	*	37	*	100	0.1	48	0.9
YELLOW PERCH	1108	*	132	*	250	0.2	200	3.9
TOTAL	2850935	99.9	304206	100.0	160379	99.7	5147	99.6
TOTAL MONTHLY FLOW SAMPLED (MG)	9584		5955		5770		6637	
TOTAL HOURS SAMPLED	456.75		312.00		312.00		312.00	

* LESS THAN 0.1 PERCENT
(MG) MILLION GALLONS, ALL UNITS COMBINED

TABLE IVG-13 (Continued)

ABUNDANCE AND PERCENT COMPOSITION OF IMPINGEMENT COLLECTIONS (CONTINUED)
JAMES A. FITZPATRICK NUCLEAR POWER PLANT - SEPTEMBER - DECEMBER, 1976

SPECIES	SEP NO.	SEP PCNT	OCT NO.	OCT PCNT	NOV NO.	NOV PCNT	DEC NO.	DEC PCNT	TOTAL NO.	TOTAL PCNT
ALEWIFE	4687	71.8	4018	49.1	146305	77.4	2942	8.1	3877550	89.9
AMERICAN EEL	21	0.3	10	0.1	4	*	2	*	105	*
BANDED KILLIFISH	0	0.0	0	0.0	0	0.0	0	0.0	2	*
BLACK CRAPPIE	2	*	0	0.0	2	*	0	0.0	13	*
BLUEGILL	2	*	7	0.1	2	*	0	0.0	48	*
BLUNTNOSE MINNOW	0	0.0	0	0.0	0	0.0	0	0.0	5	*
BOWFIN	2	*	2	*	6	*	0	0.0	10	*
BROOK STICKLEBACK	0	0.0	0	0.0	0	0.0	0	0.0	261	*
BROWN BULLHEAD	12	0.2	91	1.1	49	*	38	0.1	229	*
BROWN TROUT	0	0.0	2	*	0	0.0	4	*	20	*
BURBOT	0	0.0	5	0.1	6	*	22	0.1	42	*
CARP	0	0.0	0	0.0	0	0.0	2	*	2	*
CENTRAL MUDMINNOW	0	0.0	0	0.0	6	*	0	0.0	256	*
CHANNEL CATFISH	0	0.0	0	0.0	49	*	7	*	131	*
COHO SALMON	0	0.0	0	0.0	0	0.0	0	0.0	2	*
CHUB - UID	0	0.0	0	0.0	0	0.0	0	0.0	5	*
CREEK CHUB	0	0.0	0	0.0	0	0.0	0	0.0	7	*
EMERALD SHINER	23	0.4	112	1.4	11	*	199	0.5	983	*
FATHEAD MINNOW	0	0.0	0	0.0	0	0.0	0	0.0	50	*
FRESHWATER DRUM	0	0.0	0	0.0	4	*	2	*	89	*
GIZZARD SHAD	2	*	590	7.2	1245	0.7	868	2.4	16732	0.4
GOLDEN SHINER	2	*	2	*	2	*	2	*	80	*
GOLDFISH	2	*	0	0.0	0	0.0	2	*	10	*
JOHNNY DARTER	231	3.5	22	0.3	4	*	13	*	6708	0.2
LAKE CHUB	5	0.1	2	*	2	*	0	0.0	156	*
LAKE HERRING	0	0.0	0	0.0	0	0.0	2	*	4	*
LAKE TROUT	0	0.0	2	*	2	*	0	0.0	13	*
LOGPERCH	0	0.0	0	0.0	0	0.0	0	0.0	6	*
LONGNOSE DACE	0	0.0	0	0.0	0	0.0	2	*	82	*
LONGNOSE GAR	0	0.0	0	0.0	0	0.0	0	0.0	2	*
MINNOWS & CARPS	0	0.0	0	0.0	2	*	0	0.0	6	*
MOTTLED SCULPIN	201	3.1	79	1.0	191	0.1	370	1.0	7301	0.2
NORTHERN HOG SUCKER	0	0.0	0	0.0	0	0.0	0	0.0	4	*
NORTHERN PIKE	0	0.0	0	0.0	0	0.0	7	*	23	*
ONCORHYNCHUS SP (SALMONIDAE)	0	0.0	0	0.0	0	0.0	0	0.0	2	*
PEARL DACE	0	0.0	0	0.0	0	0.0	0	0.0	2	*
PUGNOSE MINNOW	0	0.0	0	0.0	0	0.0	0	0.0	10	*
PUMPKINSEED	12	0.2	14	0.2	24	*	18	*	190	*
RAINBOW SMELT	189	2.9	2467	30.2	38198	20.2	29651	81.8	259783	6.0
RAINBOW TROUT	2	*	0	0.0	0	0.0	0	0.0	12	*
REDFIN PICKEREL	0	0.0	0	0.0	0	0.0	0	0.0	2	*
ROCK BASS	95	1.5	72	0.9	77	*	208	0.6	1070	*
SALVELINUS SP (SALMONIDAE)	0	0.0	0	0.0	2	*	0	0.0	10	*
SEA LAMPREY	0	0.0	0	0.0	2	*	15	*	38	*
SEMOTILUS SP (CYPRINIDAE)	0	0.0	0	0.0	0	0.0	0	0.0	2	*
SILVERY MINNOW	0	0.0	0	0.0	0	0.0	0	0.0	2	*
SMALLMOUTH BASS	23	0.4	10	0.1	13	*	42	0.1	511	*
SPLAKE TROUT	0	0.0	0	0.0	13	*	22	0.1	112	*
SPOTTAIL SHINER	155	2.4	57	0.7	39	*	66	0.2	11683	0.3
STONECAT	9	0.1	22	0.3	6	*	33	0.1	173	*
TADPOLE MADTOM	0	0.0	2	*	0	0.0	0	0.0	2	*
THREESPINE STICKLEBACK	0	0.0	17	0.2	101	0.1	465	1.3	95883	2.2
TROUT PERCH	16	0.2	14	0.2	9	*	4	*	12183	0.3
TROUTS	0	0.0	0	0.0	0	0.0	0	0.0	2	*
UNIDENTIFIED	0	0.0	0	0.0	0	0.0	0	0.0	4	*
WALLEYE	0	0.0	0	0.0	0	0.0	0	0.0	9	*
WHITE BASS	2	*	31	0.4	1992	1.1	611	1.7	9508	0.2
WHITE CRAPPIE	0	0.0	0	0.0	0	0.0	0	0.0	2	*
WHITE PERCH	369	5.7	253	3.1	208	0.1	162	0.4	7339	0.2
WHITE SUCKER	95	1.5	48	0.6	6	*	4	*	396	*
YELLOW PERCH	365	5.6	227	2.8	346	0.2	469	1.3	3695	0.1
TOTAL	6524	99.9	8178	100.1	188928	99.9	36254	99.8	4313562	100.0
TOTAL MONTHLY FLOW SAMPLED (MG)	6739		5604		6170		6979		72986	
TOTAL HOURS SAMPLED	312.00		311.27		335.50		336.08		4056.260	

* LESS THAN 0.1 PERCENT
(MG) MILLION GALLONS, ALL UNITS COMBINED

TABLE IVG-13 (Continued)

ABUNDANCE AND PERCENT COMPOSITION OF FISH IN IMPINGEMENT COLLECTIONS

JAMES A. FITZPATRICK NUCLEAR POWER PLANT - 1977

SPECIES	JAN NO.	JAN %	FEB NO.	FEB %	MAR NO.	MAR %	TOTAL NO.	TOTAL %
Alewife	55	0.3	12	0.2	7344	53.1	7411	19.3
American eel	2	<0.1	0	0.0	7	0.1	9	<0.1
Bluegill	0	0.0	3	0.1	0	0.0	3	<0.1
Brook stickleback	0	0.0	0	0.0	253	1.8	253	0.7
Brown bullhead	0	0.0	9	0.2	17	0.1	26	0.1
Brown trout	2	<0.1	3	0.1	0	0.0	5	<0.1
Burbot	22	0.1	9	0.2	3	<0.1	34	0.1
Carp	0	0.0	5	0.1	0	0.0	5	<0.1
Channel catfish	4	<0.1	0	0.0	3	<0.1	7	<0.1
Chinook salmon	0	0.0	3	0.1	0	0.0	3	<0.1
Coho salmon	2	<0.1	0	0.0	3	<0.1	5	<0.1
Creek chub	0	0.0	0	0.0	4	<0.1	4	<0.1
Emerald shiner	636	3.3	53	1.1	184	1.3	873	2.3
Freshwater drum	22	0.1	0	0.0	0	0.0	22	0.1
Gizzard shad	456	2.3	735	14.6	187	1.4	1378	3.6
Golden shiner	4	<0.1	0	0.0	14	0.1	18	<0.1
Goldfish	2	<0.1	5	0.1	4	<0.1	11	<0.1
Johnny darter	12	0.1	9	0.2	0	0.0	21	0.1
Lake chub	18	0.1	16	0.3	7	0.1	41	0.1
Largemouth bass	0	0.0	3	0.1	0	0.0	3	<0.1
Longnose dace	2	<0.1	7	0.1	3	<0.1	12	<0.1
Mottled sculpin	1104	5.6	248	4.9	108	0.8	1460	3.8
Mudminnow	0	0.0	0	0.0	55	0.4	55	0.1
Pumpkinseed	4	<0.1	7	0.1	10	0.1	21	0.1
Rainbow smelt	14413	73.7	2290	45.4	4431	32.0	21134	55.0
Rock bass	301	1.5	62	1.2	95	0.7	458	1.2
<u>Salvelinus</u> sp.	10	0.1	3	0.1	0	0.0	13	<0.1
Sea lamprey	10	0.1	7	0.1	0	0.0	17	<0.1
Smallmouth bass	55	0.3	195	3.9	91	0.7	341	0.9
Splake	14	0.1	0	0.0	7	0.1	21	0.1
Spottail shiner	174	0.9	12	0.2	53	0.4	239	0.6
Stonecat	10	0.1	7	0.1	7	0.1	24	0.1
Threespine stickleback	1143	5.8	248	4.9	286	2.1	1677	4.4
Trout-perch	47	0.2	7	0.1	57	0.4	111	0.3
UID	0	0.0	0	0.0	3	<0.1	3	<0.1
UID Cyprinid	2	<0.1	0	0.0	0	0.0	2	<0.1
Walleye	2	<0.1	0	0.0	0	0.0	2	<0.1
White bass	575	2.9	100	2.0	55	0.4	730	1.9
White perch	205	1.0	923	18.3	415	3.0	1543	4.0
White sucker	8	<0.1	5	0.1	3	<0.1	16	<0.1
Yellow perch	249	1.3	55	1.1	126	0.9	430	1.1
TOTAL	19565		5041		13838		38441	

Of this total, 88.9% were alewives, 6.6% rainbow smelt, and 2.2% threespine stickleback. The remaining species accounted for 2.3%.

An annual impingement estimate is needed for annual cropping analyses and since 1976 was the first full year of plant operation and field collection the 1976 data set was chosen as being representative. Of the estimated 4,313,562 fish impinged during 1976, 89.9% were alewives, 6.0% rainbow smelt, and 2.2% threespine stickleback. This results in a yearly unweighted average of 492.4 fish/hour, of which 442.6 fish/ hour were alewives, 29.7 fish/hour rainbow smelt, and 23.6 fish/hour threespine stickleback. The remaining species accounted for 10.9 fish/hour.

The highest rate occurred during May when alewives were impinged at an estimated rate of 3578.1 fish/hour. The second highest rate for alewife, 857.4 fish/hour, occurred in April (Table IVG-13).

An estimated 74,206,252 grams (74.2 metric tons) of fish were impinged during 1976 (Table IVG-14). The estimated biomass of fish impinged per month was determined by multiplying the mean weight per species for each month by the estimated number of fish impinged during that month. The mean weight per species per month was determined by dividing the total biomass per species by the total number of fish collected in that month. The monthly total biomass per species was estimated for the January through September period and November at FitzPatrick based on the average weight of those fish analyzed per species; October and December biomass values represent the actual weight of those fish impinged. Alewives accounted for 93.9% of the impinged biomass, rainbow smelt for 2.4%, and gizzard shad for 1.4%. None of the remaining species accounted for more than 1% of the impinged biomass (Table IVG-14).

TABLE IVG-14

ESTIMATED BIOMASS OF IMPINGEMENT CATCH[a]

JAMES A. FITZPATRICK NUCLEAR POWER PLANT - 1976

SPECIES	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL TOTAL
Alewife	192213.6	151.0	284658.4	14097523.7	47651303.6	4073239.4	2621566.0	59321.7	42651.7	23706.2	570589.5	53838.6	69670763.4
American eel	-	-		3119.1	45151.2	8796.5	16237.2	5495.0	7431.9	9061.0	2253.6	5300.0	102845.5
Banded killifish	-	-	-	-	3.2	-	-	-	-	-	-	-	3.2
Black crappie	19.8	-	9.0	4.5	*	-	-	-	*	-	54.8	-	88.1
Bluegill	7.2	-	5.6	*	18.7	*	37.2	-	200.4	4.9	4.2	-	278.2
Bluntnose minnow	-	-	-	17.5	-	-	-	-	-	-	-	-	17.5
Bowfin	-	-	-	-	-	-	-	-	2840.0	237.0	340.8	-	3417.8
Brook stickleback	-	-	218.4	78.0	49.6	3.6	-	-	-	-	-	-	349.6
Brown bullhead	882.0	-	995.5	687.4	1000.2	-	-	1542.5	3007.2	16052.4	8379.0	3480.8	36027.0
Brown trout	-	-	2156.0	3312.2	-	8492.0	-	9363.0	-	4760.0	-	11510.0	39593.2
Burbot	-	-	-	-	-	-	4551.8	1474.9	-	5040.5	2128.2	541.2	13736.6
Carp	-	-	-	-	-	-	-	-	-	-	-	16400.0	16400.0
Central mudminnow (Mudminnow)	13.5	27.0	678.3	208.0	202.4	63.0	10.8	-	-	-	30.6	-	1233.6
Channel catfish	508.8	51.1	799.2	9.8	-	-	-	-	-	-	142.1	147.7	1658.7
Coho salmon	-	-	-	-	-	*	-	-	-	-	-	-	-
Chub-UID	-	-	-	-	-	-	*	-	-	-	-	-	-
Creek chub	34.5	-	-	6.2	-	-	-	-	-	-	-	-	40.7
Emerald shiner	397.8	44.2	521.4	526.4	583.2	99.2	*	85.2	156.4	795.2	71.5	835.8	4116.3
Fathead minnow	-	-	8.0	61.6	72.0	-	-	-	-	-	-	-	141.6
Freshwater drum	4056.0	79.0	3950.7	111.6	-	62.8	-	-	-	-	57.2	39.8	8357.1
Gizzard shad	157829.1	23803.2	320937.2	47758.4	18933.2	3350.2	1604.0	473.5	5.0	14455.0	150147.0	284530.4	1023826.2
Golden shiner	38.4	8.8	26.6	22.4	102.5	-	-	112.4	39.6	15.8	5.8	29.8	402.1
Goldfish	559.4	-	*	369.4	-	-	-	-	*	-	-	1540.4	2469.2
Johnny darter	19.2	13.5	25.2	329.6	11336.7	1876.8	2696.2	511.2	508.2	52.8	8.0	29.9	17407.3
Lake chub	9.0	-	41.8	289.0	762.7	331.8	1632.0	496.4	270.5	9.4	49.2	-	3891.8
Lake herring	-	-	-	-	1531.0	-	-	-	-	-	-	110.4	1641.4
Lake trout	45.0	-	30.8	-	-	-	-	-	-	373.2	18.2	-	467.2
Logperch	-	-	-	40.8	21.0	-	24.2	-	-	-	-	-	86.0
Longnose dace	50.4	31.0	220.5	7.6	-	-	19.0	-	-	-	-	22.0	350.5
Longnose gar	273.0	-	-	-	-	-	-	-	-	-	-	-	273.0
Minnows and carps	-	-	-	7.4	-	-	-	*	-	-	27.8	-	35.2
Mottled sculpin	735.0	173.4	1547.0	12185.6	12356.4	2898.0	1284.5	288.0	542.7	213.3	496.6	1184.0	33904.5
Northern hog sucker	-	-	-	-	-	19.8	-	153.2	-	-	-	-	173.0
Northern pike	-	-	6129.0	-	*	-	77.7	412.0	-	-	-	821.1	7439.8
<u>Onchorhynchus</u> sp. (Salmonidae)	-	-	-	*	-	-	-	-	-	-	-	-	-

TABLE IVG-14 (Continued)

ESTIMATED BIOMASS OF IMPINGEMENT CATCH[a] (Continued)

JAMES A. FITZPATRICK NUCLEAR POWER PLANT - 1976

SPECIES (continued)	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL TOTAL
Pearl dace	1.2	-	-	-	-	-	-	-	-	-	-	-	1.2
Pugnose minnow	-	-	-	23.2	-	30.4	-	-	-	-	-	-	53.6
Pumpkinseed	2090.2	-	15.6	642.0	1695.1	642.6	421.5	49.0	699.6	581.0	1804.8	1456.2	10097.6
Rainbow smelt	14227.2	2462.4	74484.7	251933.0	1182281.1	35652.6	6691.2	1377.0	793.8	12828.4	68756.4	94883.2	1746371.0
Rainbow trout	-	-	-	-	860.0	-	1302.0	-	749.4	-	-	-	2911.4
Redfin pickerel	-	-	211.0	-	-	-	-	-	-	-	-	-	211.0
Rock bass	14433.6	140.8	4196.5	3318.4	10362.0	5281.6	11775.0	12684.8	14506.5	8676.0	13667.5	29099.2	128141.9
Salvelinus sp. (Salmonidae)	-	-	-	-	*	43.0	-	-	-	-	18.2	-	61.2
Sea lamprey	100.0	-	101.6	249.7	*	-	89.4	-	-	-	369.4	2946.0	3855.4
Semotilus sp. (Cyprinidae)	-	-	-	-	-	-	80.6	-	-	-	-	-	80.6
Silvery minnow	-	-	4.6	-	-	-	-	-	-	-	-	-	4.6
Smallmouth bass	45026.4	252.0	8076.0	7228.8	1857.6	6172.8	2484.0	1537.2	11359.7	3953.0	3120.0	15115.8	106183.3
Splake trout	-	-	-	59.5	130.0	216.0	4332.0	3584.4	-	-	133.9	290.4	8746.2
Spottail shiner	5176.5	748.0	2356.2	3195.8	19001.9	30745.0	58903.0	4099.4	1953.0	741.0	421.2	825.0	128166.0
Stonecat	138.6	-	304.0	366.0	306.0	1336.0	2379.6	384.5	552.6	1408.0	241.2	2003.1	9419.6
Tadpole madtom	-	-	-	-	-	-	-	-	-	16.0	-	-	16.0
Threespine stickleback	33.6	35.2	4187.1	11316.6	72282.6	58493.6	19099.2	10.0	-	28.9	171.7	837.0	166495.5
Trout perch	63.0	4.2	664.2	38702.0	87247.4	22824.2	15691.4	1118.0	224.0	165.2	34.2	23.2	166761.0
Trouts (Salmonidae)	-	-	-	-	-	*	-	-	-	-	-	-	-
Unidentified	-	-	-	-	-	-	*	*	-	-	-	-	-
Walleye	213.4	-	-	4086.0	-	-	-	49.5	-	-	-	-	4348.9
White bass	8342.1	2366.0	54165.0	21724.2	17632.8	2325.6	470.4	-	*	399.9	13744.8	5254.6	126425.4
White crappie	-	-	-	-	11.2	-	-	-	-	-	-	-	11.2
White perch	36348.0	1620.1	17659.6	36521.1	63325.4	6463.8	18026.5	5673.6	9298.8	1998.7	17492.8	23603.4	238031.8
White sucker	361.0	-	-	979.3	7597.3	27143.2	56820.0	23078.4	43396.0	21172.8	2512.2	1497.6	184557.8
Yellow perch	7970.9	472.0	7211.4	24465.8	46425.2	4897.2	17275.0	14320.0	25039.0	11849.4	10103.2	13835.5	183864.6
TOTAL	492217.4	32482.9	796596.1	14571486.9	49254443.2	4301500.7	2865581.4	147694.8	166226.0	138595.0	867395.6	572032.1	74206252.1

[a] Grams; traveling screens only; estimated biomass = estimated monthly abundance multiplied by monthly mean biomass per species
- = Not applicable, fish of that species not collected
* = Fish collected during the month, but none analyzed

4. Impingement Cropping at FitzPatrick

The analysis of the impact of removing a number of fish from a population can be addressed in many different ways. In this demonstration the removal of fish by the FitzPatrick power plant is compared when available to (1) lake standing stock estimates, (2) commercial fishing removals, (3) stocking statistics for the species, and (4) exploitation rates based on tagging studies.

In 1976 the NYSDEC (Schneider 1977) conducted a forage fish stock estimate for the demersal portion of the alewife and rainbow smelt populations in the New York waters of Lake Ontario, which was divided into four sectors: (1) Eastern Outlet Basin Sector, extending from Stony Point Light north to the Cape Vincent Laboratory; (2) Oswego Sector, centered approximately at Oswego, N.Y., and extending east to the eastern shore and approximately the same distance west; (3) Rochester Sector, centered on Rochester, N.Y., and extending from Sodus Bay to approximately Thirty Mile Point; and (4) Wilson-Olcott Sector, extending from Thirty Mile Point to just west of the Niagara River. Within each sector replicate drags were conducted at the following depths: 5, 7, 10, 12, 15, 17, 20, 25, 30, 35, 40, and 50 fathoms; in addition, sector acreage estimates were made for each depth sampled. A 39-ft headrope yankee trawl was used, with these fishing dimensions: 21 ft for the sweep and 7 ft for maximum vertical opening. A standard ten-minute tow covered approximately 1.2 acres of bottom (Schneider 1977).

Trawl catches for each sector were separated into two or three depth strata, depending on their variation. For each depth stratum, average catch rates were calculated. The NYSDEC estimated standing stocks were developed by expanding the average catch per tow to total total fish per stratum (average catch x stratum average/1.2).

The average weight of each species was then expanded to a total weight per depth stratum, and summations made for the depth stratum and sector to give a total biomass (Schneider 1977).

For this analysis we converted the biomass values to numbers of fish by dividing the biomass by the average weight of the fish caught by NYSDEC. This was done for the Oswego Sector alone and for the total estimate for the four sectors combined, which represent 18% of the total New York State acreage of the lake. The standing stock estimates were extrapolated to the total New York State lake area by dividing by 0.18.

Storr (1977) has conducted mark-recapture experiments along the southern shore of Lake Ontario since 1972, marking and recapturing fish from North Sandy Pond on the eastern shore to Oswego, New York. Tag returns were also obtained from commercial and sport fisherman through a one dollar reward offering. In addition, as part of the impingement monitoring programs at FitzPatrick and Nine Mile Point impinged fish were examined for tagged fish.

A total of 20,897 fish representing 26 species have been tagged and released in the program to the end of 1976 and 1517 tages have been returned. All fish tagged during 1972 and 1973 were tagged in the immediate Nine Mile Point vicinity while from 1974 on fish were tagged at four locations in the study area. During 1974 approximately 83% of the fish tagged were released in the immediate Nine Mile Point vicinity where they would be immediately available for impingement at the Nine Mile Point plant. While no breakdown of the percentage of fish tagged at each location is available for the 1975 or 1976 data, the percentages can be assumed to be similar since the major tagging effort was at this location.

Storr (1977) has shown that, of all the species studies, only yellow perch demonstrate a true migratory pattern and these move toward the eastern end of the lake during winter to spawn in the spring. The rest of the species appear to move back and forth along the shore with little predictability. Rock bass, pumpkinseed, yellow perch, and brown bullhead ranged long distances, up to 70 miles, while smallmouth bass appeared to be territorial, generally remaining in a small area near the shoreline. White perch were observed to move moderately long distances ranging 20 miles east and west of the Nine Mile Point vicinity (Storr 1977).

The data presented by Storr (1977) are used in several ways: (1) to estimate a species domain, (2) to estimate annual mortality, and (3) as a means of approximating an exploitation rate by the FitzPatrick and Nine Mile Point plants. In analyzing the tag return data from impingement collections reference is made to Nine Mile Point since this plant has been in operation since the beginning of the tagging program and impingement collections have been examined for tag returns. Both plants impinge similar numbers of fish (Table V-1) and the use of Nine Mile Point tag returns provides an indication of expected impacts for FitzPatrick. These analyses are presented below along with analyses of standing stock data from NYSDEC data and other assessment methods by species.

a. Alewife

The NYSDEC data were used as described above and the resulting alewife standing stock estimates are presented in Table IVG-5. These estimates are only for the near bottom waters where the trawl fishes and are based on the assumption of 100% trawl efficiency. Edsall et al. (1974) in an analysis of the standing stock of alewives in Lake Michigan concluded that only 3% of the fish (80-139 mm long) taken in gill nets fished from surface to bottom in 26 fathoms were in the lower 40-ft of water. They,

therefore, used a factor of 10, based on the assumption that only 10% of the fish were in the lower 4 to 8 ft of the water column where the trawl fishes, to expand the standing stock estimates. In the results presented herein, we have estimated the alewife standing stock with and without the factor of 10 to show bottom trawled standing stocks and the full water column estimate (adjusted standing stock).

This analysis is open to two possible sources of error beside the fish location in the water column and the assumption of 100% gear efficiency. Namely the NYSDEC estimates extended only to 110-m depth contour while the standing stock estimates were extrapolated to the total New York State lake area by dividing by 0.18, since the NYSDEC estimates represent 18% of the total New York State lake area. This may result in an error if the total population estimate of the alewife is not uniformly distributed from shore to mid-lake.

Secondly, the average weight of the alewives collected by the NYSDEC was 27.2 g while the average weight of impinged fish was 18.0 g, indicating that a greater percentage of younger fish were present in impingement collections than were sampled by the trawl. The trawling program conducted by the NYSDEC either did not collect young fish (young-of-the-year and yearlings) or natural mortality of these ages had occurred by the time of the trawling and the average weight reflects the true average weight/individual of the reamining stock. The NYSDEC trawling program was conducted between 18 October and 12 November 1976, late enough in the year so that mortality of young fish stock could have occurred, whereas impingement collections at Fitz-Patrick were conducted throughout the year. Thus, the NYSDEC stock estimate may not be representative of the populations

affected by FitzPatrick impingement; however, no stock estimates are available for other times of the year. The former hypothesis that the NYSDEC simply did not collect younger fish is supported by several observations. Smith (1968) stated that younger alewives reside in the water column off the bottom for at least the first year of life. Secondly, the NYSDEC stated that many targets were observed with hydroacoustic equipment in the upper water column at the time of the surveys in the Rochester area. Thirdly, Wells (1968) found alewives in the water column throughout the year in Lake Michigan. It appears, therefore, that the trawling conducted by NYSDEC would result in an underestimate of the true standing stock since a large portion of the population would be above the bottom waters sampled by the trawl. This is additional evidence supporting the use of the multiplier to estimate total standing stock from bottom trawls. The evidence on alewife distribution in the water column, the weight differential between impinged and netted fish, and the assumption of 100% gear efficiency all support the use of the stock adjustment. The adjusted stocks are still considered conservative estimates of the true standing stock.

Alewife impingement cropping was determined by dividing the estimated yearly impingement by the NYSDEC standing stock estimates. The results indicate that the FitzPatrick plant crops between 0.32 and 3.2% of the alewives estimated to be within the Oswego Sector, between 0.17 and 1.7% of the alewives in the sampled New York waters (inshore of the 100-m depth contour), and 0.03 to 0.3% of the total New York waters stock estimate (Table IVG-15). To summarize, these estimates should be considered conservative; i.e., they overestimate impact because (1) the distribution of the fish makes a large percentage of them not vulnerable to the gear, (2) no gear avoidance

TABLE IVG-15

STANDING STOCK ESTIMATES FOR ALEWIVES AND RAINBOW SMELT IN THE NYSDEC'S OSWEGO SECTOR, ALL OF NEW YORK STATE'S WATER TO 110 m AND THE TOTAL U.S. LAKE AREA[a]

SPECIES	LOCATION	NUMBER IMPINGED	AVERAGE WEIGHT OF IMPINGED FISH (g)	AVERAGE WEIGHT OF NYSDEC FISH (g)	STANDING STOCK	ADJUSTED[d] STANDING STOCK	PERCENT CROPPED STANDING STOCK	PERCENT CROPPED ADJUSTED STANDING STOCK
ALEWIFE	OSWEGO SECTOR	3,877,550	18.0	27.2	122,998,300	1,229,983,000	3.17	0.32
	NEW YORK STATE WATERS TO 100 m[b]				226,083,000	2,260,830,000	1.71	0.17
	LAKE-WIDE (U.S. ONLY)[c]				1,256,021,000	12,560,210,000	0.31	0.03
RAINBOW SMELT	OSWEGO SECTOR	259,783	6.7	22.2	11,703,510	117,035,100	2.22	0.22
	NEW YORK STATE WATERS TO 110 m[b]				17,902,650	179,026,500	1.45	0.15
	LAKE-WIDE (U.S. ONLY)[c]				99,459,000	994,590,000	0.26	0.03

[a] Data from Schneider, 1977
[b] Represents 18% of U.S. lake surface area
[c] Extrapolated to 100% of U.S. lake surface area
[d] Standing stock from bottom trawl collections multiplied by 10 for upper water column fish

factor was used by the NYSDEC, and (3) the fish impinged were of smaller size (weight) representing younger fish which were not included in the standing stock estimate. In addition, the lower cropping ratios based on the more representative stock estimates is judged the more realistic of the two for both species.

b. Rainbow Smelt

The NYSDEC forage fishing standing stock estimate included an estimate of the rainbow smelt stock. The standing stock data derived in this section were calculated in the same manner as the alewife data. The results, therefore, may be subject to the same conservative error as the alewife results.

Annual rainbow smelt impingement at FitzPatrick represented a cropping of 2.2% of the October-November standing stock estimate in the Oswego sector, 1.5% of the smelt stock in the sampled New York State waters (inshore of the 110-m depth contour), and 0.3% of the estimated total New York State stock (Table IVG-15). When the stock adjustment factor of 10 is included, these estimates drop to 0.22, 0.15, and 0.03% for the Oswego Sector, sampled U.S. waters, and all U.S. waters, respectively. As stated above, we believe that the use of the adjusted stock numbers yields a more realistic evaluation of impact while still using a conservatively low stock estimate.

c. Yellow Perch

In order to analyze the potential effect of impingement cropping on the yellow perch population an exploitation rate based on the number of tagged fish recovered in impingement collections compared to the number of tagged fish available in the lake can be calculated.

Although yellow perch tagging began in 1972, no tagged yellow perch were recovered in impingement collections at either the FitzPatrick or Nine Mile Point plants prior to 1976. During 1976 two tagged fish were recovered at Nine Mile Point and one at FitzPatrick. Since sampling at both plants took place on three of every seven days during the year the estimated number of returns is calculated to be 5 and 2 at Nine Mile Point and FitzPatrick, respectively.

The total number of tagged fish available in 1976 was calculated from Storr (1977) by bringing forward in time the total tagged in each year adjusted for calculated mortality between years, and adding the subsequent years tagging effort. This calculation results in an estimated number of tagged yellow perch available in 1976 of 1232 fish. The two fish impingement estimate at FitzPatrick then represents an impingement exploitation rate of 0.19% of the available yellow perch. When compared to an average exploitation rate of 7.41% (Storr 1977) based on other fishing efforts (total tag returns) the impact of impingement catch is negligible. Based on the total number of yellow perch impinged during 1976 (3695 fish, Table IVG-13) and the New York State commercial catch of 23,840.9 kg (NYSDEC 1977) which represents 478,000 fish based on an average weight of 49.8 g/fish, impingement at FitzPatrick during 1976 represented 0.77% of the commercial harvest.

Therefore, it is concluded that impingement cropping of yellow perch by FitzPatrick has an insignificant effect on the population when compared to other existing pressures.

d. White Perch

Storr (1977) has tagged a total of 1,421 white perch in the vicinity of the FitzPatrick plant from 1972 to 1976 of which 488 were tagged in 1976 (Storr 1977). Only one tagged white perch has been recovered in FitzPatrick impingement collections (collected during April 1977) as of 31 July 1977 with no tag returns observed at the Nine Mile Point plant. Since annual mortality rates for tagged fish were not computed for white perch it is not possible to determine the total number of tags available at the time of the recovery in 1977 but using an assumed 50% mortality rate and considering only those fish tagged during 1976 an exploitation rate of 0.82% would result after adjustment for impingement sampling frequency. This is an overestimate of the exploitation rate since no tagged fish from years prior to 1976 are included. In addition, the lack of any tagged fish in Nine Mile Point impingement studies which have been ongoing since 1973 would indicate that impingement cropping of white perch is negligible.

A total of 20,525 kg of white perch were harvested by commercial fisherman from New York State waters of Lake Ontario during 1976 (NYSDEC 1977). Assuming an average weight of 32.4 g/fish (from 1976 impingement at FitzPatrick), a total of 633,487 fish were harvested. James A. FitzPatrick impingement during 1976 amounted to 7,339 fish. Thus, commercial fishing resulted in 86.3 times the cropping of James A. FitzPatrick impingement or impingement was 1.16% of commercial fishing. Thus the available data indicate that impingement cropping at FitzPatrick is minimal when compared to available fish in the area or commercial fishing pressure.

e. Smallmouth Bass

Storr (1977) has tagged 126 smallmouth bass since 1972 and yet none have been collected from the traveling screens at the FitzPatrick or Nine Mile Point plants through July 1977. Since the majority of these fish were tagged and released in the immediate vicinity of the two intakes, the lack of any recoveries in impingement collections would indicate that the plants do not have a significant effect on the local smallmouth bass population.

No commercial catch statistics are available for smallmouth bass so comparisons to commercial harvest were not possible, however, Storr (1977) has had 19 tages returned of a total of 126 smallmouth bass tagged. These tags, for the most part, were returned by commercial and sport fisherman and an exploitation rate of 15.1% can be assessed to commercial and sport fishing. Thus, based on the lack of any tag returns in impingement collections cropping by the plants would be at least an order of magnitude less than that by other fishing pressures.

f. Threespine Stickleback

Since no standing stock or tagging data are available for the threespine stickleback, impingement cropping rates cannot be calculated. However, the increasing local population of this species noted in Section IVG-1f indicates that impingement cropping is not adversely affecting this species.

g. Coho Salmon

Coho salmon do no occur naturally in Lake Ontario, but are stocked by various state and federal agencies. Thus, the only

population size data available are from stocking statistics. Impingement at FitzPatrick is therefore compared to stocking conducted by the NYSDEC.

An estimated total of two coho salmon were impinged during 1976 at the FitzPatrick plant. The NYSDEC stocked approximately 813,000 coho in 1975 and 177,575 in 1976. The two fish impinged at James A. FitzPatrick represent only 0.0002 and 0.001% of the fish stocked during 1975 and 1976, respectively.

h. Brown Trout

The brown trout is not native to North America but was introduced into New York during the 19th century. Recently, Lake Ontario stocks have been maintained by New York and Canadian stocking programs. Therefore, cropping at the FitzPatrick Power plant is compared to New York State stocking statistics.

An estimated 20 brown trout were impinged during 1976 at the James A. FitzPatrick power plant. The NYSDEC stocked 310,751 brown trout during 1976 and FitzPatrick impingement represents 0.006% of the stocked fish.

i. Lake Trout

The lake trout is a natural inhabitant of Lake Ontario, but the population has undergone a severe decline over the last 50 years and today is maintained by stocking. No population estimate for lake trout is available, and thus, the stocking statistics were used to compare to impingement.

An estimated 13 lake trout were impinged at James A. FitzPatrick Power plant during 1976. During 1976 the NYSDEC stocked 336,920 lake trout. The percent removal by FitzPatrick was 0.004%.

j. Brown Bullhead

An estimated 229 brown bullhead were impinged at James A. FitzPatrick Power plant during 1976. Commercial fishing during 1976 resulted in the catch of 8472.5 kg, or, with an average weight of 172 g/fish, a total of 49,255 fish. This represents 215 times the impingement cropping at the FitzPatrick plant; stated another way, FitzPatrick cropping is 0.46% of the commercial fish cropping.

Storr (1977) has tagged 8302 brown bullhead since 1972 and of these one has been collected from the traveling screens at the FitzPatrick Power plant (collected 15-16 October 1977). No tagged fish were observed in Nine Mile Point impingement collections. Since annual mortality was not calculated for the brown bullhead no estimate of the total number of tagged fish available during 1976 can be made. If only those fish tagged during 1976 (3171 fish, Storr 1977) are considered, an exploitation rate of 0.06% results when the tag return is adjusted for sampling frequency. This number is a low estimate of cropping since surviving tagged fish from previous years are not included in the available tagged fish estimate. In comparison, 325 brown bullheads have been returned to Storr (1977) by commercial and sport fisherman over the study period and this results in an exploitation rate of 3.91%. The commercial and sport fishing exploitation is therefore 65 times the exploitation rate of the FitzPatrick power plant.

k. Other Species

Of the other species of fish tagged since 1972 by Storr (1977) in significant numbers (pumpkinseed 3661 fish, rock bass 1954 fish; white sucker 372 fish; bluegill 530 fish) none except rock bass have been observed in impingement collections at the FitzPatrick or Nine Mile Point plants. One rock bass was observed at each power plant. These results indicate that impingement cropping of these additional species in the Nine Mile Point area is negligible.

5. Summary of Impingement Cropping Impacts

The potential impacts of impingement losses was determined for each of the designated representative important species as well as for several additional species for which there existed sufficient data. Impacts were quantified by various methods depending on the available data for each species such as standing stock estimates,local tagging studies, lake stocking information, and commercial fishing harvest. The lake standing stock estimates were obtained from the NYSDEC's trawl study with an adjustment made for vertical fish distribution. The tagging results represent five years worth of tagging and recapture effort by Storr (1977) and impingement monitoring at both Nine Mile Point Unit 1 and FitzPatrick. Lake stocking and commercial catch data were from NYSDEC.

Total estimated 1976 impingmeent of alewife and rainbow smelt at FitzPatrick both represented 0.03% of their respective estimated standing stocks in the U.S. waters of Lake Ontario. Both stock estimates are thought to be low due to gear avoidance and population distribution. Yellow perch impingement was found to be equivalent to 0.77% of the 1976 U.S. commercial catch. The yellow perch

tagging study results indicated that impingement affects approximately 0.19% of the available fish in the vicinity of the plant. White perch impingement at FitzPatrick during 1976 was equivalent to 1.16% of the commercial harvest and affected 0.82% of the available fish in the vicinity of the plant based on the tag results. Since no tags were observed on impinged smallmouth bass at either the FitzPatrick or Nine Mile Point plants during the entire tagging and impingement study period, it was concluded that impingement losses are negligible relative to the available fish. Although no stock information or tagging data were available for the threespine stickleback, the increasing local abundance of the species over the previous four years as monitored by impingement catches, indicates that impingement is not having significant adverse impact. Annual estimated impingement of coho salmon, brown trout, and lake trout represented 0.0002, 0.006, and 0.004% of the fish stocked for each species, respectively. Annual impingement of brown bullheads was equivalent to 0.46% of the commercial harvest and represented approximately 0.06% of the available fish based on the tagging results. Since no tagged fish of the other species tagged in the area in sufficient numbers (pumpkinseed, rock bass, white sucker, and bluegill) were collected in impingement samples. Impingement losses of these species are considered negligible.

V. CUMULATIVE LAKE ONTARIO IMPINGEMENT IMPACT ON REPRESENTATIVE IMPORTANT SPECIES

A. INTRODUCTION

Analysis of the effect of the removal of fish from a water body should consider the losses from all sources. This section presents the results of the analysis of impingement losses at all operating steam electric generating stations on Lake Ontario for those species designated as representative important by U.S. EPA.

There are nine power plants operating on Lake Ontario (Table V-1). Data for Ontario Hydro power plants were derived from a monthly weight of impinged fish (Ontario Hydro 1977a, 1977b). Also, for the Canadian plants, the classification of "herring" was used and included both alewives and gizzard shad, while the "yellow perch" category included walleye. It was judged that the inclusion of these species would not significantly bias the results since gizzard shad impingement usually represents a low percentage of alewife impingement on Lake Ontario and walleye are rarely impinged.

Where 1976 data were not available, such as for the Ginna station, Oswego Steam Station Units 1-4, and Unit 5, 1975 data were used (LMS 1976; Storr 1976).

One assumption for this type of lake-wide analysis is that each species under study is composed of only one population in the lake and not several populations. This permits the impact from all power plants to be compared against the lake-wide population estimate. However, when two or more breeding populations have been identified, as in the case of the yellow perch, then the impacts of those power plants within the range of a population must be considered separately from the impact of plants outside that range.

TABLE V-1

ESTIMATED ANNUAL IMPINGEMENT AT THE NINE OPERATING STEAM ELECTRIC GENERATING STATIONS ON LAKE ONTARIO

PLANT	YEAR	ALEWIFE	RAINBOW SMELT	YELLOW PERCH	SMALLMOUTH BASS	THREESPINE STICKLEBACK	BROWN TROUT	COHO SALMON
JAMES A. FITZPATRICK	1976	3,877,550	259,783	3,695	511	95,883	20	2
NINE MILE POINT	1976	3,060,589	136,151	3,346	272	152,628	33	2
OSWEGO UNIT 5	1975	1,146,834	41,121	496	15	121,314	29	0
OSWEGO UNIT 1-4	1975	422,216	26,555	643	82	479	31	0
GINNA	1975	361,474	130,258	485	77	35,243	30	0
LAKEVIEW	1976	81,810	7,890	4	15	N.A.	N.A.	N.A.
HEARN	1976	552,680	72,978	11	12	N.A.	N.A.	N.A.
PICKERING	1976	2,269,267	59,842	811	399	N.A.	N.A.	N.A.
LENNOX	1976	27,538	20,187	1,551	12	N.A.	N.A.	N.A.
TOTAL		11,799,958	754,765	11,042	1,395	405,547	143	4

N.A. = Not available

1. Alewife

For the purposes of the lake-wide assessment it is assumed that the alewife represents one population (one genetic stock), and therefore the effects of all the lake's power plants are combined as a single effect on one population. This assumption is supported by Wells (1968) and Smith (1968) both of whom showed that the alewife quickly establishes large numbers throughout a lake when introduced. Observations by Wells (1968) and CDM/Limnetics (1977) of both adult and larval alewife around Lake Michigan indicate that the population is lake-wide. In addition, the recent introduction of the aleiwfe to Lake Ontario (1800's) suggest that this species would not have sufficient time for the development of distinct populations in the lake.

The estimated annual impingement of alewives by all Lake Ontario power plants is given in Table V-1. A lake-wide total of 11,749,958 fish are impinged during a typical year. This rate can be compared to a total Lake Ontario stock estimate of 26.63 x 10^9 fish. The total lake estimate was calculated by assuming that alewife are equally abundant in U.S. and Canadian waters and therefore the U.S. standing stock estimate was expanded to the total lake by multiplying it by the ratio of the total lake area (19,528 km^2) to the U.S. lake area (9220 km^2). This resulted in lake-wide population estimates 2.12 times the U.S. estimate.

The assumption of similar abundances in U.S. and Canadian waters is supported by the results of the GLFL 1972 study (GLFL 1972) which showed similar catch/effort results in U.S. and Canadian waters. As discussed in Chapter IV, the adjusted standing stock is judged to be more representative since it accounts for the vertical distribution of fish in the lake. Based on the above, the annual impingement of

alewife by all the power stations on Lake Ontario results in a cropping of 0.04% of the estimated lake-wide population of alewife.

As discussed in Chapter IV cropping rates based on the estimated population are probably quite conservative since the standing stock estimate included primarily age class I and older fish whereas impingement records, at least at the Nine Mile Point and FitzPatrick plants, showed the presence of a large percentage of young-of-the-year and yearling fish. Secondly, it is well known that fish avoid trawls, and although the exact percentage caught has not been documented estimates of avoidance traditionally range from 10 to 90%. Avoidance by the fish of the gear also results in an under-estimated standing stock and a conservative lake-wide cropping estimate.

2. Rainbow Smelt

As with the alewife, the rainbow smelt was assumed to consist of one lake-wide population, and therefore the cropping of all power plants were considered together. The assumption of a lake-wide population is supported by observations of increased numbers of smelt at all plants during their spring spawning. The annual lake-wide loss of rainbow smelt due to impingement is estimated to be 732,676 fish (Table V-1) while the standing stock estimate computed as described for the alewife is approximately 2.1 billion (Table V-2). Lake-wide cropping was calculated to be 0.04%.

This estimate should be considered conservative for the same reasons specified for the alewife, i.e., the standing stock estimate is based toward older fish.

While both the alewife and rainbow smelt analysis rely on a somewhat crude lake-wide population estimate the resulting cropping factors

TABLE V-2

ESTIMATED CROPPING RATES OF THE NINE LAKE ONTARIO OPERATING STEAM ELECTRIC GENERATING STATIONS

SPECIES	ANNUAL IMPINGEMENT	LAKE STANDING STOCK OR POPULATION ESTIMATE	PERCENT CROPPED
ALEWIFE	11.80×10^6	26.63×10^9	0.04
RAINBOW SMELT	0.75×10^6	2.11×10^9	0.04
YELLOW PERCH	8665[a]		0.70[c]
BROWN TROUT	143[a]	310,751[b]	0.05
COHO SALMON	4[a]	177,575[b]	0.002

[a]U.S. power plants only
[b]Number stocked by NYSDEC-1976
[c]Based on tagging studies

indicate that within an order of magnitude error, less than 1% of either population is cropped by impingement.

3. Yellow Perch

Two spawning populations of yellow perch have been identified in Lake Ontario. Tagging results revealed that one population spends the summer and fall along the southern shore of the lake and travels during the winter to the eastern shore, where spawning occurs in the spring (Storr 1977a). A second population spawns in the Bay of Quinte (Griffiths 1976) and spreads along the northern shore of the lake during the summer and fall. Thus, the cropping of the two populations must be considered separately. Storr's (1977) data indicated that little exchange occurs between the populations and the southern population is limited in range from North Sandy Pond to Rochester, N.Y. Therefore, only the impact of the U.S. power plants on the southern yellow perch population is considered.

The yellow perch annual impingement data in Table V-1 shows the highest numbers of yellow perch being impinged in the Nine Mile Point area when compared to the other U.S. plants. Nine Mile Point and FitzPatrick combined impingement accounts for 81% of the yellow perch impinged by U.S. plants. Based on tag returns in impingement collections relative to available tags, the Nine Mile Point and FitzPatrick combined impingement totals represent 0.57% of the available fish along the southern shore of the lake. If the total impingement at all U.S. plants is assumed to effect the yellow perch in a similar manner, the resulting exploitation rate would be 0.70%. It is of interest to note that Storr (1977a) has tagged 28 yellow perch in the immediate vicinity of the Ginna station and none have been returned in impingement collections. By way of comparison, the 1976 commercial harvest of yellow perch was 478,000 fish (NYSDEC

1977) or 55 times the total U.S. impingement losses. Thus, impingement losses are equivalent to 1.81% of the commercial catch. The continued success of the yellow perch population under both the commercial and sport fishery pressure is evidence that the relatively minimal impingement losses have not affected the population.

4. Smallmouth Bass

Although smallmouth bass were present in impingement collections at all plants around the lake, Storr (1977a and 1977b) tagging data for the species indicates that they tend to remain in one local. Since no population estimates are available on either a lake-wide or local basis, the tagging studies along the southern shore furnish the only possibility for quantification of impingement impacts. Storr (1977a and 1977b) has tagged a total of 228 smallmouth bass along the southern shore of the lake with 99 released in the vicinity of the Ginna station and 129 released near the Nine Mile Point and FitzPatrick plants. No tagged fish have been observed in impingement collections from any of the plants while 10-15% (Storr 1977a and 1977b) have been returned by other fishing methods. These data indicate that the impingement losses of smallmouth bass, which amount to only 1395 fish annually for the entire lake, do not have any measurable effect on either the lake-wide population or the local population in the vicinity of each plant.

5. Threespine Stickleback

Since no population estimates or tagging data are available for the threespine stickleback no estimate of impingement cropping could be made. The increasing numbers of the species observed in impingement catchs (see Section IVG) suggests that the population is increasing and thus not being adversely affected by impingement.

6. Brown Trout

Because the Canadian plants list all of the salmonids impinged together, a separate estimate of annual impingement by species is not possible; therefore, only the impingement at the U.S. plants was considered.

A total of 143 brown trout were impinged at the U.S. plants. The only population estimate available for comparison is the number of fish stocked in 1976 by the NYSDEC, 310,751 fish. The proportion of impinged fish to stocked fish was 0.05% (Table V-2). This level of impingement loss is considered negligible in relation to both fishing pressure and natural mortality.

7. Coho Salmon

Only four coho salmon were recorded from the impingement collections reported and this figure represented 0.002% of the 177,575 fish stocked in 1976.

8. Studies from Other Water Bodies

One method of determining the reasonableness of the foregoing lake-wide analysis is to compare the results to similar analyses conducted for power plants located on another similar water body. CDM/Limnetics (1977) conducted a lake-wide assessment of impingement on Lake Michigan for 82 species of fish. Included in these analyses were lake-wide impingement cropping estimates for alewife and rainbow smelt. There are 17 utility power stations surrounding Lake Michigan from which impingement data were collected. An estimate of alewife standing stock was conducted in a manner similar to that conducted herein (Chapter IV) and resulted in an estimated lake-wide

cropping of 0.064%. Impingement cropping of alewives by Lake Ontario power plants was estimated at 0.09%. Thus, the estimates of impingement for the two lakes are similar.

Rainbow smelt impingement on Lake Michigan resulted in an estimated cropping of 0.067% in 1973 and 0.065% in 1974. The Lake Ontario estimate was 0.07% for 1976. Therefore, the rainbow smelt cropping estimates calculated for the two lakes are also similar. The excellent agreement between these two studies as well as the minimal cropping rates found indicate that for these two species, impingement cropping has a minimal if not negligible effect.

The lake-wide cropping data presented above can be compared to exploitation rates for other species as a means of examining the relative impact of impingement on Lake Ontario to other sources of impact. For example, McFadden (1977) presented a list of 67 exploitation rates on 33 fish species from around the world (Table V-3). The lowest exploitation rate listed is 5% for walleye from Fife Lake, Michigan and the average exploitation rate for all lakes combined was 27%. These data resulted for the most part from commercial and sport fishing pressures on various populations which were judged to be sustaining the pressure without population decline. In all cases the exploitation rates calculated for the representative important species on Lake Ontario are an order of magnitude less than those given by McFadden. Thus, impingement cropping from Lake Ontario fish populations must be considered insignificant when contrasted with the pressure placed on fish populations by commercial and sport fisheries. This was also shown to be the case on a species by species analysis conducted in Chapter IV.

TABLE V-3

SUMMARY OF PUBLISHED* ESTIMATES OF EXPLOITATION OF FISH POPULATIONS

EXPLOITATION RATE (%)	NAME OF SPECIES SCIENTIFIC	COMMON	LOCATION	REFERENCE
25	Lepomis macrochirus	Bluegill	Sugar Loaf Lake, Mich.	Cooper and Latta 1954
36			Spear Lake, Ind.	Ricker 1955
35			Gordy Lake, Ind.	Gerking 1953
15-20			Muskellunge Lake, Ind.	Ricker 1945
29	Lepomis microlophus	Redear sunfish	Gordy Lake, Ind.	Gerking 1953
23			Muskellunge Lake, Ind.	Ricker 1945
11	Pomoxis nigromaculatus	Black crappie	Oliver Lake, Ind.	Gerking 1953
36	Micropterus salmoides	Largemouth bass	Gordy Lake, Ind.	Gerking 1953
12			Shoe Lake, Ind.	Ricker 1945
17			Oliver Lake, Ind.	Gerking 1950
20-48			Southerland Res., Calif.	LaFaunce et al. 1964
20			Clear Lake, Calif.	Kimsey 1957
14			Gladstone Lake, Minn.	Maloney et al. 1962
22	Micropterus dolomieui	Smallmouth bass	Waugoshance Point, L. Mich.	Latta 1963
5-18			Oneida Lake, N.Y.	Forney 1961
16	Ambloplites rupestris	Rock bass	Oliver Lake, Ind.	Gerking 1950
5	Stizostedion vitreum	Walleye	Fife Lake, Mich.	Schneider 1969
15-28			Spirit Lake, Ia.	Rose 1947; 1955
20-40			Escanaba Lake, Wis.	Patterson 1953; Niemuth et al. 1959
27			Many Point Lake, Minn.	Olson 1957
32	Esox lucius	Northern pike	Murphy Flowage, Wis.	Snow 1958
50			Wisconsin waters	Threinen et al. 19
14			Lake George, Minn.	Groebner 1964
32-49			Grove Lake, Minn.	Groebner 1964
23			Ball Club Lake, Minn.	Johnson and Peterson 1955
22-28			Grace Lake, Minn.	Wesloh and Olson 1962
38			Fletcher Floodwater, Mich.	Christensen and Williams 1959
40	Coregonus clupeaformis	Lake whitefish	Georgian Bay, L. Huron	Cucin and Regier, 1965
21			Lake Superior	Dryer 1964
13-17	Salmo gairdneri	Rainbow trout	New York streams	Hartman 1959
20-26			New York lakes	Hartman 1959
19-75	Salvelinus fontinalis	Brook trout	Lawrence Creek, Wis.	McFadden 1961
30	Ictalurus punctatus	Channel catfish	Sacramento Valley, Calif.	McCammon and LaFaunce 1961
25	Ictalurus nebulosus	Brown bullhead	Shoe Lake, Inc.	Ricker 1945
49	Pleuronectes platessa	Plaice	North Sea, 1929-38	Beverton and Holt 1957
33			1950-64	Gulland 1968
31	Hippoglassoides platessoides	American plaice	Gulf of St. Lawrence	Poweles 1969

TABLE V-3 (Continued)

SUMMARY OF PUBLISHED* ESTIMATES OF EXPLOITATION OF FISH POPULATIONS

EXPLOITATION RATE (%)	NAME OF SPECIES SCIENTIFIC	COMMON	LOCATION	REFERENCE
[illegible]9	Clupea harengus	Atlantic herring	South coast, Ireland 1906-36	Burd and Bracken 1965
10	-		1951-55	
42			1956-60	
25			1961-63	
19	Cynoscion nebulosus	Spotted seatrout	Pine Island Fla., 1961	Iversen and Moffett 1962
40	Pseudotolithus typus Pseudotolithus senegalensis		Coast of Nigeria, 1961-62	Longhurst 1964
11	Gadus morhua	Atlantic cod	Gulf of St. Lawrence 1949-52	Paloheimo and Kohler 1968
25			1955-65	
49	Tilapia esculenta		L. Victoria, Africa 1958-59	Garrod 1963
42			1959-59	
32			1959-60	
34			1960-60	
25	Alosa sapidissima	American shad	Connecticut River, Conn.	Walburg 1960
47 58 31	Aplodinotus grunniens	Freshwater drum	Upper Miss. R. impoundments, 1944-48	Butler 1965
11	Micropterus salmoides	Largemouth bass	Browns Lake, Wis., 1953	Mraz and Threinen 1957
[illegible]5	Salmo salar	Atlantic salmon	Little Codroy River Nfld, 1955-63	Murray 1968
59	Salvelinus fontinalis	Brook trout	Sydenham River, Ont., 1966-67	Marshall and MacCrimmon 1970
23	Salmo trutta	Brown trout	Sydenham River, Ont., 1966-67	Marshall and MacCrimmon 1970
7	Stizostedion vitreum	Walleye	Nipigon Bay, L. Superior, 1955	Ryder 1968
13			1956	
34			1957	
14-70	Esox masquinongy	Muskellunge	Nogies Creek, Ont. 1952-60	Muir 1963
29	Stizostedion vitreum	Walleye	Escanaba Lake, Wis. 1946-69	Kempinger et al. 1975
46	Esox lucius	Northern pike		
27	Esox masquinongy	Muskellunge		
15	Perca flavescens	Yellow perch		
29	Lepomis gibbosus	Pumpkinseed		
21	Ambloplites rupestris	Rock bass	Escanaba Lake, Wis. 1946-69	Kempinger et al. 1975
42	Lepomis macrochirus	Bluegill		
[illegible]	Pomoxis nigromaculatus	Black crappie		

*From McFadden (1977, Table 10.3-1)

It can then be concluded that current impingement losses attributable to FitzPatrick and the other plants on Lake Ontario have no measurable direct or indirect impact on the present sport or commercial fisheries.

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