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Nuclear Power Plant
P.O. Box 41
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New York Power Authority

Harry P. Salmon, Jr.
Resident Manager

July 9, 1992
JAFP-92-0522

New York State Department of
Environmental Conservation
50 Wolf Road
Albany, New York 12233

Attention: Mr. James Colquhoun
Chief, Bureau of Environmental Protection

SUBJECT: 1991 ANNUAL BIOLOGICAL MONITORING REPORT
FOR THE JAMES A. FITZPATRICK NUCLEAR POWER PLANT
SPDES PERMIT NO. NY0020109

Gentlemen:

Attached is the 1991 Annual Biological Monitoring Report. This report is submitted in accordance with Part 1, Additional Requirement 11(a-h) of SPDES Permit No. NY0020109 for the James A. FitzPatrick Nuclear Power Plant.

If you have any questions concerning the enclosed report, please contact Mr. Alan McKeen of the plant staff at (315) 349-6703.

Very truly yours,

HARRY P. SALMON, JR.

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New York Power Authority

June 1992

FINAL

SPDES Annual Biological Monitoring Report

James A. FitzPatrick Nuclear Power Pla

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New York Power Authority

June 1992

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SPDES Annual Biological Monitoring Report

James A. FitzPatrick Nuclear Power Plant

1991

EA Engineering, Science, and Technology

EA Project No. 60224.01

Final

James A. FitzPatrick Nuclear Power Plant
1991 SPDES Annual
Biological Monitoring Report
SPDES Permit No. NY0020109, Section 11

Prepared for

New York Power Authority
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June 1992

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EXECUTIVE SUMMARY

This report presents the results of impingement abundance studies conducted during 1991, as required by the State Pollutant Discharge Elimination System (SPDES) Permit No. NY 002 0109, Section 11 (dated 1 August 1991) for the James A. FitzPatrick Nuclear Power Plant (JAFNPP).

Impingement abundance was monitored between 4 and 20 days per month, for a total of 79 samples in 1991. An occurrence of upwelling necessitated one additional impingement collection during 1991. The additional sample was collected in July 1991.

Impingement sampling at JAFNPP during 1991 resulted in the collection of 55,569 organisms (including damaged individuals). The collection was categorized into 42 fish species and 1 fish taxa identified to genus (*Cottus*). Two invertebrate taxa (crayfish [Cambaridae] and clam [Mollusca]) were also represented in the 1991 samples. One amphibian, the mudpuppy (*Necturus* sp.) was collected in an impingement sample in May 1991. Alewife was the most numerous species (36,816), comprising 66 percent of the total catch. Alewife, rainbow smelt, spottail shiner, and trout-perch accounted for 94 percent (52,433) of the sample collections.

1. INTRODUCTION

James A. FitzPatrick Nuclear Power Plant (JAFNPP) is located on the shore of Lake Ontario approximately 11 km (7 mi) northeast of the City of Oswego, New York. JAFNPP is an 821-MWe boiling water reactor.

The water intake structure is located 274 m (900 ft) offshore in approximately 7.3 m (24 ft) of water; the discharge structure, with a 236-m (774-ft) diffuser, is located 334 m (1,100 ft) offshore in approximately 9.1 m (30 ft) of water.

Water enters the intake and flows through trash racks, which are spaced approximately 7.5 cm (3 in.) apart and used for removing large items such as logs, and then through 9.5-mm (3/8-in.) mesh traveling screens, which are used for screening out smaller materials. Periodically, the traveling screens are rotated and washed to remove impinged organisms or other material into a sluiceway and then into an impingement collection basket. Impingement of aquatic organisms at JAFNPP has been monitored annually since 1975 in order to estimate species abundance and composition. The composition of the impingement collections has ranged from 26 to 54 fish species per year. Alewife and rainbow smelt generally have been the most abundant fishes in the impingement collections. Of the remaining species found in impingement collections, white perch, gizzard shad, trout-perch, spottail shiner, and tessellated darter were most numerous.

This report presents the results of impingement abundance studies conducted in 1991 as required by the State Pollutant Discharge Elminiation System (SPDES) Permit No. NY 002 0109, Section 11 (dated 1 August 1991) for JAFNPP.

Impingement abundance was monitored between 4 and 20 days per month, for a total of 79 samples in 1991.

As required by correspondence from the New York Power Authority (NYPA) to the Nuclear Regulatory Commission (NYPA 1981), all impingement samples are checked for the presence of the Asiatic clam (*Corbicula* sp.). No *Corbicula* sp. molluscs were found in the 1991 impingement collections.

2. METHODS AND MATERIALS

2.1 SCHEDULE (PERMIT SECTION 10.a)

In accordance with Permit Section 10.a, impingement collections were scheduled for 78 days between 1 January and 31 December 1991 as listed below:

Month	Number of Days*
JAN	4
FEB	4
MAR	4
APR	16
MAY	20
JUN	4
JUL	4
AUG	6
SEP	4
OCT	4
NOV	4
DEC	4
Total	78

* Days assigned within each month were selected randomly using random numbers tables (Rand Corporation 1955).

Stratified random samples were collected over a 24-hour period. Sample dates were scheduled such that no more than 10 days occurred between samples. Table 2-1 lists the scheduled sampling dates.

In 1991, the 78 scheduled impingement samples were successfully completed. There were four occasions when samples were rescheduled and successfully collected on alternate dates. Two of these dates occurred in December due to maintenance conducted on the traveling screens while JAFNPP was shut down. The other rescheduled impingements occurred in April and May; one in each month. Details of all rescheduled samples are given in Appendix A.

TABLE 2-1 SCHEDULED AND COMPLETED IMPINGEMENT SAMPLES BY DATE FOR THE JAMES A. FITZPATRICK NUCLEAR POWER PLANT, 1991

Scheduled Sample	Completed Sample	Scheduled Sample	Completed Sample	Scheduled Sample	Completed Sample
03 JAN	03 JAN	02 MAY	02 MAY	02 AUG	02 AUG
10 JAN	10 JAN	03 MAY	03 MAY	07 AUG	07 AUG
18 JAN	18 JAN	04 MAY	04 MAY	15 AUG	15 AUG
28 JAN	28 JAN	06 MAY	06 MAY	16 AUG	16 [illegible]G
		07 MAY	07 MAY	22 AUG	22 AUG
06 FEB	06 FEB	08 MAY	08 MAY	30 AUG	30 AUG
15 FEB	15 FEB	10 MAY	10 MAY		
22 FEB	22 FEB	11 MAY	11 MAY	04 SEP	04 SEP
27 FEB	27 FEB	12 MAY	12 MAY	12 SEP	12 SEP
		14 MAY	14 MAY	17 SEP	17 SEP
07 MAR	07 MAR	15 MAY	20 MAY*	25 SEP	25 SEP
15 MAR	15 MAR	16 MAY	16 MAY		
22 MAR	22 MAR	17 MAY	17 MAY	03 OCT	03 OCT
25 MAR	25 MAR	19 MAY	19 MAY	11 OCT	11 OCT
		21 MAY	21 MAY	21 OCT	21 OCT
03 APR	03 APR	22 MAY	22 MAY	29 OCT	29 OCT
04 APR	07 APR*	23 MAY	23 MAY		
05 APR	05 APR	24 MAY	24 MAY	05 NOV	05 NOV
06 APR	06 APR	30 MAY	30 MAY	14 NOV	14 NOV
08 APR	08 APR	31 MAY	31 MAY	20 NOV	20 NOV
09 APR	09 APR			26 NOV	26 NOV
10 APR	10 APR	07 JUN	07 JUN		
13 APR	13 APR	13 JUN	13 JUN	05 DEC	05 DEC
14 APR	[illegible]4 APR	18 JUN	18 JUN	12 DEC	20 DEC*
17 APR	17 APR	27 JUN	27 JUN	18 DEC	23 DEC*
19 APR	19 A[illegible]			27 DEC	27 DEC
24 APR	24 [illegible]	03 JUL	02 JUL*		
25 APR	25 APR	11 JUL	03 JUL		
26 APR	26 APR	17 JUL	11 JUL		
27 APR	27 APR	26 JUL	17 JUL		
30 APR	30 APR		26 JUL		

* Void sample; see Appendix A.

A period of upwelling occurred in Lake Ontario near JAFNPP from 30 June through 8 July 1991. The extent and duration of the upwelling necessitated the collection of an additional impingement sample as required in the JAFNPP SPDES Permit (Section 11.B.7) in effect from 1 January 1991 through 31 July 1991. The sample was collected over the period 1-2 July and is reported along with the regularly scheduled samples for July 1991.

2.2 SAMPLING PROCEDURES (PERMIT SECTIONS 10.b,c,d,e)

All sampling procedures were accomplished according to Standard Operating Procedures (SOPs) (NYPA 1985, Rev. 5; NYPA 1991, Rev. 6). Samples were initiated around 1300 hours of the sampling day. Before sample collection, the traveling screens were rotated and washed for 15 minutes, after which the collection basket, with a 9.5-mm (3/8-in.) stretch mesh liner, was positioned at the end of the sluiceway. The collection basket remained in place for 24 hours, unless high impingement or debris loads required that it be emptied, in which case it was removed, emptied, and repositioned.

A subsampling routine was utilized for occasions when high impingement rates or high debris loads were encountered. The subsampling technique was based on volume, and the total 24-hour catch was estimated using the following formula:

$$\textit{Estimated No. of Fish in Total Sample} = \frac{\textit{Volume of Total Sample} \times \textit{No. of Fish in Subsample}}{\textit{Volume of Subsample}}$$

The volume of the total sample was determined by repeatedly filling a volumetrically graduated container, recording the values, and adding them. The total volume was thoroughly mixed by hand or with a shovel and spread out evenly over a flat surface. A subsample of the total sample was randomly selected and this portion of the sample was removed and measured to determine its volume. During 1991, subsamples constituted at least [illegible] percent by volume of the total sample. The fish in the subsample were then processed according to regular laboratory procedures (Section 2.3).

Cooling water flow rates, intake and discharge temperatures, and power production were obtained for each date of 1991 (Appendix B).

2.3 LABORATORY PROCESSING (PERMIT SECTION 10.d)

The impingement sample was returned to the laboratory where all organisms were sorted, identified, and enumerated. Identification was made to the lowest possible taxonomic level, which was usually species. A list of common names and their associated scientific names is included in Appendix C.

A maximum of 25 individuals of the following fishes were weighed and measured: white perch, alewife, rainbow smelt, smallmouth bass, yellow perch, and each species of salmonid. All individuals collected of other fish species were enumerated and weighed to obtain a total count and total weight for each species or taxonomic level. Total lengths were measured to the nearest millimeter (mm). In this report, 10 cm (100 mm; 4 in.) was used as a cutoff between young of the year (YOY) and older fish based on length at age information in Scott and Crossman (1973).

Weights were measured to the nearest 0.1 g (0.0002 lb) for specimens less than 10 g (0.02 lb); 1.0 g (0.002 lb) for specimens between 10 g (0.02 lb) and 2,000 g (4.4 lb); and to the nearest 25 g (0.05 lb) for specimens over 2,000 g (4.4 lb). Specimens with any unusual conditions, abnormalities, or presence of fish tags were noted on the data sheets.

2.4 WATER QUALITY DETERMINATIONS (NYPA 1985, REV. 5; NYPA 1991, REV. 6)

Intake and discharge temperatures were measured at the beginning and end of each impingement sample. Intake temperature was measured in front of the trash bars. Discharge temperature was measured in the discharge canal. Intake and discharge water temperatures ($\pm$0.5 C) were determined from a bucket of water retrieved at each location and read from a thermometer. Thermometers were calibrated bimonthly according to the SOP (NYPA 1985 Rev. 5; NYPA 1991 Rev. 6). Intake and discharge temperatures were also recorded from the plant operational log on sample days.

2.5 DATA PRESENTATION (PERMIT SECTION 11.c.i,ii)

Data are presented in Chapter 3 according to the requirements set forth in the SPDES permit:

a. Monthly and annual total of impingement by species and grand total over all species.

b. Monthly "mean" is equal to the total number of fish impinged by species on all sampling days in a given month divided by the total volume of water pumped on sampling days.

c. Total estimated impingement (D) for each month was calculated using the following formula:

$$D = \frac{c}{v} * (x)$$

where

D = Total estimated impingement
c = Number of fish collected during the sampling period
v = Volume of cooling water used during the sampling period
x = Total monthly volume of cooling water used.

The annual impingement estimate was then calculated by adding the 12 monthly impingement estimates.

d. Additional tables were calculated for mean daily impingement rate (total number of fish impinged by species on all sampling days in a month divided by the total number of sampling days) and a monthly estimated impingement based on rate (mean daily impingement rate multiplied by the total number of days in a particular month) and are available for comparison of data presentation methods.

e. Length frequency tables for the species of special interest.

f. Monthly and annual totals of biomass (grams) by species and grand totals over all species.

g. Total estimated biomass (adjusted for flow) was calculated in the same manner as estimated impingement numbers.

2.6 COLLECTION EFFICIENCY (PERMIT SECTION 11.c.ii)

To assess the efficiency of the traveling screens in removing impinged organisms from the circulating water intake system, and thus the accuracy of impingement estimates, a collection efficiency study was approved by the New York State Department of Environmental Conservation (NYSDEC) (Dunning 1986).

In 1988, the collection efficiency study for alewife was conducted and the results presented in Appendix D of the Annual Biological Monitoring Report (EA 1989). During the following year (1989), the collection efficiency studies for adult rainbow smelt and adult and YOY white perch were conducted and the results presented in Appendix E of the Annual Biological Monitoring Report (EA 1990). The remaining efficiency studies for smallmouth bass and yellow perch were to be conducted upon the acquisition of 250 individuals of each species (Dunning 1986). The number of smallmouth bass and yellow perch acquired in a given year of impingement studies have been so few that the collection of 250 individuals has been an ongoing process since 1986. In June 1991, a request was made to the NYSDEC to utilize those individuals already collected (approximately 200 smallmouth bass and 180 yellow perch) to complete the studies (Dunning 1991). However, during the remainder of 1991, several lengthy outages occurred at JAFNPP which reduced the number of impingement study data collection dates available for coordination with the remaining screen efficiencies. An outage continuing into 1992 made it impossible to conduct the screen efficiency tests prior to the end of 1991. The remaining screen efficiencies will be conducted as soon as JAFNPP returns to full power operation (expected in Summer 1992). For the species for which data on traveling screen efficiency exists (alewife, rainbow smelt, and white perch), the monthly and annual estimated impingement mortality for each species (Chapter 3) have been corrected as follows:

$$E = \frac{A}{e}$$

where

E = Estimated impingement mortality
A = Actual number of individuals per month (per applicable species)
e = Collection efficiency expressed as a decimal.

Grand totals were determined by summing the data for the 12 months of the year.

3. RESULTS AND DISCUSSION

3.1 IMPINGEMENT ABUNDANCE AND COMPOSITION (PERMIT SECTION 11.a,b,c)

Impingement sampling at JAFNPP during 1991 resulted in the collection of 55,569 organisms (including damaged individuals) composed of 42 species of fish (Table 3-1). Sculpins are the only taxon identified to the genus (*Cottus*). Two invertebrate taxa (crayfish [Cambaridae] and clam [Mollusca]) were also collected in the 1991 impingement samples. In May, an amphibian (mudpuppy, *Necturus sp.*) was collected in an impingement sample.

JAFNPP was shut down from 9 March to 14 April 1991, from 8 May to 19 August 1991, and from 28 November to 31 December 1991. On occasion during these periods, the main circulating water pumps were either non-operational or operating at a reduced capacity. This significantly reduced the numbers of organisms impinged during those months. Historically, April, May, and June are months of increased impingement abundance as fish, particularly alewife and rainbow smelt, move inshore to spawn. In 1991, the largest impingement collections occurred in April (31,193), and May (18,329), corresponding to historical trends. The seasonal increase in impingement abundance is in evidence but is of a reduced intensity due to the timing and duration of the 1991 plant outages. In May 1991, a fish deterrence study was conducted at JAFNPP that reduced impingement on the days the plant was operating. This contributed to the decrease in impingement abundance for May, particularly for alewife. Detailed results of the fish deterrence study may be found in Ross et al. (1992). In June, the impingement abundance dropped to 1,731 organisms and continued to decrease through the summer months as fish finished spawning and moved offshore and the outage continued. An increase in the impingement for the month of November (1,759) is reflective of a late fall storm event that occurred during one impingement sampling period (25-26 November 1991).

The JAFNPP SPDES permit in effect from 1 January through 31 July 1991 required an additional sample to be collected during episodes of upwelling. One episode of upwelling which occurred from 30 June through 8 July 1991 required an additional impingement sample to be collected. The results of that sample collection are incorporated into the monthly data for July in all data tables in this report.

Highest species diversity occurred in April and May (27 and 25 species, respectively) (Table 3-1). Lowest species diversity occurred in September (16 species) and October (15 species) when fish were offshore in deeper water. The outages that occurred at JAFNPP did not appear to influence the species diversity of organisms impinged during 1991.

Rainbow smelt were collected during all 12 months of 1991 and represented 24 percent of the year's impingement collection (Table 3-1). Rainbow smelt dominated the impingement sample collections in January (75 percent), February (52 percent), August (41 percent), and

TABLE 3-1 ACTUAL MONTHLY IMPINGEMENT COLLECTIONS AT JAMES A. FITZPATRICK POWER PLANT, 1991

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	Annual Total	Percent Composition
No. of Samples	4	4	4	16	20	4	5	6	4	4	4	4	79	
SPECIES														
Alewife	---	---	17	25,076	10,284	1,199	120	58	8	38	12	4	36,816	66.2
Rainbow smelt	728	155	77	5,319	5,825	234	109	101	27	1	402	199	13,177	23.7
Spottail shiner	48	15	85	274	738	29	10	1	2	10	44	2	1,258	2.3
Troutperch	2	1	1	134	939	75	11	1	1	2	13	2	1,182	2.1
Bluegill	---	---	---	1	---	---	---	---	---	2	809	11	823	1.5
Threespine stickleback	20	60	6	87	164	16	1	---	---	---	180	55	589	1.1
Sculpins	7	9	5	158	109	30	---	4	---	3	2	---	327	0.6
Tessellated darter	1	---	---	17	129	93	20	44	4	2	---	---	310	0.6
Crayfish	8	3	8	66	19	8	2	2	4	1	69	7	197	0.4
White perch	85	24	1	13	41	---	---	---	---	---	28	3	195	0.4
Gizzard shad	19	2	2	2	1	---	2	---	---	---	81	30	139	0.2
Stonecat	---	---	3	16	31	20	7	17	11	1	9	3	118	0.2
Yellow perch	4	2	---	6	13	2	2	1	2	---	57	5	94	0.2
Rock bass	9	3	3	4	4	4	1	3	5	1	13	14	64	0.1
Smallmouth bass	7	---	1	1	7	6	---	2	2	---	16	---	42	T
Central mudminnow	2	---	25	2	---	---	---	---	---	---	---	---	29	T
White bass	5	4	1	2	---	---	---	---	---	4	15	---	27	T
White sucker	---	---	---	---	4	6	4	4	1	---	---	2	25	T
Emerald shiner	10	12	---	---	---	1	---	---	---	---	---	---	23	T
Crayfish (damaged)	---	---	1	---	1	---	13	4	1	1	---	---	20	T
Lake trout	1	1	1	---	5	2	1	---	---	1	---	1	13	T
Brown trout	---	---	1	---	4	---	---	---	---	1	---	5	11	T
Walleye	---	1	---	---	---	1	2	1	2	---	---	1	9	T
Largemouth bass	---	---	---	---	---	---	---	---	---	---	8	1	9	T

NOTE: Dashes (---) indicate no catch.
T = <0.1 percent of total.

TABLE 3-1 (Cont.)

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	Annual Total	Percent Composition
SPECIES (Cont.)														
Golden shiner	---	---	---	1	1	2	3	---	---	---	---	---	7	T
Lake chub	---	---	---	2	4	---	---	---	---	---	---	1	7	T
Pumpkinseed	---	---	---	1	---	---	---	2	---	---	1	3	7	T
Longnose dace	1	3	1	---	---	---	---	---	---	---	---	1	6	T
Channel catfish	4	---	---	2	---	---	---	---	---	---	---	---	6	T
Burbot	---	1	---	1	1	---	---	---	---	---	---	1	4	T
Clam	2	2	---	---	---	---	---	---	---	---	---	---	4	T
Rainbow smelt (damaged)	---	---	---	---	---	---	---	---	---	4	---	---	4	T
Brown bullhead	---	---	---	1	---	---	1	---	---	1	---	---	3	T
Chinook salmon	---	---	---	1	1	1	---	---	---	---	---	---	3	T
American eel	---	---	---	---	---	2	---	---	---	---	---	---	2	T
Brook stickleback	---	---	---	2	---	---	---	---	---	---	---	---	2	T
Freshwater drum	2	---	---	---	---	---	---	---	---	---	---	---	2	T
Lake herring	---	---	---	1	1	---	---	---	---	---	---	---	2	T
Rainbow trout	1	---	---	---	---	---	1	---	---	---	---	---	2	T
Brook silverside	1	---	---	---	---	---	---	---	---	---	---	---	1	T
Carp	---	---	---	---	---	---	1	---	---	---	---	---	1	T
Northern pike	---	---	---	---	---	---	---	1	---	---	---	---	1	T
Sea lamprey	---	---	---	1	---	---	---	---	---	---	---	---	1	T
Ictalurus sp. (damaged)	---	---	---	1	---	---	---	---	---	---	---	---	1	T
Sea lamprey (damaged)	---	---	---	1	---	---	---	---	---	---	---	---	1	T
Tessellated darter (damaged)	---	---	---	---	---	---	---	---	---	---	---	1	1	T
Grass pickerel	---	---	---	---	1	---	---	---	---	---	---	---	1	T
Mudpuppy	---	---	---	---	1	---	---	---	---	---	---	---	1	T
Atlantic salmon	---	---	---	---	1	---	---	---	---	---	---	---	1	T
Shorthead redhorse sucker	---	---	---	---	---	---	---	1	---	---	---	---	1	T
TOTAL	967	298	239	31,193	18,329	1,731	311	247	70	73	1,759	352	55,569	100.0

December (57 percent). From late summer through winter collections of rainbow smelt are generally associated with schools of YOY. YOY are influenced by storm conditions which are also more prevalent during this period.

Alewife were collected in 10 months of the year and dominated the annual total, comprising 66 percent of the annual impingement collections. Alewife dominated the impingement samples collected during April (80 percent), May (56 percent), and June (69 percent). The seasonal migration of adult alewife determined the impingement abundance of the species for April, May, and June. Alewife impingement abundance in May was impacted by the operation of a fish deterrence study on some sample days. In October, YOY alewife were collected due to the same meteorological influences as for rainbow smelt.

The total impingement for November contained 46 percent bluegill, nearly all of which were collected in one sample that coincided with a storm event.

The remaining months of 1991 contained collections which were not dominated by any one species of fish. In March, rainbow smelt and spottail shiners were found in the collected samples in nearly equivalent numbers (32 and 36 percent, respectively). July impingement samples contained alewife and rainbow smelt in nearly equivalent numbers (39 and 35 percent, respectively). In addition to rainbow smelt and alewife, species present throughout most of the year included spottail shiner, trout-perch, and crayfish which were collected in all 12 months. Species of special interest (JAFNPP SPDES Permit No. NY 0020109) were collected with the following frequency: yellow perch (10 months), smallmouth bass and lake trout (8 months), and white perch (7 months) in 1991. The four other salmonid species collected in 1991 were found sporadically as individuals throughout the year: brown trout (4 months), chinook salmon (3 months), rainbow trout (2 months), and Atlantic salmon (1 month).

In previous years, high rates of impingement occurred at JAFNPP when strong winds from the west or northwest resulted in heavy wave action. Lifton and Storr (1977) statistically correlated wave height, water temperature, and wind action with impingement at power plants on Lake Erie and Lake Ontario. Wave height was found to be the most significant factor contributing to the correlation. They hypothesized that wave-induced turbulence and possibly turbidity interfere with a fish's normal ability to detect and avoid an intake structure, resulting in a higher rate of impingement. YOY of most species of fish appear to be most susceptible to meteorological influences (Lifton and Storr 1977). In 1991, storm conditions influenced the impingement abundance three times. The first meteorological event to influence impingement abundances occurred over the period 27-28 January with strong southwest to west winds from 15 to 30 knots, and higher gusts. The impingement sample collected during that 24-hour period contained 62 percent of the month's collection of rainbow smelt and 72 percent of the month's collection of white perch. Storm conditions also occurred during a sample collection over the period 25-26 November 1991. Winds from the northwest were recorded at speeds from 40 to 50 knots during the late afternoon and night of 25 November. The weather service issued gale warnings and predicted waves running 2.4-4.3 meters (8-14 ft) through the period. The following day, winds swung to the west then southwest and lessened to 15-25 knots with waves 0.9-1.5 meters (3-5 ft). The impingement sample collected over the 25-26 November period contained 99 percent of the month's total impingement abundance. Nearly 100 percent of the month's collection of rainbow smelt and bluegill were collected in that sample. All of the bluegill and 60 percent of the rainbow smelt collected were YOY. All of the white perch, yellow perch, and smallmouth bass collected in the sample were also YOY and comprised nearly 100 percent of the total monthly collection for those species. Another sample collected over 22-23 December 1991 during winds of 15-25 knots from the west to northwest accounted for 59 percent of the total monthly sample collection. Wave height for the period ranged from 0.9 to 2.1 meters (3-7 ft). The sample was dominated by YOY rainbow smelt which accounted for 72 percent of the month's total rainbow smelt impingement.

Of the total annual catch, alewife was the most abundant species, comprising 66 percent, followed by rainbow smelt (24 percent). The remaining species of special interest (white perch, yellow perch, smallmouth bass, and the five species of salmonids) each accounted for less than 1 percent of the total annual impingement collection. Species of special interest, including alewife and rainbow smelt, comprised 91 percent of the 1991 impingement totals. Spottail shiner and trout-perch accounted for an additional 4 percent of the organisms collected in the impingement samples.

Rates of impingement were calculated using two different methods for comparison. The mean daily impingement rate (Table 3-2) is defined as the average number of fish collected per sample day per month. The mean daily impingement rate based on flow (Table 3-3) is defined as the total number of fish impinged by species on sampling days in the month divided by the total volume of water pumped through the intake on those days. Each table defines the rate per species per month and the total impingement rate for the month.

Rates of impingement, whether calculated over time (Table 3-2) or volume (Table 3-3), generally demonstrate the same trend as the actual impingement (Table 3-1). In the spring, rates should peak as fish migrate inshore. However, as seen in Table 3-1, the rate of impingement for JAFNPP in 1991 is reflective of the influence of extended plant outages and the corresponding reduction in circulating water volume. The seasonal trend of increased fish abundance during the spring months is evident in the rate of impingement (calculated by both methods) for April, May, and June. The influence of short-term meteorological occurrences in November and December are also evident in Table 3-2 and Table 3-3. In 1991, a fish deterrence study conducted during May reduced impingement collections on some days.

The mean daily impingement rate (Table 3-2) was greatest in April (1,950 fish/day), May (916 fish/day), June (433 fish/day), and November (440 fish/day). Peaks in the rate of impingement correspond to the seasonal spawning movement of adult fish the spring (April, May, June) and the influence of periodic storm events (November) on the impingement of young fish, as previously discussed. The daily impingement rate was low in September and October (18 fish/day, equivalent for both months), when the seasonal abundance of fish was lower due to movement offshore into deeper, cooler water after spawning.

TABLE 3-2 MEAN DAILY IMPINGEMENT RATE* BY SPECIES AT JAMES A. FITZPATRICK NUCLEAR POWER PLANT, 1991

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	Annual Total
No. of Samples	4	4	4	16	20	4	5	6	4	4	4	4	79
SPECIES													
Alewife	---	---	4.25	1,567.25	514.20	299.75	24.00	9.67	2.00	9.50	3.00	1.00	466.03
Rainbow smelt	182.00	38.75	19.25	332.44	291.25	58.50	21.80	16.83	6.75	0.25	100.50	49.75	166.80
Spottail shiner	12.00	3.75	21.25	17.13	36.90	7.25	2.00	0.17	0.50	2.50	11.00	0.50	15.92
Trout-perch	0.50	0.25	0.25	8.38	46.95	18.75	2.20	0.17	0.25	0.50	3.25	0.50	14.96
Bluegill	---	---	---	0.06	---	---	---	---	---	0.50	202.25	2.75	10.42
Threespine stickleback	5.00	15.00	1.50	5.44	8.20	4.00	0.20	---	---	---	45.00	13.75	7.46
Sculpins	1.75	2.25	1.25	9.88	5.45	7.50	---	0.67	---	0.75	0.50	---	4.14
Tessellated darter	0.25	---	---	1.06	6.45	23.25	4.00	7.33	1.00	0.50	---	---	3.92
Crayfish	2.00	0.75	2.00	4.13	0.95	2.00	0.40	0.33	1.00	0.25	17.25	1.75	2.49
White perch	21.25	6.00	0.25	0.81	2.05	---	---	---	---	---	7.00	0.75	2.47
Gizzard shad	4.75	0.50	0.50	0.13	0.05	---	0.40	---	---	---	20.25	7.50	1.76
Stonecat	---	---	0.75	1.00	1.55	5.00	1.40	2.83	2.75	0.25	2.25	0.75	1.49
Yellow perch	1.00	0.50	---	0.38	0.65	0.50	0.40	0.17	0.50	---	14.25	1.25	1.19
Rock bass	2.25	0.75	0.75	0.25	0.20	1.00	0.20	0.50	1.25	0.25	3.25	3.50	0.81
Smallmouth bass	1.75	---	0.25	0.06	0.35	1.50	---	0.33	0.50	---	4.00	---	0.53
Central mudminnow	0.50	---	6.25	0.13	---	---	---	---	---	---	---	---	0.37
White bass	1.25	1.00	0.25	0.13	---	---	---	---	---	---	3.75	---	0.34
White sucker	---	---	---	---	0.20	1.50	0.80	0.67	0.25	1.00	---	0.50	0.32
Emerald shiner	2.50	3.00	---	---	---	0.25	---	---	---	---	---	---	0.29
Crayfish (damaged)	---	---	0.25	---	0.05	---	2.60	0.67	0.25	---	---	---	0.26
Lake trout	0.25	0.25	0.25	---	0.25	0.50	0.20	---	---	0.25	---	0.25	0.16
Brown trout	---	---	0.25	---	0.20	---	---	---	---	0.25	---	1.25	0.14
Walleye	---	0.25	---	---	---	0.25	0.40	0.17	0.50	0.25	---	0.25	0.11
Largemouth bass	---	---	---	---	---	---	---	---	---	---	2.00	0.25	0.11

* Number of fish impinged per day.

NOTE: Dashes (---) indicate no catch.

TABLE 3-2 (Cont.)

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	Annual Total
SPECIES (Cont.)													
Golden shiner	---	---	---	0.06	0.05	0.50	0.60	---	---	---	---	---	0.09
Lake chub	---	---	---	0.13	0.20	---	---	---	---	---	---	0.25	0.09
Pumpkinseed	---	---	---	0.06	---	---	---	0.33	---	---	0.25	0.75	0.09
Longnose dace	0.25	0.75	0.25	---	---	---	---	---	---	---	---	0.25	0.08
Channel catfish	1.00	---	---	0.13	---	---	---	---	---	---	---	---	0.08
Burbot	---	0.25	---	0.06	0.05	---	---	---	---	---	---	0.25	0.05
Clam	0.50	0.50	---	---	---	---	---	---	---	---	---	---	0.05
Rainbow smelt (damaged)	---	---	---	---	---	---	---	---	---	1.00	---	---	0.05
Brown bullhead	---	---	---	0.06	---	---	0.20	---	---	0.25	---	---	0.04
Chinook salmon	---	---	---	0.06	0.05	0.25	---	---	---	---	---	---	0.04
American eel	---	---	---	---	---	0.50	---	---	---	---	---	---	0.03
Brook stickleback	---	---	---	0.13	---	---	---	---	---	---	---	---	0.03
Freshwater drum	0.50	---	---	---	---	---	---	---	---	---	---	---	0.03
Lake herring	---	---	---	0.06	0.05	---	---	---	---	---	---	---	0.03
Rainbow trout	0.25	---	---	---	---	---	0.20	---	---	---	---	---	0.03
Brook silverside	0.25	---	---	---	---	---	---	---	---	---	---	---	0.01
Carp	---	---	---	---	---	---	0.20	---	---	---	---	---	0.01
Northern pike	---	---	---	---	---	---	---	0.17	---	---	---	---	0.01
Sea lamprey	---	---	---	0.06	---	---	---	---	---	---	---	---	0.01
Ictalurus sp. (damaged)	---	---	---	0.06	---	---	---	---	---	---	---	---	0.01
Sea lamprey (damaged)	---	---	---	0.06	---	---	---	---	---	---	---	---	0.01
Tessellated darter	---	---	---	---	---	---	---	---	---	---	---	0.25	0.01
Grass pickerel	---	---	---	---	0.05	---	---	---	---	---	---	---	0.01
Mudpuppy	---	---	---	---	0.05	---	---	---	---	---	---	---	0.01
Atlantic salmon	---	---	---	---	0.05	---	---	---	---	---	---	---	0.01
Shorthead redhorse sucker	---	---	---	---	---	---	---	0.17	---	---	---	---	0.01
Total	241.75	74.50	59.75	1,949.59	916.45	432.75	62.20	41.18	17.50	18.25	439.75	88.00	703.41

TABLE 3-3 MEAN DAILY IMPINGEMENT RATE* (BASED ON FLOW) AT JAMES A. FITZPATRICK NUCLEAR POWER PLANT, 1991

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	Annual Total
No. of Samples	4	4	4	16	20	4	5	6	4	4	4	4	79
Total Flow (MCM)	7.059	6.336	4.626	27.638	32.271	5.846	7.270	10.424	9.026	8.645	8.433	5.579	133.153
SPECIES													
Alewife	---	---	3.675	907.302	318.676	205.098	16.506	5.564	0.886	4.396	1.423	0.717	NA
Rainbow smelt	103.131	24.463	16.645	192.452	180.503	40.027	14.993	9.689	2.991	0.116	47.670	35.669	NA
Spottail shiner	6.800	2.367	18.374	9.914	22.869	4.961	1.376	0.096	0.222	1.157	5.218	0.358	NA
Trout-perch	0.283	0.158	0.216	4.848	29.097	12.829	1.513	0.096	0.111	0.231	1.542	0.358	NA
Bluegill	---	---	---	0.036	---	---	---	---	---	0.231	95.933	1.972	NA
Threespine stickleback	2.833	9.470	1.297	3.148	5.082	2.737	0.138	---	---	---	21.345	9.858	NA
Sculpins	0.992	1.420	1.081	5.717	3.378	5.132	---	0.384	---	0.347	0.237	---	NA
Tessellated darter	0.142	---	---	0.615	3.997	15.908	2.751	4.221	0.443	0.231	---	---	NA
Crayfish	---	0.473	1.729	2.388	0.589	1.368	0.275	0.192	0.443	0.116	8.182	1.255	NA
White perch	12.041	3.788	0.216	0.470	1.270	---	---	---	---	---	3.320	0.538	NA
Gizzard shad	2.692	0.316	0.432	0.072	0.031	---	0.275	---	---	---	9.605	5.377	NA
Stonecat	---	---	0.649	0.579	0.961	3.421	0.963	1.631	1.219	0.116	1.067	0.538	NA
Yellow perch	0.567	0.316	---	0.217	0.403	0.342	0.275	0.096	0.222	---	6.759	0.896	NA
Rock bass	1.275	0.473	0.649	0.145	0.124	0.684	0.138	0.288	0.554	0.116	1.542	2.509	NA
Smallmouth bass	0.992	---	0.216	0.036	0.217	1.026	---	0.192	0.222	---	1.897	---	NA
Central mudminnow	0.283	---	5.404	0.072	---	---	---	---	---	---	---	---	NA
White bass	0.708	0.631	0.216	0.072	---	---	---	---	---	---	1.779	---	NA
White sucker	---	---	---	---	0.124	1.026	0.550	0.384	0.111	0.463	---	0.358	NA
Emerald shiner	1.417	1.894	---	---	---	0.171	---	---	---	---	---	---	NA
Crayfish (damaged)	1.133	---	0.216	---	0.031	---	1.788	0.384	0.111	---	---	---	NA
Lake trout	0.142	0.158	0.216	---	0.155	0.342	0.138	---	---	0.116	---	0.179	NA
Brown trout	---	---	0.216	---	0.124	---	---	---	---	0.116	---	0.896	NA

* Number of fish impinged per day.

NOTE: MCM = Million cubic meters; dashes (---) indicate no catch.

TABLE 3-3 (Cont.)

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	Annual Total
SPECIES (Cont.)													
Walleye	---	0.158	---	---	---	0.171	0.275	0.096	0.222	0.116	---	0.179	NA
Largemouth bass	---	---	---	---	---	---	---	---	---	---	0.949	0.179	NA
Golden shiner	---	---	---	0.036	0.031	0.342	0.413	---	---	---	---	---	NA
Lake chub	---	---	---	0.072	0.124	---	---	---	---	---	---	0.179	NA
Pumpkinseed	---	---	---	0.036	---	---	---	0.192	---	---	0.119	0.538	NA
Longnose dace	0.142	0.473	0.216	---	---	---	---	---	---	---	---	0.179	NA
Channel catfish	0.567	---	---	0.072	---	---	---	---	---	---	---	---	NA
Burbot	---	0.158	---	0.036	0.031	---	---	---	---	---	---	0.179	NA
Clam	0.283	0.316	---	---	---	---	---	---	---	---	---	---	NA
Rainbow smelt (damaged)	---	---	---	---	---	---	---	---	---	0.463	---	---	NA
Brown bullhead	---	---	---	0.036	---	---	0.138	---	---	0.116	---	---	NA
Chinook salmon	---	---	---	0.036	0.031	0.171	---	---	---	---	---	---	NA
American eel	---	---	---	---	---	0.342	---	---	---	---	---	---	NA
Brook stickleback	---	---	---	0.072	---	---	---	---	---	---	---	---	NA
Freshwater drum	0.283	---	---	---	---	---	---	---	---	---	---	---	NA
Lake herring	---	---	---	0.036	0.031	---	---	---	---	---	---	---	NA
Rainbow trout	0.142	---	---	---	---	---	0.138	---	---	---	---	---	NA
Brook silverside	0.142	---	---	---	---	---	---	---	---	---	---	---	NA
Carp	---	---	---	---	---	---	0.138	---	---	---	---	---	NA
Northern pike	---	---	---	---	---	---	---	0.096	---	---	---	---	NA
Sea lamprey	---	---	---	0.036	---	---	---	---	---	---	---	---	NA
Ictalurus sp. (damaged)	---	---	---	0.036	---	---	---	---	---	---	---	---	NA
Sea lamprey (damaged)	---	---	---	0.036	---	---	---	---	---	---	---	---	NA
Tessellated darter	---	---	---	---	---	---	---	---	---	---	---	0.179	NA
Grass pickerel	---	---	---	---	0.031	---	---	---	---	---	---	---	NA
Mudpuppy	---	---	---	---	0.031	---	---	---	---	---	---	---	NA
Atlantic salmon	---	---	---	---	0.031	---	---	---	---	---	---	---	NA
Shorthead redhorse sucker	---	---	---	---	---	---	---	0.096	---	---	---	---	NA
Total	136.990	47.032	51.663	1,128.623	567.972	296.098	42.781	23.697	7.757	8.447	208.587	63.090	NA

The collection of species of special interest (JAFNPP SPDES Permit No. NY 002 0109) on a seasonal basis is reflected in the daily rate of impingement. The rate of impingement for alewife and rainbow smelt was high in April (1,900 fish/day, combined), May (805 fish/day, combined), and June (358 fish/day). Smaller increases in the rate of impingement for rainbow smelt occurred during January, November, and December and are indicative of the influence of storm periods on YOY of the species. White perch, yellow perch, and smallmouth bass, species of special interest, had increased rates of impingement in January and November; the result of storm conditions on YOY of the three species. White perch abundance was highest in January (21 fish/day) and increased slightly in November (7 fish/day). Yellow perch impingement abundance was highest in November (14 fish/day). Smallmouth bass impingement increased in January (2 fish/day) and November (4 fish/day). No other species of special interest collected at JAFNPP during 1991 exhibited any seasonal and/or meteorological influences in their monthly mean rate of impingement.

Other species collected which display seasonal trends in their rates of impingement due to either spawning movements or storm influences are: spottail shiner, trout-perch, threespine stickleback, gizzard shad, and tessellated darter. The monthly mean rate of impingement of spottail shiner increased in March (21 fish/day), April (17 fish/day), and May (37 fish/day) as they moved inshore to spawn. Increases in spottail shiner during January (12 fish/day) and November (11 fish/day) were the result of storm conditions. Trout-perch increased during the spring and early summer months (e.g., in the impingement samples in April) (8 fish/day), peaked during May (47 fish/day), and declined in June (19 fish/day), probably due to spawning behaviors. A slight increase in November for trout-perch (3 fish/day) was likely in response to storm conditions. Threespine stickleback showed seasonal increases in their impingement abundance corresponding to spawning behavior movements during the months of April, May, and June (5, 8, and 4 fish/day, respectively). Threespine stickleback also increased in the impingement samples during fall and winter storm events as seen in the increase in their impingement rates during November (45 fish/day) and December (14 fish/day). Tessellated darter were high in May (6 fish/day) and June (23 fish/day) during their spawning migrations. Gizzard shad had relatively high rates of impingement during the months of January (5 fish/day), November (20 fish/day), and December (8 fish/day) coinciding with their seasonal movements and winter storm events.

The same patterns of seasonal and meteorological influences on impingement rates were observed when the rates were calculated based on flow volumes during the sample periods (Table 3-3). The rate of impingement is expressed as the number of fish per million cubic meters (MCM) of water pumped and is most notably influenced by extended outages at the plant. Rates of impingement calculated according to flow still demonstrate the seasonal increase in impingement abundance due to shoreward spawning migrations in the spring and early summer months. The rate of impingement increased in April (1,129 fish/MCM), May (568 fish/MCM), and June (296 fish/MCM). Rates of impingement then decreased through the summer months, increasing again in late fall (November, 209 fish/MCM; and December 63 fish/MCM) as periodic storms increased the collection of YOY. The rate of impingement for the month of January (137 fish/MCM) increased due to storm conditions as well. Species specific trends evident throughout the year follow the same general behavioral and meteorological controls as in the previous method of rate calculation (Table 3-2). Alewife impingement rates increased in April (907 fish/MCM), May (319 fish/MCM), and June (205 fish/MCM). Rainbow smelt increased in January (103 fish/MCM), April (192 fish/MCM), and May (181 fish/MCM) with a slight increase in November (47 fish/MCM) and December (36 fish/MCM). Table 3-3 demonstrates similar relationships between rates of impingement and seasonal and meteorological influences for the other species of special interest (white perch, yellow perch, and smallmouth bass) as well.

Annual and monthly impingement results for alewife, rainbow smelt, and white perch presented in Tables 3-1 and 3-5 were adjusted for their respective collection efficiencies as: 99 percent for alewives (EA 1989), 92 percent for rainbow smelt (EA 1988), and 87 percent for white perch (EA 1989). Utilizing the actual number of individuals collected during 1991 (Table 3-1), the corrected impingement mortality estimates underestimated impingement by 447 fish. The results of the traveling screen efficiency studies conducted thus far, demonstrate a highly efficient mechanism for removing fish and debris from the water intake at the JAFNPP screenhouse.

Calculations of the estimated number of organisms impinged at JAFNPP during 1991 were based on the mean daily impingement rate (Table 3-4) and on the impingement rate based on flow volume (Table 3-5). Impingement rates for alewife, rainbow smelt, and white perch are additionally adjusted for screen efficiency. Estimates of impingement mortality based on daily rate (Table 3-4) are given only for comparison. Estimates of the 1991 annual impingement at JAFNPP are similar for both methods of data expression.

The estimated total number of aquatic organisms impinged at JAFNPP in 1991 was 136,936. Of those, 75,734 were estimated to be alewife (corrected for screen efficiency) equaling 55 percent of the annual total. The estimated impingement of alewife is slightly lower for 1991 than previous years due to the extended outage and the impact of the May 1991 fish deterrence study on spring impingement abundance for alewife. The estimated number of rainbow smelt impinged in 1991 was 37,105 (corrected for traveling screen efficiency; 27 percent of the total). Other species of special interest were estimated to have been impinged in the following numbers: white perch (1,320 [corrected for traveling screen efficiency]); yellow perch (588), smallmouth bass (266), lake trout (68), brown trout (60), chinook salmon (11), rainbow trout (14), and Atlantic salmon (2). All of the species of special interest combined (115,168) accounted for 84 percent of annual estimated total impingement. Estimated impingement by month during 1991 generally followed the seasonal and meteorological patterns previously discussed. The most influential factors on the impingement estimates were the extended outages and several meteorological events which occurred during 1991.

3.2 LENGTH DISTRIBUTION (PERMIT SECTION 10.d)

Length-frequency distributions are presented in Tables 3-6a through 3-6f for alewife, rainbow smelt, white perch, yellow perch, smallmouth bass, and five salmonid species (lake trout, brown trout, chinook salmon, rainbow trout and Atlantic salmon).

TABLE 3-4 ESTIMATED MONTHLY IMPINGEMENT RATE (BASED ON AVERAGE DAILY RATE*) AT JAMES A. FITZPATRICK NUCLEAR POWER PLANT, 1991

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	Annual Total
No. of Samples	4	4	4	16	20	4	5	6	4	4	4	4	79
SPECIES													
Alewife	---	---	132	47,018	15,940	8,992	744	300	60	294	90	31	11,095,987
Rainbow smelt	5,642	1,085	597	9,973	9,029	1,755	676	522	202	8	3,015	1,542	4,586,492
Spottail shiner	372	105	659	514	1,144	218	62	5	15	78	330	16	483,997
Trout-perch	16	7	8	251	1,455	562	68	5	8	16	98	16	347,150
Bluegill	---	---	---	2	---	---	---	---	---	16	6,068	85	245,711
Threespine stickleback	155	420	46	163	254	120	6	---	---	---	1,350	426	236,300
Sculpins	54	63	39	296	169	225	---	21	---	23	15	---	126,557
Tessellated darter	8	---	---	32	200	698	124	227	30	16	---	---	156,081
Crayfish	62	21	62	124	29	60	12	10	30	8	518	54	77,950
White perch	659	168	8	24	64	---	---	---	---	---	210	23	150,463
Gizzard shad	147	14	16	4	2	---	12	---	---	---	608	232	114,445
Stonecat	---	---	23	30	48	150	43	88	82	8	68	23	53,228
Yellow perch	31	14	---	11	20	15	12	5	15	---	428	39	29,778
Rock bass	70	21	23	8	6	30	6	16	38	8	98	108	32,522
Smallmouth bass	54	---	8	2	11	45	---	10	15	---	120	---	21,976
Central mudminnow	16	---	194	4	---	---	---	---	---	---	---	---	33,170
White bass	39	28	8	4	---	---	---	---	---	---	112	---	15,381
White sucker	---	---	---	---	6	45	25	21	8	31	---	16	12,431
Emerald shiner	78	84	---	---	---	8	---	---	---	---	---	---	26,030
Crayfish (damaged)	---	---	8	---	2	---	81	21	8	---	---	---	11,509
Lake trout	8	7	8	---	8	15	6	---	---	8	---	8	7,443
Brown trout	---	---	8	---	6	---	---	---	---	8	---	39	2,875
Walleye	---	7	---	---	---	8	12	5	15	8	---	8	4,885
Largemouth bass	---	---	---	---	---	---	---	---	---	---	60	8	1,692
Golden shiner	---	---	---	2	2	15	19	---	---	---	---	---	4,048
Lake chub	---	---	---	4	6	---	---	---	---	---	---	8	1,494

NOTE: Dashes (---) indicate no catches made.

TABLE 3-4 (Cont.)

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	Annual Total
SPECIES (Cont.)													
Pumpkinseed	---	---	---	2	---	---	---	10	---	---	8	23	1,439
Longnose dace	8	21	8	---	---	---	---	---	---	---	---	8	5,783
Channel catfish	31	---	---	4	---	---	---	---	---	---	---	---	5,425
Burbot	---	7	---	2	2	---	---	---	---	---	---	8	1,703
Clam	16	14	---	---	---	---	---	---	---	---	---	---	4,650
Rainbow smelt (damaged)	---	---	---	---	---	---	---	---	---	31	---	---	1,426
Brown bullhead	---	---	---	2	---	---	6	---	---	8	---	---	1,228
Chinook salmon	---	---	---	2	2	8	---	---	---	---	---	---	1,464
American eel	---	---	---	---	---	15	---	---	---	---	---	---	1,650
Brook stickleback	---	---	---	4	---	---	---	---	---	---	---	---	620
Freshwater drum	16	---	---	---	---	---	---	---	---	---	---	---	2,480
Lake herring	---	---	---	2	2	---	---	---	---	---	---	---	574
Rainbow trout	8	---	---	---	---	---	6	---	---	---	---	---	1,792
Brook silverside	8	---	---	---	---	---	---	---	---	---	---	---	1,240
Carp	---	---	---	---	---	---	6	---	---	---	---	---	546
Northern pike	---	---	---	---	---	---	---	5	---	---	---	---	375
Sea lamprey	---	---	---	2	---	---	---	---	---	---	---	---	310
Ictalurus sp. (damaged)	---	---	---	2	---	---	---	---	---	---	---	---	310
Sea lamprey (damaged)	---	---	---	2	---	---	---	---	---	---	---	---	310
Tessellated darter (damaged)	---	---	---	---	---	---	---	---	---	---	---	8	32
Grass pickerel	---	---	---	---	2	---	---	---	---	---	---	---	258
Mudpuppy	---	---	---	---	2	---	---	---	---	---	---	---	260
Atlantic salmon	---	---	---	---	2	---	---	---	---	---	---	---	262
Shorthead redhorse sucker	---	---	---	---	---	---	---	5	---	---	---	---	370
TOTAL	7,498	2,086	1,855	58,490	28,413	12,984	1,926	1,276	526	569	13,196	2,729	131,548

TABLE 3-5 ESTIMATED MONTHLY IMPINGEMENT* (BASED ON FLOW) AT JAMES A. FITZPATRICK POWER PLANT, 1991

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	Annual Total
No. of Samples	4	4	4	16	20	4	5	6	4	4	4	4	79
Flow Sampled (MCM)	7.059	6.336	4.626	27.638	32.271	5.846	7.270	10.424	9.026	8.645	8.433	5.579	133.153
Total Monthly Flow (MCM)	55.448	46.413	39.227	53.785	48.857	43.527	46.634	54.689	67.269	66.90[illegible]	62.789	42.350	627.897
SPECIES													
Alewife**	---	---	144	49,288	15,726	9,017	776	310	60	294	89	30	75,734
Rainbow smelt**	6,174	1,223	704	11,180	9,524	1,884	757	572	216	8	3,231	1,632	37,105
Spottail shiner	377	110	721	533	1,117	216	64	5	15	77	328	15	3,578
Troutperch	16	7	8	261	1,422	558	71	5	7	15	97	15	2,482
Bluegill	---	---	---	2	---	---	---	---	---	15	6,024	84	6,125
Threespine stickleback	157	440	51	169	248	119	6	---	---	---	1,340	417	2,947
Sculpins	55	66	42	307	165	223	---	21	---	23	15	---	917
Tessellated darter	8	---	---	33	195	692	128	231	30	15	---	---	1,332
Crayfish	63	22	68	128	29	60	13	11	30	8	514	53	999
White perch**	754	198	8	29	70	---	---	---	---	---	238	23	1,320
Gizzard shad	149	15	17	4	2	---	13	---	---	---	603	228	1,031
Stonecat	---	---	[illegible]	31	47	149	45	89	82	8	67	23	566
Yellow perch	31	15	---	12	20	15	13	5	15	---	424	38	588
Rock bass	71	22	25	8	6	30	6	16	37	8	97	106	432
Smallmouth bass	55	---	8	2	11	45	---	11	15	---	119	---	266
Central mudminnow	16	---	21[illegible]	4	---	---	---	---	---	---	---	---	232
White bass	39	29	8	4	---	---	---	---	---	---	112	---	192
White sucker	---	---	---	---	6	45	26	21	7	31	---	15	151
Emerald shiner	79	88	---	---	---	7	---	---	---	---	---	---	174
Crayfish (damaged)	---	---	8	---	2	---	83	21	7	---	---	---	121
Lake trout	8	7	8	---	8	15	6	---	---	8	---	8	68

* Estimate = number of fish per million cubic meters (MCM) of water pumped per month.
** Species totals corrected for traveling screen efficiency

NOTE: Dashes (---) indicate no catches made.

TABLE 3-5 (Cont.)

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	Annual Total
SPECIES (Cont.)													
Brown trout	---	---	8	---	6	---	---	---	---	8	---	38	60
Walleye	---	7	---	---	---	7	13	5	15	8	---	8	63
Largemouth bass	---	---	---	---	---	---	---	---	---	---	60	8	68
Golden shiner	---	---	---	2	2	15	19	---	---	---	---	---	38
Lake chub	---	---	---	4	6	---	---	---	---	---	---	8	18
Pumpkinseed	---	---	---	2	---	---	---	11	---	---	7	23	43
Longnose dace	8	22	8	---	---	---	---	---	---	---	---	8	46
Channel catfish	31	---	---	4	---	---	---	---	---	---	---	---	35
Burbot	---	7	---	2	2	---	---	---	---	---	---	8	19
Clam	16	15	---	---	---	---	---	---	---	---	---	---	31
Rainbow smelt (damaged)	---	---	---	---	---	---	---	---	---	31	---	---	31
Brown bullhead	---	---	---	2	---	---	6	---	---	8	---	---	16
Chinook salmon	---	---	---	2	2	7	---	---	---	---	---	---	11
American eel	---	---	---	---	---	15	---	---	---	---	---	---	15
Brook stickleback	---	---	---	4	---	---	---	---	---	---	---	---	4
Freshwater drum	16	---	---	---	---	---	---	---	---	---	---	---	16
Lake herring	---	---	---	2	2	---	---	---	---	---	---	---	4
Rainbow trout	8	---	---	---	---	---	6	---	---	---	---	---	14
Brook silverside	8	---	---	---	---	---	---	---	---	---	---	---	8
Carp	---	---	---	---	---	---	6	---	---	---	---	---	6
Northern pike	---	---	---	---	---	---	---	5	---	---	---	---	5
Sea lamprey	---	---	---	2	---	---	---	---	---	---	---	---	2
Ictalurus sp. (damaged)	---	---	---	2	---	---	---	---	---	---	---	---	2
Sea lamprey (damaged)	---	---	---	2	---	---	---	---	---	---	---	---	2
Tesselated darter (damaged)	---	---	---	---	---	---	---	---	---	---	---	8	8
Grass pickerel	---	---	---	---	2	---	---	---	---	---	---	---	2
Mudpuppy	---	---	---	---	2	---	---	---	---	---	---	---	2
Atlantic salmon	---	---	---	---	2	---	---	---	---	---	---	---	2
Shorthead redhorse sucker	---	---	---	---	---	---	---	5	---	---	---	---	5
TOTAL	8,139	2,293	2,073	62,029	28,624	13,119	2,057	1,344	536	565	13,365	2,796	136,936

TABLE 3-6a LENGTH DISTRIBUTION OF SELECT SPECIES OF SPECIAL INTEREST IMPINGED AT JAMES A. FITZPATRICK NUCLEAR POWER PLANT, 1991 - ALEWIFE

Length Interval (cm)	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	Interval Total
1.0 - 2.9	0	0	0	0	0	0	1	1	0	0	0	0	2
3.0 - 4.9	0	0	0	0	0	0	1	29	5	3	0	0	38
5.0 - 6.9	0	0	3	9	1	0	1	16	2	25	3	2	62
7.0 - 8.9	0	0	0	133	68	4	0	4	0	0	1	0	210
9.0 - 10.9	0	0	1	50	23	3	0	0	0	0	0	0	77
11.0 - 12.9	0	0	0	9	11	1	4	0	0	0	0	0	25
13.0 - 14.9	0	0	2	32	70	30	10	0	0	0	0	1	145
15.0 - 16.9	0	0	9	119	254	56	35	1	0	0	1	1	476
17.0 - 18.9	0	0	0	48	71	5	8	0	0	0	0	0	132
19.0 - 20.9	0	0	0	0	2	0	1	0	0	0	0	0	3
21.0 - 22.9	0	0	0	0	0	0	0	0	0	0	0	0	0
23.0 - 24.9	0	0	0	0	0	1	0	0	0	0	0	0	1
25.0 - 26.9	0	0	0	0	0	0	0	0	0	0	0	0	0
27.0 - 28.9	0	0	0	0	0	0	0	0	0	0	0	0	0
29.0 - 30.9	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Measured	0	0	15	400	500	100	51	51	7	28	5	4	1,171
Mean Length	0.0	0.0	13.4	12.2	14.4	15.0	15.0	5.1	4.6	5.4	8.2	10.5	13.1
Length Range (Minimum)	0.0	0.0	6.2	6.1	6.8	8.0	2.9	2.5	3.7	4.0	5.6	6.0	2.5
Length Range (Maximum)	0.0	0.0	16.5	18.7	19.5	23.7	19.0	15.9	6.6	6.0	15.3	15.3	23.7

TABLE 3-6b LENGTH DISTRIBUTION OF SELECT SPECIES OF SPECIAL INTEREST IMPINGED AT JAMES A. FITZPATRICK NUCLEAR POWER PLANT, 1991 - RAINBOW SMELT

Length Interval (cm)	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	Interval Total
1.0 - 2.9	0	0	0	0	0	0	1	0	0	0	0	0	1
3.0 - 4.9	2	2	0	0	0	0	4	79	10	0	1	0	98
5.0 - 6.9	15	23	16	37	76	12	2	7	4	0	8	5	205
7.0 - 8.9	45	40	21	175	194	33	28	1	0	0	4	5	546
9.0 - 10.9	3	2	6	28	17	1	12	0	0	0	3	24	98
11.0 - 12.9	13	7	5	32	34	1	3	0	0	0	3	28	126
13.0 - 14.9	1	8	4	86	98	1	0	3	0	0	6	4	208
15.0 - 16.9	1	0	4	29	34	2	0	0	0	0	2	2	74
17.0 - 18.9	0	0	0	4	7	0	0	0	0	0	0	0	11
19.0 - 20.9	0	0	0	1	0	0	0	0	0	0	0	0	1
21.0 - 22.9	0	0	0	0	0	0	0	0	0	0	0	0	0
23.0 - 24.9	0	0	0	0	0	0	0	0	0	0	0	0	0
25.0 - 26.9	0	0	0	0	0	0	0	0	0	0	0	0	0
27.0 - 28.9	0	0	0	0	0	0	0	0	0	0	0	0	0
29.0 - 30.9	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Measured	82	82	56	392	460	50	50	87	14	0	27	68	1,368
Mean Length	8.4	8.3	8.8	10.2	10.0	7.9	8.[illegible]	4.4	4.9	0.0	9.8	10.5	9.3
Length Range (Minimum)	4.3	4.7	5.1	5.0	5.4	5.1	2.3	3.5	3.9	0.0	4.5	5.0	2.3
Length Range (Maximum)	15.8	14.9	15.5	19.0	18.2	16.5	12.3	8.2	6.9	0.0	16.0	15.0	19.0

TABLE 3-6c LENGTH DISTRIBUTION OF SELECT SPECIES OF SPECIAL INTEREST IMPINGED AT JAMES A. FITZPATRICK NUCLEAR POWER PLANT, 1991 - WHITE PERCH

Length Interval (cm)	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	Interval Total
3.0 - 4.9	1	2	0	0	0	0	0	0	0	0	0	0	3
5.0 - 6.9	18	5	0	1	1	0	0	0	0	0	2	1	28
7.0 - 8.9	11	3	1	2	22	0	0	0	0	0	2	1	42
9.0 - 10.9	3	2	0	5	9	0	0	0	0	0	3	1	23
11.0 - 12.9	0	0	0	2	0	0	0	0	0	0	0	0	2
13.0 - 14.9	0	0	0	0	0	0	0	0	0	0	0	0	0
15.0 - 16.9	0	0	0	0	0	0	0	0	0	0	0	0	0
17.0 - 18.9	0	0	0	0	0	0	0	0	0	0	0	0	0
19.0 - 20.9	0	0	0	0	0	0	0	0	0	0	0	0	0
21.0 - 22.9	0	0	0	0	0	0	0	0	0	0	0	0	0
23.0 - 24.9	0	0	0	1	1	0	0	0	0	0	0	0	2
25.0 - 26.9	0	0	0	0	0	0	0	0	0	0	0	0	0
27.0 - 28.9	0	0	0	0	0	0	0	0	0	0	0	0	0
29.0 - 30.9	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Measured	33	12	1	11	33	0	0	0	0	0	7	3	100
Mean Length	6.8	6.7	8.0	10.8	8.9	0.0	0.0	0.0	0.0	0.0	9.5	7.6	81.5
Length Range (Minimum)	4.9	4.1	8.0	6.8	6.6	0.0	0.0	0.0	0.0	0.0	5.8	5.8	4.1
Length Range (Maximum)	9.3	9.1	8.0	24.3	23.9	0.0	0.0	0.0	0.0	0.0	9.7	9.7	24.3

TABLE 3-6d LENGTH DISTRIBUTION OF SELECT SPECIES OF SPECIAL INTEREST IMPINGED AT JAMES A. FITZPATRICK NUCLEAR POWER PLANT, 1991 - YELLOW PERCH

Length Interval (cm)	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	Interval Total
3.0 - 4.9	0	0	0	0	0	0	2	0	0	0	0	0	2
5.0 - 6.9	1	0	0	0	0	0	0	1	0	0	3	0	5
7.0 - 8.9	1	1	0	3	2	0	0	0	1	0	11	5	24
9.0 - 10.9	0	1	0	0	1	0	0	0	0	0	1	0	3
11.0 - 12.9	0	0	0	0	0	0	0	0	0	0	0	0	0
13.0 - 14.9	0	0	0	0	3	0	0	0	0	0	0	0	3
15.0 - 16.9	0	0	0	0	0	0	0	0	0	0	0	0	0
17.0 - 18.9	0	0	0	0	2	1	0	0	0	0	0	0	3
19.0 - 20.9	0	0	0	0	3	0	0	0	0	0	0	0	3
21.0 - 22.9	0	0	0	0	1	0	0	0	0	0	0	0	1
23.0 - 24.9	0	0	0	0	0	0	0	0	1	0	0	0	1
25.0 - 26.9	0	0	0	0	1	0	0	0	0	0	0	0	1
27.0 - 28.9	0	0	0	0	0	1	0	0	0	0	0	0	1
29.0 - 30.9	0	0	0	0	0	0	0	0	0	0	0	0	0
31.0 - 32.9	0	0	0	0	0	0	0	0	0	0	0	0	0
33.0 - 34.9	0	0	0	1	0	0	0	0	0	0	0	0	1
Total Measured	2	2	0	4	13	2	2	1	2	0	15	5	48
Mean Length	7.2	8.7	0.0	14.2	15.9	22.3	4.2	6.0	16.2	0.0	7.6	8.1	11.3
Length Range (Minimum)	6.0	7.4	0.0	7.5	7.4	17.3	4.0	6.0	8.1	0.0	6.2	7.5	4.0
Length Range (Maximum)	8.5	10.0	0.0	33.7	25.4	27.3	4.3	6.0	24.4	0.0	9.4	8.6	33.7

TABLE 3-6e LENGTH DISTRIBUTION OF SELECT SPECIES OF SPECIAL INTEREST IMPINGED AT JAMES A. FITZPATRICK NUCLEAR POWER PLANT, 1991 - SMALLMOUTH BASS

Length Interval (cm)	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	Interval Total
3.0 - 4.9	0	0	0	0	0	1	0	0	0	0	0	0	1
5.0 - 6.9	0	0	0	0	0	0	0	0	0	0	1	0	1
7.0 - 8.9	3	0	1	1	2	1	0	0	1	0	3	0	12
9.0 - 10.9	0	0	0	0	3	2	0	0	0	0	0	0	5
11.0 - 12.9	0	0	0	0	0	0	0	0	0	0	0	0	0
13.0 - 14.9	0	0	0	0	0	0	0	0	0	0	0	0	0
15.0 - 16.9	0	0	0	0	0	0	0	0	0	0	0	0	0
17.0 - 18.9	0	0	0	0	0	0	0	0	0	0	0	0	0
19.0 - 20.9	0	0	0	0	0	0	0	0	0	0	0	0	0
21.0 - 22.9	0	0	0	0	0	0	0	0	0	0	0	0	0
23.0 - 24.9	0	0	0	0	0	0	0	0	0	0	0	0	0
25.0 - 26.9	0	0	0	0	0	0	0	0	0	0	0	0	0
27.0 - 28.9	0	0	0	0	0	0	0	0	0	0	0	0	0
29.0 - 30.9	0	0	0	0	0	0	0	0	0	0	0	0	0
31.0 - 32.9	0	0	0	0	0	0	0	0	0	0	0	0	0
33.0 - 34.9	0	0	0	0	0	2	0	0	0	0	0	0	2
35.0 - 36.9	0	0	0	0	0	0	0	0	0	0	0	0	0
37.0 - 38.9	0	0	0	0	1	0	0	1	0	0	0	0	2
39.0 - 40.9	0	0	0	0	1	0	0	1	1	0	0	0	3
41.0 - 42.9	0	0	0	0	0	0	0	0	0	0	0	0	0
43.0 - 44.9	1	0	0	0	0	0	0	0	0	0	0	0	1
Total Measured	4	0	1	1	7	6	0	2	2	0	4	0	27
Mean Length	17.0	0.0	8.6	8.8	17.5	16.6	0.0	39.4	24.4	0.0	7.0	0.0	17.2
Length Range (Minimum)	7.6	0.0	8.6	8.8	8.1	3.6	0.0	38.8	8.0	0.0	5.0	0.0	3.6
Length Range (Maximum)	43.2	0.0	8.6	8.8	39.0	34.8	0.0	40.0	40.9	0.0	8.0	0.0	43.2

TABLE 3-6f LENGTH DISTRIBUTION OF SELECT SPECIES OF SPECIAL INTEREST IMPINGED AT JAMES A. FITZPATRICK NUCLEAR POWER PLANT, 1991 - SALMONIDS

RAINBOW TROUT

Length Interval (cm)	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	Interval Total
47.0 - 48.9	1	0	0	0	0	0	0	0	0	0	0	0	1
63.0 - 64.9	0	0	0	0	0	0	1	0	0	0	0	0	1
Total Measured	1	0	0	0	9	0	1	0	0	0	0	0	2
Mean Length	48.1	0.0	0.0	0.0	0.0	0.0	63.5	0.0	0.0	0.0	0.0	0.0	55.8
Length Range (Minimum)	48.1	0.0	0.0	0.0	0.0	0.0	63.5	0.0	0.0	0.0	0.0	0.0	48.1
Length Range (Maximum)	48.1	0.0	0.0	0.0	0.0	6.0	63.5	0.0	0.0	0.0	0.0	0.0	63.5

CHINOOK SALMON

Length Interval (cm)	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	Interval Total
7.0 - 8.9	0	0	0	0	1	1	0	0	0	0	0	0	2
41.0 - 42.9	0	0	0	1	0	0	0	0	0	0	0	0	1
Total Measured	0	0	0	1	1	1	0	0	0	0	0	0	3
Mean Length	0.0	0.0	0.0	42.5	8.2	8.8	0.0	0.0	0.0	0.0	0.0	0.0	19.8
Length Range (Minimum)	0.0	0.0	0.0	42.5	8.2	8.8	0.0	0.0	0.0	0.0	0.0	0.0	8.2
Length Range (Maximum)	0.0	0.0	0.0	42.5	8.2	8.8	0.0	0.0	0.0	0.0	0.0	0.0	42.5

ATLANTIC SALMON

Length Interval (cm)	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	Interval Total
47.0 - 48.9	0	0	0	0	1	0	0	0	0	0	0	0	1
Total Measured	0	0	0	0	1	0	0	0	0	0	0	0	1
Mean Length	0.0	0.0	0.0	0.0	48.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	48.7
Length Range (Minimum)	0.0	0.0	0.0	0.0	48.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	48.7
Length Range (Maximum)	0.0	0.0	0.0	0.0	48.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	48.7

TABLE 3-6f (Cont.)

BROWN TROUT													
Length Interval (cm)	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	Interval Total
41.0 - 42.9	0	0	0	0	1	0	0	0	0	0	0	0	1
43.0 - 44.9	0	0	0	0	0	0	0	0	0	0	0	1	1
45.0 - 46.9	0	0	0	0	1	0	0	0	0	0	0	0	1
47.0 - 48.9	0	0	0	0	0	0	0	0	0	0	0	1	1
53.0 - 54.9	0	0	1	0	0	0	0	0	0	0	0	0	1
55.0 - 56.9	0	0	0	0	1	0	0	0	0	0	0	0	1
57.0 - 58.9	0	0	0	0	0	0	0	0	0	0	0	1	1
59.0 - 60.9	0	0	0	0	0	0	0	0	0	0	0	1	1
63.0 - 64.9	0	0	0	0	0	0	0	0	0	0	0	1	1
65.0 - 66.9	0	0	0	0	0	0	0	0	0	1	0	0	1
Total Measured	0	0	1	0	3	0	0	0	0	1	0	5	10
Mean Length	0.0	0.0	53.3	0.0	48.1	0.0	0.0	0.0	0.0	66.4	0.0	54.4	53.6
Length Range (Minimum)	0.0	0.0	53.0	0.0	42.1	0.0	0.0	0.0	0.0	66.4	0.0	54.4	42.1
Length Range (Maximum)	0.0	0.0	53.0	0.0	56.6	0.0	0.0	0.0	0.0	66.4	0.0	54.4	66.4

LAKE TROUT													
Length Interval (cm)	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	Interval Total
53.0 - 54.9	0	0	0	0	1	0	0	0	0	0	0	0	1
61.0 - 62.9	0	0	0	0	1	0	0	0	0	0	0	1	2
63.0 - 64.9	0	0	0	0	0	1	1	0	0	0	0	0	2
65.0 - 66.9	0	0	1	0	0	1	0	0	0	0	0	0	2
69.0 - 70.9	0	1	0	0	2	0	0	0	0	1	0	0	4
73.0 - 74.9	0	0	0	0	1	0	0	0	0	0	0	0	1
75.0 - 76.9	1	0	0	0	0	0	0	0	0	0	0	0	1
Total Measured	1	1	1	0	5	2	1	0	0	1	0	1	13
Mean Length	76.5	70.5	66.8	0.0	65.7	64.2	64.8	0.0	0.0	69.4	0.0	62.1	66.7
Length Range (Minimum)	76.5	70.5	66.8	0.0	54.3	64.2	64.8	0.0	0.0	69.4	0.0	62.1	54.3
Length Range (Maximum)	76.5	70.5	66.8	0.0	73.2	64.2	64.8	0.0	0.0	69.4	0.0	62.1	76.5

Length-frequency for species such as alewife and rainbow smelt, which are collected throughout the year, generally follow a seasonal pattern. Adults and subadults of both species are most often collected during spring months when spawning migrations move fish into inshore waters.

Late summer and fall collections are most often comprised of YOY (< 100 mm.; < 4 in.) as they attain a size susceptible to impingement while remaining in shallow inshore nursery areas. Scott and Crossman (1973) noted the late summer length attained by alewife as 51-75 mm (2-3 in.) and that of rainbow smelt as 51 mm (2 in.).

In 1991, collections of alewife followed the seasonal length distribution pattern as described (Table 3-6a). Alewife collected from March through July were primarily adult and subadult fish. From August through December, most alewife were YOY (< 100 mm; 4 in.). Overall, the alewife measured from samples collected in 1991 were comprised of 67 percent adults and subadults (> 100 mm; 4 in.) and 33 percent YOY. The minimum length measured was 2.5 cm (1 in.); the maximum was 23.7 cm (9.3 in.).

Rainbow smelt collections (Table 3-6b) in 1991 were dominated by YOY (69 percent of all rainbow smelt measured in 1991). In April and May, length-frequency data is a reflection of the movement of adults and subadults to inshore spawning areas. The percentage of YOY in the samples was highest in the summer, particularly July and August. At times during the year, YOY rainbow smelt were collected that were damaged to an extent that made it impossible to accurately obtain length measurements on individual fish (e.g., January, February, July, and August). The minimum length measured for rainbow smelt collected in 1991 was 2.3 cm (0.9 in.); the maximum length recorded was 19.0 cm (7.5 in.).

White perch measured from the 1991 impingement samples were predominantly YOY (Table 3-6c). Ninety-six percent of all white perch measured were YOY. January and February samples each contained 100 percent of YOY white perch. Adult and subadult white perch were collected only in April and May. The minimum length recorded for white perch was 4.1 cm (1.6 in.); the maximum length recorded was 24.3 cm (9.6 in.).

Yellow perch collected in 1991 were recorded as YOY, subadults and adults (Table 3-6d). In 1991, YOY yellow perch comprised 71 percent of all yellow perch measured. Yellow perch followed seasonal trends in abundance in the impingement samples; adults and subadults were collected primarily in May with YOY collected in July-December. The highest number of yellow perch collected and measured occurred in Novembe the result of a storm during an impingement sample period. All of the yellow perch collected during that sample were YOY. However, the largest sample not associated with a storm event was collected in May 1991 and included YOY, subadults, and adults. The minimum length recorded for the yellow perch measured was 4.0 cm (1.6 in.). The maximum length for yellow perch measured was 33.7 cm (13.3 in.).

Smallmouth bass (Table 3-6e) were collected as adults, subadults, and YOY sporadically throughout 1991. Overall, the smallmouth bass collected and measured were predominantly YOY and juveniles from the 1990 and 1991 year classes. The YOY smallmouth bass accounted for 70 percent of all the smallmouth bass measured during 1991. Adult smallmouth bass were collected in spring (May and June) and summer (August and September) samples. The minimum length for smallmouth bass collected in 1991 was 3.6 cm (1.4 in.). The maximum length measured for smallmouth bass collected was 43.2 cm (17.0 in.).

Lake trout, brown trout, Atlantic salmon, chinook salmon, and rainbow trout were collected occasionally throughout the year. All of the lake trout, brown trout, rainbow trout, and Atlantic salmon collected were adults. Of the three chinook salmon collected, one was an adult (April) and two were parr-marked fingerlings (May and June).

3.3 BIOMASS (PERMIT SECTION 10.d)

Total biomass (Table 3-7) of the 1991 impingement samples at JAFNPP was 674,732 g (674.7 kg, 1,484 lb). Alewife (438,025 g, 199.1 lb) comprised 65 percent of the total biomass collected in 1991. The annual total biomass for the remaining species of special interest was as follows: rainbow smelt (64,306 g, 29.2 lb), yellow perch (2,054 g, 0.9 lb), smallmouth bass (6,611 g, 3 lb), white perch (1,228 g, 0.6 lb), and the salmonid species combined (57,332 g, 26.1 lb). The biomass of those species combined totaled an additional 19 percent of the total biomass for 1991. The combined biomass of all species of special interest accounted for 84 percent of the total biomass collected in 1991. Biomass is generally more widely distributed among the species collected since a few heavy-bodied fish such as salmonids may weigh more than large numbers of fragile-bodied fishes such as rainbow smelt. For example, in 19[illegible] a total of 30 salmonids were collected weighing 57,332 g; a total of 13,177 rainbow smelt were collected weighing 64,306 g.

The estimated biomass (Table 3-8) calculated based on water volume was 2,004,885 g (2,005 kg, 911 lb) of which alewife (9[illegible],886 g, 419 lb) constituted 46 percent. Rainbow smelt (150,648 g, 68 lb) and the other species of special interest combined together accounted for an additional 26 percent of the total estimated biomass. The estimated biomass combined (1,445,585 g) for all species of special interest (alewife, rainbow smelt, yellow perch, white perch, smallmouth bass, and the five salmonid species) collected in 1991 accounted for 72 percent of the annual estimated biomass of impinged organisms at JAFNPP.

3.4 WATER QUALITY (NYPA 1991 Rev. 6)

Intake temperatures recorded from grab samples taken during impingement sampling at JAFNPP ranged from a minimum of 3.0 C (37.4 F) on 6 February 1991 to a maximum of 24.0 C (75.2 F) on 25 July 1991. Discharge temperatures taken on sample days ranged from a minimum of 10.5 C (50.9 F) on 6 February 1991 to a maximum of 37.0 C (98.6 F) on 22 August 1991.

TABLE 3-7 TOTAL BIOMASS* OF IMPINGED ORGANISMS COLLECTED AT JAMES A. FITZPATRICK NUCLEAR POWER PLANT, 1991

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	Annual Total
No. of Samples	4	4	4	16	20	4	5	6	4	4	4	4	79
SPECIES													
Alewife	---	---	287	268,186	145,398	21,694	2,216	69	4	31	96	44	438,025
Rainbow smelt	1,926	526	321	26,658	30,752	470	285	42	11	<1	2,016	1,300	64,306
Spottail shiner	143	54	209	1,843	6,192	296	79	[illegible]	6	45	216	12	9,095
Trout-perch	9	4	4	1,309	8,202	783	73	10	6	12	77	16	10,505
Bluegill	---	---	---	7	---	---	---	---	---	2	1,526	31	1,566
Threespine stickleback	23	72	8	134	287	[illegible]	3	---	---	---	222	60	834
Sculpins	16	40	11	796	371	68	---	2	---	5	2	---	1,311
Tessellated darter	2	---	---	48	241	92	13	8	4	1	---	---	401
Crayfish	14	20	14	246	118	33	20	6	13	<1	134	17	635
White perch	266	74	5	291	392	---	---	---	---	---	185	15	1,228
Gizzard shad	5,573	1,184	480	22	333	---	7	---	---	---	3,011	5,640	16,250
Stonecat	---	---	95	670	1,621	1,132	408	993	690	98	174	132	6,013
Yellow perch	14	12	---	598	759	272	1	2	137	---	237	22	2,054
Rock bass	204	131	513	244	726	1,401	275	646	1,256	279	317	1,582	7,574
Smallmouth bass	1,790	---	8	8	1,350	1,222	---	1,139	1,012	---	82	---	6,611
Central mudminnow	18	---	73	6	---	---	---	---	---	---	---	---	97
White bass	65	58	18	657	---	---	---	---	---	---	340	---	1,138
White sucker	---	---	---	---	3,560	3,158	887	2,682	1,100	3,981	---	739	16,107
Emerald shiner	31	32	---	---	---	6	---	---	---	---	---	---	69
Crayfish ([illegible])	---	---	<1	---	1	---	16	<1	<1	---	---	---	18
Lake trout	3,000	3,000	2,140	---	12,090	4,700	2,150	---	---	2,800	---	1,650	31,530
Brown trout	---	---	2,265	---	4,785	---	---	---	---	3,450	---	10,325	20,825
Walleye	---	1,900	---	---	---	985	5,450	1,550	[illegible]	1,900	---	2,500	17,347
Largemouth bass	---	---	---	---	---	---	---	---	---	---	106	20	126
Golden shiner	---	---	---	7	10	17	11	---	---	---	---	---	45
Lake chub	---	---	---	48	83	---	---	---	---	---	---	4	135

* Units of biomass are expressed as grams. If weight is designated as <1 and <0.5 grams, it was not added into the total.

NOTE: Dashes (---) indicate no catch.

TABLE 3-7 (Cont.)

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	Annual Total
SPECIES (Cont.)													
Pumpkinseed	—	—	—	17	—	—	—	<1	—	—	70	48	136
Longnose dace	17	12	2	—	—	—	—	—	—	—	—	14	45
Channel catfish	8	—	—	6	—	—	—	—	—	—	—	—	14
Burbot	—	78	—	985	3,450	—	—	—	—	—	—	380	4,893
Clam	8	2	—	—	—	—	—	—	—	—	—	—	10
Rainbow smelt (damaged)	—	—	—	—	—	—	—	—	—	2	—	—	2
Brown bullhead	—	—	—	95	—	—	542	—	—	113	—	—	750
Chinook salmon	—	—	—	825	4	5	—	—	—	—	—	—	834
American eel	—	—	—	—	—	3,030	—	—	—	—	—	—	3,030
Brook stickleback	—	—	—	3	—	—	—	—	—	—	—	—	3
Freshwater drum	36	—	—	—	—	—	—	—	—	—	—	—	36
Lake herring	—	—	—	1,130	940	—	—	—	—	—	—	—	2,070
Rainbow trout	613	—	—	—	—	—	2,550	—	—	—	—	—	3,163
Brook silverside	1	—	—	—	—	—	—	—	—	—	—	—	1
Carp	—	—	—	—	—	—	2,000	—	—	—	—	—	2,000
Northern pike	—	—	—	—	—	—	—	2,000	—	—	—	—	2,000
Sea lamprey	—	—	—	72	—	—	—	—	—	—	—	—	72
Ictalurus sp. (damaged)	—	—	—	1	—	—	—	—	—	—	—	—	1
Sea lamprey (damaged)	—	—	—	32	—	—	—	—	—	—	—	—	32
Tessellated darter (damaged)	—	—	—	—	—	—	—	—	—	—	—	<1	<1
Grass pickerel	—	—	—	—	34	—	—	—	—	—	—	—	34
Mudpuppy	—	—	—	—	136	—	—	—	—	—	—	—	136
Atlantic salmon	—	—	—	—	980	—	—	—	—	—	—	—	980
Shorthead redhorse sucker	—		—	—	—	—	—	644	—	—	—	—	644
TOTAL	13,777	7,199	6,454	304,934	222,815	39,389	16,986	9,795	7,301	12,720	8,811	24,551	674,732

TABLE 3-8 ESTIMATED MONTHLY BIOMASS (BASED ON FLOW*) OF IMPINGED ORGANISMS COLLECTED AT JAMES A. FITZPATRICK NUCLEAR POWER PLANT, 1991

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	Annual Total
No. of Samples	4	4	4	16	20	4	5	6	4	4	4	4	79
Flow Sampled (MCM)	7.059	6.336	4.626	27.638	32.271	5.846	7.270	10.424	9.026	8.645	8.433	5.579	133.153
Total Monthly Flow (MCM)	55.448	46.413	39.227	53.785	48.85[illegible]	43.527	46.634	54.689	67.269	66.909	62.789	42.350	627.897
SPECIES													
Alewife	---	---	2,434	521,904	220,127	61,525	14,215	362	30	240	715	334	921,886
Rainbow smelt	15,129	3,853	2,722	51,874	46,557	3,499	1,828	220	82	6	15,010	9,868	150,648
Spottail shiner	1,123	396	1,772	3,587	9,374	2,204	507	2	45	348	1,608	91	21,057
Trout-perch	71	29	34	2,547	12,417	5,830	468	52	45	93	573	121	22,280
Bluegill	---	---	---	14	---	---	---	---	---	15	11,362	235	11,626
Threespine stickleback	181	527	68	261	435	186	19	---	---	---	1,653	455	3,785
Sculpins	126	293	93	1,549	562	506	---	10	---	39	15	---	3,193
Tessellated darter	16	---	---	78	365	685	83	42	30	8	---	---	1,307
Crayfish	110	147	119	479	179	246	128	31	97	4	998	129	2,667
White perch	2,089	542	42	566	593	---	---	---	---	---	1,377	114	5,323
Gizzard shad	43,776	8,673	4,070	43	504	---	45	---	---	---	22,419	42,813	122,343
Stonecat	---	---	806	1,304	2,454	8,428	2,617	5,210	5,142	758	1,296	1,002	29,017
Yellow perch	110	88	---	1,164	1,149	2,025	6	10	1,021	---	1,765	167	7,505
Rock bass	1,602	960	4,350	475	1,099	10,431	1,764	3,389	9,361	2,159	2,360	12,009	49,959
Smallmouth bass	14,060	---	68	16	2,044	9,099	---	5,976	7,542	---	611	---	39,416
Central mudminnow	141	---	619	12	---	---	---	---	---	---	---	---	772
White bass	511	425	15[illegible]	1,279	---	---	---	---	---	---	2,532	---	4,900
White sucker	---	---		---	5,390	23,513	5,690	14,071	8,198	30,811	---	5,610	93,283
Emerald shiner	244	23[illegible]	---	---	---	45	---	---	---	---	---	---	523
Crayfish (damaged)	---	---	4	---	2	---	103	4	<1	---	---	---	11[illegible]
Lake trout	23,565	21,976	18,147	---	18,304	34,994	13,791	---	---	71	---	12,525	154,973

* Number of grams per million cubic meters (MCM). If weight is designated as <1 and was less than 0.5 g, it was not added into the [illegible]d.

NOTE: Dashes (---) indicate no catch.

TABLE 3-8 (Cont.)

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	Annual Total
SPECIES (Cont.)													
Brown trout	—	—	19,206	—	7,244	—	—	—	—	26,702	—	78,378	131,530
Walleye	—	13,918	—	—	—	7,334	34,959	8,132	22,820	14,705	—	18,977	120,845
Largemouth bass	—	—	—	—	—	—	—	—	—	—	789	152	941
Golden shiner	—	—	—	14	15	127	71	—	—	—	—	—	227
Lake chub	—	—	—	93	126	—	—	—	—	—	—	30	249
Pumpkinseed	—	—	—	33	—	—	—	4	—	—	521	364	922
Longnose dace	134	88	17	—	—	—	—	—	—	—	—	106	345
Channel catfish	63	—	—	12	—	—	—	—	—	—	—	—	75
Burbot	—	571	—	1,917	5,223	—	—	—	—	—	—	2,885	10,596
Clam	63	15	—	—	—	—	—	—	—	—	—	—	78
Rainbow smelt (damaged)	—	—	—	—	—	—	—	—	—	15	—	—	15
Brown bullhead	—	—	—	185	—	—	3,477	—	—	875	—	—	4,537
Chinook salmon	—	—	—	1,605	6	37	—	—	—	—	—	—	1,648
American eel	—	—	—	—	—	22,560	—	—	—	—	—	—	22,560
Brook stickleback	—	—	—	6	—	—	—	—	—	—	—	—	6
Freshwater drum	283	—	—	—	—	—	—	—	—	—	—	—	283
Lake herring	—	—	—	2,199	1,423	—	—	—	—	—	—	—	3,622
Rainbow trout	4,815	—	—	—	—	—	16,357	—	—	—	—	—	21,172
Brook silverside	8	—	—	—	—	—	—	—	—	—	—	—	8
Carp	—	—	—	—	—	—	12,829	—	—	—	—	—	12,829
Northern pike	—	—	—	—	—	—	—	10,493	—	—	—	—	10,493
Sea lamprey	—	—	—	140	—	—	—	—	—	—	—	—	140
Ictalurus sp. (damaged)	—	—	—	2	—	—	—	—	—	—	—	—	2
Sea lamprey (damaged)	—	—	—	62	—	—	—	—	—	—	—	—	62
Tessellated darter (damaged)	—	—	—	—	—	—	—	—	—	—	—	3	3
Grass pickerel	—	—	—	—	51	—	—	—	—	—	—	—	51
Mudpuppy	—	—	—	—	206	—	—	—	—	—	—	—	206
Atlantic salmon	—	—	—	—	1,484	—	—	—	—	—	—	—	1,484
Shorthead redhorse sucker	—	—	—	—	—	—	—	3,379	—	—	—	—	3,379
TOTAL	108,220	52,735	54,724	593,420	337,333	293,274	108,957	51,387	54,414	98,449	65,604	186,5[illegible]3	2,004,885

3.5 HISTORICAL IMPINGEMENT COMPARISONS (PERMIT SECTION 11.c.iii)

The number of fish impinged during 1991, not adjusted for collection efficiency, was used for comparison of the number of fish impinged in previous years. Impinged fish have been collected annually at JAFNPP since 1975. Impingement abundance is highest in the spring and peaks in May when about 44 percent of the impingement occurs (Figure 3-1). The high abundance in spring coincides with the movement of fish to the shallow inshore areas to spawn. Migration inshore occurs when lake temperatures warm to preferred species-specific temperature ranges; the timing may vary slightly every year. Impingement abundance decreases starting in June as adult fish move offshore after spawning. Impingement abundance then increases slightly in the fall (October, November, and December) as YOY fish (particularly alewife and rainbow smelt) attain a size susceptible to impingement. Associated with the increase in impingement of fish in the fall and winter are specific meteorological conditions to which YOY seem particularly susceptible. Historically, strong winds from the west or northwest that cause greater wave action have resulted in short-term increases in impingement abundance at JAFNPP.

Lifton and Storr (1977) found statistically significant correlations between environmental factors (wave height, water temperature, and wind action) and impingement at power plants on Lake Erie and Lake Ontario. Wave height had a higher correlation than either of the other factors. They hypothesized that wave-induced turbulence and possibly turbidity interfere with a fish's normal ability to detect and avoid an intake structure.

Meteorological conditions cause behavioral changes in fish populations that may be reflected in the impingement collections (Lifton and Storr 1977). Alewives exhibit definite fluctuations in population size (Scott and Crossman 1973; Christie 1974; Elrod et al. 1979, 1980; O'Gorman and Schneider 1986; O'Gorman et al. 1988, unpublished). Christie (1974) hypothesized that periodic massive die-offs of alewife in the spring might occur due to some combination of climatic conditions and the physical condition of individuals in the population. The alewife population in Lake Ontario declined due to a die-off during Winter 1976-1977; a winter of severe cold. Losses were estimated as high as 60-75 percent of the adult population, resulting in the complete elimination of the 1976 year class.

The total estimated impingement for 1976 (Table 3-9) accounted for 47 percent of the total impingement over the last 16 years (1976-1991). The estimated alewife impinged in 1976 (3,877,550; LMS 1977) accounted for 56 percent of the total estimated alewife impingement through 1991 (6,922,723) at JAFNPP. The 1976 estimated impingement for alewife accounted for 42 percent of all fish impinged thus far at JAFNPP. Since 1976, Lake Ontario winters have been milder than normal, no catastrophic die-offs of the magnitude of 1976 have been recorded. Several smaller die-offs have been noted, e.g., 1983 and 1986 (O'Gorman et al. 1988, unpublished). Additionally, the annual salmonid stocking program begun in 1978 may have contributed to a lakewide reduction in abundance of alewife due to increased predation by the salmonids.

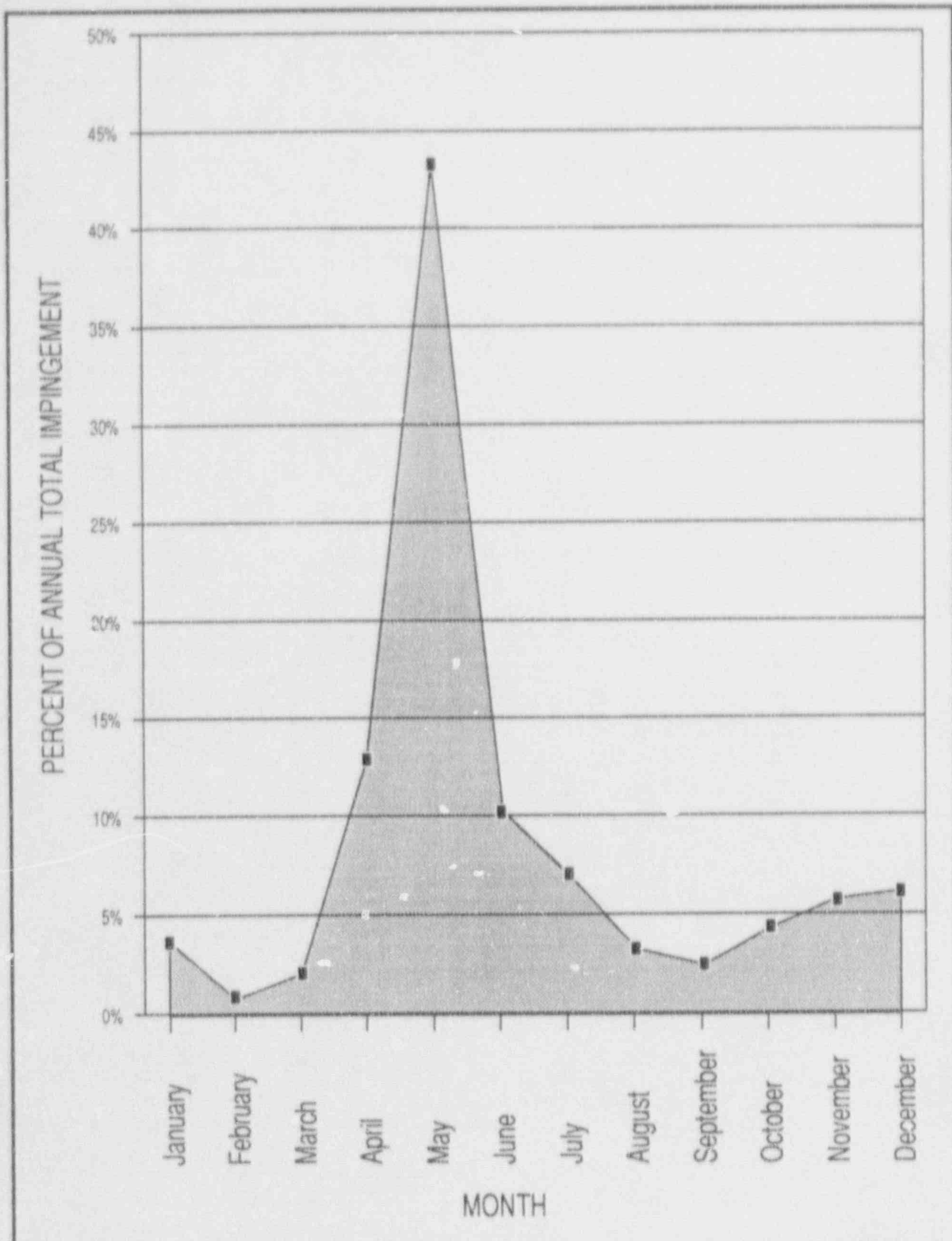

Figure 3-1. Total monthly impingement estimates for all years combined (1976-1991) at James A. FitzPatrick Nuclear Power Plant.

TABLE 3-9 ESTIMATED MONTHLY IMPINGEMENT (BASED ON FLOW) AT JAMES A. FITZPATRICK NUCLEAR POWER PLANT, 1976-1991

Year	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	Total
1976	12,208	1,300	50,037	689,46	2,850,935	304,206	160,379	5,147	6,524	8,178	188,928	36,254	4,313,562
1977	19,526	5,068	13,813	50,490	119,725	15,910	152	223	15,560	32,428	29,711	30,837	333,443
1978	41,595	16,646	87,854	25,014	88,712	42,847	13,392	33,708	31,570	246	558	42,051	424,193
1979	13,436	9,115	8,362	5,629	14,453	1,675	219	227	18,132	30,649	46,209	96,123	244,229
1980	45,794	10,197	2,998	27,371	13,854	59,916	19,690	5,966	4,072	42,751	40,026	23,632	296,267
1981	6,169	8,046	17,572	44,405	34,936	35,879	55,165	116,356	49,081	153,223	2,378	4,050	527,260
1982	47,283	3,533	14,095	91,148	110,301	38,996	142,100	22,753	11,453	877	2,205	118,508	603,252
1983	4,826	1,421	3,945	9,832	51,562	2,739	832	4,945	15,071	2,870	1,277	16,674	115,994
1984	1,441	1,538	2,539	3,332	140,421	43,211	95,471	6,958	3,616	101	2,788	71,168	372,584
1985	16,065	6,486	0	20,715	186,113	117,628	53,100	22,900	31,458	2,716	128,768	10,020	595,969
1986	17,750	1,974	3,100	48,697	96,717	11,690	16,991	22,685	18,854	6,879	7,065	8,422	260,824
1987	42,959	912	93	5,775	55,500	7,494	8,936	9,127	3,437	6,570	4,349	19,220	164,382
1988	15,618	4,713	3,174	56,707	53,127	7,831	913	5,685	108	119	5,856	13,218	167,069
1989	8,521	3,732	1,136	32,120	196,640	217,552	17,628	735	985	22,166	11,122	2,699	515,036
1990	931	1,674	6,232	436	2,781	3,168	428	17,933	24,202	73,971	8,386	17,774	157,916
1991	7,597	2,183	2,022	60,703	27,755	12,887	1,993	1,296	521	565	13,097	2,675	133,294
Total	301,719	78,538	216,982	1,171,840	4,043,532	923,629	587,389	276,644	234,644	384,309	492,723	513,325	9,225,274

OUTAGES:
1976 - No plant operating data.
1977- 22 JUN - 23 SEP 1977
1978 - 17 SEP - 06 DEC 1978
1979 - 16 MAR - 07 SEP 1979
1980 - 07 MAY - 13 AUG 1980
1981 - 30 OCT - 09 MAR 1981
1983 - 04 JUN - 02 SEP 1983
1984 - 16 SEP - 05 NOV 1984
1985 - 16 FEB - 01 JUN 1985
1986 - 15 MAR - 30 MAR; 29 SEP - 08 OCT 1986
1987 - 16 JAN - 28 APR 1987
1988 - 28 AUG - 23 NOV 1988
1989 - 16 SEP - 06 OCT 1989
1990 - 01 APR - 27 JUN 1990
1991 - 09 MAR - 14 APR; 08 MAY - 19 AUG; 28 NOV - 31 DEC 1991

Other outages may have occurred from 1976 to 1991, however, impingement is influenced most by extended outages as shown.

The severe winter of 1976-1977 also affected the rainbow smelt population as shown in Figure 3-2. Rainbow smelt are subject to lakewide population fluctuations which appear to be caused in part by cannibalism of young smelt by adult smelt and by predation by the stocked salmonids on adult smelt (O'Gorman et al. 1990, unpublished). When interpreting impingement data on rainbow smelt, lakewide patterns in population fluctuations are difficult to ascertain due to the strong influence of meteorological conditions which occur during sample collections. As previously discussed, strong west or northwest winds with a continued increase in wave action result in short-term increases in impingement abundance with wave height correlated at a higher level (Lifton and Storr 1977). These conditions do occur on Lake Ontario particularly in January, November, and December, and cause an increase in YOY rainbow smelt which are shown to be susceptible to impingement in greater numbers during previously described meteorological conditions. These conditions could cause an increase in the impingement abundance of YOY rainbow smelt at a time prior to their recruitment into the lake population (i.e., late summer and fall of the year spawned). The abundance of rainbow smelt in the impingement collections may then appear high at a time when the lakewide population of rainbow smelt is exhibiting a reduction in overall population size.

The estimated impingement of white perch, yellow perch, smallmouth bass, and salmonids (Figure 3-2), species of interest due to their significance as forage or sport fish, are shown for 1976-1991 in Figure 3-2. Fluctuations in their abundances appear to be attributable primarily to natural fluctuations of individual populations and localized meteorological occurrences influencing the impingement process. Increases in smallmouth bass and white perch impingement abundance are most often influenced by short-term meteorological conditions previously described. Late fall and winter storms often cause large numbers of YOY of both species to be collected upon impingement. In 1988 and 1990, this was true of smallmouth bass; in 1977 and 1983, it was true for white perch (EA 1983, 1988, 1989; TI 1978).

The population of yellow perch in Lake Ontario has been declining since the late 1970s, due in part to poor reproductive success. USFWS biologists have found that in 11 years of assessment fishing, YOY were caught in large numbers only in 1978 and 1985; 1978 was the year with the highest abundance (O'Gorman 1990). In Figure 3-2, yellow perch impingement abundance estimates were also highest in 1978. The JAFNPP outage in 1985 could have obscured any increase in yellow perch due to reduced impingement and collection during the outage. An increase in yellow perch impingement during 1990 was due to meteorological conditions during one sample in June. Few yellow perch were collected in the other 1990 impingement samples. The number of yellow perch impinged in 1991 is slightly higher than for 1990 but is not proportionately different from the impingement numbers for years prior to 1990. Most of the yellow perch collected in 1991 were also collected as the result of a single storm event in November. O'Gorman (1990) speculates that the yellow perch stock in northeastern Lake Ontario will continue to decline primarily due to poor reproduction and recent heavy exploitation of older (> age 3) fish in sport and commercial fisheries.

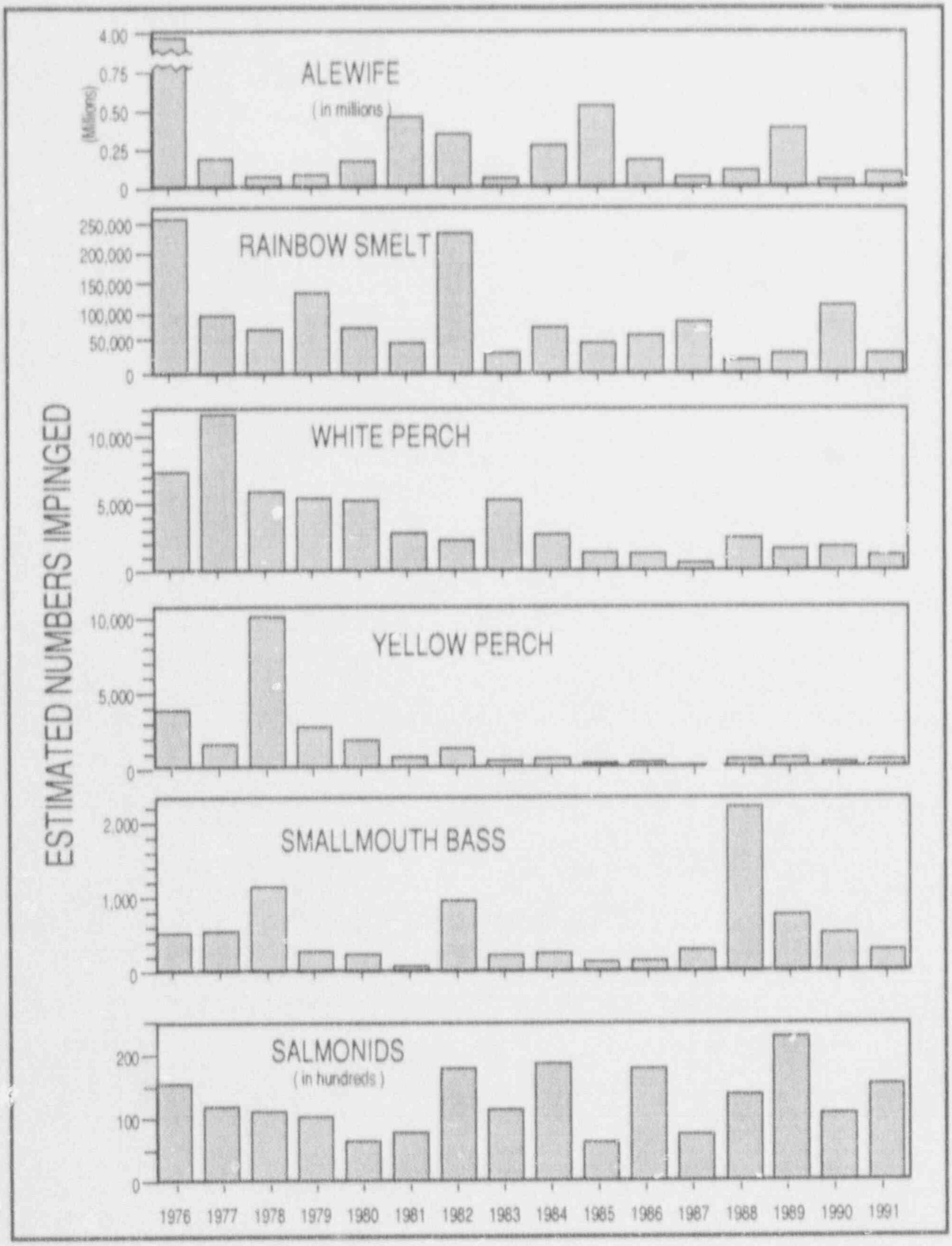

Figure 3-2. Estimated impingement (based on flow) for select species (1976-1991) at James A. FitzPatrick Nuclear Power Plant.

The estimated number of salmonids impinged in 1991 is not far from the yearly average (16 years) of 132. Fluctuations in the estimated numbers of salmonids impinged at JAFNPP occur due to the plant outages that reduce the estimated impingement and occasional storm conditions which may necessitate the use of the required subsample protocol. Extrapolation of subsample results slightly inflates estimates for salmonids due to the mathematical process for extrapolation and the small number of salmonids collected.

The timing and duration of station outages for refueling and maintenance also influenced impingement abundance and species composition. During extended maintenance and/or refueling outages, the operation of the main circulating water pumps is generally reduced to one or two of the three existing pumps. The concurrent reduction in flow through the intake generally results in a reduction in impingement abundance and species diversity during the outage. Years in which extended outages resulted in the reduction of fish impingement are visible on Figure 3-2. The timing of refueling and maintenance outages during spring spawning migrations of alewife and rainbow smelt occurred in 1979, 1980, 1985, 1987, 1990, and 1991. Outages that occurred in the late summer and fall when YOY were susceptible to impingement occurred in 1977, 1978, 1981, 1983, 1984, 1988, 1991. The influence of station outages must be considered when interpreting the historical impingement abundance estimates.

Natural biological factors such as population size, migration patterns, schooling, and spawning behaviors, in conjunction with external environmental factors such as water temperatures, currents, and localized meteorological conditions, play an important role in seasonal variations in species occurrence or absence. Overall, the alewife has been the most abundant species in impingement collections (Figure 3-3). Alewife and rainbow smelt combined have accounted for 91 percent of estimated impingement abundance from 1976 to 1991. Other species that have been dominant include threespine stickleback (2 years), white perch (2 years), spottail shiner (5 years), gizzard shad (3 years), darters (1 year), trout-perch (2 years), and sculpins (1 year). The species composition has ranged from 26 to 54 species per year in the impingement collections at JAFNPP. Species composition has changed little during the 16 years that impingement collections have been analyzed.

It appears that changes in relative abundance of fish populations in the vicinity of JAFNPP are the result of natural fluctuations in abundance. When these fluctuations are larger, they can be detected in the annual estimates of fish impinged at JAFNPP. Most often the impingement abundance numbers are influenced by station operating conditions and localized short-term meteorological conditions. No long-term trends in fish population abundance due to impingement have been apparent.

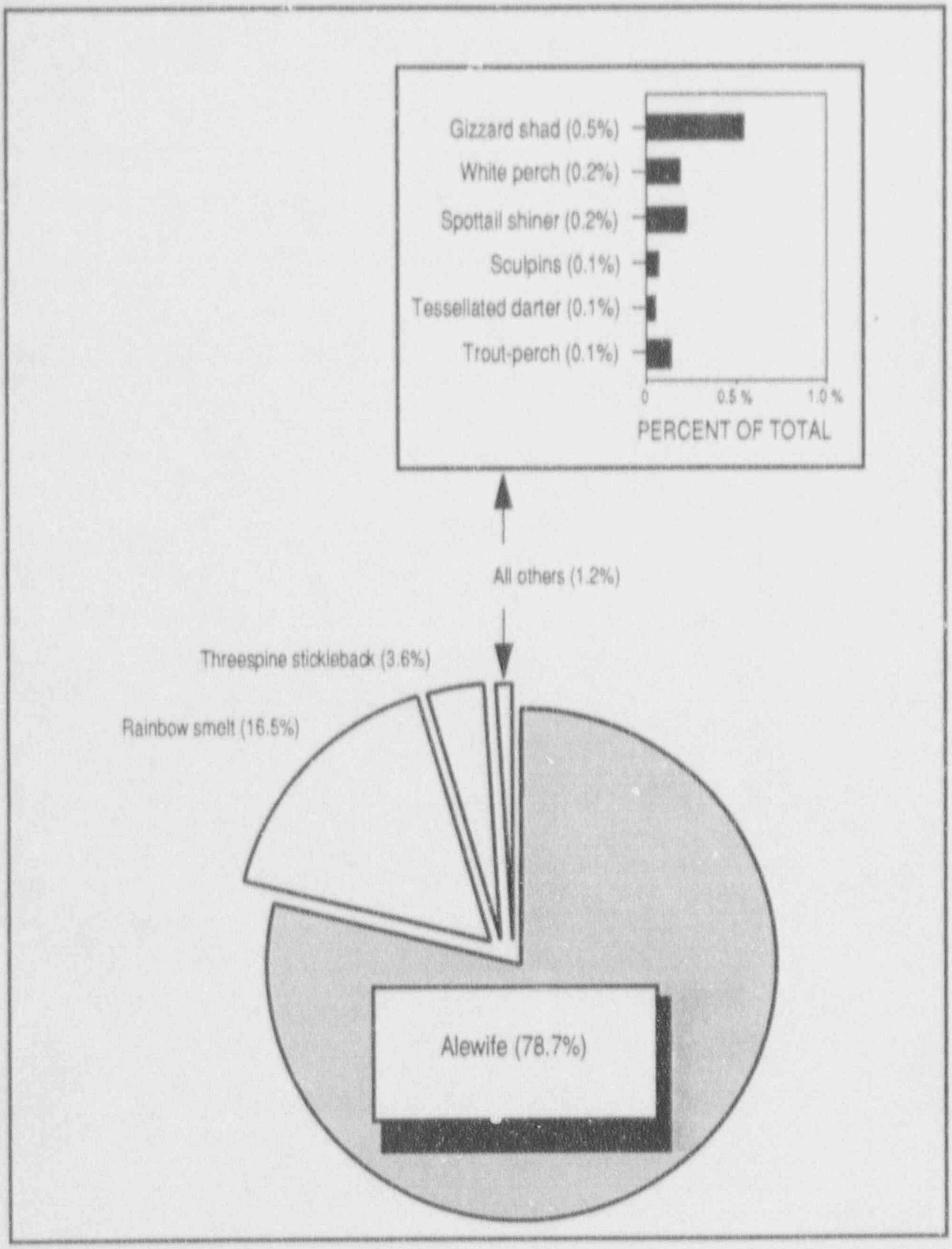

Figure 3-3. Relative proportions of the impingement collections for dominant species - all years combined (1976-1991) at James A. FitzPatrick Nuclear Power Plant.

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Appendix A

Exceptions to Standard Operating Procedures for Impingement at James A. FitzPatrick Nuclear Power Plant 1991

APPENDIX A

EXCEPTIONS TO STANDARD OPERATING PROCEDURES FOR IMPINGEMENT AT JAMES A. FITZPATRICK NUCLEAR POWER PLANT, 1991

4 APR — Void Impingement Sample: The impingement sample scheduled for completion on 4 April 1991 was declared void prior to completion. Maintenance work on a traveling screen was completed and a previously tagged screen was washed and rotated. This caused an unknown amount of debris to enter the collection basket voiding the sample. The sample was successfully completed on 7 April 1991.

15 MAY — Void Impingement Sample: The impingement sample scheduled for completion on 15 May 1991 was declared void prior to completion. Maintenance work on a traveling screen was completed and the previously tagged traveling screen was washed and rotated. This caused an unknown amount of debris to enter the collection basket voiding the sample. The sample was successfully completed on 20 May 1991.

2 JUL — Upwelling Sample: A period of upwelling occurred in Lake Ontario that necessitated the collection of an additional impingement sample as required by the JAFNPP SPDES Permit Section 11.B.7.

18 DEC — Rescheduled Samples: Maintenance work on the washwater pumps 18 December and work on the traveling screens made it impossible to collect impingement samples successfully on the assigned dates. The samples were rescheduled and successfully collected on 20 and 23 December 1991.

Appendix B

Station Operating Conditions at
James A. FitzPatrick Nuclear Power Plant
1991

TABLE B-1 STATION OPERATION CONDITIONS AT JAMES A. FITZPATRICK NUCLEAR POWER PLANT, 1991

STATION: James A. FitzPatrick Nuclear Power Plant MONTH: January

Date	No. of Circulating Water Pumps	No. of Service Water Pumps	Total Volume of Water Pumped (m^3)	Mean Electrical Output (MWe)	Temperature (C)	
					Intake	Discharge
1	3	2	1,813,021.1	829	5.4	24.1
2	3	2	1,813,021.1	830	4.1	22.7
3	3	2	1,813,021.1	829	4.2	22.9
4	3	2	1,813,021.1	830	2.1	20.8
5	3	2	1,791,437.5	830	2.4	20.9
6	3	2	1,791,437.5	831	2.9	21.4
7	3	2	1,791,437.5	831	3.1	21.4
8	3	2	1,791,437.5	830	2.9	21.4
9	3	2	1,791,4[illegible]5	830	3.7	21.4
10	3	2	1,791,437.5	830	3.2	21.1
11	3	2	1,791,437.5	827	3.1	20.9
12	3	2	1,813,021.1	829	5.2	22.7
13	3	2	1,791,437.5	830	4.1	22.0
14	3	2	1,813,021.1	829	4.7	23.1
15	3	2	1,813,021.1	830	3.3	21.6
16	3	2	1,813,021.1	830	4.0	22.4
17	3	2	1,813,021.1	830	2.9	21.4
18	3	2	1,791,437.5	830	2.6	21.1
19	3	2	1,813,021.1	831	4.4	22.2
20	3	2	1,813,021.1	832	3.4	21.8
21	3	2	1,791,437.5	831	3.0	20.9
22	3	2	1,856,188.2	832	6.0	23.4
23	3	2	1,856,188.2	830	6.8	23.4
24	3	2	1,791,437.5	831	3.3	20.5
25	3	2	1,769,853.9	831	3.3	20.4
26	3	2	1,791,437.5	688	3.7	18.2
27	3	2	1,769,853.9	365	4.1	12.7
28	3	2	1,726,686.7	380	3.8	12.3
29	3	2	1,661,936.0	377	3.1	11.3
30	3	2	1,683,519.6	380	2.6	11.1
31	3	2	1,683,519.6	381	2.8	11.2

TABLE B-1 (Cont.)

STATION: James A. FitzPatrick Nuclear Power Plant MONTH: February

Date	No. of Circulating Water Pumps	No. of Service Water Pumps	Total Volume of Water Pumped (m^3)	Mean Electrical Output (MWe)	Temperature (C)	
					Intake	Discharge
1	2/3/2	2	1,940,342.4	240	2.6	8.7
2	2	2	1,504,310.4	0	1.5	1.5
3	2/3	2	1,722,326.4	94	3.5	7.9
4	3	2	1,640,352.4	537	4.2	16.5
5	3	2	1,295,015.0	356	2.4	11.7
6	3	2	1,510,850.9	376	2.1	11.4
7	3	2	1,532,434.5	408	2.2	11.9
8	3	2	1,618,768.8	591	3.0	16.2
9	3	2	1,640,352.8	746	3.1	19.2
10	3	2	1,683,519.6	831	3.2	21.2
11	3	2	1,683,519.6	832	2.7	20.7
12	3	2	1,683,519.6	831	2.7	20.6
13	3	2	1,705,103.4	830	2.4	20.3
14	3	2	1,683,519.6	830	2.2	20.1
15	3	2	1,683,519.6	832	1.8	19.8
16	3	2	1,683,519.6	830	1.4	19.2
17	3	2	1,683,519.6	832	1.8	19.6
18	3	2	1,683,519.6	831	1.8	19.6
19	3	2	1,683,519.6	830	2.8	20.6
20	3	2	1,683,519.6	831	3.2	20.9
21	3	2	1,683,519.6	831	3.2	20.9
22	3	2	1,683,519.6	832	3.3	21.1
23	3	2	1,683,519.6	833	2.9	20.6
24	3	2	1,683,519.6	830	2.7	20.5
25	3	2	1,683,519.6	831	2.4	20.3
26	3	2	1,683,519.6	831	2.8	20.6
27	3	2	1,683,519.6	830	2.6	20.4
28	3	2	1,683,519.6	830	3.2	21.0

TABLE B-1 (Cont.)

STATION: James A. FitzPatrick Nuclear Power Plant MONTH: March

Date	No. of Circulating Water Pumps	No. of Service Water Pumps	Total Volume of Water Pumped (m^3)	Mean Electrical Output (MWe)	Temperature (C)	
					Intake	Discharge
1	3	2	1,683,519.6	830	3.2	20.8
2	3	2	1,683,519.6	832	3.3	21.2
3	3	2	1,683,519.6	832	3.6	21.3
4	3	2	1,683,519.6	831	3.4	21.2
5	3	2	1,683,519.6	831	3.5	21.2
6	3	2	1,683,519.6	831	3.9	21.6
7	3	2	1,683,519.6	832	4.1	21.8
8	3/2	2	1,455,256.8	703	3.2	18.7
9	2	[illegible]	1,504,310.4	4	2.1	2.8
10	2/	2/1	1,406,203.2	0	2.1	2.1
11	0	1	98,107.2	0	2.1	4.7
12	0	1	98,107.2	0	1.8	5.0
13	0	1	98,107.2	0	2.0	4.9
14	0	1/2	130,809.6	0	1.5	2.2
15	0/2	2	196,214.4	0	2.3	4.8
16	2	2	1,068,278.4	0	2.4	3.5
17	2	2	1,504,310.4	0	3.1	3.2
18	2	2	1,504,310.4	0	3.1	4.1
19	2	2/1	1,438,905.6	0	3.2	3.1
20	2	1	1,406,203.2	0	3.6	3.4
21	2	1	1,406,203.2	0	3.2	3.1
22	2	1	1,406,203.2	0	3.4	3.3
23	2	1	1,406,203.2	0	3.4	3.2
24	2	1	1,406,203.2	0	3.5	3.3
25	2	1	1,406,203.2	0	4.0	3.8
26	2	1	1,406,203.2	0	4.1	3.9
27	2	1	1,406,203.2	0	4.3	4.1
28	2	1/2/1	1,471,608.0	0	5.8	5.6
29	2	1	1,406,203.2	0	6.1	5.8
30	2	1	1,406,203.2	0	5.4	5.2
31	2	1	1,406,203.2	0	5.1	4.9

TABLE B-1 (Cont.)

STATION: James A. FitzPatrick Nuclear Power Plant MONTH: April

Date	No. of Circulating Water Pumps	No. of Service Water Pumps	Total Volume of Water Pumped (m^3)	Mean Electrical Output (MWE)	Temperature (C)	
					Intake	Discharge
1	2	1	1,406,203.2	0	4.3	4.2
2	2	1	1,406,203.2	0	5.3	5.1
3	2	1	1,406,203.2	0	4.8	4.6
4	2	1	1,406,203.2	0	4.6	[illegible]
5	2	1	1,406,203.2	0	5.3	5.1
6	2	1	1,406,203.2	0	5.9	5.7
7	2	1	1,406,203.2	0	6.9	6.8
8	2	1	1,406,203.2	0	6.5	6.3
9	2	1	1,406,203.2	0	6.6	6.4
10	2	1	1,406,203.2	0	8.2	8.1
11	2	1	1,406,203.2	0	8.8	8.6
12	2	1	1,406,203.2	0	8.4	8.3
13	2	1	1,406,203.2	0	6.2	6.6
14	2	1	1,406,203.2	124	5.8	11.3
15	2/3	1/2	1,722,326.4	384	6.0	15.7
16	3	2	2,158,358.4	386	6.7	14.9
17	3	2	2,158,358.4	383	7.3	15.6
18	3	2	2,158,358.4	518	7.4	17.9
19	3	2	2,158,358.4	751	6.9	21.5
20	3	2	2,158,358.4	828	6.4	22.4
21	3	2	2,158,358.4	829	6.6	22.6
22	3	2	2,158,358.4	829	7.1	23.2
23	3	2	2,158,358.4	828	7.3	23.4
24	3	2	2,158,358.4	829	7.4	23.4
25	3	2	2,158,358.4	829	7.9	23.8
26	3	2	2,158,358.4	829	8.1	24.1
27	3	2	2,158,358.4	831	8.6	24.2
28	3	2	2,158,358.4	831	9.3	24.8
29	3	2	2,158,358.4	830	7.1	22.7
30	3	2	2,158,358.4	830	7.7	23.3

TABLE B-1 (Cont.)

STATION: James A. FitzPatrick Nuclear Power Plant MONTH: May

Date	No. of Circulating Water Pumps	No. of Service Water Pumps	Total Volume of Water Pumped (m^3)	Mean Electrical Output (MWe)	Temperature (C)	
					Intake	Discharge
1	3	2	2,158,358.4	830	9.8	25.3
2	3	2	2,158,358.4	830	9.2	24.8
3	3	2	2,158,358.4	831	.9	25.5
4	3	2	2,158,358.4	831	9.3	24.9
5	3	2	2,158,358.4	830	9.6	25.2
6	3	2	2,158,358.4	831	7.8	23.4
7	3/2	2/1	1,907,640.0	531	8.7	18.6
8	2	1	1,406,203.2	0	8.9	8.7
9	2	1	1,406,203.2	0	8.3	8.0
10	2/3/2	1	1,624,219.2	0	9.4	9.1
11	2	1/2/1	1,438,905.6	0	10.2	9.8
12	2	1	1,406,203.2	0	10.2	9.8
13	2	1	1,406,203.2	0	10.1	9.7
14	2	1	1,406,203.2	0	11.0	10.6
15	2	1	1,406,203.2	0	11.6	11.2
16	2	1	1,406,203.2	0	10.7	10.3
17	2	1	1,406,203.2	0	11.5	11.1
18	2	1	1,406,203.2	0	11.3	10.9
19	2	1	1,406,203.2	0	10.4	10.1
20	2	1	1,406,203.2	0	10.9	10.5
21	2	1	1,406,203.2	0	10.4	9.8
22	2	1	1,406,203.2	0	12.7	12.3
23	2	1	1,406,203.2	0	12.6	12.1
24	2	1	1,406,203.2	0	12.[illegible]	11.8
25	2	1	1,406,203.2	0	14.7	14.3
26	2	1	1,406,203.2	0	11.2	10.8
27	2	1	1,406,203.2	0	8.8	8.3
28	2	1	1,406,203.2	0	13.3	12.9
29	2	1	1,406,203.2	0	15.7	15.4
30	2	1	1,406,203.2	0	16.4	16.3
31	2	1	1,406,203.2	0	18.2	18.1

TABLE B-1 (Cont.)

STATION: James A. FitzPatrick Nuclear Power Plant MONTH: June

Date	No. of Circulating Water Pumps	No. of Service Water Pumps	Total Volume of Water Pumped (m3)	Mean Electrical Output (MWe)	Temperature (C)	
					Intake	Discharge
1	2	1	1,406,203.2	0	18.2	18.0
2	2	1	1,406,203.2	0	18.6	18.4
3	2	1	1,406,203.2	0	18.9	18.7
4	2	1	1,406,203.2	0	16.6	16.4
5	2	1	1,406,203.2	0	12.0	11.8
6	2	1	1,406,203.2	0	13.2	12.8
7	2	1	1,406,203.2	0	16.9	16.4
8	2	1	1,406,203.2	0	17.6	17.1
9	2	1	1,406,203.2	0	18.1	17.6
10	2	1	1,406,203.2	0	18.7	18.3
11	2	1	1,406,203.2	0	19.3	18.9
12	2	1	1,406,203.2	0	20.1	19.7
13	2	1	1,406,203.2	0	*	*
14	2	1	1,406,203.2	0	19.3	18.9
15	2	1	1,406,203.2	0	19.1	18.7
16	2	1	1,406,203.2	0	20.1	19.7
17	2	1/2	1,471,608.0	0	20.1	19.7
18	2	2	1,504,310.4	0	19.8	19.3
19	2	2	1,504,310.4	0	19.6	19.2
20	2	2	1,504,310.4	0	21.3	20.8
21	2	2	1,504,310.4	0	21.6	21.2
22	2	2	1,504,310.4	0	20.3	20.0
23	2	2	1,504,310.4	0	14.1	13.7
24	2	2	1,504,310.4	0	17.9	17.4
25	2	2	1,504,310.4	0	18.3	17.9
26	2	2	1,504,310.4	0	17.4	17.1
27	2	2	1,504,310.4	0	19.9	19.5
28	2	2	1,504,310.4	0	21.7	21.2
29	2	2	1,504,310.4	0	22.4	21.9
30	2	2	1,504,310.4	0	14.3	13.9

* Computer inopertaive.

TABLE B-1 (Cont.)

STATION: James A. FitzPatrick Nuclear Power Plant MONTH: July

Date	No. of Circulating Water Pumps	No. of Service Water Pumps	Total Volume of Water Pumped (m^3)	Mean Electrical Output (MWe)	Temperature (C)	
					Intake	Discharge
1	2	2	1,504,310.4	0	15.9	15.4
2	2	2	1,504,310.4	0	17.9	17.4
3	2	2	1,504,310.4	0	16.0	15.6
4	2	2	1,504,310.4	0	9.3	8.8
5	2	2	1,504,310.4	0	8.8	8.3
6	2	2	1,504,310.4	0	12.7	12.2
7	2	2	1,504,310.4	0	16.4	15.9
8	2	2	1,504,310.4	0	18.6	18.1
9	2	2	1,504,310.4	0	20.4	19.9
10	2	2	1,504,310.4	0	21.3	20.8
11	2	2	1,504,310.4	0	22.0	21.5
12	2	2	1,504,310.4	0	22.3	21.9
13	2	2	1,504,310.4	0	21.8	21.3
14	2	2	1,504,310.4	0	22.3	21.9
15	2	2	1,504,310.4	0	22.7	22.2
16	2	2	1,504,310.4	0	22.7	22.1
17	2	2	1,504,310.4	0	22.8	22.3
18	2	2	1,504,310.4	0	23.1	22.6
19	2	2	1,504,310.4	0	23.7	23.1
20	2	2	1,504,310.4	0	24.2	24.1
21	2	2	1,504,310.4	0	25.0	24.4
22	2	2	1,504,310.4	0	24.9	24.4
23	2	2	1,504,310.4	0	24.6	24.1
24	[illegible]	2	1,504,310.4	0	24.7	24.2
25	2	2	1,504,310.4	0	24.8	24.3
26	2	2	1,504,310.4	0	24.9	24.4
27	2	2	1,504,310.4	0	24.7	24.2
28	2	2	1,504,310.4	0	24.9	24.4
29	2	2	1,504,310.4	0	24.4	23.9
30	2	2	1,504,310.4	0	24.2	23.7
31	2	2	1,504,310.4	0	24.1	23.6

TABLE B-1 (Cont.)

STATION: James A. FitzPatrick Nuclear Power Plant MONTH: August

Date	No. of Circulating Water Pumps	No. of Service Water Pumps	Total Volume of Water Pumped (m^3)	Mean Electrical Output (MWe)	Temperature (C)	
					Intake	Discharge
1	2	2	1,504,310.4	0	24.1	23.6
2	2	2	1,504,310.4	0	24.2	23.7
3	2	2	1,504,310.4	0	23.9	23.1
4	2	2	1,504,310.4	0	24.0	23.4
5	2	2	1,504,310.4	0	23.8	23.3
6	2	2	1,504,310.4	0	23.6	23.1
7	2	2	1,504,310.4	0	23.9	23.4
8	2	2	1,504,310.4	0	24.3	23.8
9	2	2	1,504,310.4	0	21.7	21.2
10	2	2	1,504,310.4	0	22.9	22.5
11	2	2	1,504,310.4	0	23.1	22.6
12	2	2	1,504,310.4	0	22.9	22.4
13	2	2	1,504,310.4	0	23.1	22.6
14	2	2	1,504,310.4	0	23.2	22.9
15	2	2	1,504,310.4	0	23.7	23.2
16	2	2	1,504,310.4	0	23.8	23.2
17	2	2	1,504,310.4	0	23.3	22.8
18	2	2	1,504,310.4	0	23.8	23.6
19	2	2	1,504,310.4	50	23.6	26.8
20	2/3	2	1,940,342.4	512	22.4	33.2
21	3	2/3/2	2,223,763.2	796	21.6	36.1
22	3	2	2,158,358.4	810	23.3	38.2
23	3	2	2,158,358.4	811	23.4	38.4
24	3	2	2,158,358.4	816	22.5	37.4
25	3	2	2,158,358.4	828	10.9	26.3
26	3	2	2,158,358.4	822	17.1	32.3
27	3	2	2,158,358.4	813	20.5	35.6
28	3	2/3	2,223,763.2	729	23.7	37.3
29	3	3	2,256,465.6	483	23.9	33.3
30	3	3	2,256,465.6	511	23.8	33.7
31	3	3	2,256,465.6	530	24.2	34.3

TABLE B-1 (Cont.)

STATION: James A. FitzPatrick Nuclear Power Plant MONTH: September

Date	No. of Circulating Water Pumps	No. of Service Water Pumps	Total Volume of Water Pumped (m^3)	Mean Electrical Output (MWe)	Temperature (C)	
					Intake	Discharge
1	3	3	2,256,465.6	801	20.7	35.4
2	3	3	2,256,465.6	818	20.0	35.0
3	3	3	2,256,465.6	820	20.7	35.7
4	3	3	2,256,465.6	817	21.5	36.6
5	3	3	2,256,465.6	816	22.2	37.2
6	3	3	2,256,465.6	815	22.2	37.3
7	3	3	2,256,465.6	814	22.3	37.3
8	3	3	2,256,465.6	815	22.2	37.3
9	3	3	2,256,465.6	813	21.7	36.8
10	3	3	2,256,465.6	817	21.8	36.9
11	3	3	2,256,465.6	815	22.4	37.4
12	3	3	2,256,465.6	818	21.8	36.8
13	3	3	2,256,465.6	815	21.6	36.7
14	3	3	2,256,465.6	817	21.5	36.6
15	3	3	2,256,465.6	818	21.0	36.1
16	3	3	2,256,465.6	814	22.6	37.6
17	3	3	2,256,465.6	814	22.4	37.4
18	3	3	2,256,465.6	816	21.8	36.8
19	3	3	2,256,465.6	815	21.6	36.6
20	3	3	2,256,465.6	812	21.2	36.1
21	3	3	2,256,465.6	819	21.0	36.1
22	3	3	2,256,465.6	819	20.7	35.8
23	3	3	2,256,465.6	820	20.2	35.3
24	3	3	2,256,465.6	819	20.2	35.4
25	3	3	2,256,465.6	820	19.3	34.3
26	3	3/2	2,223,763.2	809	19.3	34.4
27	3	2	2,158,358.4	814	17.4	32.3
28	3	2	2,158,358.4	813	17.8	32.8
29	3	2	2,158,358.4	810	17.8	33.3
30	3	2	2,158,358.4	811	17.7	33.2

TABLE B-1 (Cont.)

STATION: James A. FitzPatrick Nuclear Power Plant MONTH: October

Date	No. of Circulating Water Pumps	No. of Service Water Pumps	Total Volume of Water Pumped (m^3)	Mean Electrical Output (MWe)	Temperature (C)	
					Intake	Discharge
1	3	2	2,158,358.4	806	17.8	32.7
2	3	2	2,158,358.4	811	17.8	33.2
3	3	2	2,158,358.4	808	18.1	33.7
4	3	2	2,158,358.4	813	17.9	33.5
5	3	2	2,158,358.4	599	17.7	29.8
6	3	2	2,158,358.4	800	17.7	32.9
7	3	2	2,158,358.4	817	15.8	31.5
8	3	2	2,158,358.4	823	16.0	31.8
9	3	2	2,158,358.4	822	16.4	32.1
10	3	2	2,158,358.4	824	16.1	31.8
11	3	2	2,158,358.4	825	16.2	31.9
12	3	2	2,158,358.4	823	16.1	31.8
13	3	2	2,158,358.4	824	15.8	31.5
14	3	2	2,158,358.4	823	16.1	31.3
15	3	2	2,158,358.4	824	15.3	30.6
16	3	2	2,158,358.4	824	15.5	31.1
17	3	2	2,158,358.4	823	15.4	31.2
18	3	2	2,158,358.4	824	15.6	30.9
19	3	2	2,158,358.4	826	15.3	30.5
20	3	2	2,158,358.4	826	15.2	30.6
21	3	2	2,158,358.4	824	14.7	30.1
22	3	2	2,158,358.4	825	14.9	30.7
23	3	2	2,158,358.4	824	14.5	30.2
24	3	2	2,158,358.4	823	14.4	29.7
25	3	2	2,158,358.4	808	14.8	29.8
26	3	2	2,158,358.4	814	15.3	30.7
27	3	2	2,158,358.4	826	15.1	30.8
28	3	2	2,158,358.4	825	14.0	29.8
29	3	2	2,158,358.4	823	13.4	29.2
30	3	2	2,158,358.4	825	13.3	28.5
31	3	2	2,158,358.4	824	12.4	27.9

TABLE B-1 (Cont.)

STATION: James A. FitzPatrick Nuclear Power Plant MONTH: November

Date	No. of Circulating Water Pumps	No. of Service Water Pumps	Total Volume of Water Pumped (m^3)	Mean Electrical Output (MWe)	Temperature (C)	
					Intake	Discharge
1	3	2	2,158,358.4	824	12.1	27.2
2	3	2	2,158,358.4	522	10.7	22.1
3	3	2	2,158,358.4	788	12.0	27.0
4	3	2	2,158,358.4	822	11.4	27.3
5	3	2	2,158,358.4	823	11.1	27.0
6	3	2	2,158,358.4	749	[illegible]	25.3
7	3	2	2,158,358.4	824	11.1	26.6
8	3	2	2,158,358.4	825	10.0	25.8
9	3	2	2,158,358.4	824	10.6	26.1
10	3	2	2,158,358.4	606	10.4	22.8
11	3	2	2,158,358.4	716	8.9	23.0
12	3	2	2,158,358.4	821	9.6	24.5
13	3	2	2,158,358.4	825	10.1	25.4
14	3	2	2,158,358.4	825	9.2	24.3
15	3	2	2,158,358.4	826	9.3	25.0
16	3	2	2,158,358.4	827	9.7	24.8
17	3	2	2,158,358.4	825	10.0	25.1
18	3	2	2,158,358.4	825	9.7	24.9
19	3	2	2,158,358.4	826	9.6	24.9
20	3	2	2,158,358.4	826	10.1	25.4
21	3	2	2,158,358.4	822	10.2	25.2
22	3	2	2,158,358.4	826	10.1	25.1
23	3	2	2,158,358.4	828	10.1	25.3
24	3	2	2,158,358.4	827	9.7	24.9
25	3	2	2,158,358.4	826	7.9	22.9
26	3	2	2,158,358.4	825	7.6	22.6
27	3/2	[illegible]	2,158,358.4	649	8.9	21.0
28	2	2	1,504,310.4	4	8.1	8.4
29	2	2	1,504,310.4	0	8.2	7.7
30	2	2	1,504,310.4	0	8.3	7.8

TABLE B-1 (Cont.)

STATION: James A. FitzPatrick Nuclear Power Plant MONTH: December

Date	No. of Circulating Water Pumps	No. of Service Water Pumps	Total Volume of Water Pumped (m^3)	Mean Electrical Output (MWe)	Temperature (C)	
					Intake	Discharge
1	2	2	1,504,310.4	0	8.7	8.2
2	2	2/1	1,47[illegible],608.0	0	7.5	7.1
3	2	1	1,406,203.2	0	7.3	7.0
4	2	1	1,406,203.2	0	6.5	6.2
5	2	1	1,406,203.2	0	6.5	6.1
6	2	1	1,406,203.2	0	6.8	6.4
7	2	1	1,406,203.2	0	6.8	6.5
8	2	1	1,406,203.2	0	6.8	6.5
9	2	1	1,406,203.2	0	6.8	6.6
10	2	1	1,406,203.2	0	7.3	6.9
11	2	1	1,406,203.2	0	7.4	7.1
12	2	1	1,406,203.2	0	7.1	6.7
13	2	1	1,406,203.2	0	7.4	7.0
14	2	1	1,406,203.2	0	7.1	6.7
15	2	1	1,406,203.2	0	5.1	4.7
16	2	1	1,406,203.2	0	4.7	4.3
17	2	1	1,406,203.2	0	[illegible].2	4.7
18	2	1	1,406,203.2	0	3.8	3.4
19	2	1	1,406,203.2	0	4.4	4.1
20	2	1	1,406,203.2	0	3.1	2.6
21	2	1	1,406,203.2	0	2.6	2.2
22	2	1	1,406,203.2	0	2.9	2.4
23	2	1	1,406,203.2	0	2.6	2.1
24	2	1	1,406,203.2	0	2.7	2.2
25	2	1	1,406,203.2	0	3.2	2.6
26	2	1	1,406,203.2	0	3.7	3.1
27	2	1	1,406,203.2	0	2.9	2.3
28	2	1	1,406,203.2	0	3.5	3.0
29	2	1	1,406,203.2	0	3.1	2.6
30	2	1	1,406,203.2	0	1.9	1.4
31	2	1	1,406,203.2	0	2.6	2.1

Appendix C

Scientific and Common Names of all Taxa Collected in 1991

APPENDIX C

SCIENTIFIC AND COMMON NAMES OF ALL TAXA COLLECTED IN 1991

Scientific Name	Common Name
Alosa pseudoharengus	Alewife
Ambloplites rupestris	Rock bass
Anguilla rostrata	American eel
Aplodinotus grunniens	Freshwater drum
Cambaridae	Crayfish family
Catostomus commersoni	White sucker
Coregonus artedii	Cisco
Cottus sp. (non ricei)	Sculpin family
Couesius plumbeus	Lake chub
Culaea inconstans	Brook stickleback
Cyprinus carpio	Carp
Dorosoma cepedianum	Gizzard shad
Esox americanus vermiculatus	Grass pickerel
Esox lucius	Northern pike
Etheostoma olmstedi	Tessellated darter
Gasterosteus aculeatus	Threespine stickleback
Ictalurus nebulosus	Brown bullhead
Ictalurus punctatus	Channel catfish
Labidesthes sicculus	Brook silverside
Lepomis gibbosus	Pumpkinseed
Lepomis macrochirus	Bluegill
Lota lota	Burbot
Micropterus dolomieui	Smallmouth bass
Micropterus salmoides	Largemouth bass
Mollusca	Clam family
Morone americana	White perch
Morone chrysops	White bass
Moxostoma macrolepidotum	Shorthead redhorse sucker
Necturus maculosus	Mudpuppy
Notemigonus crysoleucas	Golden shiner
Notropis atherinoides	Emerald shiner
Notropis hudsonius	Spottail shiner
Noturus flavus	Stonecat
Oncorhynchus mykiss	Rainbow trout
Oncorhynchus tshawytscha	Chinook salmon
Osmerus mordax	Rainbow smelt
Perca flavescens	Yellow perch
Percopsis omiscomaycus	Trout-perch
Petromyzon marinus	Sea lamprey
Rhinichthys cataractae	Longnose dace
Salmo salar	Atlantic salmon
Salmo trutta	Brown trout
Salvelinus namaycush	Lake trout
Stizostedion vitreum	Walleye
Umbra limi	Central mudminnow

Appendix D

Daily Impingement Collection Totals at
James A. FitzPatrick Nuclear Power Plant
1991

TABLE D-1 DAILY IMPINGEMENT COLLECTION TOTALS AT JAMES A. FITZPATRICK NUCLEAR POWER PLANT, 1991

	JANUARY				FEBRUARY				MARCH			
Sample Dates	3	10	18*	28	6	15	22	27	7	15	22	26
SPECIES												
Alewife	---	---	---	---	---	---	---	---	1	---	13	3
Rainbow smelt	179	76	22	451	36	35	75	9	34	3	23	17
Spottail shiner	1	8	20	19	5	4	5	1	78	1	5	1
Trout-perch	---	1	---	1	---	---	1	---	1	---	---	---
Bluegill	---	---	---	---	---	---	---	---	---	---	---	---
Threespine stickleback	1	1	---	18	41	6	11	2	---	2	4	---
Sculpins	1	1	2	3	2	3	2	2	3	2	---	---
Tessellated darter	---	1	---	---	---	---	---	---	---	---	---	---
Crayfish	---	1	4	3	---	---	2	1	6	---	---	2
White perch	---	4	20	61	2	9	12	1	1	---	---	---
Gizzard shad	2	3	6	8	---	1	1	---	2	---	---	---
Stonecat	---	---	---	---	---	---	---	---	3	---	---	---
Yellow perch	---	---	4	---	---	---	2	---	---	---	---	---
Rock bass	---	1	4	4	---	2	---	1	3	---	---	---
Smallmouth bass	---	---	6	1	---	---	---	---	1	---	---	---
Central mudminnow	2	---	---	---	---	---	---	---	25	---	---	---
White bass	---	---	---	5	---	---	4	---	1	---	---	---
White sucker	---	---	---	---	---	---	---	---	---	---	---	---
Emerald shiner	---	---	---	10	---	2	8	2	---	---	---	---
Crayfish (damaged)	---	---	---	---	---	---	---	---	---	---	1	---
Lake trout	---	1	---	---	---	1	---	---	1	---	---	---
Brown trout	---	---	---	---	---	---	---	---	1	---	---	---
Walleye	---	---	---	---	---	---	1	---	---	---	---	---
Largemouth bass	---	---	---	---	---	---	---	---	---	---	---	---

* 50 percent subsample taken; numbers extrapolated according to the SOP.

NOTE: Dashes (---) indicate no catch.

TABLE D-1 (Cont.)

Sample Dates	JANUARY 3	10	18*	28	FEBRUARY 6	15	22	27	MARCH 7	15	22	26
SPECIES (Cont.)												
Golden shiner	---	---	---	---	---	---	---	---	---	---	---	---
Lake chub	---	---	---	---	---	---	---	---	---	---	---	---
Pumpkinseed	---	---	---	---	---	---	---	---	---	---	---	---
Longnose dace	---	---	---	1	1	---	1	1	1	---	---	---
Channel catfish	---	---	4	---	---	---	---	---	---	---	---	---
Burbot	---	---	---	---	---	---	1	---	---	---	---	---
Clam	2	---	---	---	---	1	---	1	---	---	---	---
Rainbow smelt (damaged)	---	---	---	---	---	---	---	---	---	---	---	---
Brown bullhead	---	---	---	---	---	---	---	---	---	---	---	---
Chinook salmon	---	---	---	---	---	---	---	---	---	---	---	---
American eel	---	---	---	---	---	---	---	---	---	---	---	---
Brook stickleback	---	---	---	---	---	---	---	---	---	---	---	---
Freshwater drum	---	---	---	2	---	---	---	---	---	---	---	---
Lake herring	---	---	---	---	---	---	---	---	---	---	---	---
Rainbow trout	1	---	---	---	---	---	---	---	---	---	---	---
Brook silverside	---	1	---	---	---	---	---	---	---	---	---	---
Carp	---	---	---	---	---	---	---	---	---	---	---	---
Northern pike	---	---	---	---	---	---	---	---	---	---	---	---
Sea lamprey	---	---	---	---	---	---	---	---	---	---	---	---
Ictalurus sp. (damaged)	---	---	---	---	---	---	---	---	---	---	---	---
Sea lamprey (damaged)	---	---	---	---	---	---	---	---	---	---	---	---
Tessellated darter (damaged)	---	---	---	---	---	---	---	---	---	---	---	---
Grass pickerel	---	---	---	---	---	---	---	---	---	---	---	---
Mudpuppy	---	---	---	---	---	---	---	---	---	---	---	---
Atlantic salmon	---	---	---	---	---	---	---	---	---	---	---	---
Shorthead redhorse sucker	---	---	---	---	---	---	---	---	---	---	---	---
Total	189	99	92	587	87	64	126	21	162	8	46	23

TABLE D-1 (Cont.)

Sample Dates	APRIL 03*	5	6	7	8	9	10	13*	14	17	19	24	25	26	27	30
SPECIES																
Alewife	2,636	1,019	188	161	335	178	157	4,096	1,813	4,903	1,095	2,612	1,943	1,577	1,214	1,149
Rainbow smelt	296	205	18	24	63	34	30	1,264	351	756	512	404	203	285	288	586
Spottail shiner	114	29	5	9	7	4	3	14	9	29	12	16	10	6	2	5
Trout-perch	6	10	1	2	3	2	1	22	1	5	8	14	9	21	18	11
Bluegill	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—
Threespine stickleback	22	3	1	—	2	—	2	8	2	27	6	2	5	1	6	—
Sculpins	20	7	4	3	12	2	5	12	2	20	17	21	4	18	5	6
Tessellated darter	—	—	—	—	1	—	—	2	—	2	1	1	3	5	1	1
Crayfish	4	2	1	2	1	1	4	6	1	6	6	10	10	4	5	3
White perch	—	—	—	—	1	—	1	4	—	2	2	1	—	1	1	—
Gizzard shad	—	—	—	—	—	—	—	—	—	—	—	2	—	—	—	—
Stonecat	4	—	—	—	1	—	—	6	—	1	1	2	2	—	2	1
Yellow perch	2	—	1	—	—	—	—	—	—	1	—	—	—	—	—	—
Rock bass	—	—	—	—	—	—	—	—	1	—	—	—	—	1	—	—
Smallmouth bass	2	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—
Central mudminnow	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
White bass	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	1
White sucker	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Emerald shiner	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Crayfish (damaged)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Lake trout	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Brown trout	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Walleye	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Largemouth bass	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Golden shiner	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—

TABLE D-1 (Cont.)

Sample Dates	APRIL															
	03*	5	6	7	8	9	10	13*	14	17	19	24	25	26	27	30
SPECIES (Cont.)																
Lake chub	—	—	—	1	—	—	—	—	—	—	—	—	1	—	—	—
Pumpkinseed	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—
Longnose dace	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Channel catfish	—	—	—	—	1	—	—	—	—	1	—	—	—	—	—	—
Burbot	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Clam	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Rainbow smelt (damaged)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Brown bullhead	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1
Chinook salmon	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—
American eel	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Brook stickleback	2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Freshwater drum	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Lake herring	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1
Rainbow trout	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Brook silverside	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Carp	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Northern pike	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Sea lamprey	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Ictalurus sp. (damaged)	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—
Sea lamprey (damaged)	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—
Tessellated darter (damaged)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Grass pickerel	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Mudpuppy	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Atlantic salmon	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Shorthead redhorse sucker	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Total	3,108	1,278	219	202	427	221	203	5,434	2,181	5,754	1,660	3,086	2,191	1,920	1,544	1,765

TABLE D-1 (Cont.)

	MAY																			
Sample Dates	2	3	4	6	7	8	10	11	12	14	16	17	19	20	21	22	23	24	30	31
SPECIES																				
Alewife	1,390	1,027	3,792	896	619	306	160	160	280	174	182	167	214	189	200	138	102	140	71	77
Rainbow smelt	424	563	3,091	596	76	84	47	48	57	56	58	20	314	106	88	75	59	45	12	6
Spottail shiner	18	33	250	336	5	3	6	7	10	2	1	3	28	7	7	5	8	5	2	2
Trout-perch	20	88	709	33	29	7	6	10	8	3	3	4	5	2	3	---	1	6	1	1
Bluegill	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Threespine stickleback	7	32	92	9	1	2	---	---	1	---	1	---	6	1	3	3	2	---	2	2
Sculpins	8	15	44	7	7	7	2	4	2	2	2	1	2	2	1	2	---	1	---	---
Tessellated darter	6	9	32	9	6	5	2	3	6	3	2	7	11	---	4	5	3	10	4	2
Crayfish	7	2	2	1	1	1	---	---	---	---	---	1	---	---	1	1	---	---	1	1
White perch	---	6	33	---	1	---	1	---	---	---	---	---	---	---	---	---	---	---	---	---
Gizzard shad	1	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Stonecat	1	3	1	1	2	3	2	1	2	2	3	---	2	---	---	1	2	---	2	3
Yellow perch	1	---	9	---	1	---	---	---	---	---	---	---	---	---	1	1	---	---	---	---
Rock bass	---	---	2	---	---	---	---	---	---	---	---	---	---	---	1	---	---	---	---	1
Smallmouth bass	---	1	4	---	---	---	---	---	---	---	---	---	2	---	---	---	---	---	---	---
Central mudminnow	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
White bass	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
White sucker	---	---	---	---	1	1	---	1	---	---	1	---	---	---	---	---	---	---	---	---
Emerald shiner	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Crayfish (damaged)	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	1	---	---	---
Lake trout	---	---	---	1	---	---	1	---	---	---	---	1	---	---	---	---	1	1	---	---
Brown trout	---	---	---	---	---	---	---	---	---	2	---	---	---	---	1	---	---	1	---	---
Walleye	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Largemouth bass	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Golden shiner	---	---	---	---	---	1	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Lake chub	---	1	---	---	1	---	---	---	1	---	---	---	---	---	1	---	---	---	---	---

TABLE D-1 (Cont.)

	MAY																			
Sample Dates	2	3	4	6	7	8	10	11	12	14	16	17	19	20	21	22	23	24	30	31
SPECIES (Cont.)																				
Pumpkinseed	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Longnose dace	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Channel catfish	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Burbot	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	1	---
Clam	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Rainbow smelt (damaged)	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Brown bullhead	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Chinook salmon	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	1	---	---	---	---
American eel	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Brook stickleback	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Freshwater drum	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Lake herring	---	---	1	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Rainbow trout	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Brook silverside	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Carp	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Northern pike	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Sea lamprey	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Ictalurus sp. (damaged)	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Sea lamprey (damaged)	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Tessellated darter (damaged)	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Grass pickerel	---	---	---	1	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Mudpuppy	---	---	---	---	---	1	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Atlantic salmon	---	---	---	---	---	---	---	---	---	---	---	---	1	---	---	---	---	---	---	---
Shorthead redhorse sucker	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	1,883	1,780	8,062	1,890	750	421	227	234	367	244	253	204	585	307	311	232	179	209	96	95

TABLE D-1 (Cont.)

	JUNE				JULY					AUGUST					
Sample Dates	7	13	18	27	2**	3	11	17	26	2	7	15	16	22	30
SPECIES															
Alewife	274	362	377	186	68	37	11	3	1	2	2	2	6	20	26
Rainbow smelt	201	12	---	21	80	21	6	2	---	6	19	18	7	18	33
Spottail shiner	4	22	1	2	4	---	6	---	---	---	---	---	1	---	---
Trout-perch	4	38	27	6	4	---	6	1	---	1	---	---	---	---	---
Bluegill	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Threespine stickleback	3	7	1	---	1	---	---	---	---	---	---	---	---	---	---
Sculpins	2	25	---	3	---	---	---	---	---	---	1	1	---	2	---
Tessellated darter	6	85	---	2	1	4	13	1	1	1	1	1	39	1	1
Crayfish	---	2	---	6	1	1	---	---	---	---	---	2	---	---	---
White perch	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Gizzard shad	---	---	---	---	---	---	2	---	---	---	---	---	---	---	---
Stonecat	---	9	7	4	2	2	2	1	---	2	5	---	3	6	1
Yellow perch	---	---	2	---	---	2	---	---	---	---	---	---	1	---	---
Rock bass	---	1	1	2	---	---	---	1	---	---	1	2	---	---	---
Smallmouth bass	1	5	---	---	---	---	---	---	---	---	---	---	---	1	2
Central mudminnow	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
White bass	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
White sucker	---	2	2	2	---	1	---	1	2	---	1	---	---	---	---
Emerald shiner	---	1	---	---	---	---	---	---	---	---	---	---	---	---	---
Crayfish (damaged)	---	---	---	---	---	---	7	6	---	1	---	---	3	---	---
Lake trout	1	---	1	---	---	---	---	1	---	---	---	---	---	---	---
Brown trout	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Walleye	---	---	1	---	---	---	1	---	1	1	---	---	---	---	---
Largemouth bass	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---

** Upwelling sample taken; numbers recorded according to SOP.

TABLE D-1 (Cont.)

	JUNE				JULY					AUGUST					
Sample Dates	7	13	18	27	2**	3	11	17	26	2	7	15	16	22	30
SPECIES (Cont.)															
Golden shiner	---	2	---	---	1	---	---	1	1	---	---	---	---	---	---
Lake chub	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Pumpkinseed	---	---	---	---	---	---	---	---	---	---	---	---	2	---	---
Longnose dace	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Channel catfish	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Burbot	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Clam	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Rainbow smelt (damaged)	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Brown bullhead	---	---	---	---	---	---	1	---	---	---	---	---	---	---	---
Chinook salmon	1	---	---	---	---	---	---	---	---	---	---	---	---	---	---
American eel	---	---	---	2	---	---	---	---	---	---	---	---	---	---	---
Brook stickleback	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Freshwater drum	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Lake herring	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Rainbow trout	---	---	---	---	---	---	---	---	1	---	---	---	---	---	---
Brook silverside	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Carp	---	---	---	---	---	---	---	1	---	---	---	---	---	---	---
Northern pike	---	---	---	---	---	---	---	---	---	---	---	---	---	---	1
Sea lamprey	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Ictalurus sp. (damaged)	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Sea lamprey (damaged)	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Tessellated darter (damaged)	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Grass pickerel	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Mudpuppy	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Atlantic salmon	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Shorthead redhorse sucker	---	---	---	---	---	---	---	---	---	---	---	1	---	---	---
Total	562	573	420	236	162	68	55	19	7	14	30	27	62	48	66

TABLE D-1 (Cont.)

	SEPTEMBER				OCTOBER				NOVEMBER				DECEMBER				
Sample Dates	4	12	17	25	3	11	21	29	5	14	20	26***	5	20	23	27	Totals
SPECIES																	
Alewife	1	1	4	2	4	5	3	26	2	—	2	8	1	1	1	1	36,816
Rainbow smelt	16	4	4	3	—	—	1	—	—	1	1	400	8	16	152	23	13,177
Spottail shiner	1	1	—	—	—	—	—	10	—	—	—	44	—	—	1	1	1,258
Trout-perch	—	—	1	—	—	—	—	2	—	1	—	12	—	2	—	—	1,182
Bluegill	—	—	—	—	—	2	—	—	1	—	—	808	5	4	—	2	823
Threespine stickleback	—	—	—	—	—	—	—	—	—	—	—	180	13	13	17	12	589
Sculpins	—	—	—	—	—	2	1	—	—	—	2	—	—	—	—	—	327
Tessellated darter	3	—	1	—	1	—	—	1	—	—	—	—	—	—	—	—	310
Crayfish	2	—	2	—	—	1	—	—	1	—	—	68	—	4	—	3	197
White perch	—	—	—	—	—	—	—	—	—	—	—	28	—	1	1	1	195
Gizzard shad	—	—	—	—	—	—	—	—	—	1	—	80	6	1	22	1	139
Stonecat	5	4	—	2	1	—	—	—	—	1	—	8	—	3	—	—	118
Yellow perch	—	—	—	2	—	—	—	—	—	1	—	56	1	—	2	2	94
Rock bass	—	1	2	2	—	—	1	—	4	—	1	8	4	2	6	2	64
Smallmouth bass	1	1	—	—	—	—	—	—	—	—	—	16	—	—	—	—	42
Central mudminnow	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	29
White bass	—	—	—	—	—	—	—	—	2	1	—	12	—	—	—	—	27
White sucker	1	—	—	—	1	1	2	—	—	—	—	—	—	1	—	1	25
Emerald shiner	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	23
Crayfish (damaged)	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	20
Lake trout	—	—	—	—	—	—	—	1	—	—	—	—	—	1	—	—	13
Brown trout	—	—	—	—	—	—	—	1	—	—	—	—	2	1	1	1	11
Walleye	1	—	—	1	—	—	—	1	—	—	—	—	—	—	1	—	9
Largemouth bass	—	—	—	—	—	—	—	—	—	—	—	8	—	—	—	1	9
Golden shiner	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	7

*** 25% subsample taken; numbers extrapolated according to the SOP.

TABLE D-1 (Cont.)

Sample Dates	SEPTEMBER 4	12	17	25	OCTOBER 3	11	21	29	NOVEMBER 5	14	20	26***	DECEMBER 5	20	23	27	Totals
SPECIES (Cont.)																	
Lake chub	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	7
Pumpkinseed	—	—	—	—	—	—	—	—	1	—	—	—	—	1	2	—	7
Longnose dace	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	6
Channel catfish	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	6
Burbot	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	4
Clam	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	4
Rainbow smelt (damaged)	—	—	—	—	—	4	—	—	—	—	—	—	—	—	—	—	4
Brown bullhead	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	3
Chinook salmon	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	3
American eel	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	2
Brook stickleback	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	2
Freshwater drum	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	2
Lake herring	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	2
Rainbow trout	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	2
Brook silverside	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1
Carp	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1
Northern pike	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1
Sea lamprey	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1
Ictalurus sp. (damaged)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1
Sea lamprey (damaged)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1
Tesselated darter (damaged)	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	1
Grass pickerel	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1
Mudpuppy	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1
Atlantic salmon	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1
Shorthead redhorse sucker	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1
Total	31	12	14	13	8	15	8	42	11	6	6	1,736	40	54	207	51	55,569