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Martin Marietta Environmental Systems

HUDSON RIVER ECOLOGICAL STUDY IN THE AREA OF INDIAN POINT

1984 ANNUAL REPORT

Prepared for

Consolidated Edison Company of
New York, Inc.
4 Irving Place
New York, New York 10003

and

New York Power Authority
123 Main Street, 14th Floor
White Plains, New York 10601

Jointly Financed by

Central Hudson Gas and Electric Corporation

Consolidated Edison Company of New York, Inc.

New York Power Authority

Niagara Mohawk Power Corporation

Orange and Rockland Utilities, Inc.

July 1985

MARTIN MARIETTA

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FOREWORD

The 1984 Indian Point Annual Report was prepared by Martin Marietta Environmental Systems for Consolidated Edison Company of New York, Inc. (Con Edison) and New York Power Authority under Contract Number 5-04120. The objective of this report is to summarize data collected during 1984 impingement monitoring and to relate these data to biological knowledge and historical impingement patterns. Data are presented for fish and blue crabs collected from intake screens at Indian Point Station Units 2 and 3.

SUMMARY

Impingement of fish and blue crabs at Indian Point Units 2 and 3 was monitored during 1984. Blue crabs were collected daily and fish were sampled according to a seasonally stratified sampling design.

Approximately 153,000 fish were collected during 1984. After adjusting for collection efficiency and scaling up for plant operating days, it was estimated that about 850,000 fish weighing a total of 9,900 kg were impinged during the year. An average of approximately 500 fish were impinged per million cubic meters of water sampled. Total number of fish impinged and number per unit volume were similar to 1983 impingement levels and lower than in all other years since 1976.

Of the total estimated number of fish impinged, approximately 40% were impinged at Unit 2. (Unit 2 was not sampled during the summer stratum due to outages.) Approximately 509,000 fish, weighing an estimated 6,000 kg, were impinged at Unit 3. The coefficient of variation calculated for estimated impingement was 13.0% at Unit 2 and 9.4% at Unit 3.

Fifty-six species were collected at Indian Point. White perch comprised approximately 64% of the total number of fish collected and were dominant in the winter, while bay anchovy and Atlantic tomcod were the most abundant species during the summer. Seasonal patterns observed for individual species were generally similar to previous years. Species richness in 1984 was similar to that in 1982 and 1983, but lower than that from 1976 to 1981.

Three hundred and forty-eight blue crabs weighing a total of 41 kg were collected from intake screens. Blue crabs were impinged from 29 June to 27 November. Only 20 crabs were collected at Unit 2, which was not operated during most of the summer stratum. As in 1983, most of the blue crabs collected in 1984 were males. Although fewer crabs were collected in 1984 than in 1983, the seasonal distributions were similar for the two years.

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I. INTRODUCTION

Fish impingement has been measured annually at Indian Point Generating Station since 1972, and monitoring for blue crab impingement was initiated in 1983. Fish and crab impingement data collected in 1984 are presented in this report and related to similar studies of previous years.

Chapter I contains an introduction to the Indian Point Station. The experimental design, methods of sample collection and processing, and methods of data analysis are presented in Chapter II. Chapter III summarizes plant operating and water quality data and presents estimates of annual fish impingement and an evaluation of their precision. A discussion of seasonal impingement patterns and historical impingement trends are also provided in Chapter III. Blue crab impingement data collected during 1984 are summarized and interpreted in Chapter IV. Appendix A contains the formulae used for estimating annual fish impingement. Water chemistry data are provided in Appendix B. Appendices C and D contain data collected for fish and blue crabs, respectively.

Indian Point Generating Station

The Indian Point Generating Station is located on the east bank of the Hudson River at river mile 43 (Fig. I-1). The station has three units. Unit 1 began operation in 1962 and was retired from operation in 1974. Unit 2, which is owned and operated by Con Edison, and Unit 3, which is owned and operated by New York Power Authority, began commercial operations in 1973 and 1976, respectively.

Each unit utilizes a once-through cooling system. The combined pumping capacity of Units 2 and 3 is 6,588 m^3/min. Each of these units has six circulator pumps with individual pumping capacities of 530 m^3/min and six service water pumps with a total capacity of 114 m^3/min.

In 1984, dual speed pumps were installed at Unit 2. These pumps eliminate the need to recirculate cooling water to accomplish the reduction in flow rate required by the Hudson River Cooling Tower Settlement Agreement. The Settlement Agreement requires the utilities to operate Indian Point Station at 60% of pumping capacity during November through April. Prior to this agreement, the flow rate was reduced to 60% when the temperature was below 4°C.

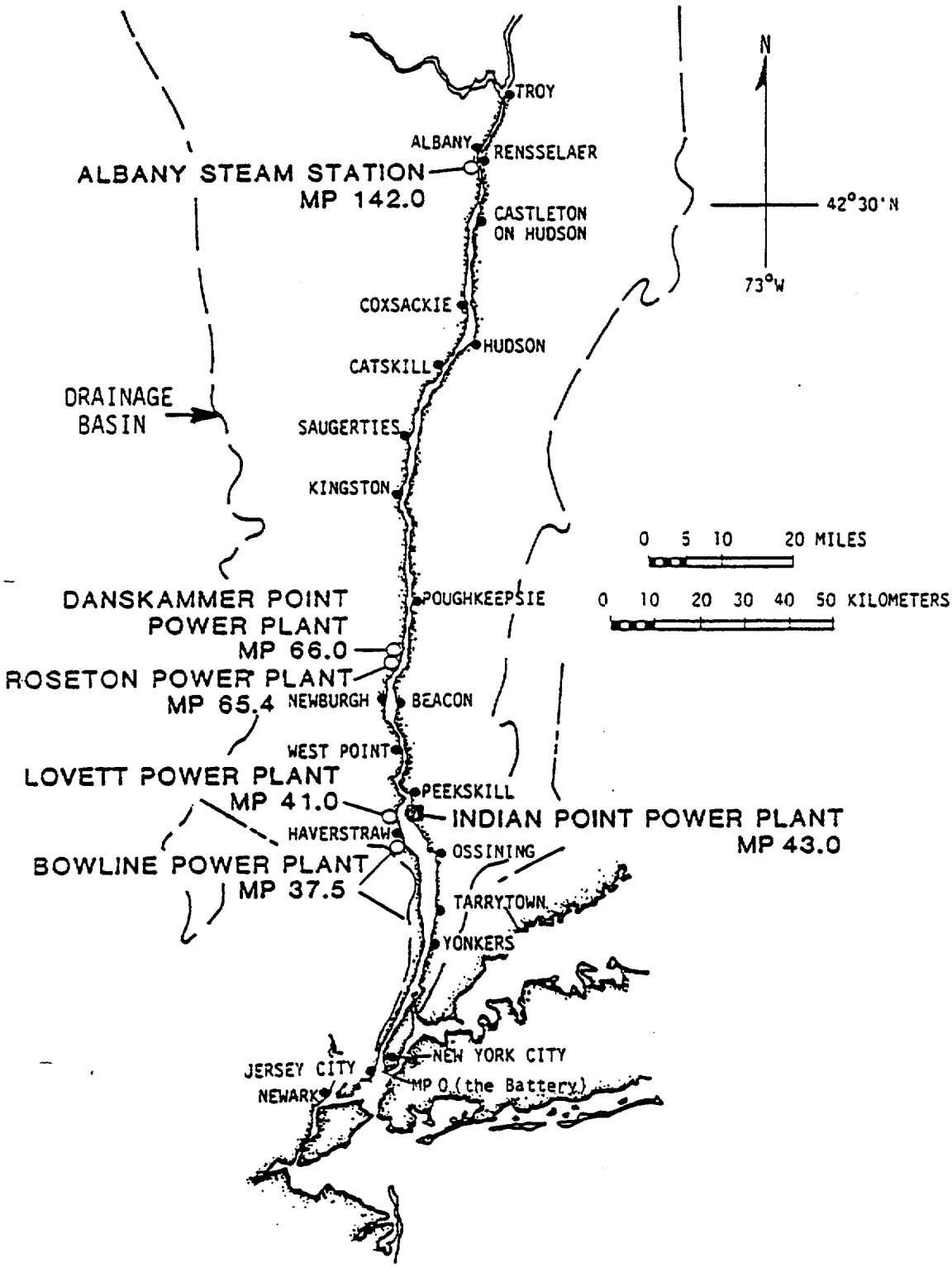

Figure I-1. Location of Indian Point Station relative to other Hudson River stations.

Unit 2 has a fixed screen at each circulator intake and a traveling screen within each intake forebay (Fig. I-2). Unit 3 has a traveling screen at each intake opening and lacks fixed screens (Fig. I-3).

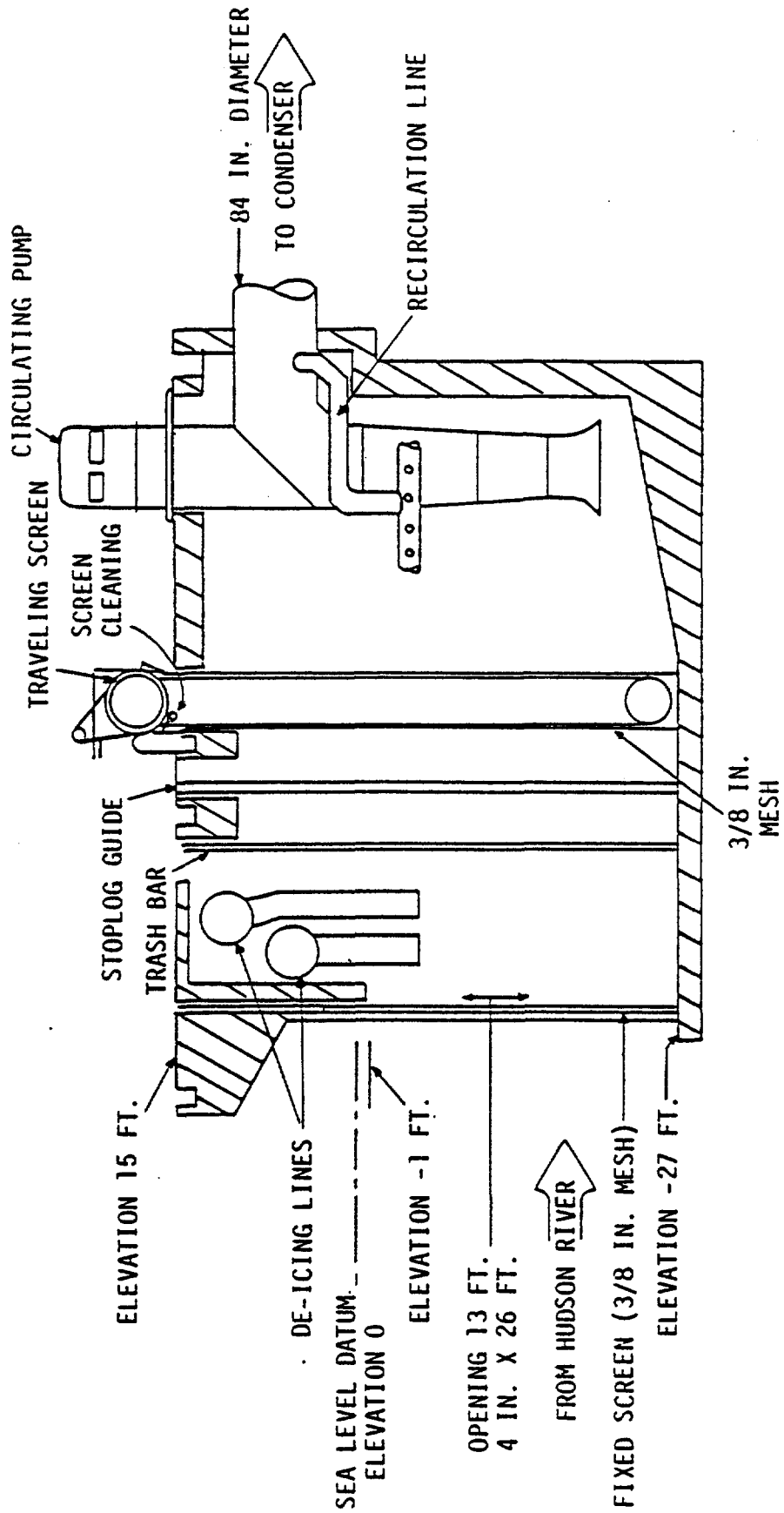

Figure I-2. Schematic cross-section of intake structures at Indian Point Unit 2.

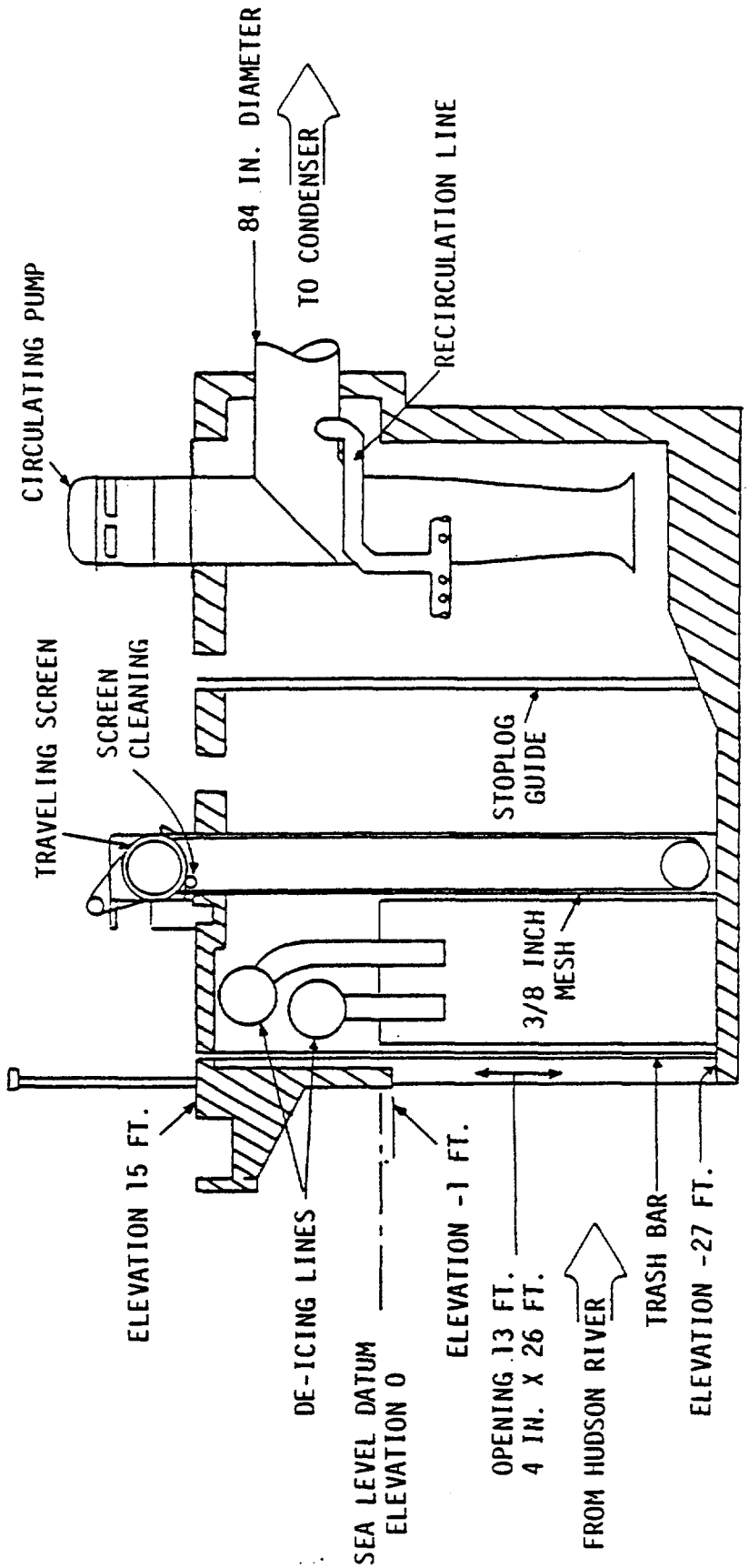

Figure I-3. Schematic cross-section of intake structures at Indian Point Unit 3.

II. METHODS

A. EXPERIMENTAL DESIGN

From June 1972 until July 1981, fish impinged on the intake screens at the Indian Point Generating Station were collected daily. In July 1981, Con Edison initiated a reduced sampling program based upon a stratified random design of 110 sampling days (30% sampling intensity) allocated across four seasonal strata for each unit according to a Neyman allocation procedure (Cochran 1977). This procedure assigns the number of sampling days in direct proportion to both the variance and the number of days in each stratum. The seasonal allocation of sampling days and the number of plant operating days for 1984 are presented in Table II-1. The procedures for development of this sampling design were summarized in the 1979 and 1981 Indian Point annual reports (Texas Instruments (TI) 1980b; Con Edison 1982b).

The allocated number of sampling days were randomly assigned within strata. When sampling could not take place on a scheduled day (due to a unit outage, abnormal screen wash procedure, or other reason) an alternative day was chosen from within the same stratum, if possible. The dates sampled and the dates the plant operated are shown in Tables II-2 and II-3.

Blue crab impingement at Indian Point was monitored in 1983 and 1984. In contrast to the reduced schedule used for sampling fish, impinged blue crabs were collected daily.

B. SAMPLE COLLECTION AND PROCESSING

For each sample, all fish and blue crabs washed from the intake screens of a unit were collected. Impingement samples usually represented approximately 24 hours of elapsed time since the screens are rotated and washed at about the same time each day. The following plant operation data were recorded for all sample collections: time of screen wash, screen wash order, head loss at each screen, operating condition of each circulator pump, and whether the wash was scheduled or unscheduled. Time of screen wash and pump operating condition were used in the calculation of sampling volume and therefore affect estimates of impingement rate (number per million cubic meters of water).

Table II-1. Number of plant operation days, allocated impingement sampling days, and actual impingement sampling days at Indian Point Units 2 and 3 during 1984.

		Number of Days		
		Plant Operation[a]	Impingement Collections	Allocated in Stratified Design
Unit 2	Winter (Jan-Mar)	81	30	30
	Spring (Apr-Jun)	64	10	10
	Summer (Jul-Sep)	9	0	11
	Fall (Oct-Dec)	84	54	59
	TOTAL	238	94	110
Unit 3	Winter (Jan-Mar)	66	27	27
	Spring (Apr-Jun)	91	18	18
	Summer (Jul-Sep)	92	31	31
	Fall (Oct-Dec)	57	34	34
	TOTAL	306	110	110

[a]A unit was considered operating if any circulator pump operated at any time during that day.

Table II-2. Sampling dates and average daily sampling volumes compared with operating dates and average operating volumes at Indian Point Unit 2 during 1984.

	Sampling dates	Average daily sampling volume (millions of m^3)	Standard deviation	Operating dates	Average daily operating volume (millions of m^3) [a]	Standard deviation
January	3,5,9,12,16,18, 20,22,23,24,25	2.6	0.43	1-31	2.8	0.08
February	3,4,8,11,12,13, 27,28	1.9	0.71	1-15, 26-29	2.2	0.89
March	3,7,9,10,11,13,16, 19,21,22,25	2.7	0.21	1-31	2.8	0.08
April	5,8,10	2.7	0.07	1-30	2.8	0.10
May	15,18,25,30,31	3.6	0.13	1-31	3.8	0.39
June	1,2	4.2	0.05	1-3	3.7	1.21
July	[b]	0.0	0.00	[c]	0.0	0.00
August	[b]	0.0	0.00	23,30	0.2	0.14
September	[b]	0.0	0.00	18-20, 26-29	0.4	0.23
October	14-25, 27-30[d]	1.8	0.99	5-31	1.9	1.35
November	1,4,7,8,9,11,12, 13,18,19,20,21,23, 25,27,28,29,30	2.2	0.33	1-30	2.8	0.25
December	1,2,3,4,6,7,12,13, 14,15,17,19,20,27, 28,29,30	1.9	0.68	1-21, 26-31	2.2	0.94

[a] Includes service water
[b] No sampling during entire month
[c] Unit outage during entire month
[d] No fish were collected on 3 sampling dates (11-13 October)

Table II-3. Sampling dates and average daily sampling volumes compared with operating dates and average daily operating volumes at Indian Point Unit 3 during 1984.

	Sampling dates	Average daily sampling volume (millions of m^3)	Standard deviation	Operating dates	Average daily operating volume (millions of m^3)[a]	Standard deviation
January	28,31	1.1	0.35	26-31	1.0	0.47
February	13,14,15,21,23, 25,27,28	2.8	0.51	1-29	2.2	0.45
March	3,5,7,9,13-22, 24,25,30	2.7	0.24	1-31	2.8	0.13
April	5,8,10,18,29	2.7	0.10	1-30	2.8	0.14
May	8,10,15,18,19, 21,27	4.1	0.75	1-31	4.3	0.66
June	3,4,9,10,17,21	4.5	0.10	1-30	4.6	0.18
July	2,6,8,9,11,15,22, 26,28,31	4.5	0.30	1-31	4.7	0.21
August	4,5,6,8,10,16,18, 21,22,24,26,28,30	3.7	1.44	1-31	4.1	1.11
September	1,3,5,10,13,14, 19,21	4.4	4.66	1-30	4.7	0.14
October	6,8,10,11,15,19, 20,21	2.9	1.85	1-21	3.1	1.60
November	27-30	1.4	0.59	26-30	1.6	0.52
December	1-17,23,26,27, 30,31	2.2	0.26	1-31	2.4	0.21

[a]includes service water

Water temperature (°C) and conductivity (micro Siemens/cm) were measured for each collection of fish using a YSI model 33 meter. Measurements were taken 0.5 m below the water surface at specific locations for each unit. Conductivity was converted to salinity (ppt) using an equation which corrected for temperature (Aanderaa Instruments 1983).

Fish

For each sample, fish were identified to species and were further separated into four general size classes based on their total length in millimeters:

Length Class 1 = 0 mm up to Division 1
Length Class 2 = Division 1 + 1 mm up to Division 2
Length Class 3 = Division 2 + 1 mm up to 250 mm
Length Class 4 = 251 mm and larger.

Divisions 1 and 2 represent the upper length limits of young-of-year and yearling age classes, respectively. These values were determined for each species from length-frequency analysis of impingement collections conducted previously. Values were updated in accordance with Standard Operating Procedures (EA Engineering, Science, and Technology 1984) approximately every two weeks in order to compensate for growth.

For each length class of each species collected, the total number of fish and the total wet weight (g) were determined. When the number of fish in length class 1 or 2 was greater than 100, a subsample of 100 individuals was used to estimate the number of fish in that length class. The weight of all fish in the subsample (W_S) and the weight of all fish in the length class (W_T) were recorded. The total number of fish in the length class (N_L) was then estimated by the following equation:

$$N_L = \frac{W_T}{W_S} \times 100.$$

The total number of individuals of each species collected was calculated as the sum of the number of fish in each of the four length classes.

Exceptions to fish processing procedures were made for some species. When shortnose or Atlantic sturgeon were found, the number, total length, and weight of individuals were recorded in a log, and live sturgeon were returned to the river. Striped bass and Atlantic tomcod were examined for possible finclips from

marking studies in the region. One finclipped Atlantic tomcod was recaptured in early 1984, and 76 striped bass were confirmed as recaptures from the hatchery program.

Blue Crabs

For each blue crab the following data were recorded:

- Wet weight (to the nearest g)
- Carapace width (distance from carapace tip to carapace tip in mm)
- Survival (alive or dead)
- Condition (intact or not intact, determined by whether body or shell parts were missing)
- Sex (male or female).

Total count and total weight were calculated for each collection. All living crabs were returned to the river after sample processing.

C. DATA ANALYSIS

Collection Efficiency

Although collections of fish impinged on the intake screens at Indian Point provide an indication of seasonal and annual impingement patterns, they do not represent the total number of fish actually impinged. Many impinged fish may be lost prior to collection because of scavenging fish and birds, tidal currents, deterioration, disintegration, or screenwash collection inefficiency.

Collection efficiency studies at Units 2 and 3 were conducted between 1974 and 1982 (TI 1975, 1976a, 1977, 1980a, 1980b; Con Edison 1982a, 1983). Collection efficiency was found to be related to temperature, and adjustment factors were developed accordingly. The following equations were used to adjust the 1984 impingement data for collection efficiency:

$$\text{Unit 2 efficiency} = (-0.00871)\ (\text{Temperature } (^{\circ}\text{C})) + 0.51858$$

$$\text{Unit 3 efficiency} = (-0.00792)\ (\text{Temperature } (^{\circ}\text{C})) + 0.71640.$$

Regression analysis indicated that both the y-intercept and the slope for collection efficiency at each unit were significantly different from zero. Collection efficiency at Unit 3 was significantly higher than at Unit 2, but the slopes of the two regression equations were not significantly different from each other (Con Edison 1983). The magnitude of the collection efficiency adjustment for both units combined is illustrated in Figure II-1.

Annual Impingement Estimates

Three calculation steps were required to generate estimates for annual impingement of fish:

- Adjustment for collection efficiency

  The number of fish collected each day was adjusted using the collection efficiency equations described in the previous section.

- Estimation for each seasonal stratum

  The adjusted number of fish impinged was scaled up by the number of operating days to estimate the total number impinged in that stratum.

- Summation for the year

  The estimated number of fish impinged in each of the four strata were summed to yield an estimate of annual impingement.

Equations used for these calculations are provided in Appendix A.

Procedures followed for the estimation of annual impingement at Indian Point are summarized in Figure II-2. Numbers unadjusted for collection efficiency are referred to as "number collected." Numbers adjusted for collection efficiency represent predicted impingement on sampling days and are referred to as "number impinged." "Estimated impingement" refers to impingement data that has been scaled up to account for operating days when no fish samples were collected.

Precision Estimates

To determine the effectiveness of the stratified sampling design, the coefficient of variation was calculated for each

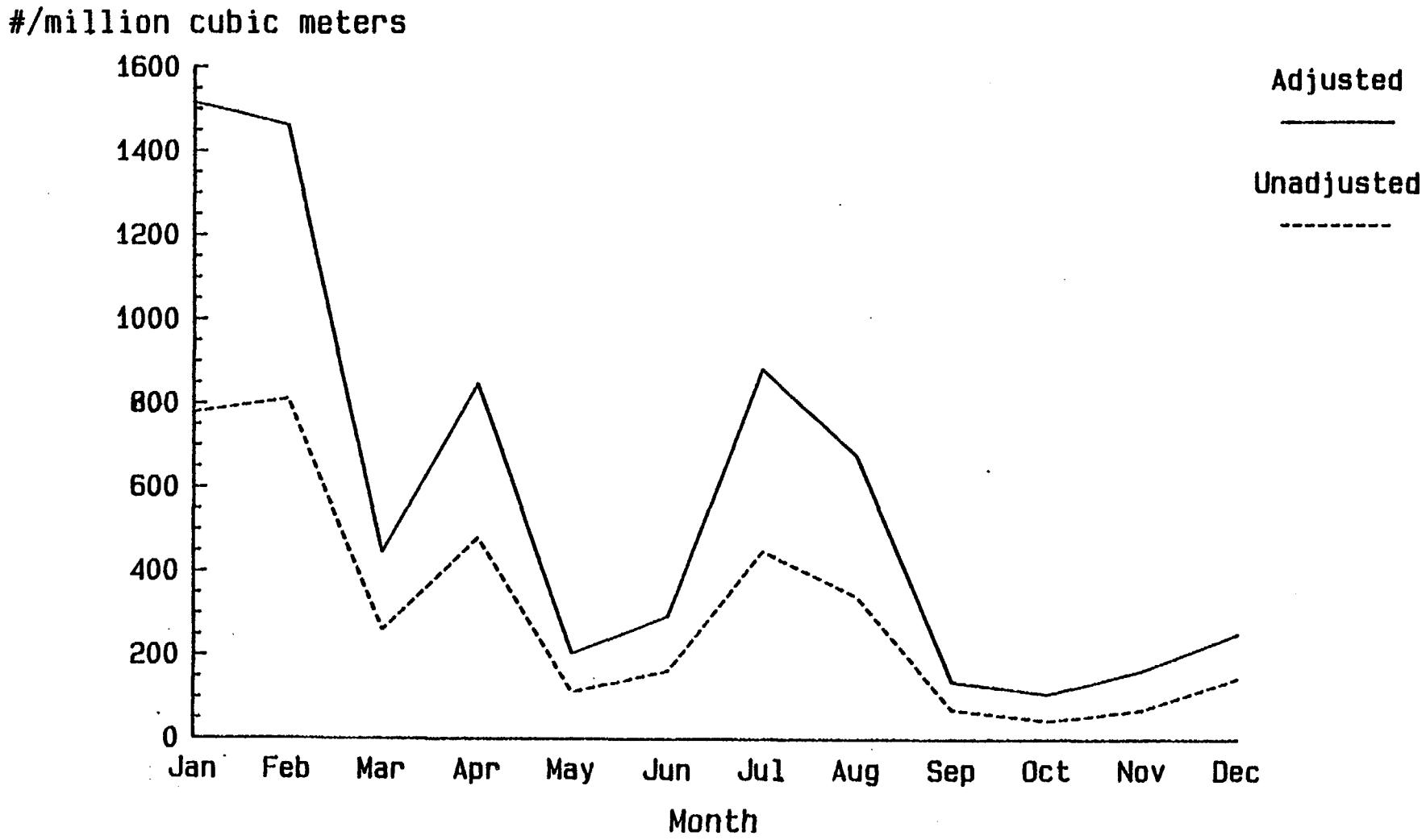

Figure II-1. Comparison of unadjusted and adjusted number of fish impinged per million cubic meters of intake water at Indian Point Units 2 and 3 during 1984.

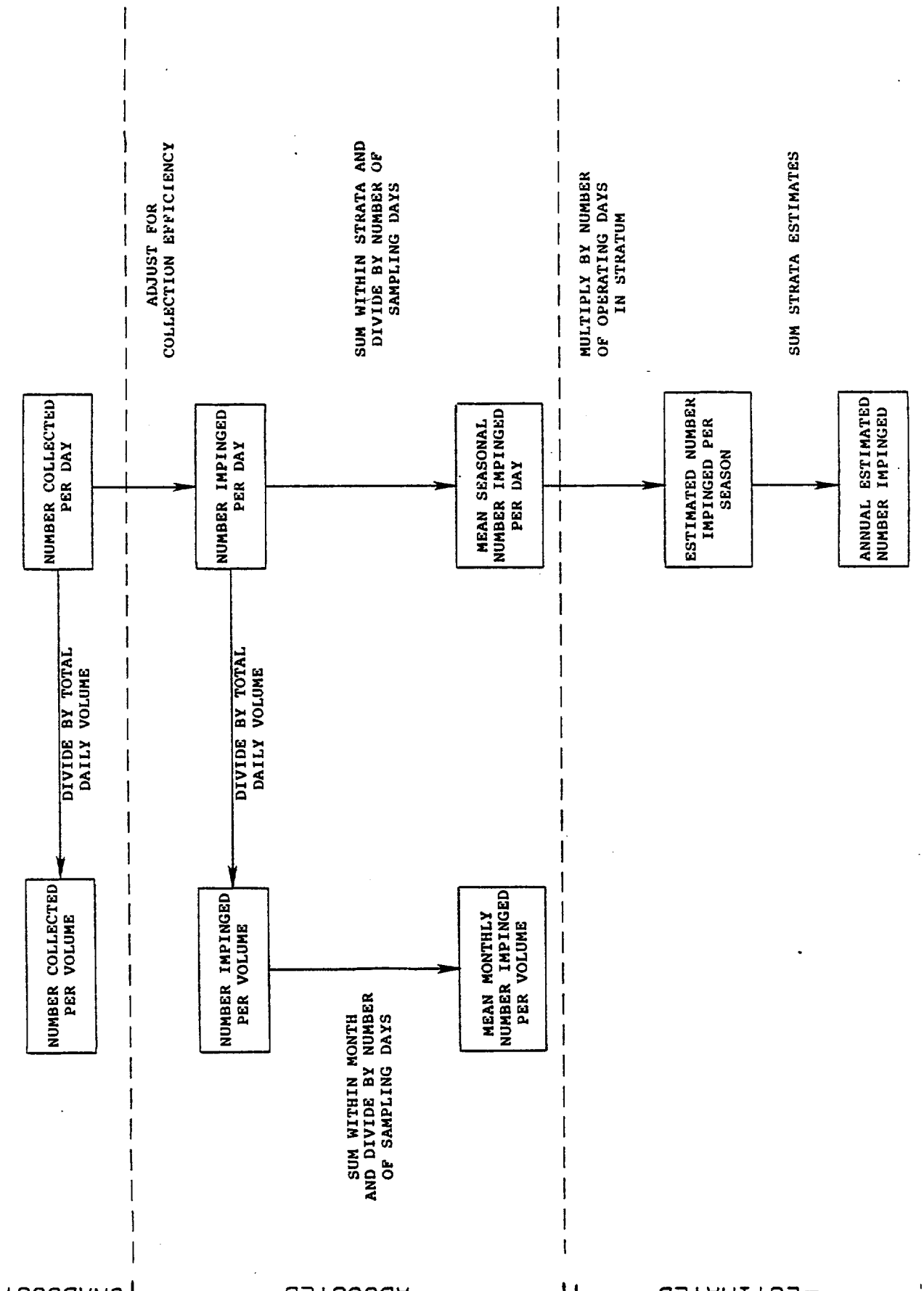

Figure II-2. Flowchart summarizing the analytical procedures used in this report.

unit for each individual species and all species combined. The coefficient of variation was calculated by dividing the standard error of the annual estimate by the estimate of total impingement for the year and multiplying by 100. The standard error was calculated from the variances of the four strata using the equation presented in Appendix A. The coefficient of variation represents the level of precision of the annual estimate.

III. RESULTS AND DISCUSSION

A. PLANT OPERATION AND WATER QUALITY DATA

Extended outages occurred at Unit 2 during 1984. Unit 2 operated for only 9 days during the summer stratum and impingement sampling during this stratum was not conducted. Because of these outages, only 94 of the 110 (85.5%) samples allocated for Unit 2 in the stratified design were collected (Table II-1). Unit 3 operated most of the year, with extended outages occurring only in January and November. However, all of the samples allocated for each stratum at Unit 3 were collected (Table II-1). The total volume of water circulated during sampling periods is given by month in Table III-1.

Monthly mean temperatures measured at Indian Point during 1984 followed expected seasonal patterns (Fig. III-1). Daily winter temperatures ranged from 0°C to 8°C, while spring and summer temperatures ranged from 7°C to 21°C and 22°C to 30°C, respectively. Fall temperatures were between 7°C and 20°C.

Monthly mean salinities are also summarized in Figure III-1. The lowest values occurred during spring, corresponding to the expected period of high freshwater input from rainfall and melting snow. Salinity increased during the summer when rainfall is typically low, and reached a daily maximum of 4.2 ppt during October.

B. SPECIES COMPOSITION AND ESTIMATED FISH IMPINGEMENT DURING 1984

A total of 56 fish species were impinged at Indian Point in 1984 (Table C-15). However, not all species were impinged at each unit; 48 species were impinged at Unit 2 and 52 species were impinged at Unit 3 (Tables III-2 and III-3). Ten species comprised 98% of the total estimated number of fish impinged (Table III-4). White perch accounted for 64% of the total number of fish impinged. Bay anchovy and Atlantic tomcod were the only other species to account for greater than 10% of the total number of fish impinged (13% and 12%, respectively).

The estimated number of fish impinged for the year was 339,859 (3,906 kg biomass) at Unit 2 and 508,759 (6,000 kg biomass) at Unit 3. However, the mean impingement rate (fish per million cubic meters of water sampled) was approximately 17% higher at Unit 2 (549.5) than at Unit 3 (455.4)(Table III-5).

Table III-1. Total circulating water volume pumped (in millions of cubic meters) in association with impingement sampling at Indian Point Units 2 and 3 during 1984.

Month	Unit 2	Unit 3	Units 2 and 3
January	28.6	2.3	30.9
February	15.6	18.6	34.2
March	29.9	45.6	75.5
April	8.0	13.7	21.7
May	17.8	28.8	46.6
June	8.5	27.2	35.7
July	0.0(a)	45.2	45.2
August	0.0(a)	48.0	48.0
September	0.0(a)	35.1	35.1
October	28.3	22.9	51.2
November	38.8	5.5	44.3
December	33.0	49.4	82.4
TOTAL	208.5	342.3	550.8

(a)No sampling due to unit outage for entire month

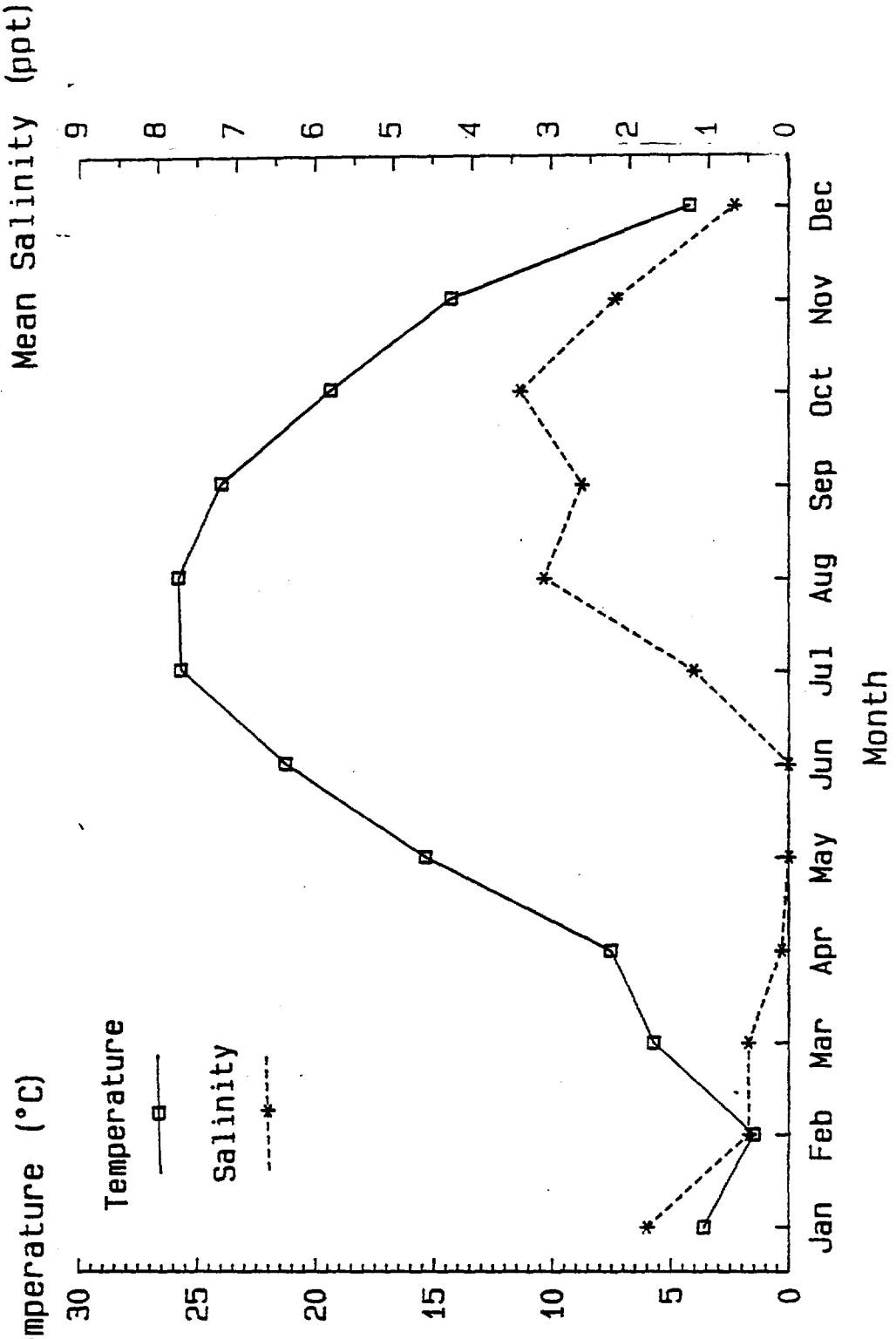

Figure III-1. Monthly mean salinity and temperature measured on impingement monitoring days at Indian Point during 1984 (calculated from mean of measurements taken at Units 2 and 3).

Table III-2. Estimated number of fish impinged at Indian Point Unit 2 during 1984 and the variance of the estimate.

COMMON NAME	WINTER	SPRING	SUMMER	FALL	1984 TOTAL	STANDARD ERROR	COEFFICIENT OF VARIATION
ALEWIFE	54	379	0	2877	3310	443	13.4
AMERICAN EEL	22	135	0	233	390	67	17.2
AMERICAN SHAD	0	0	0	242	242	49	20.3
ATLANTIC MENHADEN	0	0	0	8	8	3	41.9
ATLANTIC SILVERSIDE	0	0	0	4	4	2	59.8
ATLANTIC STURGEON	11	0	0	4	15	6	43.9
ATLANTIC TOMCOD	307	2079	0	323	2709	906	33.4
BANDED KILLIFISH	93	0	0	8	101	24	23.7
BAY ANCHOVY	16	640	0	3028	3684	789	21.4
BLACK CRAPPIE	0	0	0	4	4	2	59.8
BLUEBACK HERRING	87	150	0	3014	3251	456	14.0
BLUEFISH	0	0	0	30	30	10	32.5
BLUEGILL	6	14	0	202	222	48	21.8
BROWN BULLHEAD	6	18	0	0	24	17	71.6
BUTTERFISH	0	0	0	127	127	22	17.5
CARP	5	0	0	0	5	4	79.3
CENTRARCHID UNIDENTIFIED	0	50	0	0	50	33	65.1
CHANNEL CATFISH	0	18	0	0	18	16	91.9
CREVALLE JACK	0	0	0	36	36	7	20.4
FOURSPINE STICKLEBACK	21	0	0	0	21	13	61.6
GIZZARD SHAD	1467	0	0	7	1474	324	21.9
GOLDEN SHINER	33	0	0	0	33	15	44.4
GOLDFISH	81	0	0	4	85	23	27.0
HOGCHOKER	34	1607	0	344	1985	742	37.4
LARGEMOUTH BASS	5	0	0	0	5	4	79.3
LOOKDOWN	0	0	0	21	21	8	35.1
MUMMICHOG	0	17	0	0	17	16	91.9
NORTHERN PIPEFISH	0	0	0	112	112	16	14.3
PUMPKINSEED	687	185	0	27	898	102	11.3
RAINBOW SMELT	139	0	0	704	844	131	15.5
REDBREAST SUNFISH	0	0	0	3	3	2	59.8
RED HAKE	253	0	0	0	253	126	50.0
ROCK BASS	6	0	0	0	6	4	79.3
SHORTNOSE STURGEON	0	18	0	0	18	16	91.9
SILVER HAKE	54	0	0	0	54	20	36.6
SMALLMOUTH BASS	6	0	0	0	6	4	79.3
SPOTTAIL SHINER	830	170	0	15	1015	117	11.5
STRIPED BASS	2885	521	0	1144	4551	675	14.8
STRIPED SEAROBIN	0	0	0	4	4	3	59.8
SUMMER FLOUNDER	6	0	0	0	6	4	79.3
TESSELATED DARTER	0	31	0	4	35	19	55.6
THREESPINE STICKLEBACK	72	0	0	0	72	19	25.8
WEAKFISH	0	0	0	1358	1358	224	16.5
WHITE CATFISH	1143	562	0	512	2216	263	11.9
WHITE PERCH	246762	52015	0	11558	310336	43872	14.1
WHITE SUCKER	0	17	0	0	17	16	91.9
WINTER FLOUNDER	6	0	0	0	6	4	79.3
YELLOW PERCH	111	71	0	0	182	48	26.5
TOTAL ALL TAXA	255207	58695	0	25957	339859	44280	13.0

STANDARD ERROR----------STANDARD ERROR OF 1984 TOTAL
COEFFICIENT OF VARIATION-STANDARD ERROR/1984 TOTAL *100

Table III-3. Estimated number of fish impinged at Indian Point Unit 3 during 1984 and the variance of the estimate.

COMMON NAME	WINTER	SPRING	SUMMER	FALL	1984 TOTAL	STANDARD ERROR	COEFFICIENT OF VARIATION
ALEWIFE	21	1425	2448	810	4704	586	12.5
AMERICAN EEL	64	784	433	418	1699	149	8.8
AMERICAN SHAD	0	98	100	261	458	96	21.0
ATLANTIC MENHADEN	0	0	23	0	23	11	48.7
ATLANTIC NEEDLEFISH	0	0	6	0	6	5	82.3
ATLANTIC SILVERSIDE	0	0	6	0	6	5	82.3
ATLANTIC STURGEON	0	0	29	0	29	10	34.3
ATLANTIC TOMCOD	57	15423	80001	373	95855	22262	23.2
BANDED KILLIFISH	74	44	65	3	186	45	24.0
BAY ANCHOVY	0	8878	97633	2575	109086	17421	16.0
BLACK CRAPPIE	3	0	0	0	3	3	76.9
BLUEBACK HERRING	14	6912	2567	722	10216	1904	18.6
BLUEFISH	0	0	6342	121	6464	966	14.9
BLUEGILL	50	103	243	31	426	99	23.3
BROWN BULLHEAD	78	78	12	0	168	43	25.7
BUTTERFISH	0	0	1590	204	1794	357	19.9
CARP	3	0	0	3	6	3	50.8
CENTRARCHID UNIDENTIFIED	0	35	221	0	256	141	55.0
CHAIN PICKEREL	4	0	0	0	4	3	76.9
CREVALLE JACK	0	0	11	46	57	14	24.1
FOURBEARD ROCKLING	0	0	0	3	3	2	63.5
FOURSPOT FLOUNDER	0	0	6	0	6	5	82.3
GIZZARD SHAD	43	8	0	31	81	17	20.4
GOLDEN SHINER	108	8	0	3	116	31	27.0
GOLDFISH	138	0	0	5	143	31	21.4
HICKORY SHAD	0	0	0	3	3	2	63.5
HOGCHOKER	11	6838	2086	513	9447	2427	25.7
LARGEMOUTH BASS	3	0	0	0	3	3	76.9
LOOKDOWN	0	0	6	15	20	7	35.1
MUMMICHOG	0	0	6	0	6	5	82.3
NORTHERN PIPEFISH	0	18	12	8	38	17	46.0
PUMPKINSEED	1531	448	197	34	2210	245	11.1
RAINBOW SMELT	158	26	370	179	733	133	18.2
REDBREAST SUNFISH	4	8	35	5	51	13	25.7
SHORTNOSE STURGEON	0	9	0	0	9	8	89.6
SILVER HAKE	0	9	0	0	9	8	89.6
SMALLMOUTH BASS	4	0	0	0	4	3	76.9
SPOTTAIL SHINER	973	239	41	10	1263	179	14.2
STRIPED BASS	1300	1441	2515	1159	6414	779	12.1
SUMMER FLOUNDER	0	9	6	0	14	9	62.8
TAUTOG	0	0	6	0	6	5	82.3
TESSELATED DARTER	4	9	12	5	29	11	37.2
TIDEWATER SILVERSIDE	0	426	0	0	426	381	89.6
THREESPINE STICKLEBACK	135	0	0	0	135	24	17.7
WEAKFISH	0	0	9712	481	10193	3162	31.0
WHITE BASS	4	0	0	0	4	3	76.9
WHITE CATFISH	1208	8925	760	466	11360	2756	24.3
WHITE PERCH	84211	99956	26799	23333	234299	26810	11.4
WHITE SUCKER	0	18	0	0	18	11	61.4
WINTER FLOUNDER	0	0	6	0	6	5	82.3
YELLOW BULLHEAD	0	0	34	3	37	13	33.9
YELLOW PERCH	152	41	29	5	227	39	17.3
TOTAL ALL TAXA	90354	152212	234365	31827	508759	47991	9.4

STANDARD ERROR----------STANDARD ERROR OF 1984 TOTAL
COEFFICIENT OF VARIATION-STANDARD ERROR/1984 TOTAL *100

Table III-4. Estimated number of fish impinged at Indian Point Units 2 and 3 during 1984 for the ten most abundant species and all species combined[a].

Species	Both Units			Unit 2		Unit 3	
	Number	Percent of Total	Cumulative Percent	Number	Percent of Total	Number	Percent of Total
White perch	544,635	64.2	64.2	310,336	91.3	234,299	46.1
Bay anchovy	112,770	13.3	77.5	3,684	1.1	109,086	21.4
Atlantic tomcod	98,564	11.6	89.1	2,709	0.8	95,855	18.8
White catfish	13,576	1.6	92.3	2,216	0.7	11,360	2.2
Blueback herring	13,467	1.6	90.7	3,251	1.0	10,216	2.0
Weakfish	11,551	1.4	96.3	1,358	0.4	10,193	2.0
Hogchoker	11,432	1.3	94.9	1,985	0.6	9,447	1.9
Striped bass	10,965	1.3	93.6	4,551	1.3	6,414	1.3
Alewife	8,014	0.9	97.2	3,310	1.0	4,704	0.9
Bluefish	6,494	0.8	98.0	30	0.0	6,464	1.3
All species combined	848,618			339,859		508,759	

[a] Includes all species comprising over 0.5% of the total number impinged for the two units combined.

Table III-5. Estimated mean number of fish impinged per day and mean number of fish impinged per million cubic meters (rate) in each seasonal stratum at Indian Point Units 2 and 3 during 1984.

		Percent of Allocated Days Sampled	Mean Daily Estimate[a]	Standard Error	Coefficient of Variation[c]	Mean Impingement Rate[a]	Standard Error	Coefficient of Variation[c]
Unit 2	Winter (Jan-Mar)	100	3,150.7	454.7	14.4	1,344.8	196.6	14.6
	Spring (Apr-Jun)	100	917.1	382.6	41.7	327.3	147.5	45.1
	Summer (Jul-Sep)[b]	0	0.0	0.0	0.0	0.0	0.0	0.0
	Fall (Oct-Dec)	92	309.0	25.7	8.3	148.9	11.5	7.7
	1984 Total	85	1,280.6			549.5		
Unit 3	Winter (Jan-Mar)	100	1,369.0	136.8	10.0	561.6	55.3	9.8
	Spring (Apr-Jun)	100	1,672.7	301.0	18.0	460.2	98.1	21.3
	Summer (Jul-Sep)	100	2,575.4	416.0	16.2	601.5	92.3	15.3
	Fall (Oct-Dec)	100	558.4	46.4	8.3	235.3	19.4	8.2
	1984 Total	100	1,508.1			455.4		

[a]Adjusted for collection efficiency.

[b]No sampling days; only 9 plant operating days in stratum.

[c]Coefficient of variation equals the standard error divided by the mean, times 100.

C. ACCURACY AND PRECISION EVALUATION OF IMPINGEMENT ESTIMATES

Accuracy

The accuracy of daily impingement estimates depends upon the degree to which daily impingement samples are representative of actual impingement. When estimating impingement on intake screens at power plants, three potential sources of bias should be considered: 1) reimpingement, 2) impingement on inoperative traveling screens, and 3) collection efficiency.

The first of these sources does not affect the estimate at the Indian Point Station because impinged fish are not returned to the river. Impingement on inoperative traveling screens is also not a source of bias at Indian Point because each screen is located in a separate forebay with its own circulator pump. The remaining source of potential bias, collection efficiency, is potentially large since the intake screens are washed at approximately 24 hr intervals, allowing time for impinged fish to be lost (by disintegration, predation, etc.) from the screens before collection. In addition, estimates of daily impingement are calculated by multiplying the actual number of fish collected times the collection efficiency, thus making them very sensitive to this potential bias.

To account for the loss of impinged fish prior to sampling, collection efficiency adjustment factors (CEFs) were calculated based on studies conducted with marked fish in 1974, 1975, 1976, 1978, 1979, 1980, and 1982 (TI 1975, 1976a, 1977, 1980a, 1980b; Con Edison 1982a, 1983). The CEFs applied to the 1984 data are specific for each unit and depend largely on water temperature. However, other factors that may affect the calculation of CEFs include: the length of time the fish are held on the screens between screen washes, the species and size of fish used in the marking study, the flow rate, and the screen location within a unit (i.e., which circulator). Some of these factors have been examined in previous Indian Point studies (TI 1976a, 1980b).

The projection of daily estimates of impingement to an annual estimate is another source of error that could affect accuracy. The annual estimate is calculated by scaling up the daily estimates for the number of operating days in each stratum. The use of a reduced sampling design precludes the direct testing of the assumption that impingement on sampling days is representative of impingement on all operating days within a stratum. However, if it is assumed that variations in sampling volume are the major source of error, one indirect method of

evaluating this assumption is to examine the relationship between sampling volume and operating volume by stratum. In 1984, as in previous years, average seasonal sampling volume did not differ greatly from average operating volume (Fig. III-2 and III-3). Thus it is unlikely that calculation of an annual estimate of impingement from daily estimates is a source of inaccuracy.

Precision

Although the accuracy of impingement estimates derived from the reduced sampling program cannot be directly determined, the precision of these estimates can be measured. In this report, the coefficient of variation for the annual estimate of impingement was used as a measure of the level of precision.

In 1984, the coefficient of variation for the annual estimate of impingement was 13.0% at Unit 2 and 9.4% at Unit 3. These precision levels are similar to those found in 1981 and 1982, but more precise than those for the 1983 estimates.

In conjunction with development of the seasonally stratified design, the precision level for the annual estimate of impingement was predicted to be 9.5% at Unit 2 and 8.2% at Unit 3 (TI 1980b). The level of precision at Unit 2 in 1984 was less than predicted. This was probably due to the large variance in impingement during the spring stratum (coefficient of variation was 41.7%, Table III-5) when only 10 days were allocated for sampling. The overall coefficient of variation at Unit 3 for 1984 was close to the predicted value of 8.2%, and the coefficients of variation at Unit 3 for each season were lower than at Unit 2 (Table III-5).

Coefficients of variation for each species ranged from 8.8% to 91.9% (Table III-2 and III-3), indicating that strata were inadequately sampled for some species. Estimates of impingement for more than 90% of the species collected were less precise than the estimate for total impingement. This situation might be anticipated because the Neyman allocation process was based upon the variance for all species combined rather than for individual species.

D. SEASONAL IMPINGEMENT PATTERNS

Peaks in monthly mean impingement rates of fish occurred during summer and winter, with a smaller peak in April (Fig. III-4). White perch accounted for most of the winter and April peaks, constituting 96% of total impingement from January

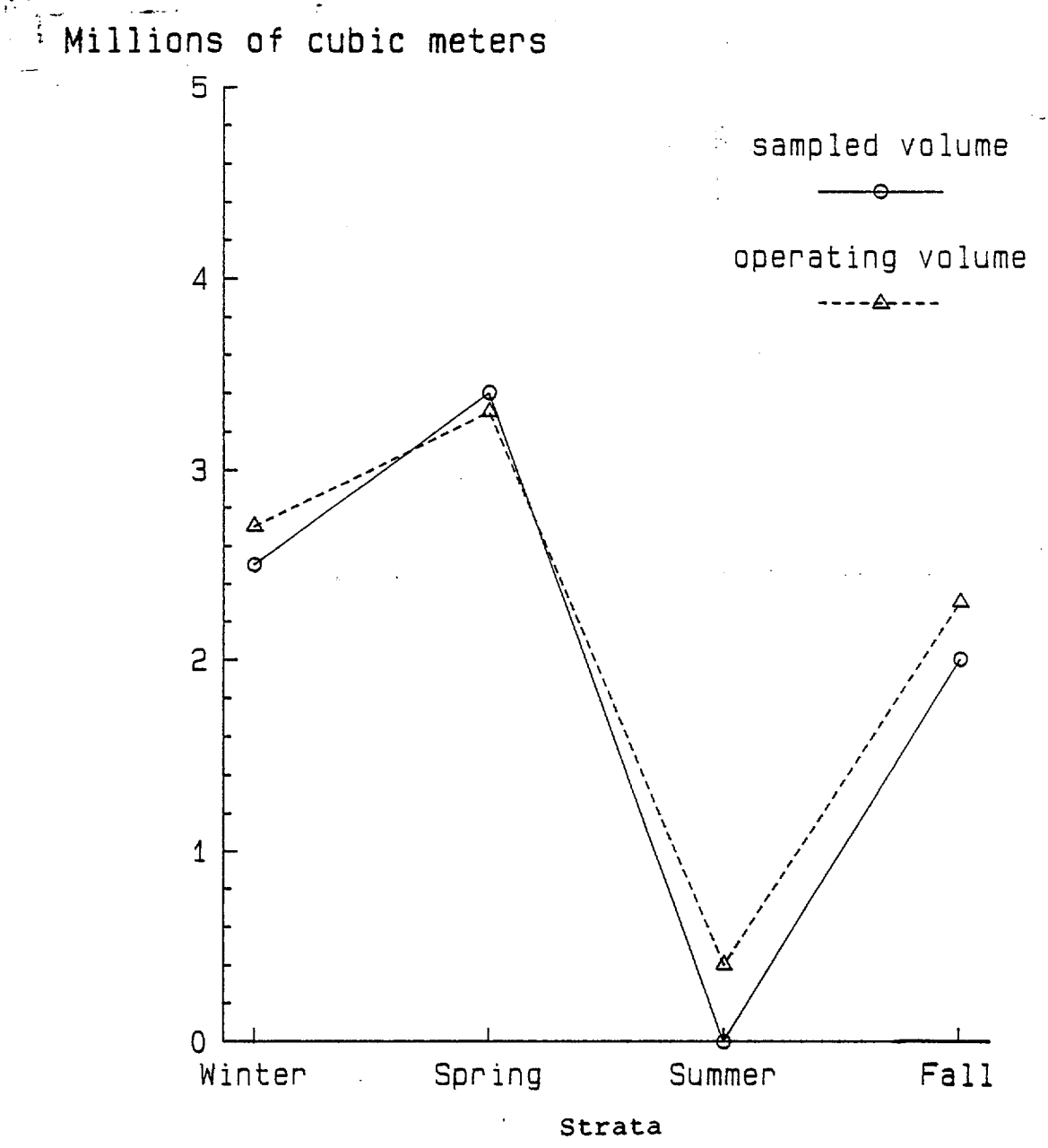

Figure III-2. Seasonal mean volume (millions of cubic meters of water) circulated during operation and sampling at Indian Point Unit 2 during 1984.

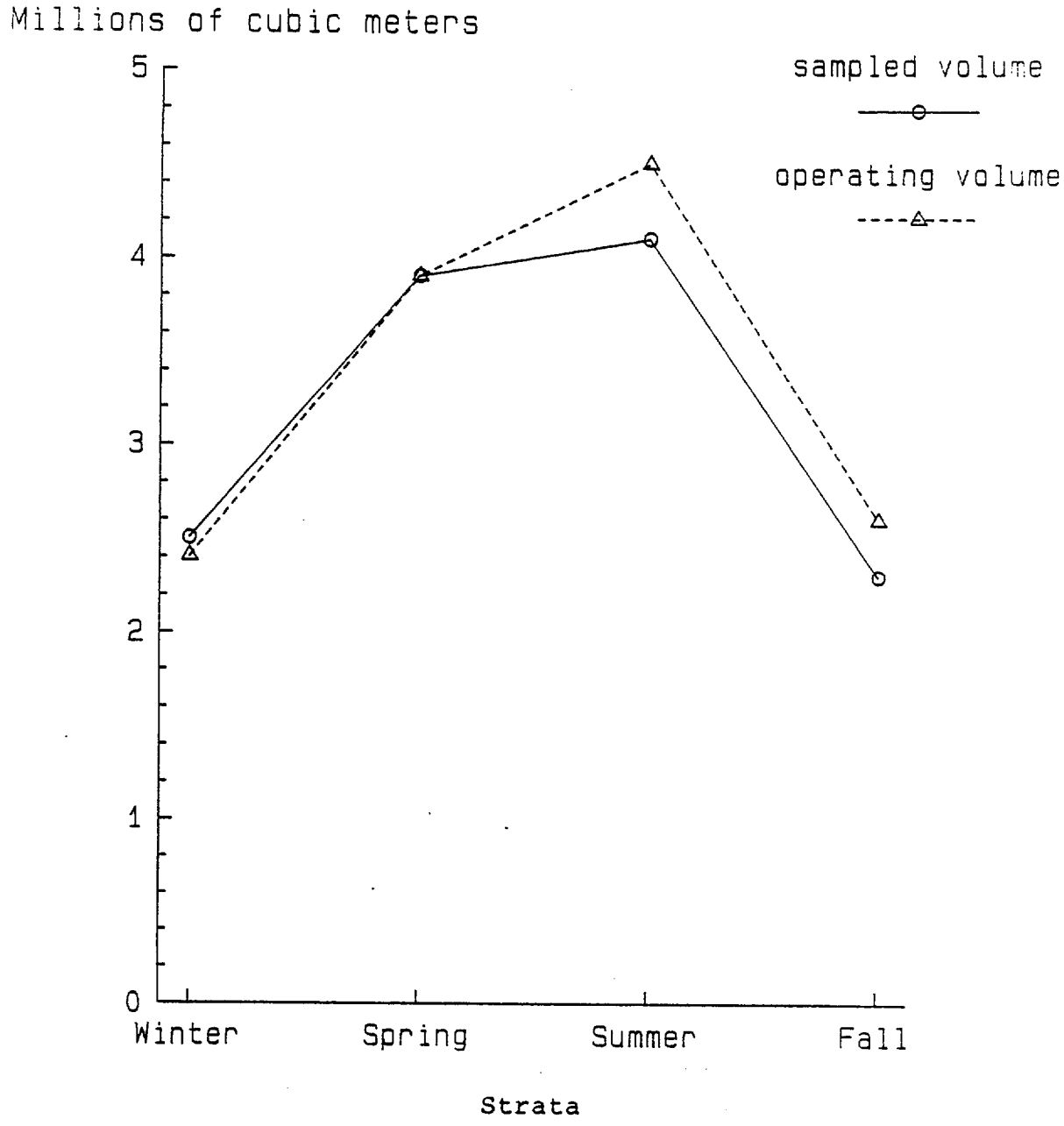

Figure III-3. Seasonal mean volume (millions of cubic meters of water) circulated during operation and sampling at Indian Point Unit 3 during 1984.

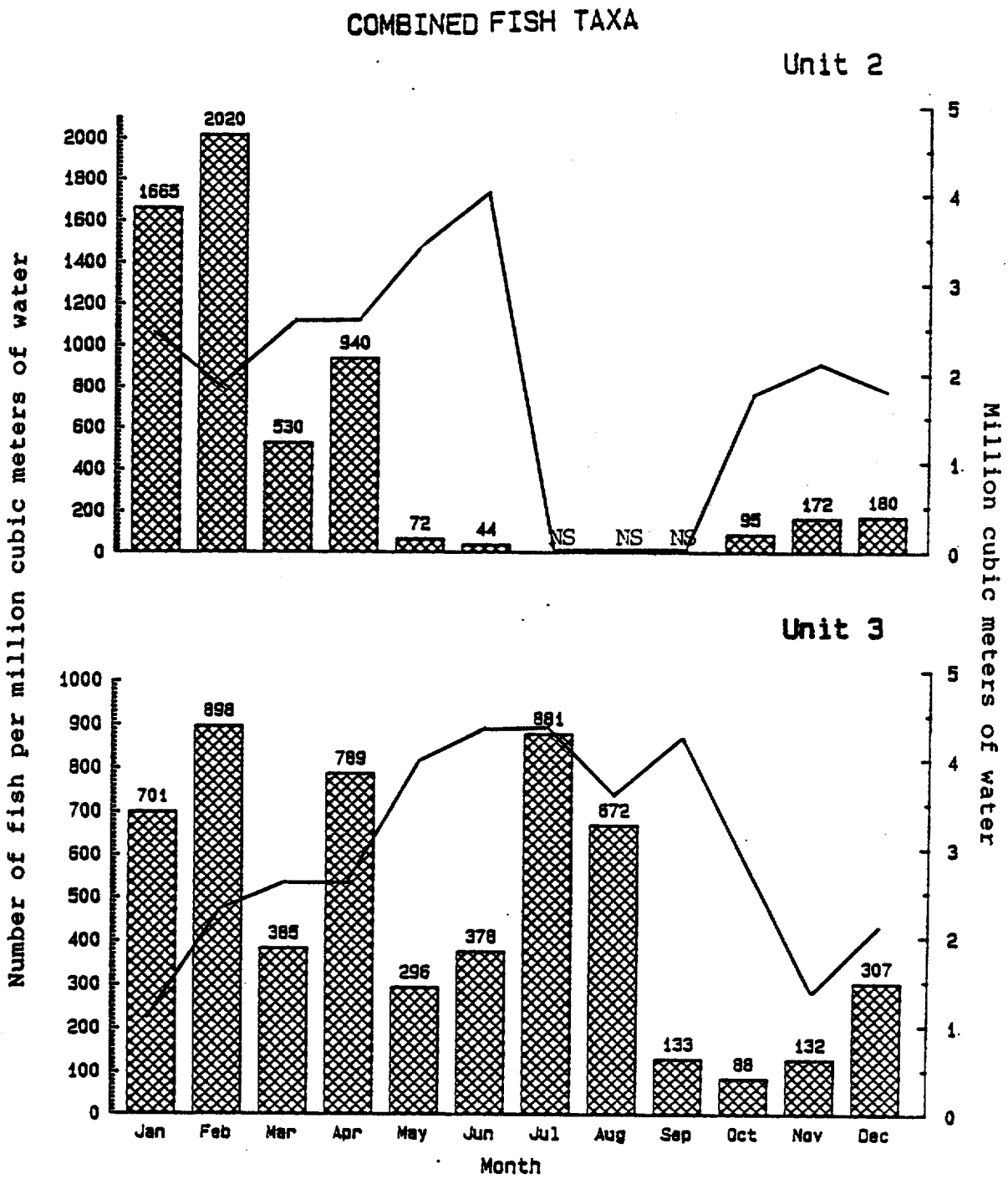

Figure III-4. Monthly mean number of fish impinged per million cubic meters of sampling volume at Indian Point Units 2 and 3 during 1984 and monthly mean volume sampled (million cubic meters). NS indicates no samples were taken. Bars represent impingement rate. Line graph represents sampling volume.

to April (Fig. III-5). Bay anchovy and Atlantic tomcod accounted for 76% of the total number of fish impinged during the summer peak.

The seasonal impingement patterns of fifteen species have been discussed in previous impingement reports. These species were selected based on their abundance, designation as endangered or representative important species, or importance to commercial or sport fisheries:

White perch*
Bay anchovy*
Atlantic tomcod*
Blueback herring
Alewife*
White catfish*
Hogchoker
Striped bass*
Bluefish
Weakfish*
Spottail shiner*
Rainbow smelt
American shad
Atlantic sturgeon*
Shortnose sturgeon*

White Perch

Impingement of white perch in 1984 was highest at both units from January to April (Fig. III-6). Total impingement for both units combined declined by an order of magnitude in May (Fig. III-7). Yearling white perch constituted the majority of impingement from January through July (Fig. III-7). White perch that were spawned in 1984 first appeared in impingement samples in August. Impingement during November and December consisted almost exclusively of young-of-year individuals.

The seasonal pattern of impingement for white perch corresponds to the pattern of abundance in the Indian Point vicinity. White perch typically overwinter in the Indian Point area (TI 1976b, 1979, 1980c), and this concentration of fish probably contributed to the higher rates of impingement during winter. This species generally migrates out of the area to spawn in May (TI 1976b, 1980c), thus accounting for the reduction in their impingment at that time. Migration of white perch back to the overwintering area generally occurs during late fall and early winter when temperatures decline (TI 1976b, 1979, 1980c).

*Indicates endangered or representative important species as designated by the U.S. Environmental Protection Agency (TI 1980c).

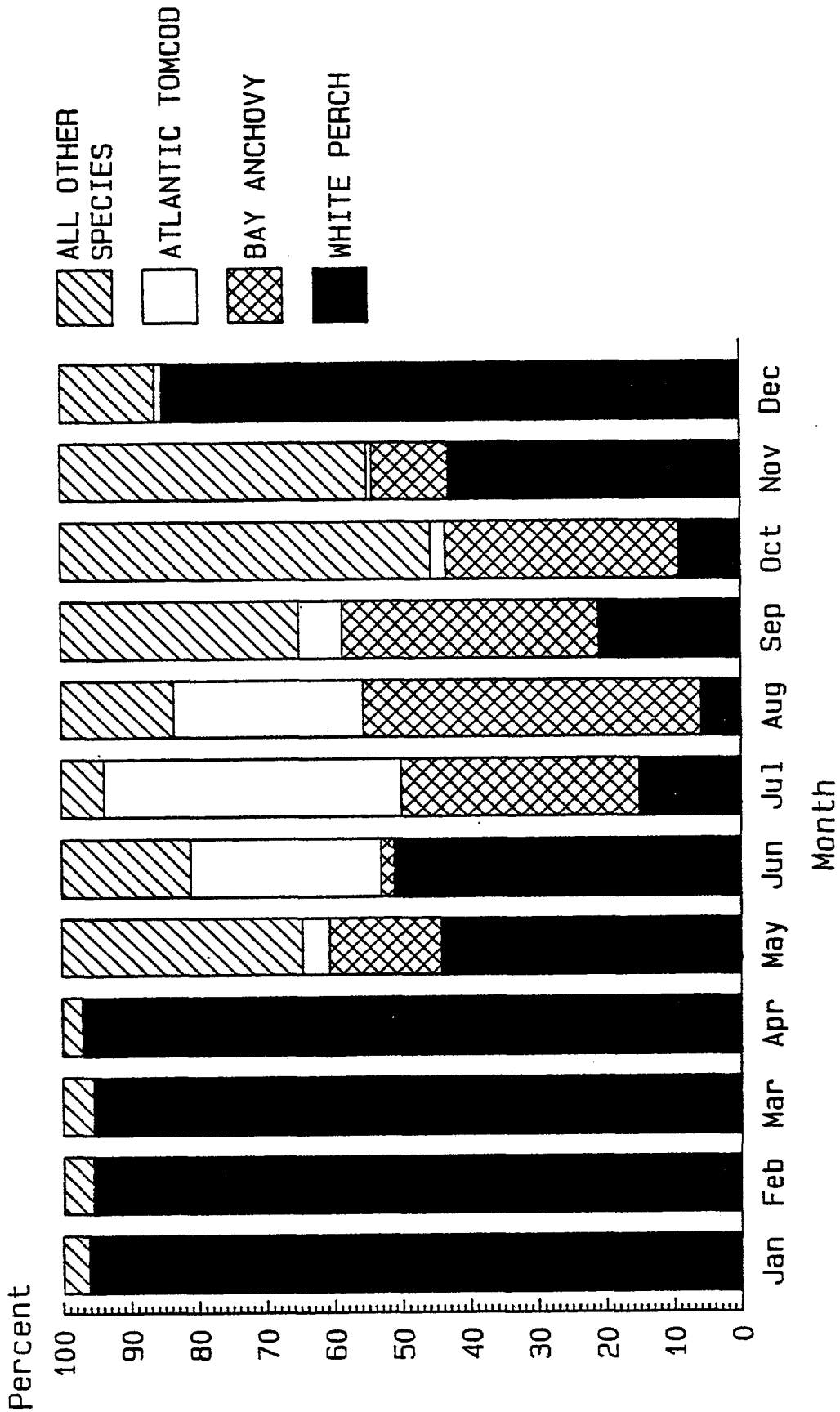

Figure III-5. Species composition of impinged fish at Indian Point Units 2 and 3 during 1984 based on the number of fish impinged (adjusted for collection efficiency).

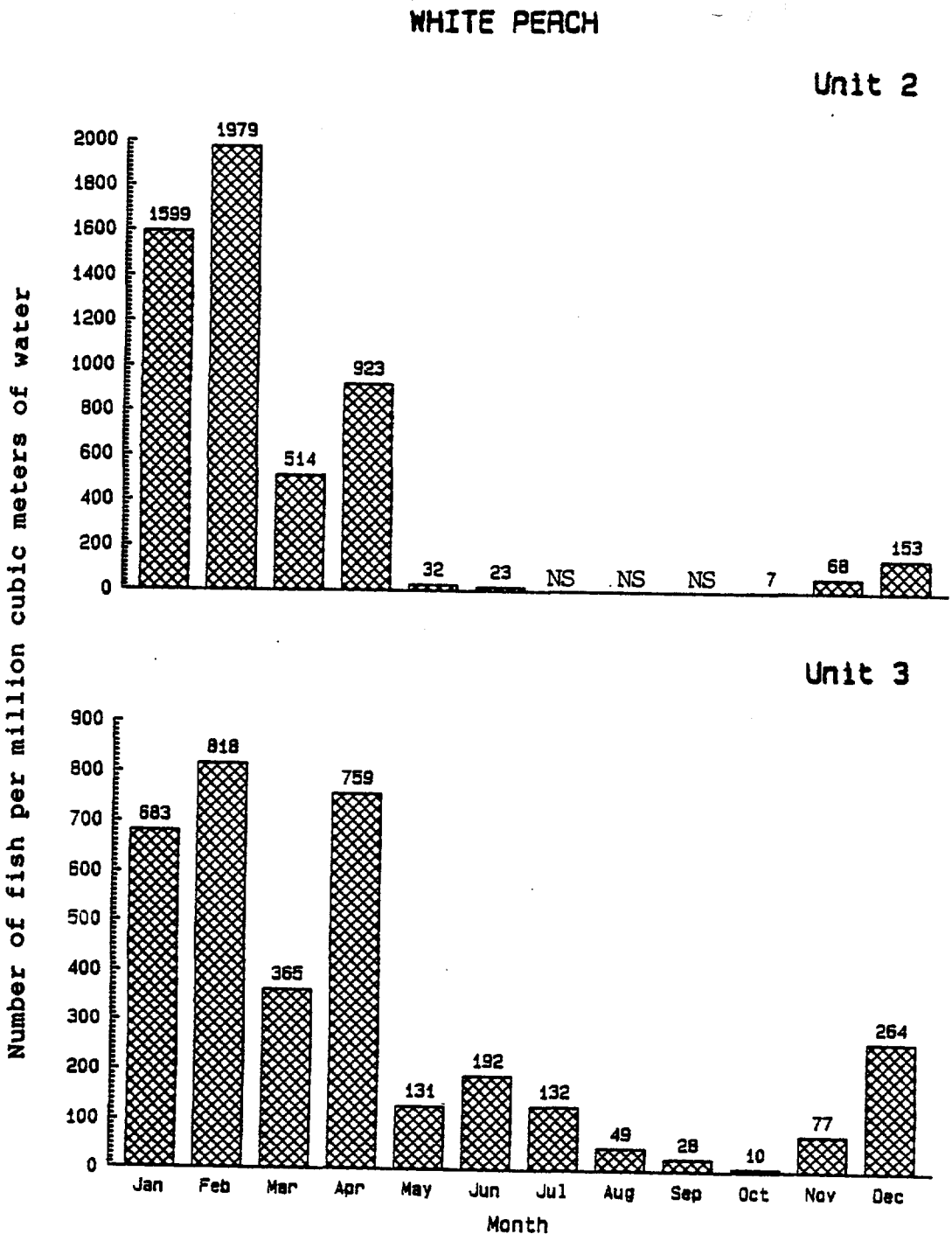

Figure III-6. Monthly mean number of white perch impinged per million cubic meters of sampling volume at Indian Point Units 2 and 3 during 1984. NS indicates no samples were taken.

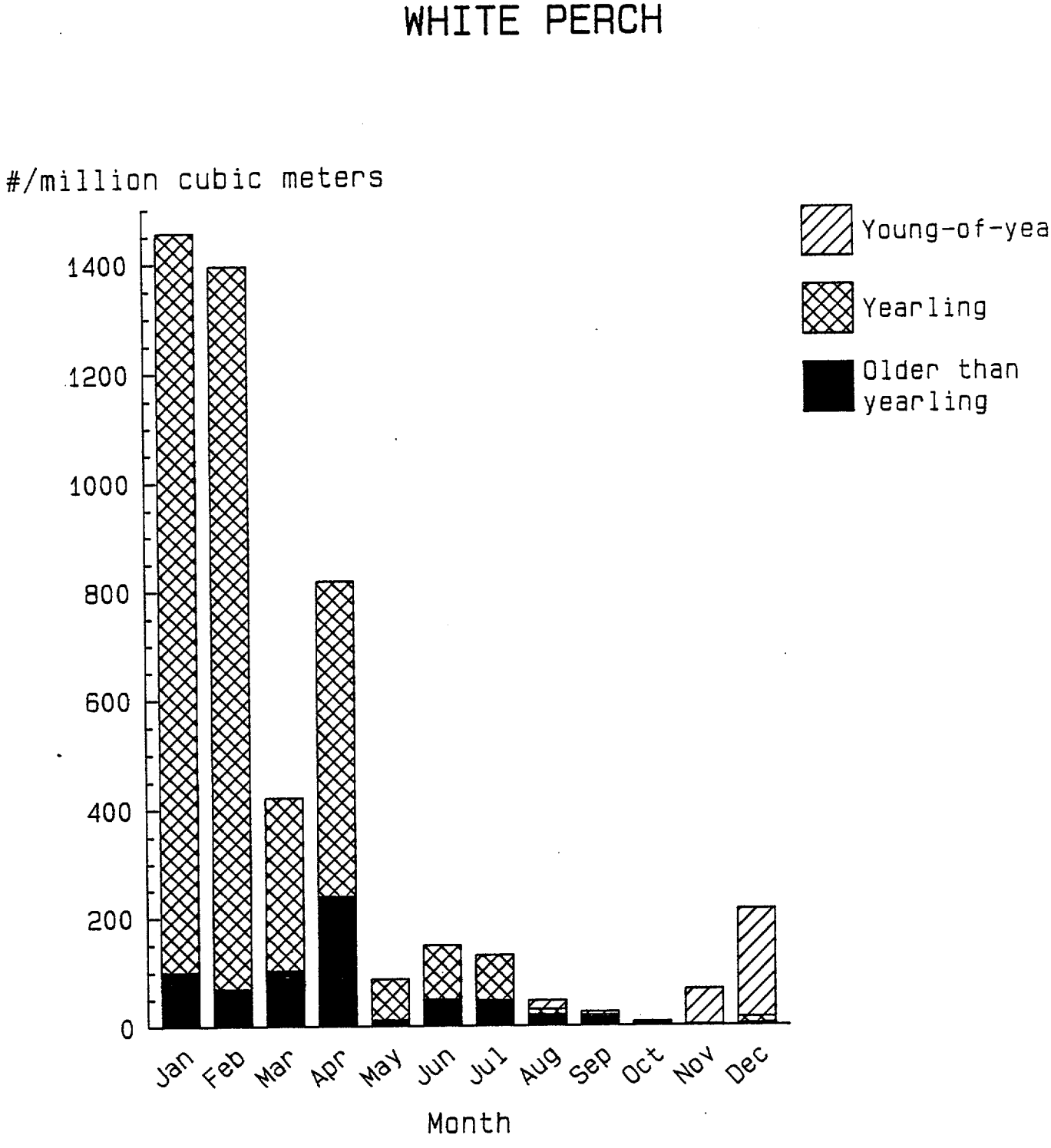

Figure III-7. Monthly mean number of young-of-year, yearling, and older than yearling white perch impinged per million cubic meters of sampling volume at Indian Point Units 2 and 3 during 1984.

Bay Anchovy

Bay anchovy were primarily impinged from May through November, with a large peak occurring during July and August (Fig. III-8). This peak was comprised mostly of yearling and older fish (Fig. III-9), as most young-of-year anchovies are not large enough to be impinged at that time of year. Due to outages at Unit 2 during the summer, 96% of the anchovies collected were taken from Unit 3.

The seasonal impingement pattern of bay anchovy may reflect the interaction between its salinity preference and its seasonal movements. In general, this species overwinters in areas of high salinity (Markle 1976), thereby accounting for its relative low abundance in impingement collections during this season. In May, Hudson River bay anchovy migrate upriver (TI 1976b), though they are not typically found in freshwater (Dovel 1971). Anchovies did not become heavily impinged at Indian Point until July when salinity reached 2 ppt (Fig. III-1).

Atlantic Tomcod

Atlantic tomcod were impinged in every month of 1984 with the greatest impingement occurring from June through August (Fig. III-10). Over 98% of Atlantic tomcod collected from the screens were young-of-year (Fig. III-11). Similar patterns of Atlantic tomcod impingement have been found in previous studies at Indian Point.

Atlantic tomcod spawn in winter, upstream of Indian Point (Normandeau Associates (NA) 1984a, Werme et al. 1983). Their peak impingment corresponded to a time when young-of-year fish reach impingeable size and become locally concentrated in the region (TI 1980b). Reduced tomcod impingement in the fall may be related to their migration away from Indian Point to less brackish spawning areas.

Blueback Herring, Alewife, and American Shad

Impingement patterns for blueback herring, alewife, and American shad are similar. Each exhibited negligible impingement until spring and slightly higher impingement during the fall (Figs. III-12, III-13, and III-14).

The seasonal impingement of these species corresponds to their seasonal migration patterns. These species are anadromous, and they migrate to the ocean in the fall. This accounts for

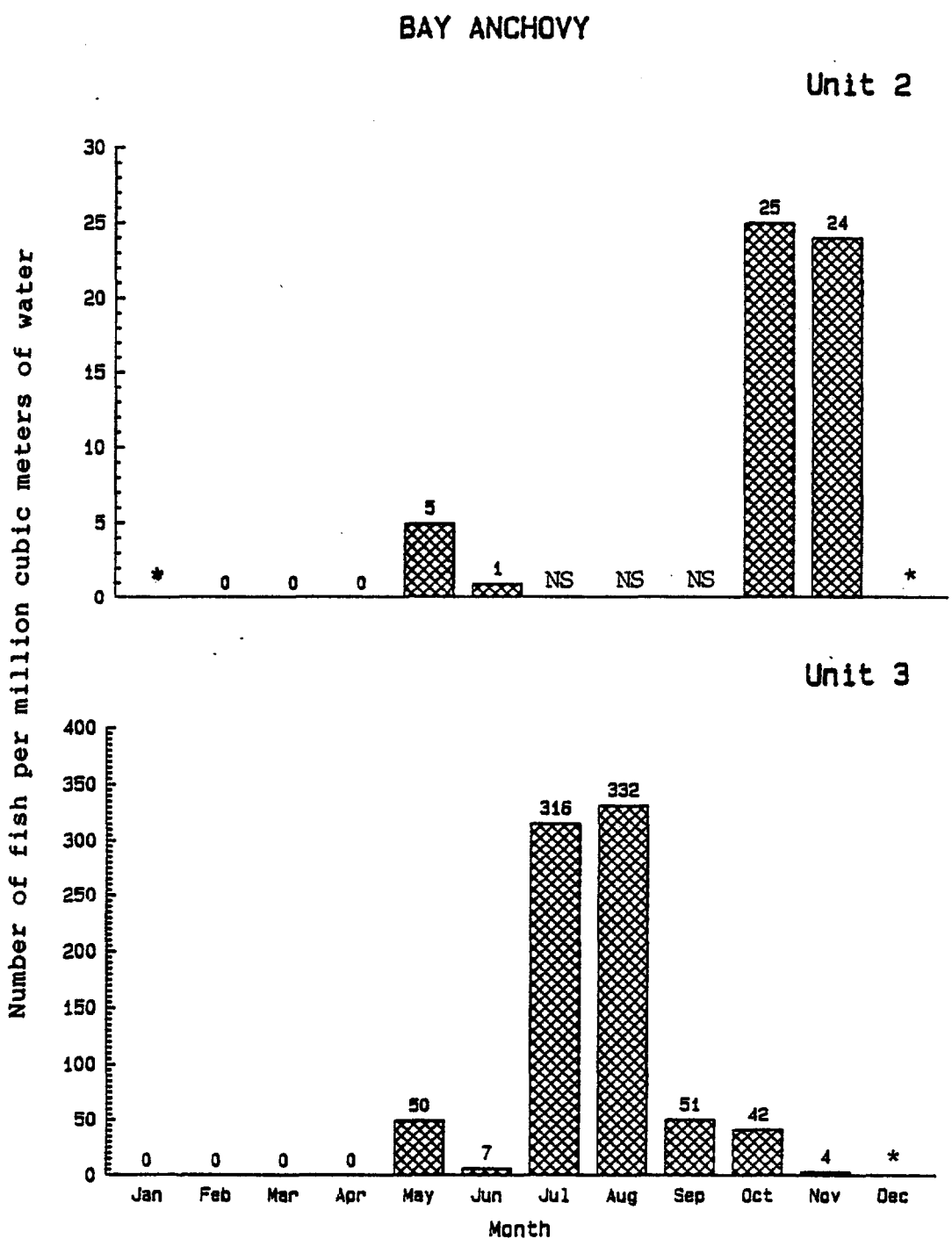

Figure III-8. Monthly mean number of bay anchovy impinged per million cubic meters of sampling volume at Indian Point Units 2 and 3 during 1984. NS indicates no samples were taken. An * indicates that impingement was less than 0.5 fish per million cubic meters.

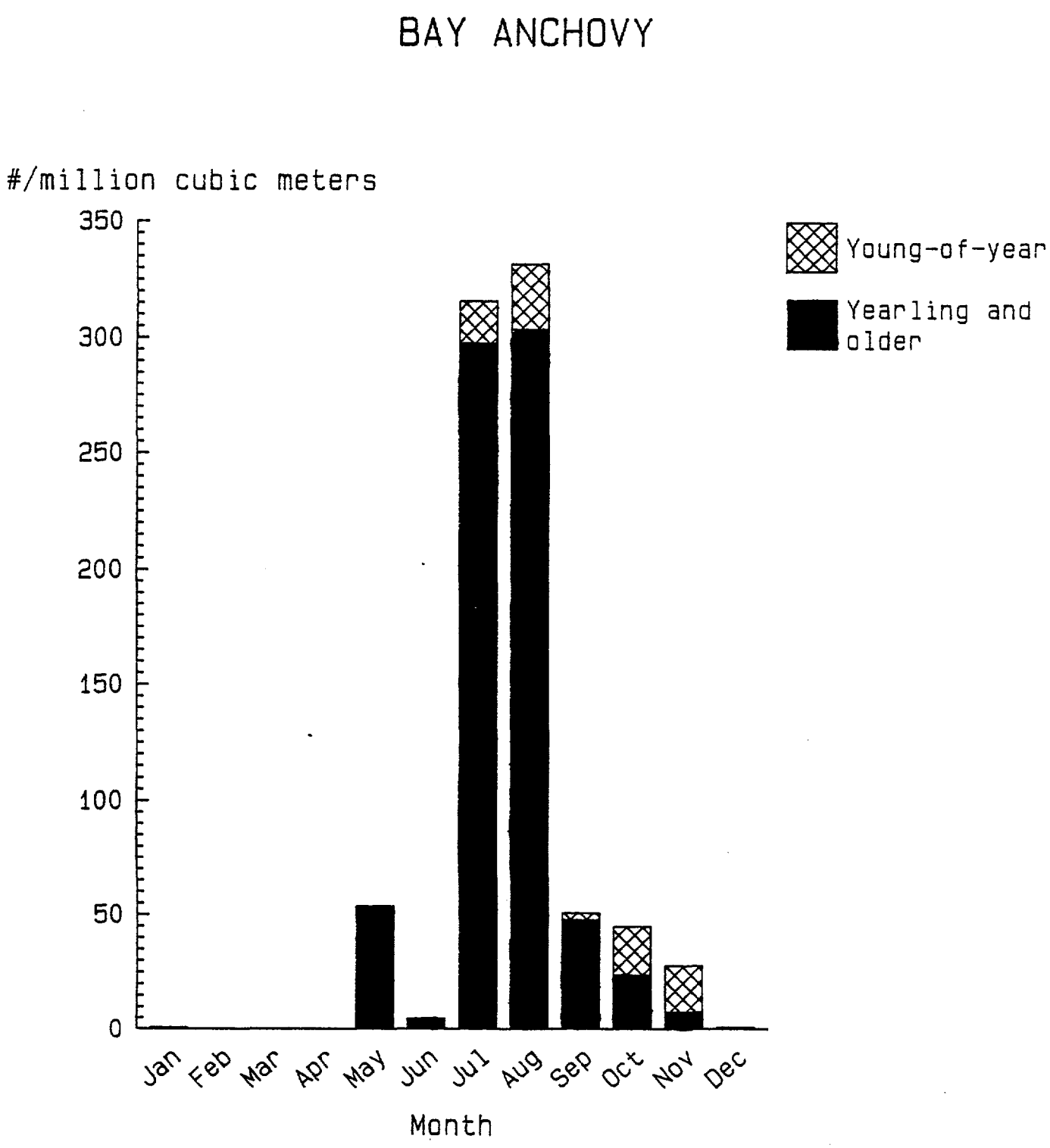

Figure III-9. Monthly mean number of young-of-year and yearling and older bay anchovy impinged per million cubic meters of sampling volume at Indian Point Units 2 and 3 during 1984.

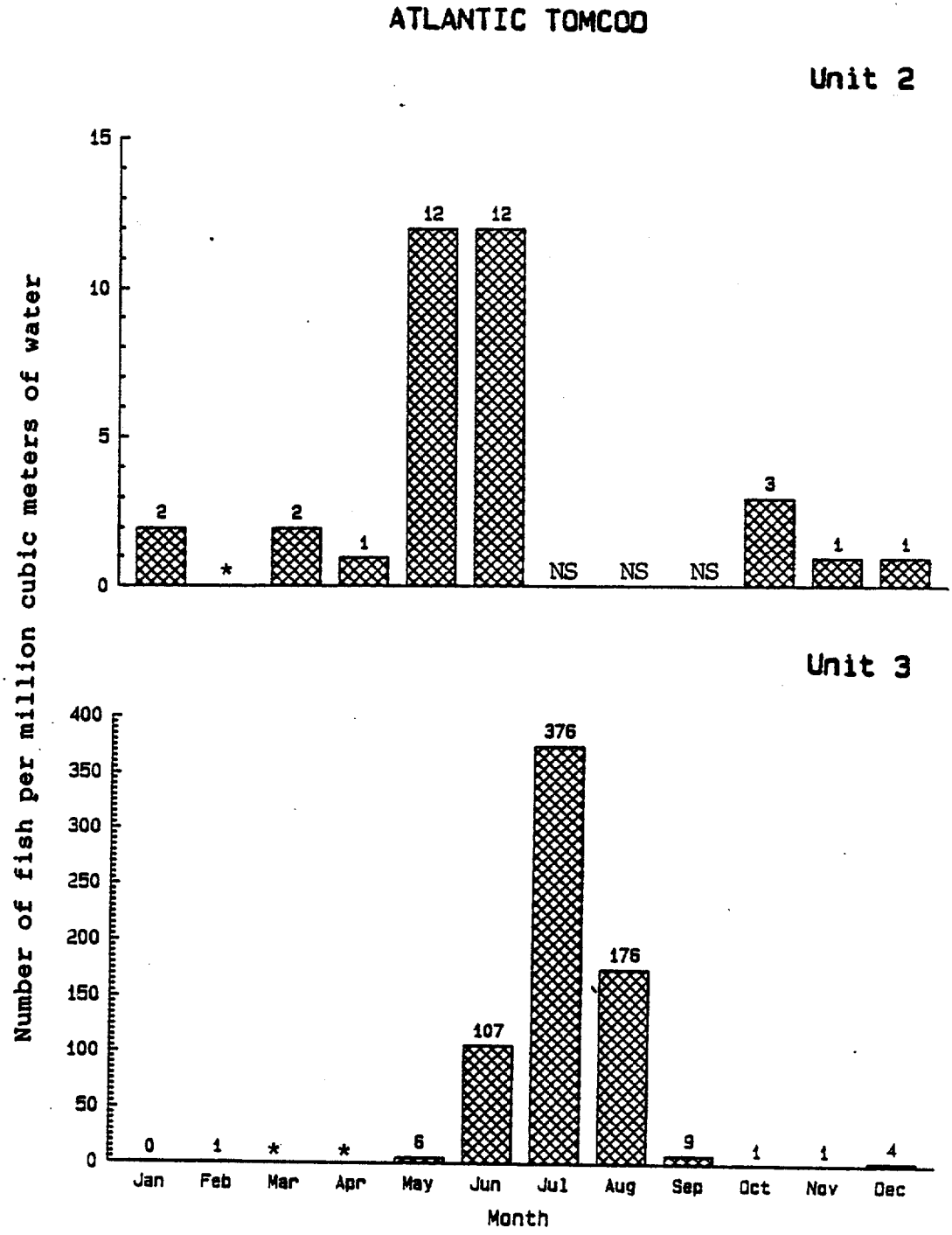

Figure III-10. Monthly mean number of Atlantic tomcod impinged per million cubic meters of sampling volume at Indian Point Units 2 and 3 during 1984. NS indicates no samples were taken. An * indicates that impingement was less than 0.5 fish per million cubic meters.

ATLANTIC TOMCOD

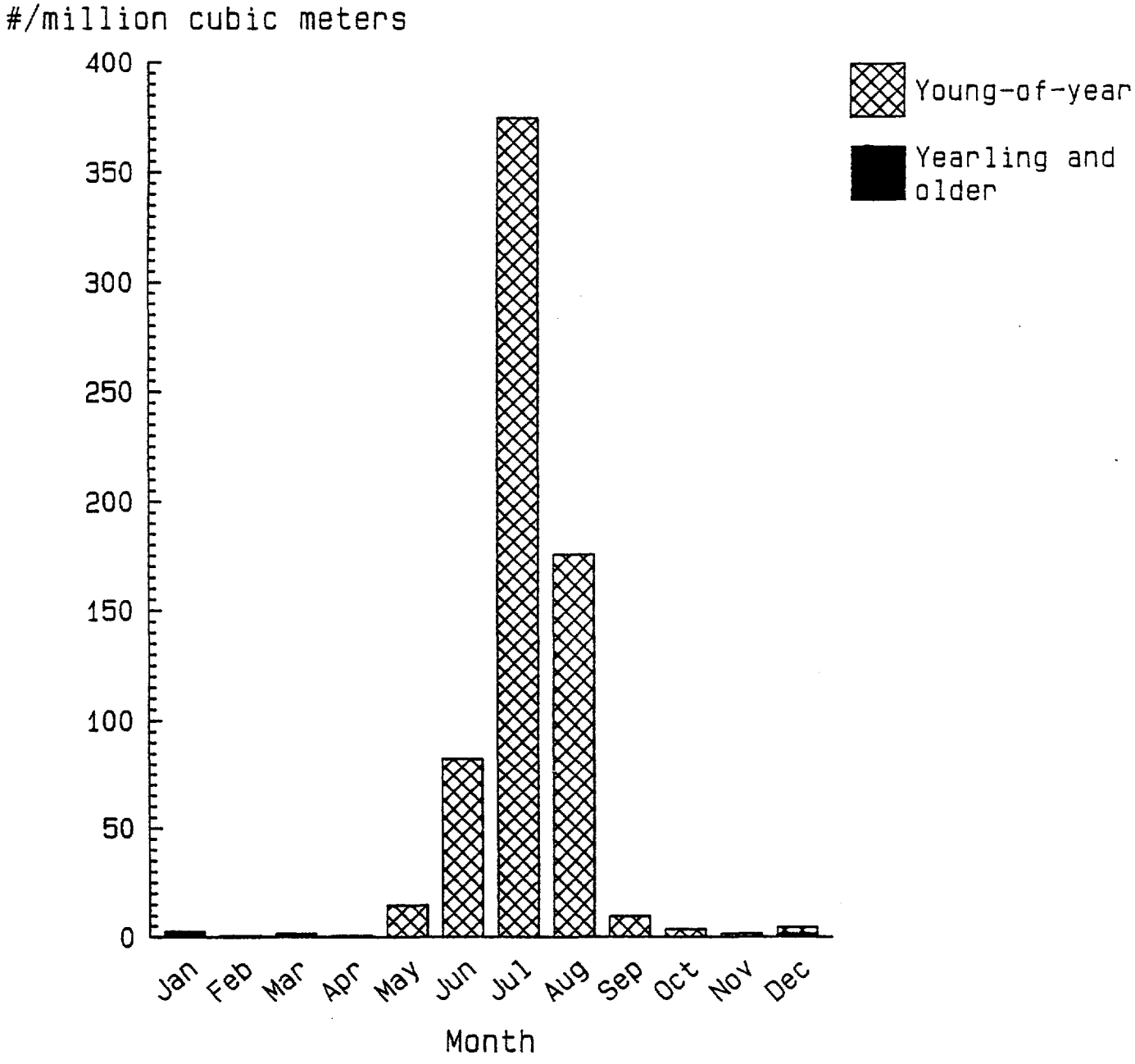

Figure III-11. Monthly mean number of young-of-year and yearling and older Atlantic tomcod impinged per million cubic meters of sampling volume at Indian Point Units 2 and 3 during 1984.

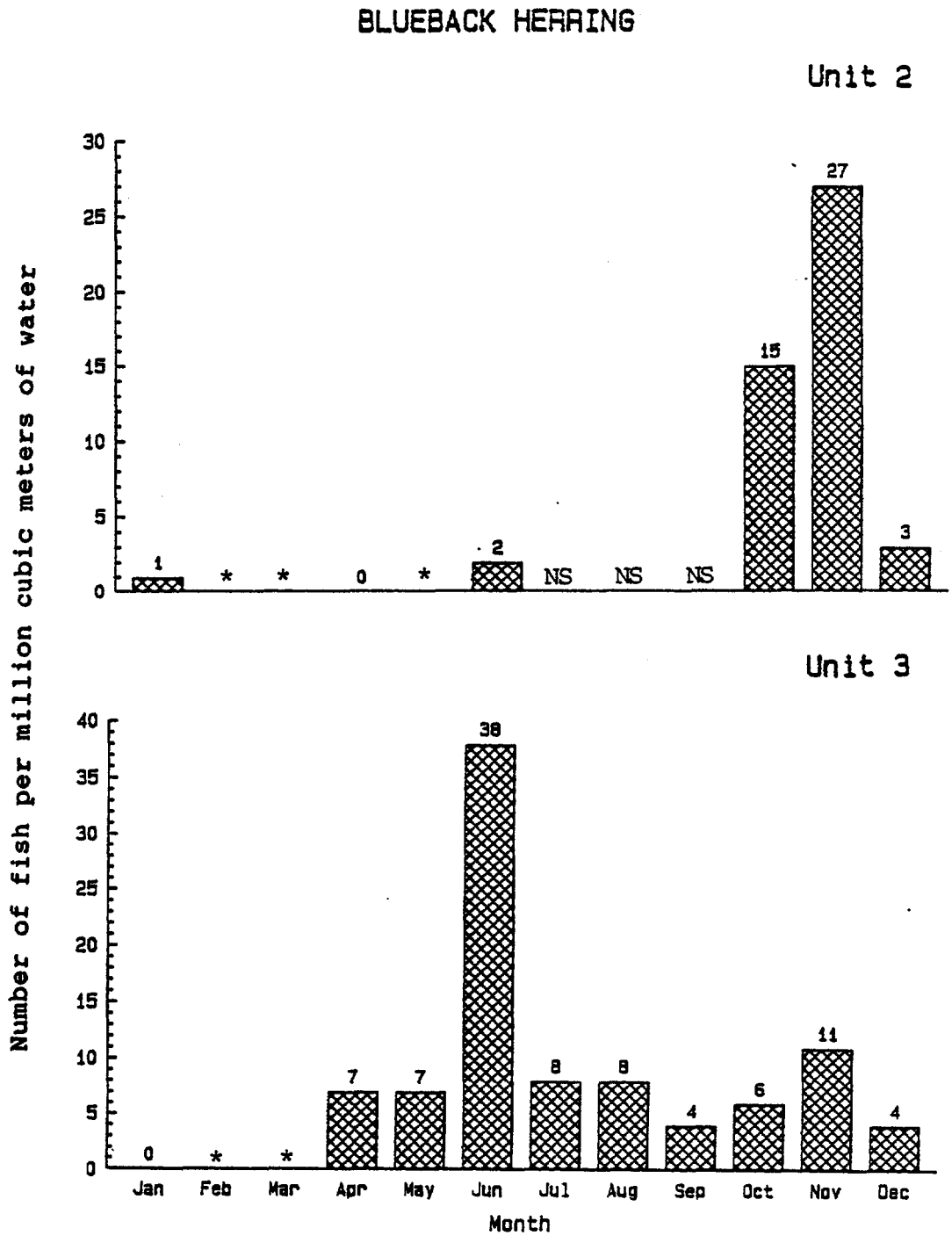

Figure III-12. Monthly mean number of blueback herring impinged per million cubic meters of sampling volume at Indian Point Units 2 and 3 during 1984. NS indicates no samples were taken. An * indicates that impingement was less than 0.5 fish per million cubic meters.

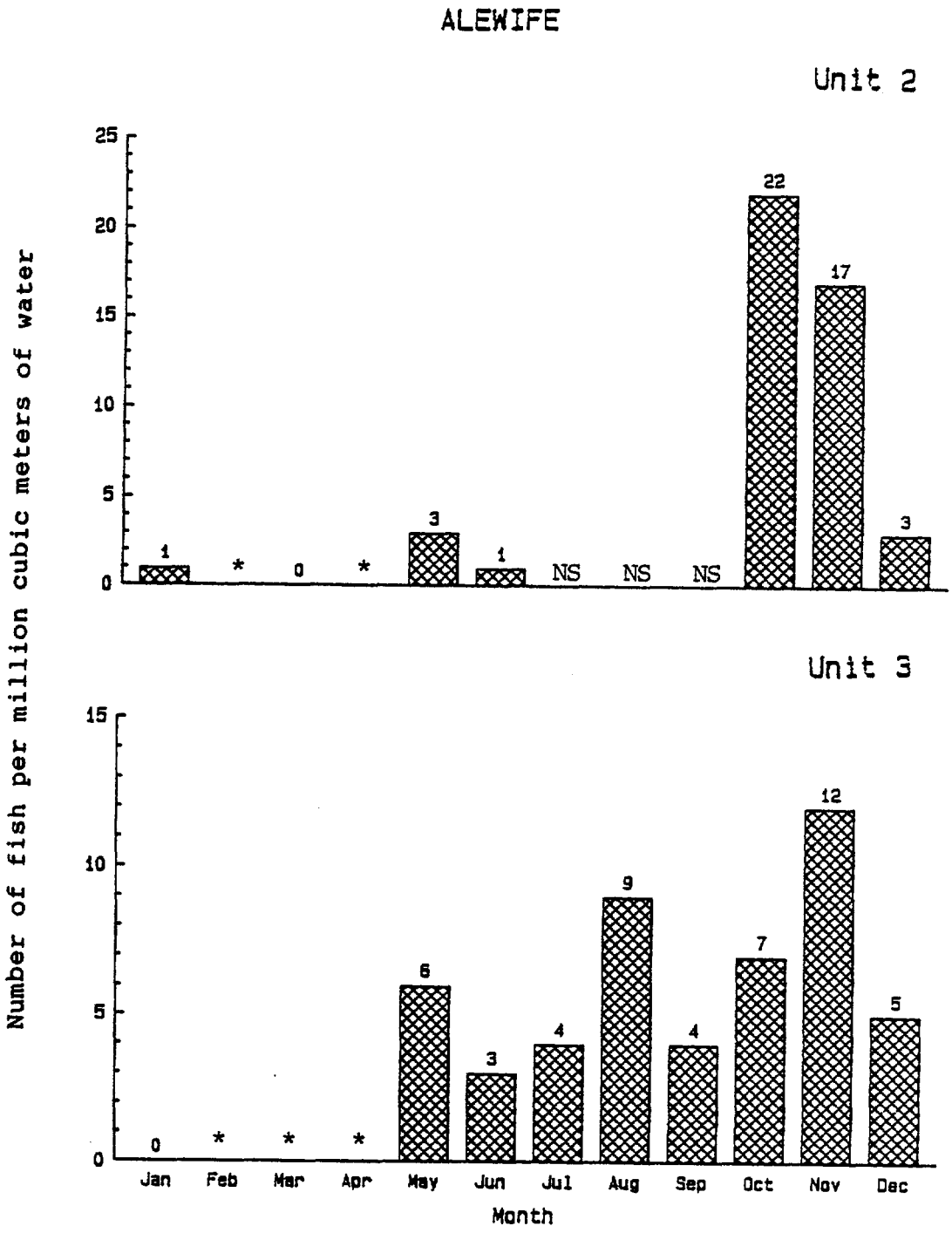

Figure III-13. Monthly mean number of alewife impinged per million cubic meters of sampling volume at Indian Point Units 2 and 3 during 1984. NS indicates no samples were taken. An * indicates that impingement was less than 0.5 fish per million cubic meters.

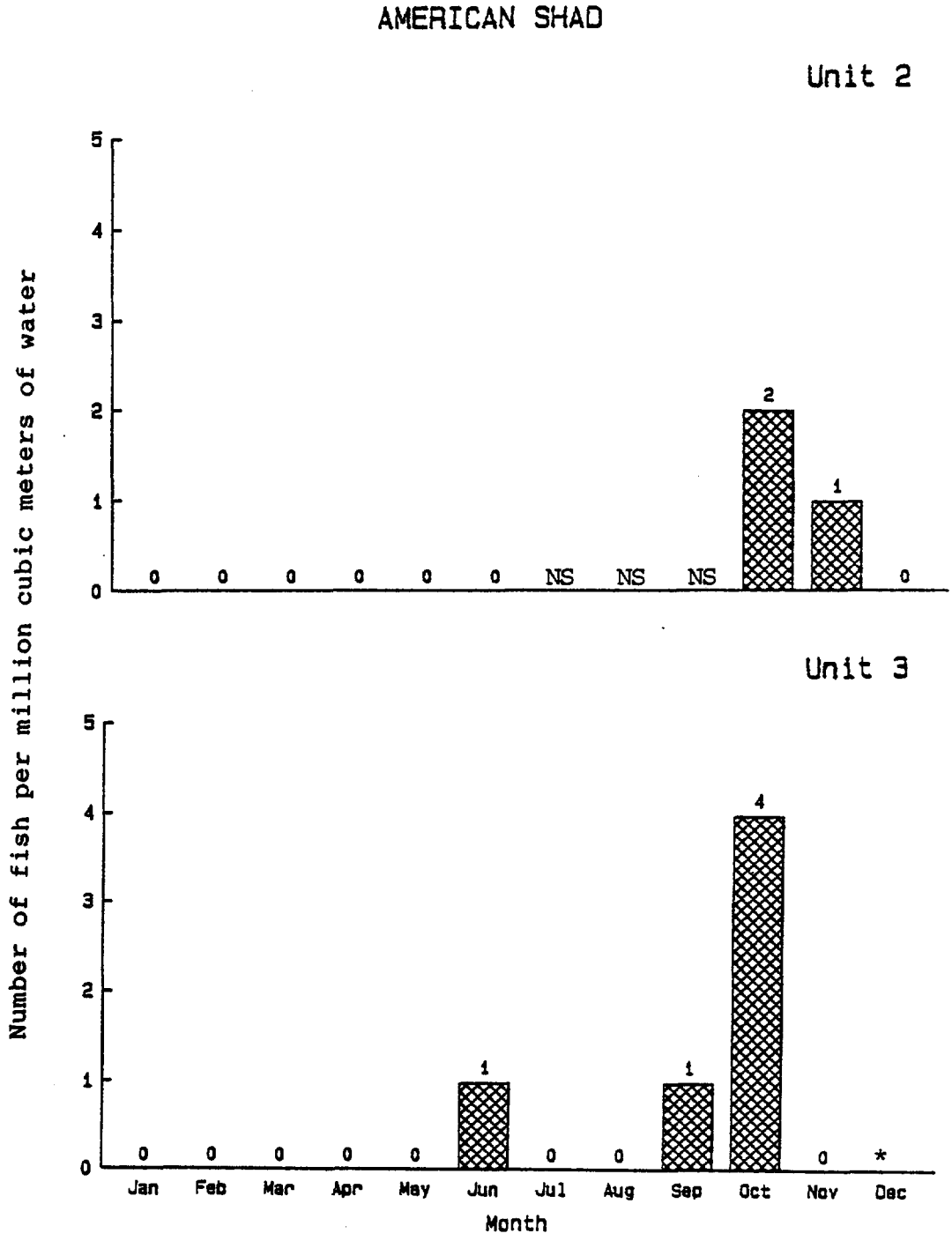

Figure III-14. Monthly mean number of American shad impinged per million cubic meters of sampling volume at Indian Point Units 2 and 3 during 1984. NS indicates no samples were taken. An * indicates that impingement was less than 0.5 fish per million cubic meters.

their relative absence from impingement collections until late spring when the three species migrate upriver to spawn (TI 1976b). Slightly higher impingement during the fall may be associated with downriver migration and the time when the young-of-year reach an impingeable size.

White Catfish

White catfish were impinged in every month, with slightly more fish impinged in winter and spring than in the rest of the year (Fig. III-15). They are primarily a fresh water species, and their periods of greatest impingement in 1984 corresponded to periods of low salinity at Indian Point (Fig. III-1). Similarly, the periods when white catfish were impinged in lowest numbers corresponded to periods of higher salinity. The January peak in impingement of white catfish is not explainable by salinity, but a similar peak in December or January has been reported for previous impingement studies at Indian Point.

Hogchoker

Hogchokers are a resident species in the Indian Point region, and were impinged in every month (Fig. III-16). A large peak in impingement was apparent at both units in May when water temperature was increasing rapidly. Similar peaks in impingement during May have been reported in all previous years of study and were particularly pronounced in 1982 and 1983. These May peaks correspond to peaks in abundance of this species at the Indian Point region, as reported in earlier trawls surveys (TI 1976b).

Striped Bass

Striped bass were impinged at Indian Point throughout the year with slightly higher impingement occurring during winter months (Fig. III-17). A similar pattern of increased impingement during the winter has been observed in previous years (NA 1984b).

Bluefish and Weakfish

Bluefish and weakfish were entirely absent from impingement collections from January through June and were most abundant in summer (Figs. III-18 and III-19). Because Unit 2 was down

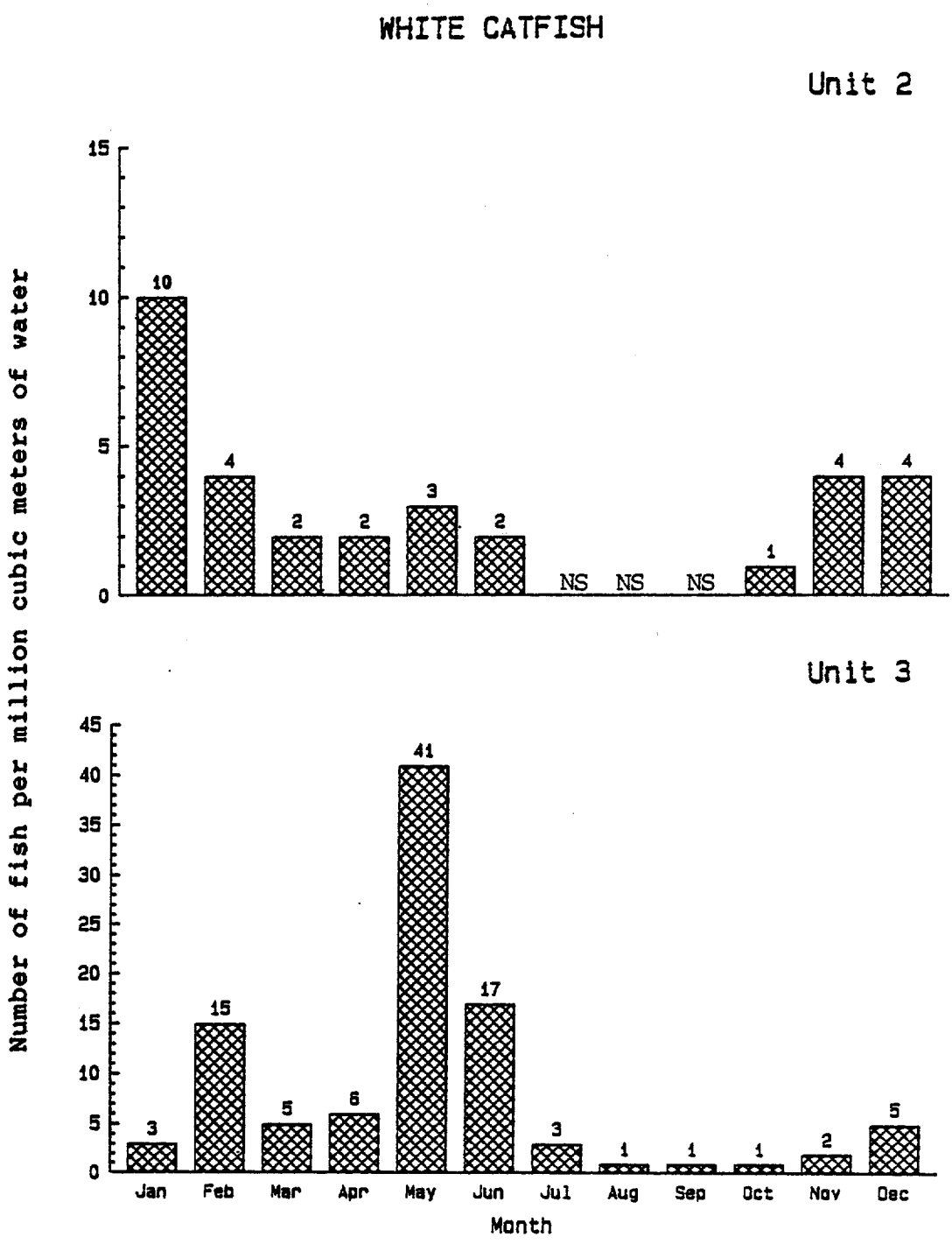

Figure III-15. Monthly mean number of white catfish impinged per million cubic meters of sampling volume at Indian Point Units 2 and 3 during 1984. NS indicates no samples were taken.

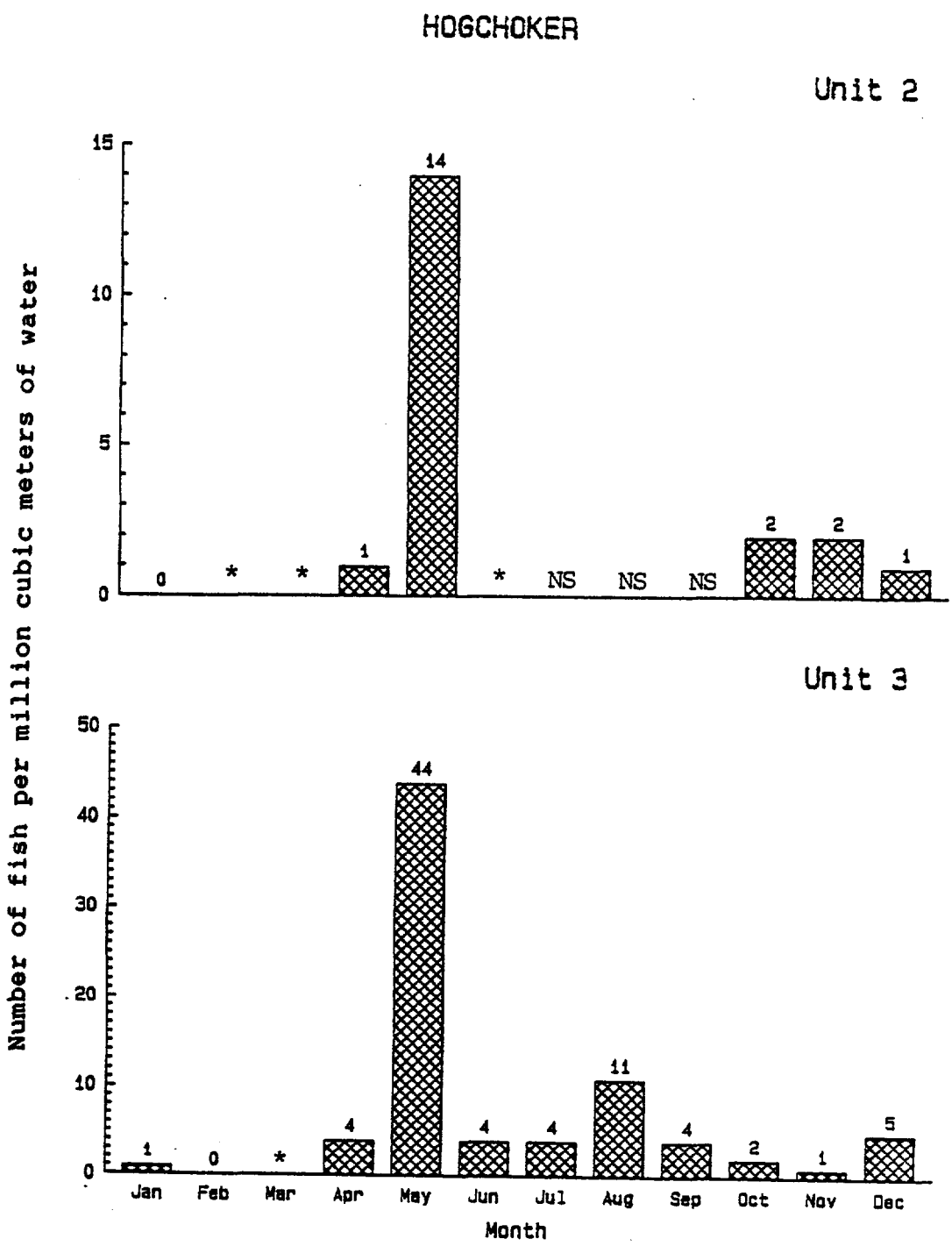

Figure III-16. Monthly mean number of hogchoker impinged per million cubic meters of sampling volume at Indian Point Units 2 and 3 during 1984. NS indicates no samples were taken. An * indicates that impingement was less than 0.5 fish per million cubic meters.

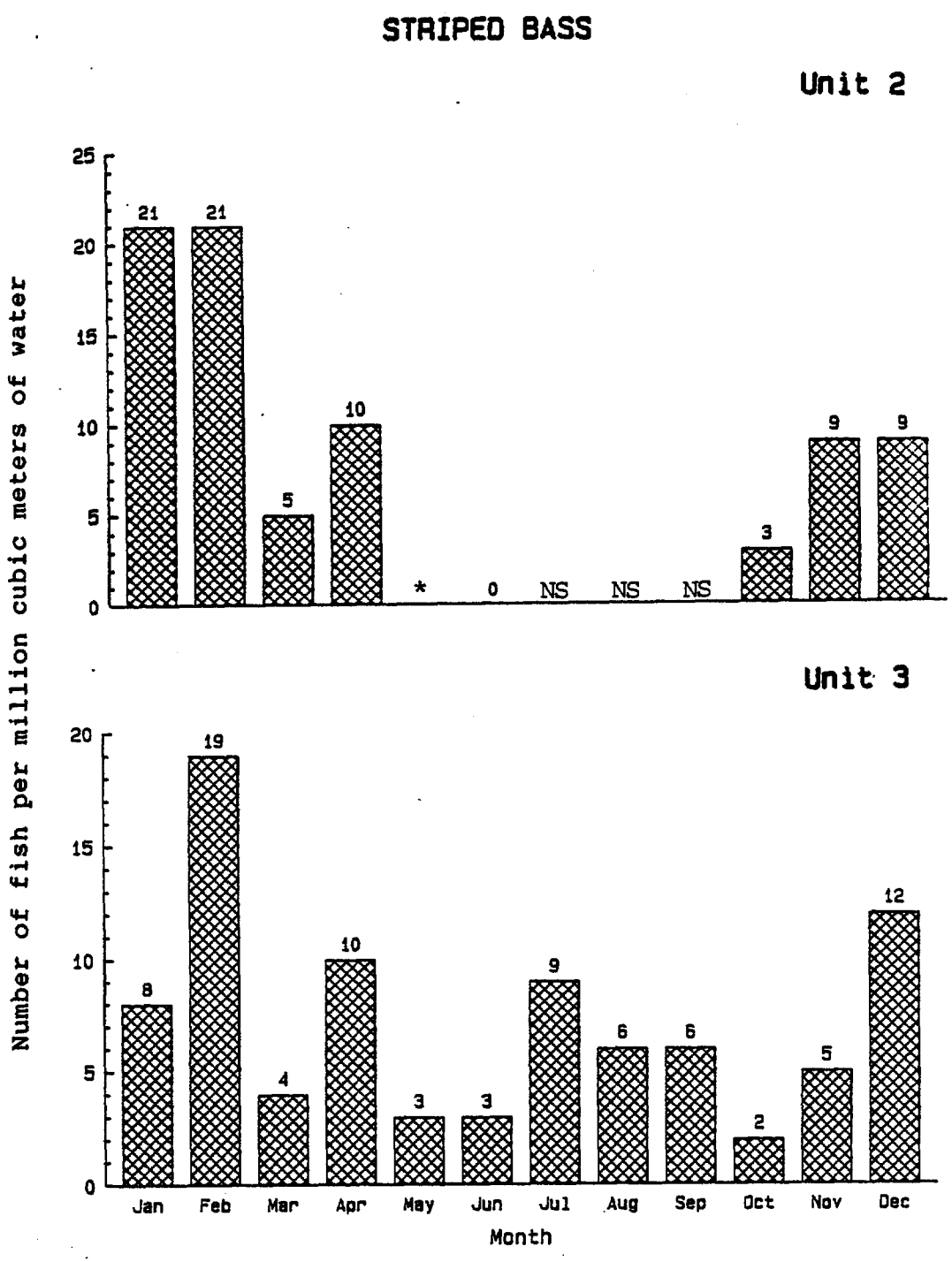

Figure III-17. Monthly mean number of striped bass impinged per million cubic meters of sampling volume at Indian Point Units 2 and 3 during 1984. NS indicates no samples were taken. An * indicates that impingement was less than 0.5 fish per million cubic meters.

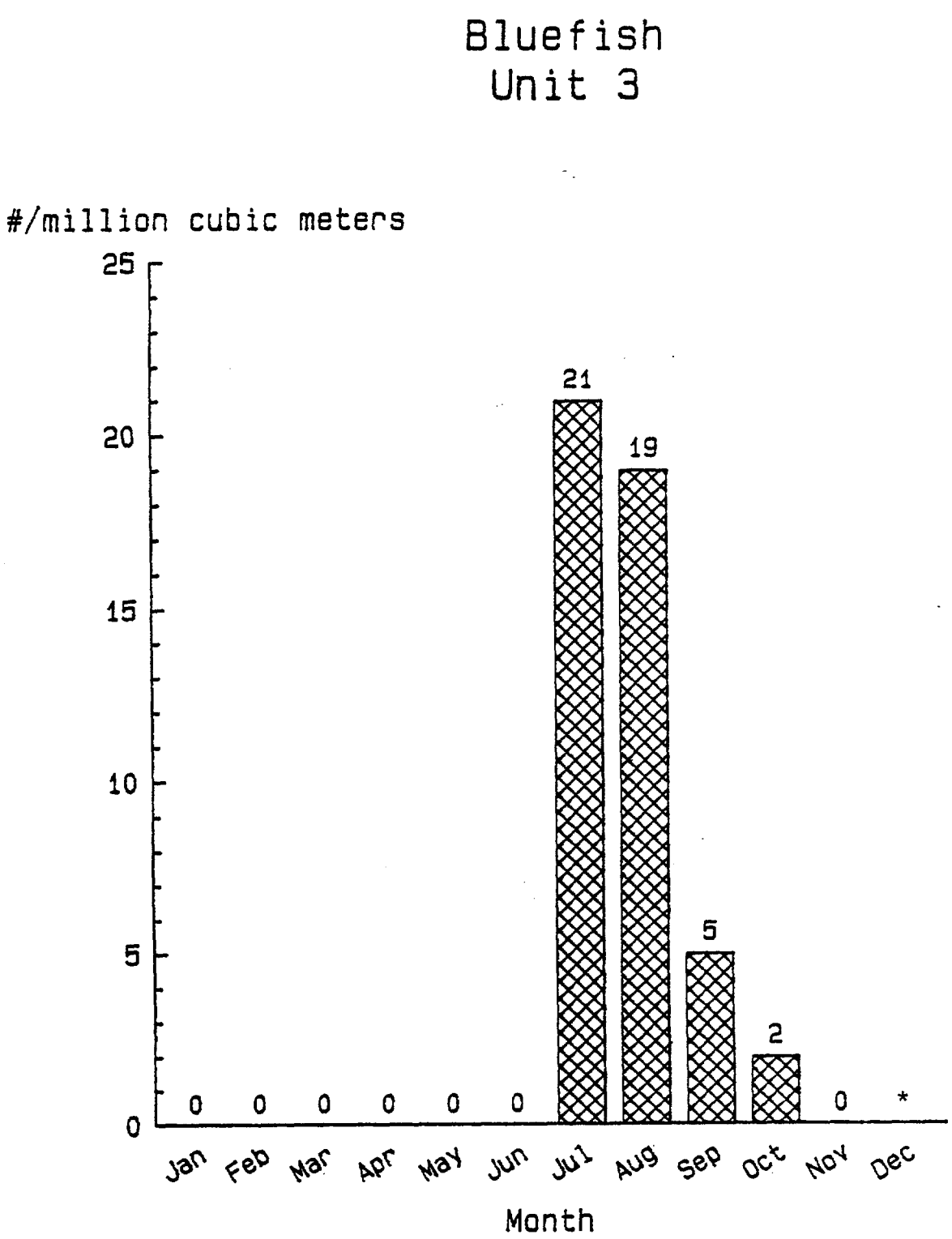

Figure III-18. Monthly mean number of bluefish impinged per million cubic meters of sampling volume at Indian Point Unit 3 during 1984. No bluefish were collected at Unit 2. An * indicates that impingement was less than 0.5 fish per million cubic meters.

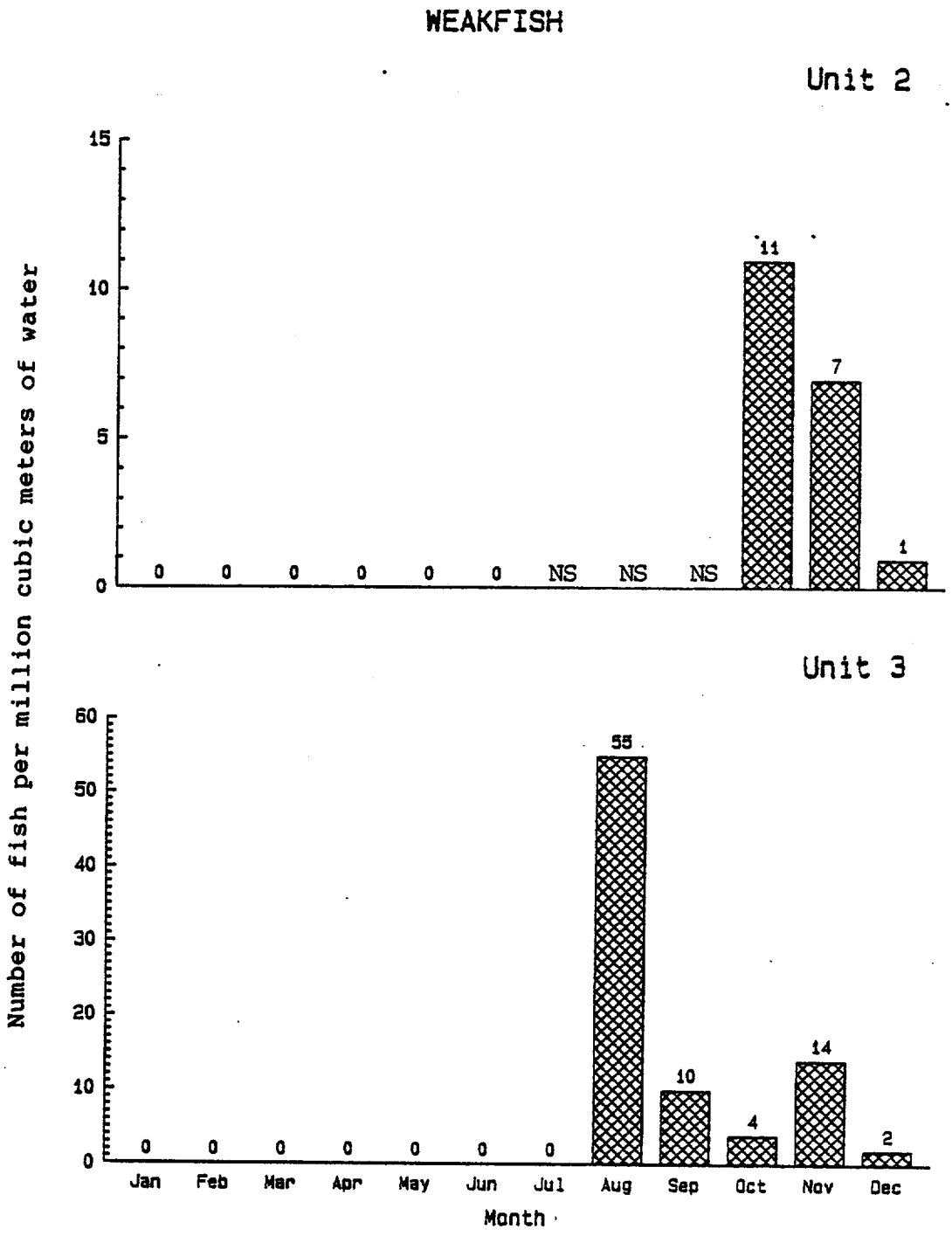

Figure III-19. Monthly mean number of weakfish impinged per million cubic meters of sampling volume at Indian Point Units 2 and 3 during 1984. NS indicates no samples were taken.

during the summer, only seven bluefish were collected there in 1984. Both of these species overwinter offshore in marine waters, accounting for their absence from impingement samples until July. The summer peak in impingement corresponds with the period when these fish return to the estuary to feed.

Spottail Shiner and Rainbow Smelt

Monthly impingement rates for spottail shiner and rainbow smelt are given in Figures III-20 and III-21, respectively. These species combined accounted for less than 1% of the total estimated number of fish impinged for the year. The increase in the rate of spottail shiner impingement during January and February may be due to overwintering of this species in deepwater areas like Indian Point (TI 1976b). However, no seasonal patterns can be discerned for rainbow smelt since few smelt were caught throughout the year. Impingement patterns for this species have been inconsistent in previous years, with peaks occurring in different seasons in different years.

Atlantic and Shortnose Sturgeon

Eight Atlantic sturgeon and 2 shortnose sturgeon were collected in 1984 with no apparent seasonal pattern. These species have typically been collected in low numbers at Indian Point. The large size of adult fish, their demersal nature, and their low abundance (TI 1976b) probably contribute to the low impingement rate of sturgeon at Indian Point.

E. HISTORICAL PERSPECTIVE ON FISH IMPINGEMENT

Total Fish Impingement Rate

Estimated annual fish impingement at Indian Point during 1984 was approximately equal to that in 1983 and about one-half of that in 1982. The annual number of fish impinged from 1982 to 1984 was lower than from 1977 to 1981 (Table III-6). The rate of impingement, calculated as the total estimated number of fish impinged divided by the total operating volume, has also decreased dramatically since 1981 and was lower in 1983 and 1984 than in all previous years since 1976 (Fig. III-22).

There are at least three possible explanations for this apparent decrease in impingement at Indian Point in 1982:

Table III-6. Historical impingement data for finfish species collected at Indian Point (units combined) during 1976 through 1984.

Year	Volume (million m^3)[a]	Estimated No. Impinged (millions)	Impingement Rate (No./million m^3)	No. Species Collected
1976	1329	1.63	1190	58
1977	2159	6.47	2910	72
1978	2030	3.91	1870	72
1979	1935	4.48	2230	74
1980	1822	3.21	1710	76
1981	1617	4.57[b]	2830	72
1982	1273	1.60	1260	43
1983	1286	0.85	661	49
1984	1710	0.85	496	56

[a]Includes service water
[b]Reduced sampling design was used for estimates from July 1981 to present

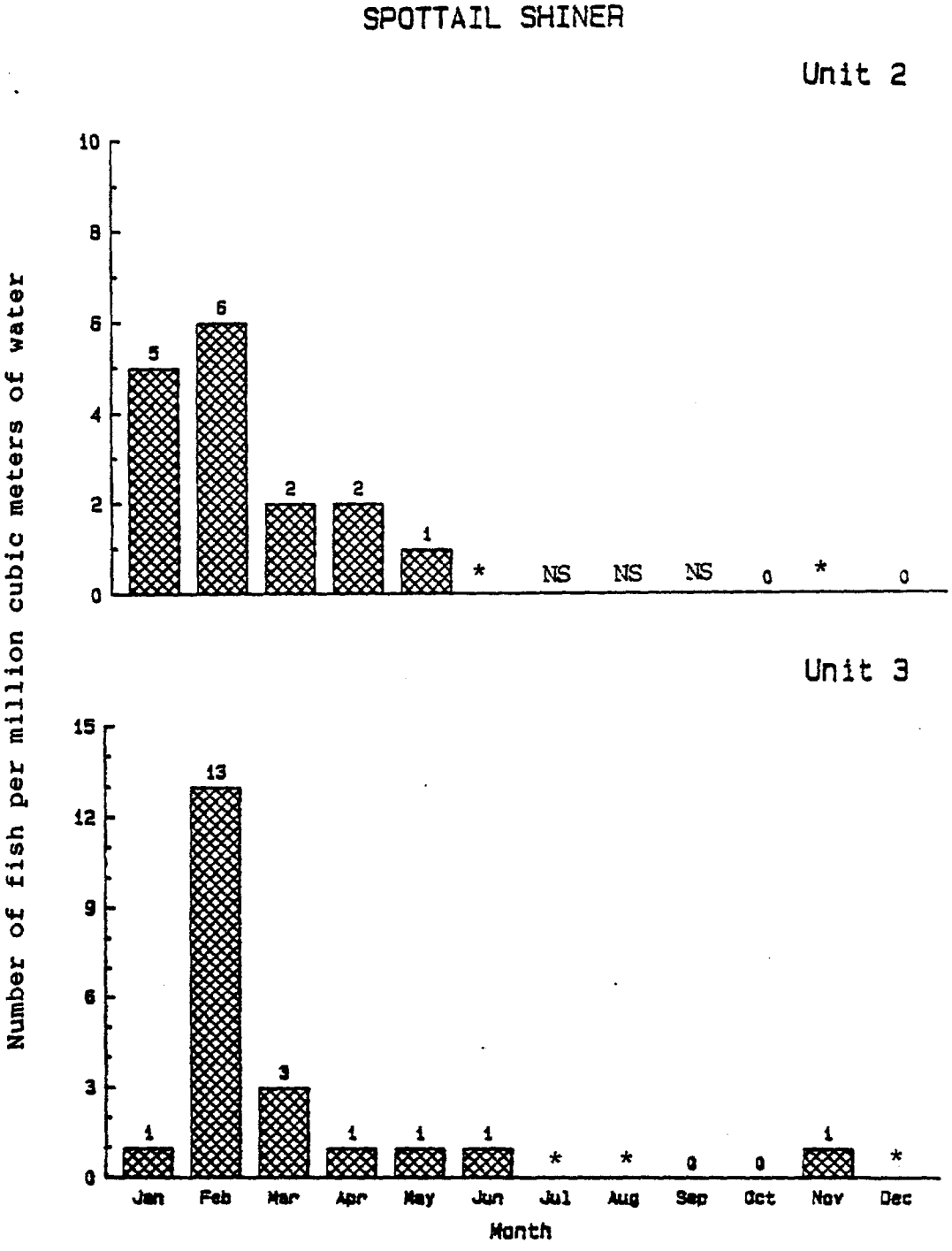

Figure III-20. Monthly mean number of spottail shiner impinged per million cubic meters of sampling volume at Indian Point Units 2 and 3 during 1984. NS indicates no samples were taken. An * indicates that impingement was less than 0.5 fish per million cubic meters.

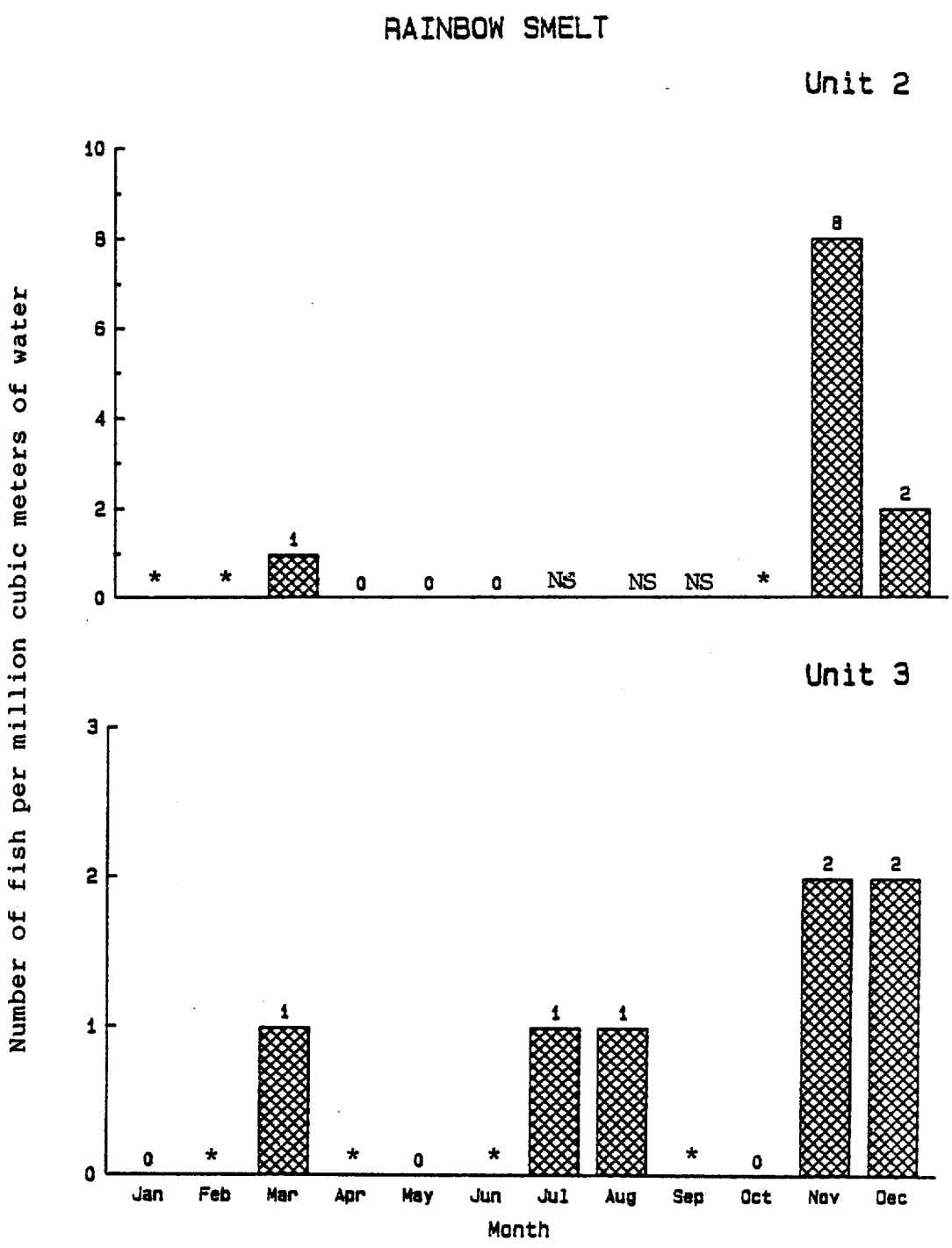

Figure III-21. Monthly mean number of rainbow smelt impinged per million cubic meters of sampling volume at Indian Point Units 2 and 3 during 1984. NS indicates no samples were taken. An * indicates that impingement was less than 0.5 fish per million cubic meters.

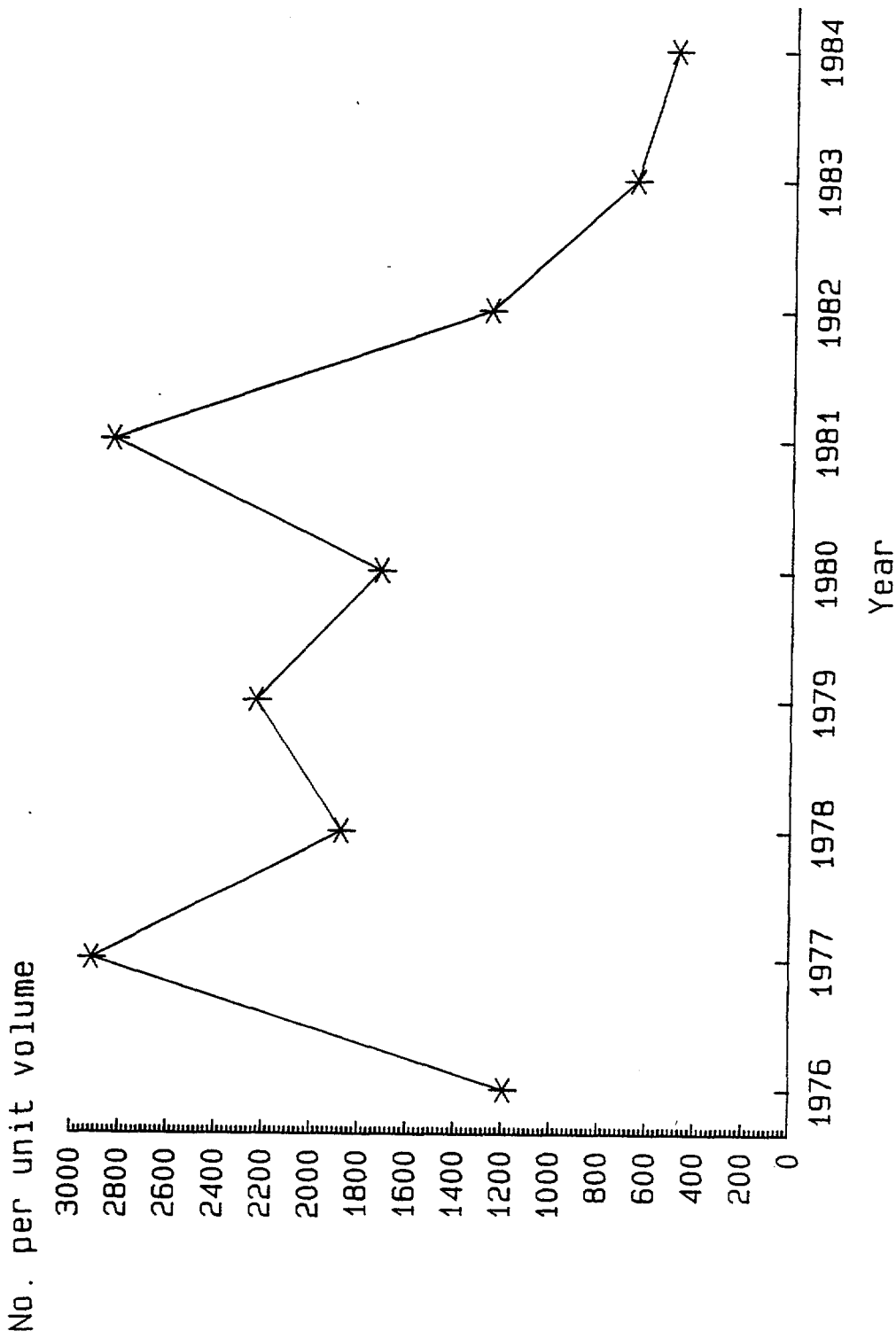

Figure III-22. Estimated number of fish impinged per million cubic meters of water circulated at Indian Point Units 2 and 3 combined during 1976 to 1984

- Impingement estimates after 1981 may have been an artifact of the reduced sampling design and thus may not reflect actual impingement rates.

- Planned outages and reductions in circulator pumping rates instituted in 1981 as part of the Hudson River Settlement Agreement may have successfully reduced impingement at Indian Point.

- There may have been fewer fish in ambient waters susceptible to impingement during 1982 to 1984.

The reduction in impingement rate that began in 1982 coincided with the first year that the stratified sampling design was used for the entire year. As discussed earlier, if impingement on sampling days was not representative of impingement on the remaining days within that stratum, then the estimate of impingement would be biased. This explanation appears to be unlikely, since sampling days are selected at random. In addition, sampling volume was generally representative of operating volume in 1984 (Figures III-2 and III-3).

The initiation of planned outages and reductions in circulator pumping rates also coincided with the recent decline in the rate of fish impingement at Indian Point. Although the annual total volume circulated through the plant (operating volume) was not lower in recent years than in 1977 to 1981 (Table III-6), shifts in the temporal distribution of impingement caused by outages and flow rate reductions may have contributed to the decline in total impingement. If total plant operating volume is reduced at times of potentially high impingement and increased at times of lower impingement potential, then the overall impingement rate should decrease. However, the mean rate of impingement from 1977 to 1981 was 2300 fish per million cubic meters (Table III-6), and impingment rates were not this great during any month in 1984 (Figure III-4). Therefore, although temporal shifts in operating schedules could have contributed to some reduction in impingement rate, they obviously cannot account for the entire decline observed since 1982.

Finally, it is possible that the large decline in fish impingement since 1982 reflects a general decline in species abundance in the Hudson River. The relationship between year class strength for the dominant fish species, white perch, and impingement at Indian Point was examined. Trends in this index did not correspond to declines in impingement since 1981 (NA 1985). However, continuation of reduced levels of impingement in the future may suggest the need for further examination of this explanation.

Species Composition and Abundance

Since 1975, the total number of species collected annually in impingement monitoring samples has ranged from 43 to 76. The number of species dropped in 1982 and then began to increase again slightly in 1983 (Table III-6). However, species richness has remained much lower than the species richness in the 1977 to 1981 period.

The sharp decline in species richness occurred when the impingement monitoring program was changed to a reduced sampling design. A decrease in the total number of impingement monitoring days should result in a decrease in the number of species collected, since rarer species are less likely to be collected when fewer fish were sampled (Hairston 1969). In addition, disproportionately fewer days are sampled during the spring and summer when these less abundant species have historically been captured.

Relatively few species have dominated the impingement samples since 1975. American shad, weakfish, blueback herring, Atlantic tomcod, bay anchovy, and white perch are the only species since 1975 to comprise more than 5% of the total number of fish impinged in any year. All other species combined have never constituted more than 12% of the total number of fish impinged in any year since 1975 (Fig. III-23).

In 1984, and every year since 1975, the dominant species in terms of abundance was white perch (Fig. III-23). However, the portion of total fish impingement constituted by white perch has varied considerably among years (i.e., between 39% and 76%). Plant operating schedules may have contributed to the flucuations observed in the relative abundance of white perch among years. For instance, in years when the seasonal distribution of total volume circulated at Indian Point Station was such that more water was withdrawn from the Hudson River during the winter (when white perch are abundant), the relative abundance of white perch in impingement collections should be greatest. This hypothesis is supported by the fact that the percent of annual impingement comprised by white perch in each year since 1976 was significantly correlated with the percent of annual volume circulated during January through April during those years (Fig. III-24). However, other factors, such as abundance of white perch in ambient waters, may have also contributed to these fluctuations.

Several dominant species other than white perch have exhibited variations in their relative abundances in impingement samples at Indian Point. Blueback herring constituted approximately 20% to 30% of the fish impinged from 1975 through 1978. However, since 1979, blueback herring have comprised

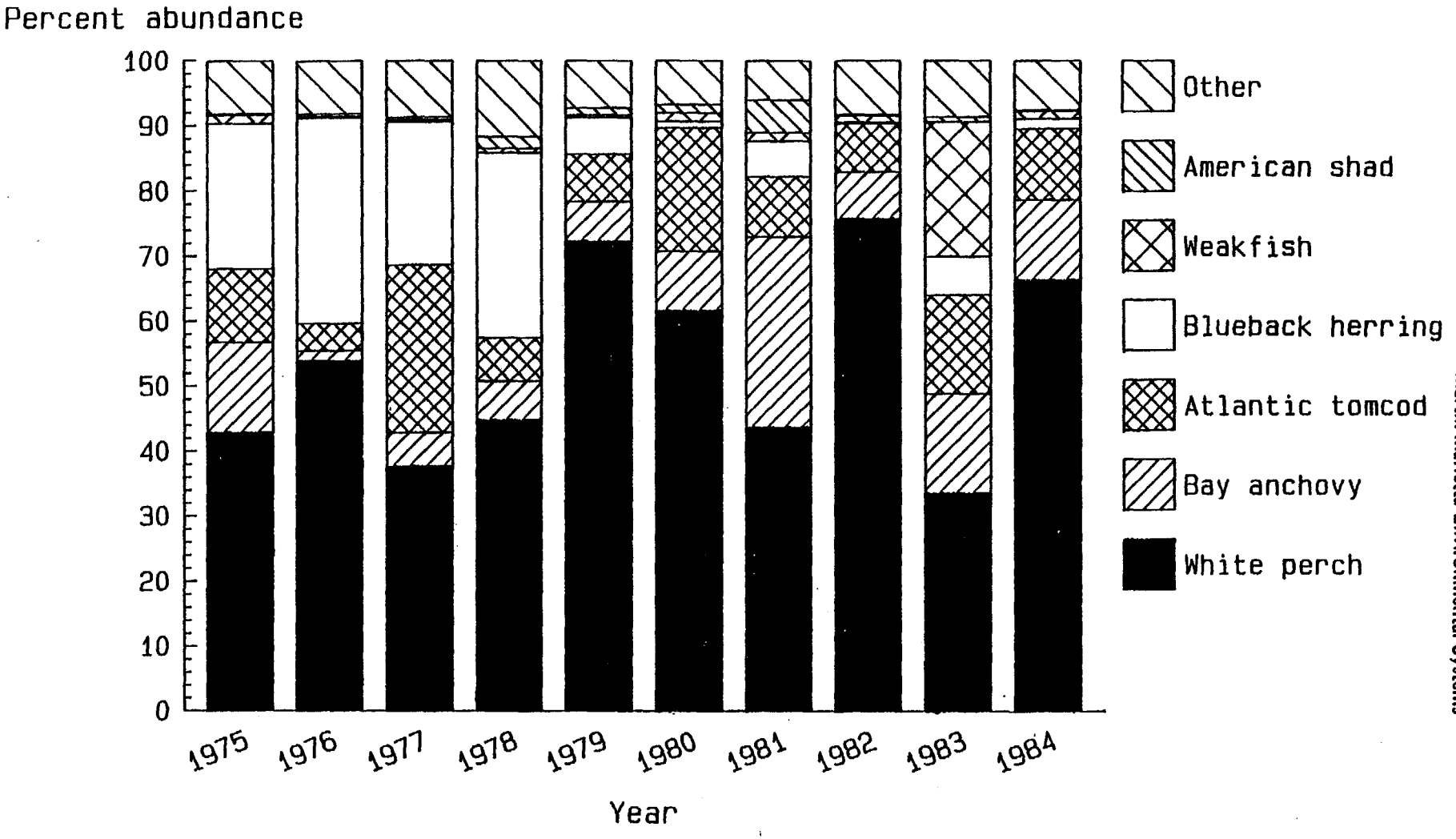

Figure III-23. Percent composition of annual impingement collections at Indian Point since 1975. All species comprising more than 5% of the total number are shown individually.

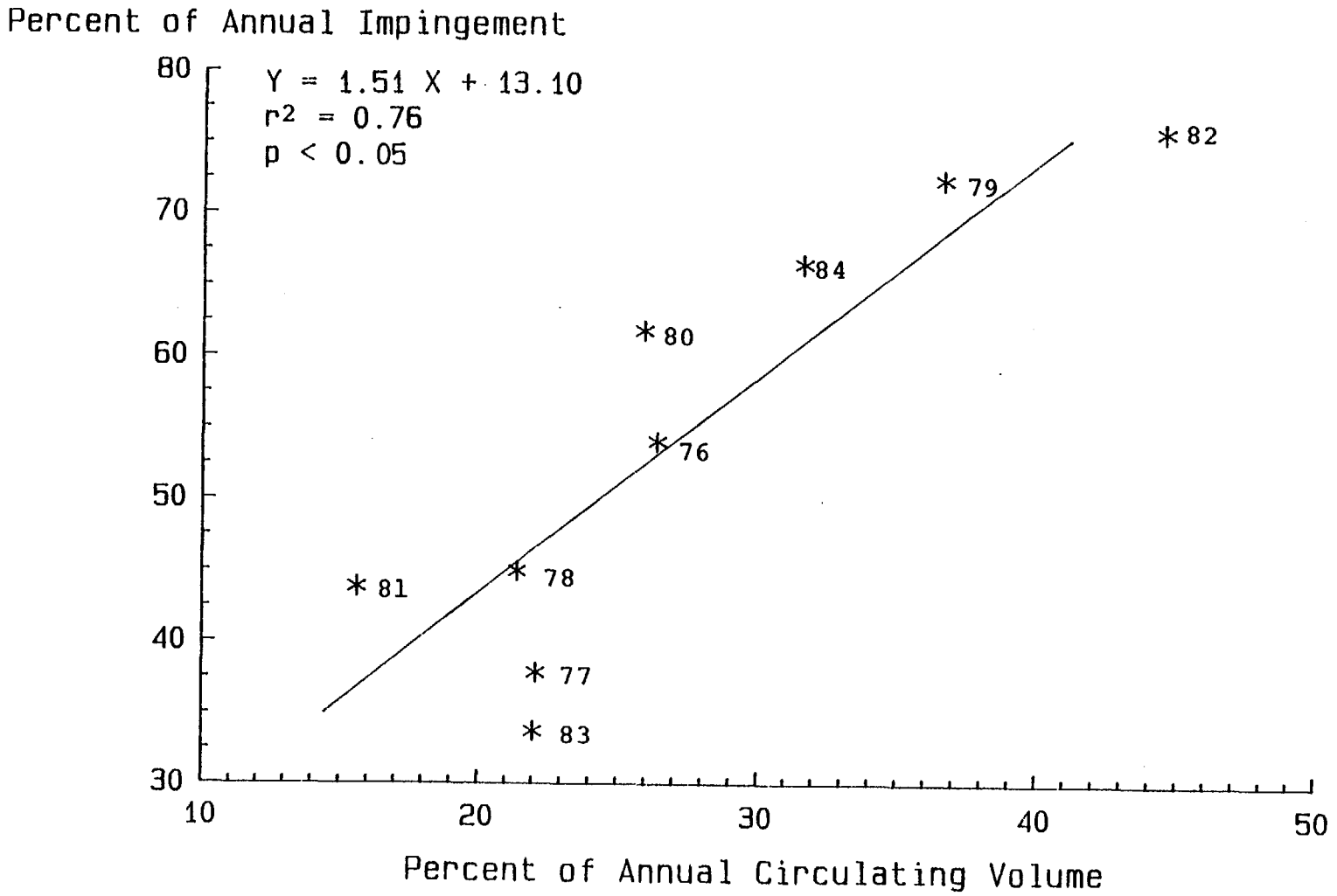

Figure III-24. Relationship between the percent of annual operating volume circulated during January through April and the percent of annual impingement constituted by white perch. Points are labeled by year.

less than 6% of total fish impingement. The decline in blueback herring impingement may reflect a decline in the abundance of this fish in the lower Hudson River. Mean catch-per-unit-effort (CPUE) of juvenile blueback herring was lower in every month during 1979 and 1980, than in 1976-1978 (Con Edison 1982a). Further, CPUE of yearling and older blueback herring in the Hudson River estuary beach seine study in 1979 was much lower than for 1976 through 1978, particularly in the lower estuary (TI 1981). Standing crop estimates for blueback herring in recent year class reports suggest that the reduced abundance of blueback herring in the Hudson River has continued from 1979 until the present.

The relative abundances of bay anchovy and Atlantic tomcod impinged at Indian Point have also varied widely over the last 10 years (from 1.5% to 29.2% and from 4.2% to 25.8% of total fish impingement, respectively) without any obvious long-term trends.

A large increase in weakfish abundance occurred in August 1983, which was the only year since 1975 when weakfish constituted more than 2% of the total number of fish impinged. This appearance of large numbers of weakfish in late summer was not repeated in 1984.

IV. BLUE CRAB IMPINGEMENT

Total Impingement

Three hundred forty-eight blue crabs, weighing a total of 41 kg, were collected from the intake screens in 1984 (Table IV-1). Blue crab impingement at the Indian Point Station was highly seasonal; crabs were only found on the screens between 29 June and 27 November. Due to extended outages at Unit 2 during the summer, most of the blue crabs collected in 1984 were impinged at Unit 3.

The seasonal pattern of blue crab impingement might be explained by salinity patterns. Blue crabs are generally less abundant in freshwater (Williams 1965), and crabs were only collected at Indian Point after the salinity rose above 0.1 ppt in June. When the salinity decreased again in November (Fig. III-1), fewer crabs were collected. No crabs were found in impingement samples during the winter because blue crabs overwinter in deeper, more saline portions of the estuary (Van Engel 1958).

The total number of blue crabs collected in 1984 was less than half of the number caught in 1983. This difference does not appear to be related to salinity because no obvious differences were observed between the salinity patterns of 1983 and 1984. The decline in number may be a result of the narrower temporal distribution of blue crabs in 1984 compared with that in 1983. In 1983, crabs were collected from May to December, whereas in 1984 crabs were only collected from late June through November. The operating schedule of the plant may have also contributed to the difference in impingement between years. The total number of unit operating days and the total volume of water circulated during the period when crabs were susceptible to impingement were about one third greater in 1983 than in 1984 due to outages at Unit 2 in 1984.

Accuracy

Since impinged crabs were collected each day, the total number of crabs impinged is not a statistical estimate and thus is not subject to errors in precision. However, the accuracy of the number impinged is subject to bias due primarily to collection inefficiency. Since no data are available

Table IV-1. Total numbers and weights (in grams) of blue crabs collected from intake screens at Indian Point Units 2 and 3 during 1984.

		Jun	Jul	Aug	Sep	Oct	Nov	Total
Number	Unit 2	0	0	0	0	11	9	20
	Unit 3	3	17	67	115	126	0	328
	Total	3	17	67	115	137	9	348
Weight	Unit 2	0	0	0	0	1,228	194	1,422
	Unit 3	550	1,187	5,739	16,805	15,651	0	39,932
	Total	550	1,187	5,739	16,805	16,879	194	41,354

to estimate the collection efficiency for blue crabs, the numbers presented in 1983 and 1984 are useful for evaluating trends and patterns, but may not represent the actual number of blue crabs impinged at Indian Point.

Size Distribution

The size distribution of impinged blue crabs was skewed to the left and was attenuated at approximately 160 mm carapace width (Fig. IV-1). Few small (<50 mm) and few large (≥190 mm) crabs were collected (3.4% of the total number). The mean carapace width of blue crabs collected during 1984 was 124.5 mm. A similarly skewed distribution of blue crab size was found for blue crabs impinged in 1983.

The mean carapace width increased from July to September and decreased in the fall (Fig. IV-2). It was greatest for crabs collected in June. However, only 3 crabs were collected in that month and may not be representative of the size distribution of the population. The decrease in mean carapace width in October and November is probably due to a second cohort of blue crabs spawned during the summer that began to reach impingeable size in October. This is supported by the fact that the number of crabs less than 60 mm increased eight-fold from September to October (Table D-4).

Sex Ratio

Over 81% of the blue crabs collected at Indian Point in 1984 were males. This is not unusual in fresh to oligohaline waters since male blue crabs osmoregulate more efficiently at low salinities than do adult females (Tan and Van Engel 1966) and males typically greatly outnumber females in low salinity headwaters (Millikin and Williams 1984). The ratio of male to female blue crabs impinged in 1984 generally exhibited a decreasing trend over time, particularly after September (Fig. IV-3). This may be due to an influx of smaller crabs with a more balanced ratio of males to females. Alternatively, more females may have entered the Indian Point area as the salinity increased. The sex ratio pattern of crabs impinged in 1984 was similar to that for 1983.

Survival and Condition

The percentage of blue crabs collected alive and intact during impingement collections is summarized by month in Figure IV-4. More than 50% of the crabs collected in each

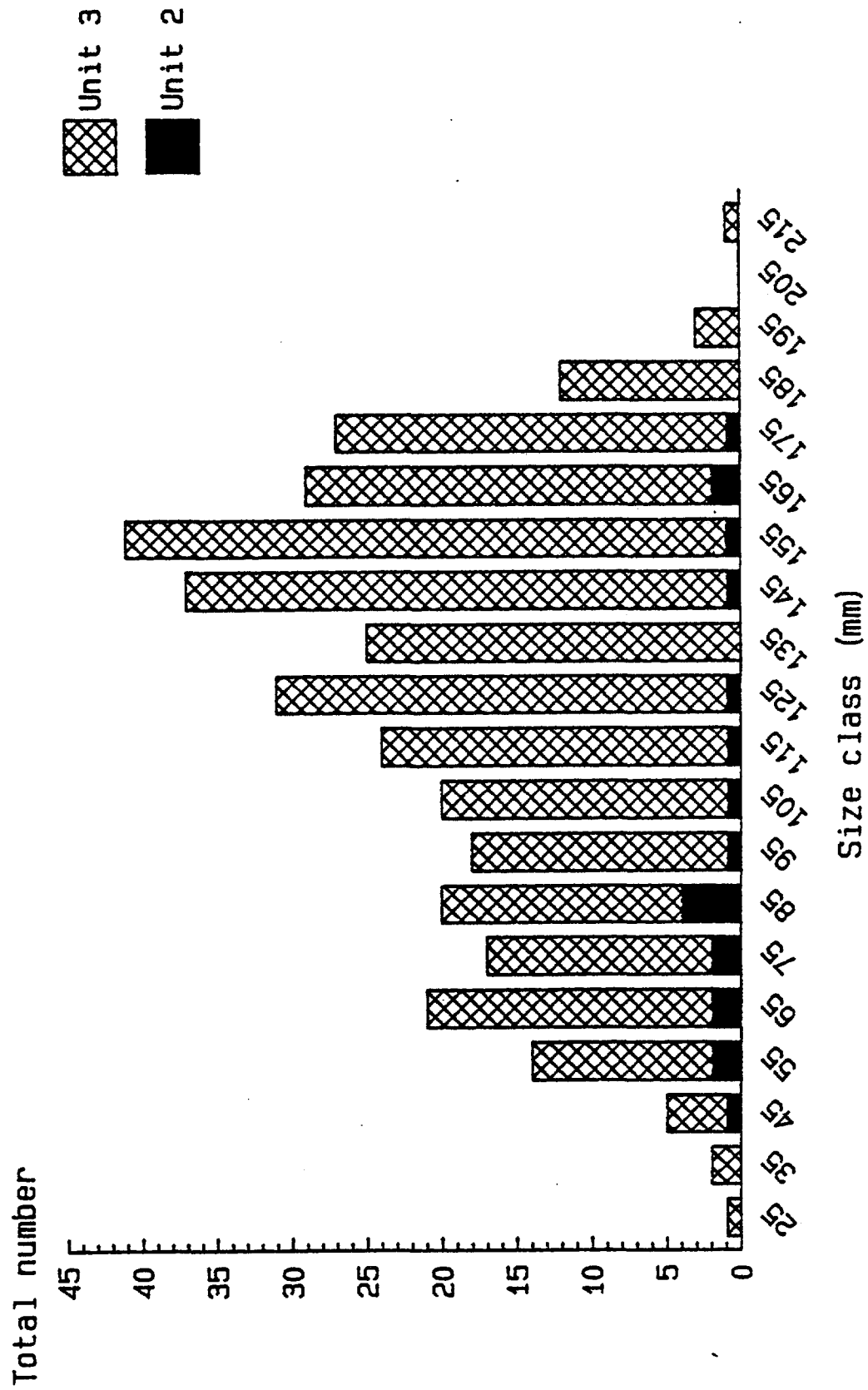

Figure IV-1. Size distribution of blue crabs collected from intake screens at Indian Point Units 2 and 3 during 1984. Size class labels are the midpoint of 10 mm carapace width intervals.

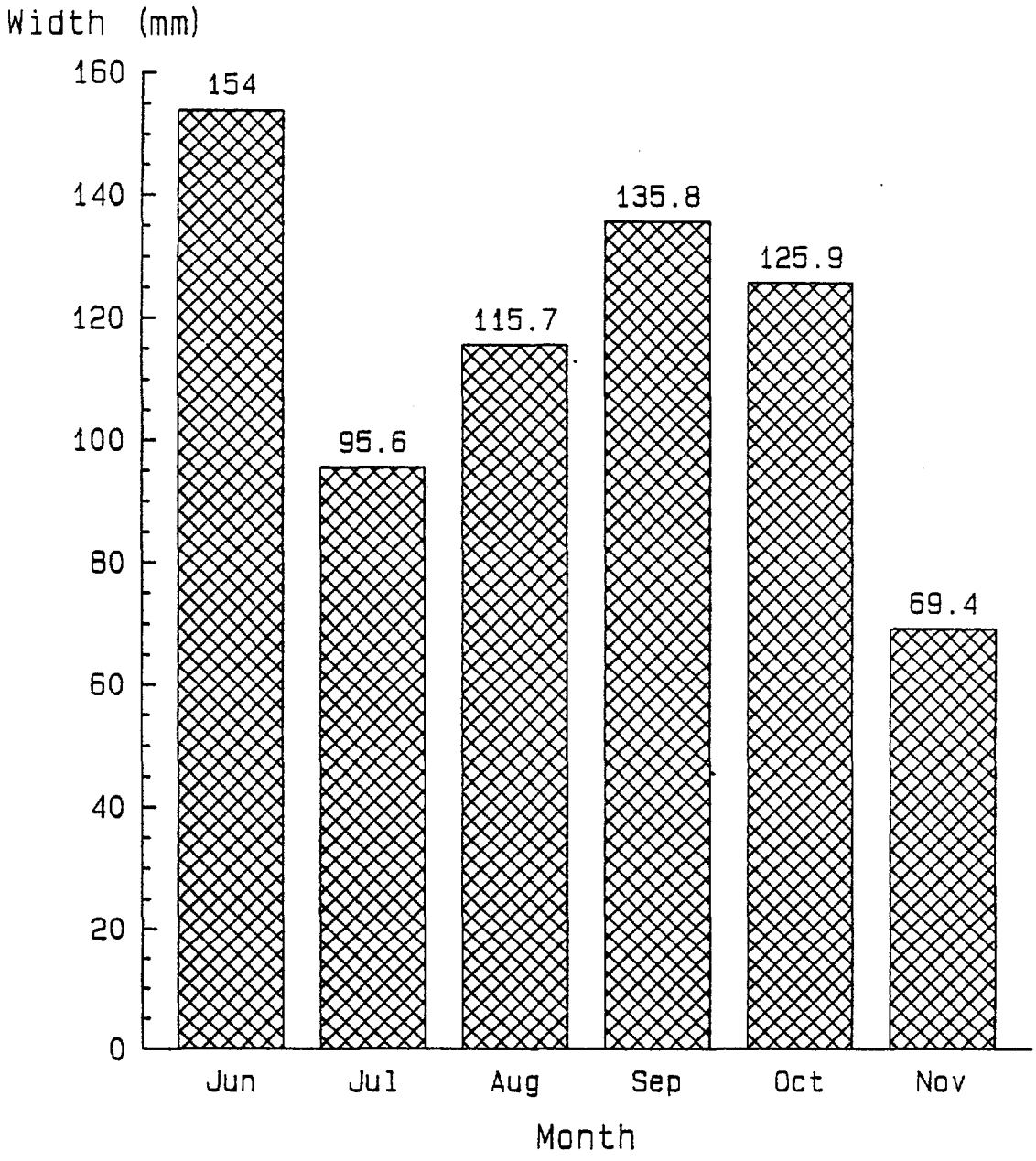

Figure IV-2. Monthly mean carapace width (mm) of blue crabs collected from intake screens at Indian Point Units 2 and 3 during 1984. Values on top of bars are the number of crabs collected in that month.

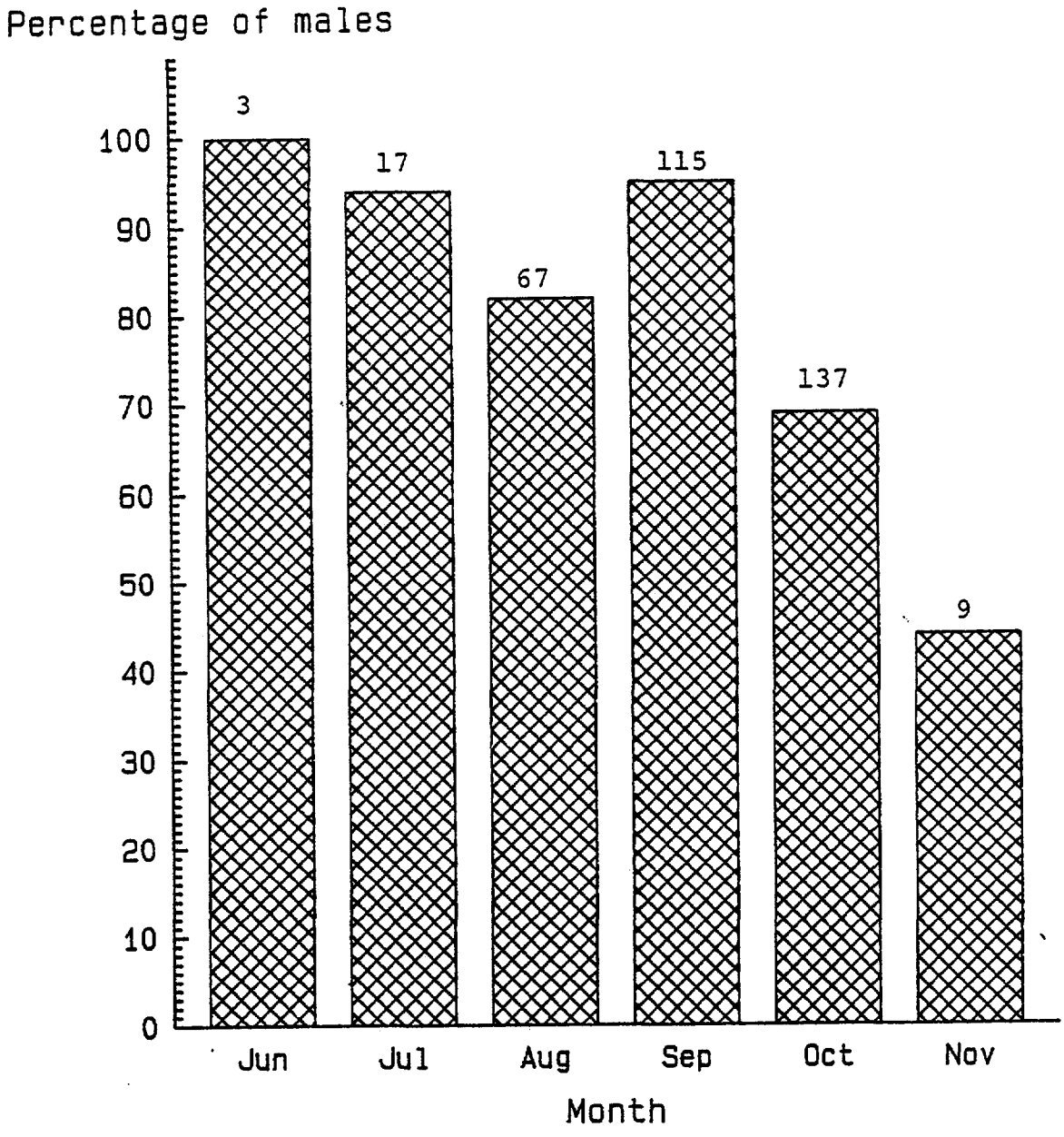

Figure IV-3. Percent of the total number of blue crabs collected from intake screens at Indian Point Units 2 and 3 during 1984 that were males. Values on top of bars are the number of crabs collected in that month.

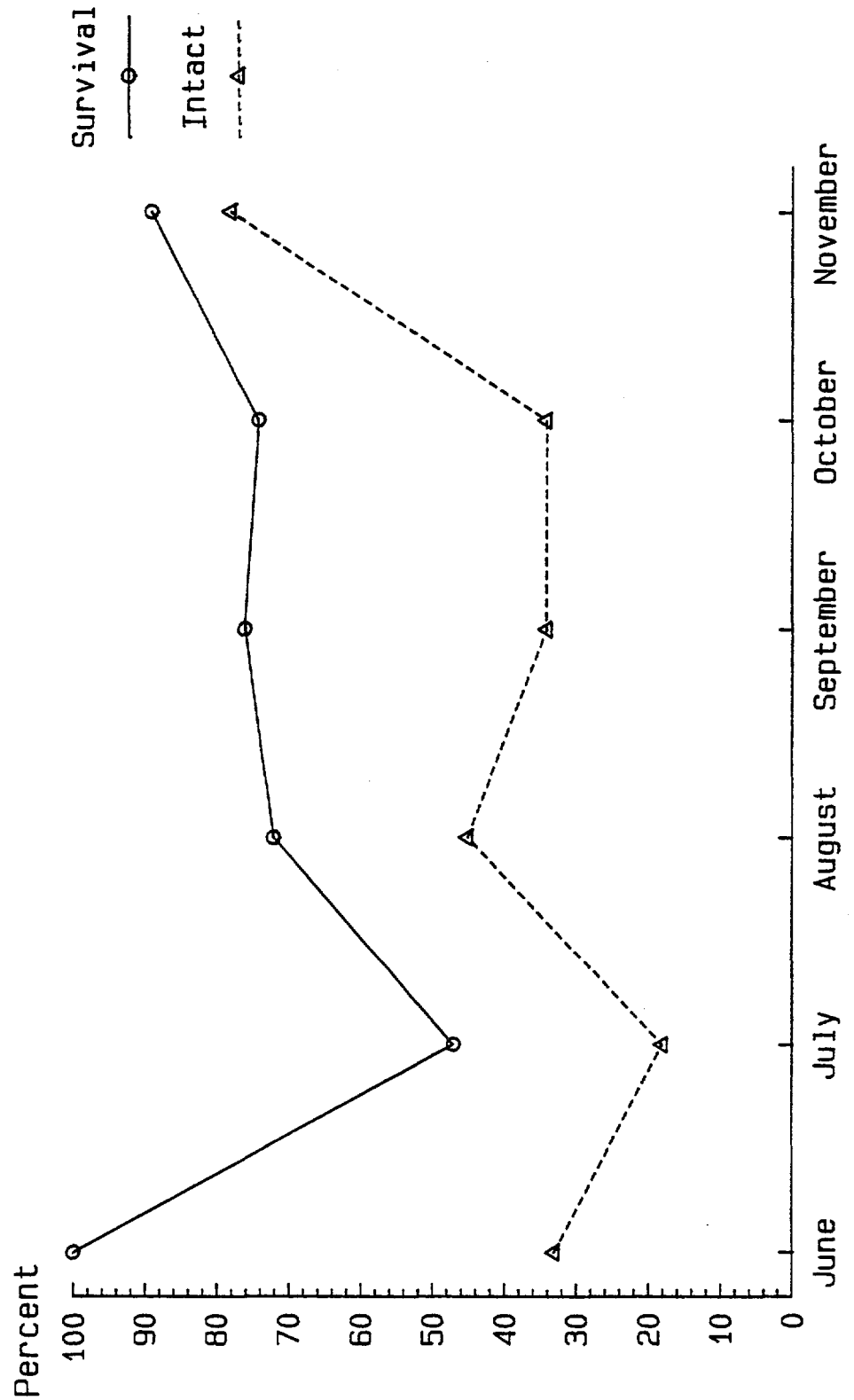

Figure IV-4. Percent of the total number of crabs intact and percent survival of blue crabs collected from intake screens at Indian Point Units 2 and 3 during 1984.

month, except November, were missing appendages or had broken shells. However, more than 70% of the crabs caught in all months, except July, were alive after screen washing. (The number of crabs collected in June and November was low and thus the percentages in these months may be unreliable.) Mean percent survival for each month ranged from 66% to 100% in 1983 and from 47% to 100% in 1984. The range of the mean percentage of crabs intact was 31% to 86% in 1983 and 18% to 78% in 1984 (Appendix D). The percent of blue crabs collected intact and percent survival exhibited similar seasonal patterns and were probably related because the survival of a crab is at least partly a function of its outward condition.

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APPENDIX A

METHODS FOR CALCULATION OF IMPINGEMENT ESTIMATES AND IMPINGEMENT RATES

APPENDIX A

FISH IMPINGEMENT DATA CALCULATIONS

All of the following calculations were done separately for Units 2 and 3. These calculations were made using impingement data for all fish taxa combined and for each species individually.

Adjustment for Collection Efficiency

In order to estimate the number of fish impinged on a sampling day, the number collected on that day was divided by the corresponding collection efficiency (Equation 1).

$$Y_{ijh} = \frac{C_{ijh}}{E_{ijh}} \qquad (1)$$

where i = day in month j (1 to n_{jh})

j = month in stratum h

h = stratum (winter, spring, summer, fall)

n_{jh} = number of sampling days in month j, in stratum h

where Y_{ijh} = number of fish impinged on day i, in month j, in stratum h

C_{ijh} = total count on day i, in month j, in stratum h (unadjusted for collection efficiency)

E_{ijh} = collection efficiency estimate for day i in month j, in stratum h (calculated as shown in Section II-C).

Calculation of Annual Impingement Estimate

To estimate annual impingement the mean impingement for each seasonal stratum ($\bar{Y}_h$) was first calculated using Equation 2.

$$Y_h = \frac{\sum Y_{ijh}}{n_h} \qquad (2)$$

where n_h = number of sampling days in stratum h.

Then the total number of fish impinged over the year was estimated by Equation 3.

$$T = \sum_{h=1}^{4} N_h \bar{Y}_h \qquad (3)$$

where T = total estimated number of fish impinged

N_h = number of days in stratum h that the Unit operated (a unit was considered to be operating if any water, excluding service water, was circulated)

$\bar{Y}_h$ = mean daily estimate for stratum h.

Calculation of Variance for Impingement Estimates

The standard error of the total number of fish impinged is calculated from the within-stratum variances (S_h^2) as a measure of the estimate's precision (Equation 4).

$$S.E.(T) = \sqrt{\sum_{h=1}^{4} \frac{N_h (N_h - n_h) S_h^2}{n_h}} \qquad (4)$$

where S.E.(T) = standard error of the total estimated number of fish impinged

n_h = number of sampling days in stratum h.

The coefficient of variation was calculated to relate the precision to the total estimate using Equation 5.

$$C.V.(T) = \frac{S.E.(T)}{T} \times 100 \qquad (5)$$

where C.V. = coefficient of variation.

Estimation of Weight of Impinged Fish

The total weight of fish impinged for each stratum was estimated using Equation 6.

$$W_h = \frac{w_h}{C_h} T_h \qquad (6)$$

where W_h = total estimated weight of fish impinged in stratum h

w_h = total weight of fish actually collected in stratum h

C_h = total count of fish actually collected in stratum h

T_h = total estimated number of fish impinged in stratum h.

Calculation of Monthly Impingement Rate

Monthly mean impingement rate per unit volume circulated was calculated from the daily adjusted impingement and the daily volume circulated (Equation 7).

$$A_{jh} = \frac{1}{n_{jh}} \sum_{i=1}^{n_{jh}} \frac{Y_{ijh}}{V_{ijh}} \qquad (7)$$

where A_{jh} = mean adjusted impingement rate per unit volume for month j, in stratum h

V_{ijh} = circulating volume on day i, in month j, in stratum h.

APPENDIX B

PHYSICAL DATA

Table B-1. Intake temperature (°C) measured at Indian Point Units 2 and 3 on impingement sampling days during 1984.

DATE	UNIT 2	UNIT 3	MEAN
03JAN84	2.2		2.2
05JAN84	3.9		3.9
09JAN84	2.6		2.6
12JAN84	0.8		0.8
16JAN84	0.8		0.8
18JAN84	2.3		2.3
20JAN84	1.6		1.6
22JAN84	2.6		2.6
23JAN84	2.8		2.8
24JAN84	2.2		2.2
25JAN84	2.0		2.0
28JAN84		1.2	1.2
31JAN84		1.0	1.0
03FEB84	4.7		4.7
04FEB84	4.0		4.0
08FEB84	0.0		0.0
11FEB84	2.0		2.0
12FEB84	2.0		2.0
13FEB84	2.0	3.0	2.5
14FEB84		2.7	2.7
15FEB84		3.5	3.5
21FEB84		2.0	2.0
23FEB84		2.2	2.2
25FEB84		2.6	2.6
27FEB84	2.4	2.8	2.6
28FEB84	2.6	2.5	2.5
03MAR84	4.8	5.0	4.9
05MAR84		5.0	5.0
07MAR84	7.0	7.5	7.3
09MAR84	2.3	2.5	2.4
10MAR84	2.9		2.9
11MAR84	2.8		2.8
13MAR84	3.0	3.0	3.0
14MAR84		4.0	4.0
15MAR84		4.0	4.0
16MAR84	4.0	4.0	4.0
17MAR84		3.9	3.9
18MAR84		4.9	4.9
19MAR84	5.0	5.0	5.0
20MAR84		6.0	6.0
21MAR84	7.0	7.0	7.0
22MAR84	4.0	4.0	4.0
24MAR84		3.7	3.7
25MAR84	3.7	3.7	3.7
30MAR84		5.0	5.0
05APR84	7.0	7.0	7.0
08APR84	8.0	8.0	8.0
10APR84	7.5	7.5	7.5
18APR84		10.0	10.0
29APR84		10.0	10.0
08MAY84		16.0	16.0
10MAY84		15.5	15.5
15MAY84	16.5	16.5	16.5
18MAY84	15.5	15.5	15.5
19MAY84		15.8	15.8
21MAY84		16.0	16.0
25MAY84	17.8		17.8
27MAY84		18.1	18.1
30MAY84	17.8		17.8
31MAY84	16.2		16.2
01JUN84	16.1		16.1
02JUN84	15.2		15.2
03JUN84		17.6	17.6
04JUN84		17.5	17.5
09JUN84		18.5	18.5
10JUN84		18.3	18.3
17JUN84		20.9	20.9
21JUN84		21.2	21.2
02JUL84		27.3	27.3
06JUL84		24.2	24.2
08JUL84		29.3	29.3
09JUL84		29.6	29.6
11JUL84		25.0	25.0
15JUL84		26.6	26.6
22JUL84		26.1	26.1
26JUL84		26.3	26.3
28JUL84		23.3	23.3
31JUL84		25.1	25.1
04AUG84		26.4	26.4
05AUG84		27.6	27.6
06AUG84		26.1	26.1
08AUG84		27.4	27.4
10AUG84		27.0	27.0
16AUG84		26.5	26.5
18AUG84		26.5	26.5
21AUG84		27.3	27.3
22AUG84		26.3	26.3
24AUG84		26.0	26.0
26AUG84		26.5	26.5
28AUG84		25.5	25.5
30AUG84		26.0	26.0
01SEP84		26.0	26.0
03SEP84		25.5	25.5
05SEP84		24.5	24.5
10SEP84		24.0	24.0
13SEP84		23.5	23.5
14SEP84		24.0	24.0
19SEP84		22.0	22.0
21SEP84		22.0	22.0
060CT84		19.0	19.0
080CT84		18.5	18.5
100CT84		20.0	20.0
110CT84	19.0	19.0	19.0
120CT84	19.5		19.5
130CT84	20.0		20.0
140CT84	19.0		19.0
150CT84	18.0	18.0	18.0
160CT84	17.5		17.5
170CT84	18.0		18.0
180CT84	17.0		17.0
190CT84	17.0	17.0	17.0
200CT84	18.0	18.0	18.0
210CT84	17.5	18.5	18.0
220CT84	18.0		18.0
230CT84	17.0		17.0
240CT84	17.5		17.5
250CT84	17.5		17.5
270CT84	17.0		17.0
280CT84	18.0		18.0
290CT84	18.0		18.0
300CT84	17.5		17.5
01NOV84	19.0		19.0
04NOV84	17.5		17.5
07NOV84	15.0		15.0
08NOV84	15.0		15.0
09NOV84	15.0		15.0
11NOV84	15.5		15.5
12NOV84	16.0		16.0
13NOV84	17.0		17.0
18NOV84	14.0		14.0
19NOV84	13.0		13.0
20NOV84	13.0		13.0
21NOV84	13.0		13.0
23NOV84	12.0		12.0
25NOV84	11.5		11.5
27NOV84	12.0	12.0	12.0
28NOV84	11.5	11.5	11.5
29NOV84	11.0	11.0	11.0
30NOV84	11.0	11.0	11.0
01DEC84	10.0	10.0	10.0
02DEC84	10.5	10.5	10.5
03DEC84	10.0	10.0	10.0
04DEC84	10.0	10.0	10.0
05DEC84		10.0	10.0
06DEC84	10.0	10.0	10.0
07DEC84	11.0	11.0	11.0
08DEC84		10.0	10.0
09DEC84		10.0	10.0
10DEC84		10.0	10.0
11DEC84		9.5	9.5
12DEC84	9.0	9.0	9.0
13DEC84	11.0	11.0	11.0
14DEC84	9.0	9.0	9.0
15DEC84	10.0	10.0	10.0
16DEC84		9.5	9.5
17DEC84	9.0	9.0	9.0
19DEC84	9.0		9.0
20DEC84	8.0		8.0
23DEC84		8.5	8.5
26DEC84		8.5	8.5
27DEC84	8.0	8.0	8.0
28DEC84	8.0		8.0
29DEC84	7.5		7.5
30DEC84	8.0	8.0	8.0
31DEC84		7.0	7.0

Table B-2. Intake conductivity (micro Siemens per cm) and salinity (ppt) measured at Indian Point Units 2 and 3 on impingement samplings days during 1984.

	CONDUCTIVITY			SALINITY
DATE	UNIT 2	UNIT 3	MEAN	MEAN
03JAN84	89		89	0.0
05JAN84	90		90	0.0
09JAN84	82		82	0.0
12JAN84	300		300	0.2
16JAN84	450		450	0.3
18JAN84	4600		4600	4.4
20JAN84	4500		4500	4.4
22JAN84	3400		3400	3.2
23JAN84	3200		3200	2.9
24JAN84	2800		2800	2.6
25JAN84	2700		2700	2.5
28JAN84		2200	2200	2.1
31JAN84		1400	1400	1.3
03FEB84	1300		1300	1.1
04FEB84	1510		1510	1.3
08FEB84	10		10	0.0
11FEB84	169		169	0.1
12FEB84	450		450	0.3
13FEB84	1000	1350	1175	1.0
14FEB84		1400	1400	1.2
15FEB84		2200	2200	1.9
21FEB84		110	110	0.0
23FEB84		115	115	0.0
25FEB84		100	100	0.0
27FEB84	211	120	166	0.0
28FEB84	191	210	201	0.1
03MAR84	100	98	99	0.0
05MAR84		108	108	0.0
07MAR84	103	105	104	0.0
09MAR84	93	98	96	0.0
10MAR84	440		440	0.3
11MAR84	460		460	0.3
13MAR84	1100	1100	1100	0.9
14MAR84		1450	1450	1.2
15MAR84		1200	1200	1.0
16MAR84	1400	1400	1400	1.2
17MAR84		1650	1650	1.4
18MAR84		980	980	0.8
19MAR84	1625	1625	1625	1.3
20MAR84		550	550	0.4
21MAR84	335	335	335	0.2
22MAR84	180	180	180	0.1
24MAR84		110	110	0.0
25MAR84	105	105	105	0.0
30MAR84		1275	1275	1.0
05APR84	600	625	613	0.4
08APR84	140	145	143	0.0
10APR84	100	100	100	0.0
18APR84		110	110	0.0
29APR84		190	190	0.1
08MAY84		110	110	0.0
10MAY84		105	105	0.0
15MAY84	115	115	115	0.0
18MAY84	105	105	105	0.0
19MAY84		140	140	0.0
21MAY84		137	137	0.0
25MAY84	140		140	0.0
27MAY84		150	150	0.0
30MAY84	143		143	0.0
31MAY84	130		130	0.0
01JUN84	130		130	0.0
02JUN84	128		128	0.0
03JUN84		135	135	0.0
04JUN84		135	135	0.0
09JUN84		142	142	0.0
10JUN84		148	148	0.0
17JUN84		280	280	0.1
21JUN84		441	441	0.2
02JUL84		1147	1147	0.5
06JUL84		1596	1596	0.8
08JUL84		410	410	0.1
09JUL84		360	360	0.1
11JUL84		336	336	0.1
15JUL84		212	212	0.0
22JUL84		1870	1870	0.9
26JUL84		5830	5830	3.0
28JUL84		6040	6040	3.4
31JUL84		5010	5010	2.7
04AUG84		4970	4970	2.6
05AUG84		4660	4660	2.3
06AUG84		4090	4090	2.1
08AUG84		5560	5560	2.8
10AUG84		6030	6030	3.1
16AUG84		6250	6250	3.3
18AUG84		6250	6250	3.3
21AUG84		6750	6750	3.5
22AUG84		7000	7000	3.7
24AUG84		6500	6500	3.4
26AUG84		7000	7000	3.7
28AUG84		6000	6000	3.2
30AUG84		6000	6000	3.2
01SEP84		6000	6000	3.2
03SEP84		5000	5000	2.6
05SEP84		4500	4500	2.4
10SEP84		5000	5000	2.7
13SEP84		4800	4800	2.6
14SEP84		4900	4900	2.7
19SEP84		4000	4000	2.2
21SEP84		4450	4450	2.5
060CT84		3900	3900	2.3
080CT84		5000	5000	3.1
100CT84		6025	6025	3.6
110CT84	4900	4900	4900	3.0
120CT84	5000		5000	3.0
130CT84	4800		4800	2.9
140CT84	5500		5500	3.4
150CT84	4800	4800	4800	3.0
160CT84	4900		4900	3.1
170CT84	4700		4700	2.9
180CT84	5000		5000	3.2
190CT84	5500	5500	5500	3.5
200CT84	5000	5000	5000	3.1
210CT84	5500	6000	5750	3.6
220CT84	6000		6000	3.8
230CT84	6000		6000	3.9
240CT84	6250		6250	4.0
250CT84	6500		6500	4.2
270CT84	6000		6000	3.9
280CT84	6500		6500	4.1
290CT84	5750		5750	3.6
300CT84	5000		5000	3.2
01NOV84	5250		5250	3.2
04NOV84	4500		4500	2.8
07NOV84	4600		4600	3.1
08NOV84	4950		4950	3.3
09NOV84	5250		5250	3.5
11NOV84	5250		5250	3.5
12NOV84	4900		4900	3.2
13NOV84	4200		4200	2.7
18NOV84	3300		3300	2.2
19NOV84	2700		2700	1.8
20NOV84	2300		2300	1.5
21NOV84	2000		2000	1.3
23NOV84	1900		1900	1.3
25NOV84	1700		1700	1.2
27NOV84	1450	1475	1463	1.0
28NOV84	1800	1800	1800	1.2
29NOV84	1600	1600	1600	1.1
30NOV84	1200	1200	1200	0.8
01DEC84	1300	1300	1300	0.9
02DEC84	1300	1300	1300	0.9
03DEC84	725	725	725	0.5
04DEC84	1900	1900	1900	1.4
05DEC84		1500	1500	1.1
06DEC84	1200	1200	1200	0.8
07DEC84	1300	1300	1300	0.9
08DEC84		1625	1625	1.1
09DEC84		1975	1975	1.4
10DEC84		2200	2200	1.6
11DEC84		1975	1975	1.4
12DEC84	1275	1275	1275	0.9
13DEC84	1600	1600	1600	1.1
14DEC84	700	700	700	0.5
15DEC84	1000	1000	1000	0.7
16DEC84		725	725	0.5
17DEC84	325	325	325	0.2
19DEC84	1000		1000	0.7
20DEC84	750		750	0.5
23DEC84		235	235	0.1
26DEC84		170	170	0.0
27DEC84	160	160	160	0.0
28DEC84	200		200	0.1
29DEC84	190		190	0.1
30DEC84	175	175	175	0.0
31DEC84		225	225	0.1

APPENDIX C

IMPINGEMENT DATA FOR FISH

Table C-1. Actual number of fish collected from intake screens at Indian Point Unit 2 during 1984 (unadjusted for collection efficiency).

COMMON NAME	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
ALEWIFE	8	2	0	1	17	4	0	0	0	393	270	42	737
AMERICAN EEL	1	2	1	0	6	2	0	0	0	7	18	37	74
AMERICAN SHAD	0	0	0	0	0	0	0	0	0	43	15	0	58
ATLANTIC MENHADEN	0	0	0	0	0	0	0	0	0	1	1	0	2
ATLANTIC SILVERSIDE	0	0	0	0	0	0	0	0	0	0	0	1	1
ATLANTIC STURGEON	1	0	1	0	0	0	0	0	0	0	1	0	3
ATLANTIC TOMCOD	31	2	23	3	80	39	0	0	0	45	23	13	259
BANDED KILLIFISH	6	7	4	0	0	0	0	0	0	1	0	1	19
BAY ANCHOVY	3	0	0	0	34	3	0	0	0	398	310	4	752
BLACK CRAPPIE	0	0	0	0	0	0	0	0	0	0	1	0	1
BLUEBACK HERRING	12	3	1	0	1	8	0	0	0	278	437	44	784
BLUEFISH	0	0	0	0	0	0	0	0	0	4	3	0	7
BLUEGILL	0	0	1	1	0	0	0	0	0	33	14	2	51
BROWN BULLHEAD	0	0	1	0	1	0	0	0	0	0	0	0	2
BUTTERFISH	0	0	0	0	0	0	0	0	0	24	6	0	30
CARP	1	0	0	0	0	0	0	0	0	0	0	0	1
CENTRARCHID UNIDENTIFIED	0	0	0	0	0	3	0	0	0	0	0	0	3
CHANNEL CATFISH	0	0	0	0	1	0	0	0	0	0	0	0	1
CREVALLE JACK	0	0	0	0	0	0	0	0	0	3	5	1	9
FOURSPINE STICKLEBACK	0	3	1	0	0	0	0	0	0	0	0	0	4
GIZZARD SHAD	262	8	0	0	0	0	0	0	0	0	0	2	272
GOLDEN SHINER	1	1	4	0	0	0	0	0	0	0	0	0	6
GOLDFISH	5	10	0	0	0	0	0	0	0	1	0	0	16
HOGCHOKER	0	4	2	3	90	1	0	0	0	32	37	18	187
LARGEMOUTH BASS	0	1	0	0	0	0	0	0	0	0	0	0	1
LOOKDOWN	0	0	0	0	0	0	0	0	0	4	1	0	5
MUMMICHOG	0	0	0	0	0	1	0	0	0	0	0	0	1
NORTHERN PIPEFISH	0	0	0	0	0	0	0	0	0	5	22	1	28
PUMPKINSEED	30	50	46	1	7	3	0	0	0	1	3	3	144
RAINBOW SMELT	5	3	17	0	0	0	0	0	0	1	150	39	215
RED HAKE	47	0	0	0	0	0	0	0	0	0	0	0	47
REDBREAST SUNFISH	0	0	0	0	0	0	0	0	0	0	0	1	1
ROCK BASS	0	0	1	0	0	0	0	0	0	0	0	0	1
SHORTNOSE STURGEON	0	0	0	0	1	0	0	0	0	0	0	0	1
SILVER HAKE	10	0	0	0	0	0	0	0	0	0	0	0	10
SMALLMOUTH BASS	0	0	1	0	0	0	0	0	0	0	0	0	1
SPOTTAIL SHINER	75	44	33	6	4	1	0	0	0	0	4	0	167
STRIPED BASS	293	163	70	36	1	0	0	0	0	55	148	99	865
STRIPED SEAROBIN	0	0	0	0	0	0	0	0	0	1	0	0	1
SUMMER FLOUNDER	0	0	1	0	0	0	0	0	0	0	0	0	1
TESSELATED DARTER	0	0	0	1	1	0	0	0	0	0	0	1	3
THREESPINE STICKLEBACK	3	3	7	0	0	0	0	0	0	0	0	0	13
WEAKFISH	0	0	0	0	0	0	0	0	0	200	111	22	333
WHITE CATFISH	136	38	35	6	20	8	0	0	0	17	73	47	380
WHITE PERCH	22321	15329	7368	3350	213	75	0	0	0	128	1204	1837	51825
WHITE SUCKER	0	0	0	0	0	1	0	0	0	0	0	0	1
WINTER FLOUNDER	0	0	1	0	0	0	0	0	0	0	0	0	1
YELLOW PERCH	2	6	12	5	0	0	0	0	0	0	0	0	25
TOTAL ALL TAXA	23253	15679	7631	3413	477	149	0	0	0	1675	2857	2215	57349

Table C-2. Actual number of fish collected from intake screens at Indian Point Unit 3 during 1984 (unadjusted for collection efficiency).

COMMON NAME	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
ALEWIFE	0	3	3	4	118	42	85	262	79	117	28	147	888
AMERICAN EEL	1	12	5	6	40	44	50	16	9	15	5	138	341
AMERICAN SHAD	0	0	0	0	0	11	0	0	18	77	0	12	118
ATLANTIC MENHADEN	0	0	0	0	0	0	2	1	1	0	0	0	4
ATLANTIC NEEDLEFISH	0	0	0	0	0	0	0	0	1	0	0	0	1
ATLANTIC SILVERSIDE	0	0	0	0	0	0	1	0	0	0	0	0	1
ATLANTIC STURGEON	0	0	0	0	0	0	1	3	1	0	0	0	5
ATLANTIC TOMCOD	0	10	6	1	105	1595	8591	5021	159	24	3	113	15628
BANDED KILLIFISH	1	14	6	1	2	2	9	2	0	1	0	0	38
BAY ANCHOVY	0	0	0	0	898	108	6934	8982	948	851	11	6	18738
BLACK CRAPPIE	0	1	0	0	0	0	0	0	0	0	0	0	1
BLUEBACK HERRING	0	3	1	68	130	589	178	193	72	113	25	122	1494
BLUEFISH	0	0	0	0	0	0	472	523	103	39	0	2	1139
BLUEGILL	0	6	8	1	9	2	36	1	4	5	2	4	78
BROWN BULLHEAD	0	11	11	2	4	3	2	0	0	0	0	0	33
BUTTERFISH	0	0	0	0	0	0	5	88	190	69	0	0	352
CARP	0	1	0	0	0	0	0	0	0	1	0	0	2
CENTRARCHID UNIDENTIFIED	0	0	0	0	0	4	37	0	0	0	0	0	41
CHAIN PICKEREL	0	1	0	0	0	0	0	0	0	0	0	0	1
CREVALLE JACK	0	0	0	0	0	0	0	1	1	11	5	0	18
FOURBEARD ROCKLING	0	0	0	0	0	0	0	0	0	0	0	1	1
FOURSPOT FLOUNDER	0	0	0	0	0	0	0	1	0	0	0	0	1
GIZZARD SHAD	3	6	3	1	0	0	0	0	0	0	0	12	25
GOLDEN SHINER	0	21	9	1	0	0	0	0	0	0	0	1	32
GOLDFISH	1	27	11	0	0	0	0	0	0	0	0	2	41
HICKORY SHAD	0	0	0	0	0	0	0	0	0	0	0	1	1
HOGCHOKER	1	0	2	37	706	55	80	206	76	43	3	144	1353
LARGEMOUTH BASS	0	1	0	0	0	0	0	0	0	0	0	0	1
LOOKDOWN	0	0	0	0	0	0	0	0	1	5	0	0	6
MUMMICHOG	0	0	0	0	0	0	1	0	0	0	0	0	1
NORTHERN PIPEFISH	0	0	0	0	2	0	1	0	1	2	1	0	7
PUMPKINSEED	0	280	152	9	17	26	24	5	5	1	2	10	531
RAINBOW SMELT	0	1	43	1	0	2	21	40	3	0	5	63	179
REDBREAST SUNFISH	0	0	1	1	0	0	2	2	2	0	0	2	10
SHORTNOSE STURGEON	0	0	0	0	1	0	0	0	0	0	0	0	1
SILVER HAKE	0	0	0	0	1	0	0	0	0	0	0	0	1
SMALLMOUTH BASS	0	0	1	0	0	0	0	0	0	0	0	0	1
SPOTTAIL SHINER	1	168	105	6	10	12	3	4	0	0	2	2	313
STRIPED BASS	15	208	143	88	45	40	207	125	105	29	20	390	1415
SUMMER FLOUNDER	0	0	0	0	1	0	1	0	0	0	0	0	2
TAUTOG	0	0	0	0	0	0	1	0	0	0	0	0	1
TESSELATED DARTER	0	0	1	0	0	1	2	0	0	0	0	2	6
THREESPINE STICKLEBACK	0	18	20	0	0	0	0	0	0	0	0	0	38
TIDEWATER SILVERSIDE	0	0	0	0	50	0	0	0	0	0	0	0	50
WEAKFISH	0	0	0	0	0	0	0	1494	177	77	43	52	1843
WHITE BASS	0	0	1	0	0	0	0	0	0	0	0	0	1
WHITE CATFISH	6	181	153	52	718	253	74	32	26	17	10	149	1671
WHITE PERCH	1260	10958	11490	6833	2285	2965	2996	1105	531	203	289	8407	49322
WHITE SUCKER	0	0	0	0	0	2	0	0	0	0	0	0	2
WINTER FLOUNDER	0	0	0	0	0	0	0	0	1	0	0	0	1
YELLOW BULLHEAD	0	0	0	0	0	0	3	0	3	1	0	0	7
YELLOW PERCH	0	27	16	3	0	2	2	2	1	0	0	2	55
TOTAL ALL TAXA	1289	11958	12191	7115	5142	5758	19821	18109	2518	1701	454	9784	95840

Table C-3. Actual number of fish collected from intake screens at Indian Point Units 2 and 3 during 1984 (unadjusted for collection efficiency).

COMMON NAME	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
ALEWIFE	8	5	3	5	135	46	85	262	79	510	298	189	1625
AMERICAN EEL	2	14	6	6	46	46	50	16	9	22	23	175	415
AMERICAN SHAD	0	0	0	0	0	11	0	0	18	120	15	12	176
ATLANTIC MENHADEN	0	0	0	0	0	0	2	1	1	1	1	0	6
ATLANTIC NEEDLEFISH	0	0	0	0	0	0	0	0	1	0	0	0	1
ATLANTIC SILVERSIDE	0	0	0	0	0	0	1	0	0	0	0	1	2
ATLANTIC STURGEON	1	0	1	0	0	0	1	3	1	0	1	0	8
ATLANTIC TOMCOD	31	12	29	4	185	1634	8591	5021	159	69	26	126	15887
BANDED KILLIFISH	7	21	10	1	2	2	9	2	0	2	0	1	57
BAY ANCHOVY	3	0	0	0	932	111	6934	8982	948	1249	321	10	19490
BLACK CRAPPIE	0	1	0	0	0	0	0	0	0	0	1	0	2
BLUEBACK HERRING	12	6	2	68	131	597	178	193	72	391	462	166	2278
BLUEFISH	0	0	0	0	0	0	472	523	103	43	3	2	1146
BLUEGILL	0	6	9	2	9	2	36	1	4	38	16	6	129
BROWN BULLHEAD	0	11	12	2	5	3	2	0	0	0	0	0	35
BUTTERFISH	0	0	0	0	0	0	5	88	190	93	6	0	382
CARP	1	1	0	0	0	0	0	0	0	1	0	0	3
CENTRARCHID UNIDENTIFIED	0	0	0	0	0	7	37	0	0	0	0	0	44
CHAIN PICKEREL	0	1	0	0	0	0	0	0	0	0	0	0	1
CHANNEL CATFISH	0	0	0	0	1	0	0	0	0	0	0	0	1
CREVALLE JACK	0	0	0	0	0	0	0	1	1	14	10	1	27
FOURBEARD ROCKLING	0	0	0	0	0	0	0	0	0	0	0	1	1
FOURSPINE STICKLEBACK	0	3	1	0	0	0	0	0	0	0	0	0	4
FOURSPOT FLOUNDER	0	0	0	0	0	0	0	1	0	0	0	0	1
GIZZARD SHAD	265	14	3	1	0	0	0	0	0	0	0	14	297
GOLDEN SHINER	1	22	13	1	0	0	0	0	0	0	0	1	38
GOLDFISH	6	37	11	0	0	0	0	0	0	1	0	2	57
HICKORY SHAD	0	0	0	0	0	0	0	0	0	0	0	1	1
HOGCHOKER	1	4	4	40	796	56	80	206	76	75	40	162	1540
LARGEMOUTH BASS	0	2	0	0	0	0	0	0	0	0	0	0	2
LOOKDOWN	0	0	0	0	0	0	0	0	1	9	1	0	11
MUMMICHOG	0	0	0	0	0	1	1	0	0	0	0	0	2
NORTHERN PIPEFISH	0	0	0	0	2	0	1	0	1	7	23	1	35
PUMPKINSEED	30	330	198	10	24	29	24	5	5	2	5	13	675
RAINBOW SMELT	5	4	60	1	0	2	21	40	3	1	155	102	394
RED HAKE	47	0	0	0	0	0	0	0	0	0	0	0	47
REDBREAST SUNFISH	0	0	1	1	0	0	2	2	2	0	0	3	11
ROCK BASS	0	0	1	0	0	0	0	0	0	0	0	0	1
SHORTNOSE STURGEON	0	0	0	0	2	0	0	0	0	0	0	0	2
SILVER HAKE	10	0	0	0	1	0	0	0	0	0	0	0	11
SMALLMOUTH BASS	0	0	2	0	0	0	0	0	0	0	0	0	2
SPOTTAIL SHINER	76	212	138	12	14	13	3	4	0	0	6	2	480
STRIPED BASS	308	371	213	124	46	40	207	125	105	84	168	489	2280
STRIPED SEAROBIN	0	0	0	0	0	0	0	0	0	1	0	0	1
SUMMER FLOUNDER	0	0	1	0	1	0	1	0	0	0	0	0	3
TAUTOG	0	0	0	0	0	0	1	0	0	0	0	0	1
TESSELATED DARTER	0	0	1	1	1	1	2	0	0	0	0	3	9
THREESPINE STICKLEBACK	3	21	27	0	0	0	0	0	0	0	0	0	51
TIDEWATER SILVERSIDE	0	0	0	0	50	0	0	0	0	0	0	0	50
WEAKFISH	0	0	0	0	0	0	0	1494	177	277	154	74	2176
WHITE BASS	0	0	1	0	0	0	0	0	0	0	0	0	1
WHITE CATFISH	142	219	188	58	738	261	74	32	26	34	83	196	2051
WHITE PERCH	23581	26287	18858	10183	2498	3040	2996	1105	531	331	1493	10244	101147
WHITE SUCKER	0	0	0	0	0	3	0	0	0	0	0	0	3
WINTER FLOUNDER	0	0	1	0	0	0	0	0	1	0	0	0	2
YELLOW BULLHEAD	0	0	0	0	0	0	3	0	3	1	0	0	7
YELLOW PERCH	2	33	28	8	0	2	2	2	1	0	0	2	80
TOTAL ALL TAXA	24542	27637	19822	10528	5619	5907	19821	18109	2518	3376	3311	11999	153189

Table C-4. Total number of fish impinged at Indian Point Unit 2 during 1984 (adjusted for collection efficiency).

COMMON NAME	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
ALEWIFE	16	4	0	2	46	10	0	0	0	1074	678	97	1927
AMERICAN EEL	2	4	2	0	16	5	0	0	0	19	46	84	178
AMERICAN SHAD	0	0	0	0	0	0	0	0	0	117	38	0	155
ATLANTIC MENHADEN	0	0	0	0	0	0	0	0	0	3	3	0	6
ATLANTIC SILVERSIDE	0	0	0	0	0	0	0	0	0	0	0	2	2
ATLANTIC STURGEON	2	0	2	0	0	0	0	0	0	0	2	0	6
ATLANTIC TOMCOD	62	4	48	7	217	101	0	0	0	123	55	30	647
BANDED KILLIFISH	12	14	8	0	0	0	0	0	0	3	0	2	39
BAY ANCHOVY	6	0	0	0	92	8	0	0	0	1088	849	9	2052
BLACK CRAPPIE	0	0	0	0	0	0	0	0	0	0	3	0	3
BLUEBACK HERRING	24	6	2	0	3	21	0	0	0	760	1076	101	1993
BLUEFISH	0	0	0	0	0	0	0	0	0	11	8	0	19
BLUEGILL	0	0	2	2	0	0	0	0	0	90	35	5	134
BROWN BULLHEAD	0	0	2	0	3	0	0	0	0	0	0	0	5
BUTTERFISH	0	0	0	0	0	0	0	0	0	66	16	0	82
CARP	2	0	0	0	0	0	0	0	0	0	0	0	2
CENTRARCHID UNIDENTIFIED	0	0	0	0	0	8	0	0	0	0	0	0	8
CHANNEL CATFISH	0	0	0	0	3	0	0	0	0	0	0	0	3
CREVALLE JACK	0	0	0	0	0	0	0	0	0	8	13	2	23
FOURSPINE STICKLEBACK	0	6	2	0	0	0	0	0	0	0	0	0	8
GIZZARD SHAD	527	17	0	0	0	0	0	0	0	0	0	4	548
GOLDEN SHINER	2	2	8	0	0	0	0	0	0	0	0	0	12
GOLDFISH	10	20	0	0	0	0	0	0	0	3	0	0	33
HOGCHOKER	0	8	4	7	242	3	0	0	0	88	92	42	486
LARGEMOUTH BASS	0	2	0	0	0	0	0	0	0	0	0	0	2
LOOKDOWN	0	0	0	0	0	0	0	0	0	11	3	0	14
MUMMICHOG	0	0	0	0	0	3	0	0	0	0	0	0	3
NORTHERN PIPEFISH	0	0	0	0	0	0	0	0	0	14	56	2	72
PUMPKINSEED	60	99	96	2	19	8	0	0	0	3	8	7	302
RAINBOW SMELT	10	6	36	0	0	0	0	0	0	3	360	90	505
RED HAKE	94	0	0	0	0	0	0	0	0	0	0	0	94
REDBREAST SUNFISH	0	0	0	0	0	0	0	0	0	0	0	2	2
ROCK BASS	0	0	2	0	0	0	0	0	0	0	0	0	2
SHORTNOSE STURGEON	0	0	0	0	3	0	0	0	0	0	0	0	3
SILVER HAKE	20	0	0	0	0	0	0	0	0	0	0	0	20
SMALLMOUTH BASS	0	0	2	0	0	0	0	0	0	0	0	0	2
SPOTTAIL SHINER	150	88	69	13	11	3	0	0	0	0	10	0	344
STRIPED BASS	589	333	147	79	3	0	0	0	0	150	360	226	1887
STRIPED SEAROBIN	0	0	0	0	0	0	0	0	0	3	0	0	3
SUMMER FLOUNDER	0	0	2	0	0	0	0	0	0	0	0	0	2
TESSELATED DARTER	0	0	0	2	3	0	0	0	0	0	0	2	7
THREESPINE STICKLEBACK	6	6	15	0	0	0	0	0	0	0	0	0	27
WEAKFISH	0	0	0	0	0	0	0	0	0	546	276	51	873
WHITE CATFISH	273	77	73	13	54	21	0	0	0	47	175	107	840
WHITE PERCH	44836	31171	15387	7362	568	197	0	0	0	350	2900	4180	106951
WHITE SUCKER	0	0	0	0	0	3	0	0	0	0	0	0	3
WINTER FLOUNDER	0	0	2	0	0	0	0	0	0	0	0	0	2
YELLOW PERCH	4	12	25	11	0	0	0	0	0	0	0	0	52
TOTAL ALL TAXA	46707	31879	15936	7500	1283	391	0	0	0	4580	7062	5045	120383

Table C-5. Total number of fish impinged at Indian Point Unit 3 during 1984 (adjusted for collection efficiency).

COMMON NAME	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
ALEWIFE	0	4	4	6	202	74	166	518	151	208	45	230	1608
AMERICAN EEL	1	17	7	9	68	78	99	32	17	27	8	215	578
AMERICAN SHAD	0	0	0	0	0	19	0	0	34	137	0	19	209
ATLANTIC MENHADEN	0	0	0	0	0	0	4	2	2	0	0	0	8
ATLANTIC NEEDLEFISH	0	0	0	0	0	0	0	0	2	0	0	0	2
ATLANTIC SILVERSIDE	0	0	0	0	0	0	2	0	0	0	0	0	2
ATLANTIC STURGEON	0	0	0	0	0	0	2	6	2	0	0	0	10
ATLANTIC TOMCOD	0	14	9	2	183	2866	16959	9987	307	42	5	175	30549
BANDED KILLIFISH	1	20	9	2	3	4	18	4	0	2	0	0	63
BAY ANCHOVY	0	0	0	0	1566	190	13633	17816	1811	1509	18	9	36552
BLACK CRAPPIE	0	1	0	0	0	0	0	0	0	0	0	0	1
BLUEBACK HERRING	0	4	2	107	222	1038	364	382	139	200	40	191	2679
BLUEFISH	0	0	0	0	0	0	926	1039	196	69	0	3	2233
BLUEGILL	0	9	12	2	15	3	73	2	8	9	3	6	142
BROWN BULLHEAD	0	16	16	3	7	5	4	0	0	0	0	0	51
BUTTERFISH	0	0	0	0	0	0	10	173	359	122	0	0	664
CARP	0	1	0	0	0	0	0	0	0	2	0	0	3
CENTRARCHID UNIDENTIFIED	0	0	0	0	0	7	75	0	0	0	0	0	82
CHAIN PICKEREL	0	1	0	0	0	0	0	0	0	0	0	0	1
CREVALLE JACK	0	0	0	0	0	0	0	2	2	19	8	0	31
FOURBEARD ROCKLING	0	0	0	0	0	0	0	0	0	0	0	2	2
FOURSPOT FLOUNDER	0	0	0	0	0	0	0	2	0	0	0	0	2
GIZZARD SHAD	4	9	5	2	0	0	0	0	0	0	0	19	39
GOLDEN SHINER	0	30	13	2	0	0	0	0	0	0	0	2	47
GOLDFISH	1	39	16	0	0	0	0	0	0	0	0	3	59
HICKORY SHAD	0	0	0	0	0	0	0	0	0	0	0	2	2
HOGCHOKER	1	0	3	58	1197	97	159	406	145	76	5	225	2372
LARGEMOUTH BASS	0	1	0	0	0	0	0	0	0	0	0	0	1
LOOKDOWN	0	0	0	0	0	0	0	0	2	9	0	0	11
MUMMICHOG	0	0	0	0	0	0	2	0	0	0	0	0	2
NORTHERN PIPEFISH	0	0	0	0	3	0	2	0	2	3	2	0	12
PUMPKINSEED	0	403	224	14	29	46	48	10	10	2	3	16	805
RAINBOW SMELT	0	1	63	2	0	4	41	79	6	0	8	98	302
REDBREAST SUNFISH	0	0	1	2	0	0	4	4	4	0	0	3	18
SHORTNOSE STURGEON	0	0	0	0	2	0	0	0	0	0	0	0	2
SILVER HAKE	0	0	0	0	2	0	0	0	0	0	0	0	2
SMALLMOUTH BASS	0	0	2	0	0	0	0	0	0	0	0	0	2
SPOTTAIL SHINER	1	242	155	9	17	21	6	8	0	0	3	3	465
STRIPED BASS	21	300	210	137	77	71	410	247	200	51	32	608	2364
SUMMER FLOUNDER	0	0	0	0	2	0	2	0	0	0	0	0	4
TAUTOG	0	0	0	0	0	0	2	0	0	0	0	0	2
TESSELATED DARTER	0	0	2	0	0	2	4	0	0	0	0	3	11
THREESPINE STICKLEBACK	0	26	30	0	0	0	0	0	0	0	0	0	56
TIDEWATER SILVERSIDE	0	0	0	0	84	0	0	0	0	0	0	0	84
WEAKFISH	0	0	0	0	0	0	0	2967	341	136	69	82	3595
WHITE BASS	0	0	2	0	0	0	0	0	0	0	0	0	2
WHITE CATFISH	8	261	225	81	1235	450	147	63	49	30	16	232	2797
WHITE PERCH	1779	15758	16913	10625	3914	5232	5932	2182	1014	359	460	13098	77266
WHITE SUCKER	0	0	0	0	0	3	0	0	0	0	0	0	3
WINTER FLOUNDER	0	0	0	0	0	0	0	0	2	0	0	0	2
YELLOW BULLHEAD	0	0	0	0	0	0	6	0	6	2	0	0	14
YELLOW PERCH	0	39	24	5	0	4	4	4	2	0	0	3	85
TOTAL ALL TAXA	1817	17196	17947	11068	8828	10214	39094	35935	4813	3014	725	15247	165898

Table C-6. Total number of fish impinged at Indian Point Units 2 and 3 during 1984 (adjusted for collection efficiency).

COMMON NAME	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
ALEWIFE	16	8	4	8	248	84	166	518	151	1282	723	327	3535
AMERICAN EEL	3	21	9	9	84	83	99	32	17	46	54	299	756
AMERICAN SHAD	0	0	0	0	0	19	0	0	34	254	38	19	364
ATLANTIC MENHADEN	0	0	0	0	0	0	4	2	2	3	3	0	14
ATLANTIC NEEDLEFISH	0	0	0	0	0	0	0	0	2	0	0	0	2
ATLANTIC SILVERSIDE	0	0	0	0	0	0	2	0	0	0	0	2	4
ATLANTIC STURGEON	2	0	2	0	0	0	2	6	2	0	2	0	16
ATLANTIC TOMCOD	62	18	57	8	400	2968	16959	9987	307	165	60	205	31196
BANDED KILLIFISH	13	34	17	2	3	4	18	4	0	4	0	2	101
BAY ANCHOVY	6	0	0	0	1658	198	13633	17816	1811	2597	867	19	38605
BLACK CRAPPIE	0	1	0	0	0	0	0	0	0	0	3	0	4
BLUEBACK HERRING	24	10	4	107	225	1059	354	382	139	960	1116	292	4672
BLUEFISH	0	0	0	0	0	0	926	1039	196	80	8	3	2252
BLUEGILL	0	9	14	4	15	3	73	2	8	99	38	11	276
BROWN BULLHEAD	0	16	18	3	10	5	4	0	0	0	0	0	56
BUTTERFISH	0	0	0	0	0	0	10	173	359	187	16	0	745
CARP	2	1	0	0	0	0	0	0	0	2	0	0	5
CENTRARCHID UNIDENTIFIED	0	0	0	0	0	15	75	0	0	0	0	0	90
CHAIN PICKEREL	0	1	0	0	0	0	0	0	0	0	0	0	1
CHANNEL CATFISH	0	0	0	0	3	0	0	0	0	0	0	0	3
CREVALLE JACK	0	0	0	0	0	0	0	2	2	28	20	2	54
FOURBEARD ROCKLING	0	0	0	0	0	0	0	0	0	0	0	2	2
FOURSPINE STICKLEBACK	0	6	2	0	0	0	0	0	0	0	0	0	8
FOURSPOT FLOUNDER	0	0	0	0	0	0	0	2	0	0	0	0	2
GIZZARD SHAD	531	25	5	2	0	0	0	0	0	0	0	23	586
GOLDEN SHINER	2	32	22	2	0	0	0	0	0	0	0	2	60
GOLDFISH	11	59	16	0	0	0	0	0	0	3	0	3	92
HICKORY SHAD	0	0	0	0	0	0	0	0	0	0	0	2	2
HOGCHOKER	1	8	7	65	1439	100	159	406	145	164	97	267	2858
LARGEMOUTH BASS	0	3	0	0	0	0	0	0	0	0	0	0	3
LOOKDOWN	0	0	0	0	0	0	0	0	2	20	3	0	25
MUMMICHOG	0	0	0	0	0	3	2	0	0	0	0	0	5
NORTHERN PIPEFISH	0	0	0	0	3	0	2	0	2	17	58	2	84
PUMPKINSEED	60	502	319	16	48	54	48	10	10	4	11	22	1104
RAINBOW SMELT	10	7	99	2	0	4	41	79	6	3	368	188	807
RED HAKE	94	0	0	0	0	0	0	0	0	0	0	0	94
REDBREAST SUNFISH	0	0	1	2	0	0	4	4	4	0	0	5	20
ROCK BASS	0	0	2	0	0	0	0	0	0	0	0	0	2
SHORTNOSE STURGEON	0	0	0	0	4	0	0	0	0	0	0	0	4
SILVER HAKE	20	0	0	0	2	0	0	0	0	0	0	0	22
SMALLMOUTH BASS	0	0	4	0	0	0	0	0	0	0	0	0	4
SPOTTAIL SHINER	151	330	224	23	28	24	6	8	0	0	13	3	810
STRIPED BASS	610	633	357	216	79	71	410	247	200	201	391	834	4249
STRIPED SEAROBIN	0	0	0	0	0	0	0	0	0	3	0	0	3
SUMMER FLOUNDER	0	0	2	0	2	0	2	0	0	0	0	0	6
TAUTOG	0	0	0	0	0	0	2	0	0	0	0	0	2
TESSELATED DARTER	0	0	2	2	3	2	4	0	0	0	0	5	18
THREESPINE STICKLEBACK	6	32	44	0	0	0	0	0	0	0	0	0	82
TIDEWATER SILVERSIDE	0	0	0	0	84	0	0	0	0	0	0	0	84
WEAKFISH	0	0	0	0	0	0	0	2967	341	682	345	133	4468
WHITE BASS	0	0	2	0	0	0	0	0	0	0	0	0	2
WHITE CATFISH	282	338	298	94	1289	471	147	63	49	77	191	340	3639
WHITE PERCH	46615	46929	32300	17988	4482	5429	5932	2182	1014	709	3361	17279	184220
WHITE SUCKER	0	0	0	0	0	6	0	0	0	0	0	0	6
WINTER FLOUNDER	0	0	2	0	0	0	0	0	2	0	0	0	4
YELLOW BULLHEAD	0	0	0	0	0	0	6	0	6	2	0	0	14
YELLOW PERCH	4	51	49	16	0	4	4	4	2	0	0	3	137
TOTAL ALL TAXA	48525	49074	33882	18569	10109	10606	39094	35935	4813	7592	7786	20294	286279

Table C-7. Mean monthly number of fish impinged per million cubic meters of intake water (sampling volume) at Indian Point Unit 2 during 1984 (adjusted for collection efficiency).

COMMON NAME	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
ALEWIFE	0	0	0	0	6	3	4	9	4	7	12	5
AMERICAN EEL	1	1	0	1	2	3	2	1	0	2	1	4
AMERICAN SHAD	0	0	0	0	0	1	0	0	1	4	0	0
ATLANTIC MENHADEN	0	0	0	0	0	0	0	0	0	0	0	0
ATLANTIC NEEDLEFISH	0	0	0	0	0	0	0	0	0	0	0	0
ATLANTIC SILVERSIDE	0	0	0	0	0	0	0	0	0	0	0	0
ATLANTIC STURGEON	0	0	0	0	0	0	0	0	0	0	0	0
ATLANTIC TOMCOD	0	1	0	0	6	107	376	176	9	1	1	4
BANDED KILLIFISH	1	1	0	0	0	0	0	0	0	0	0	0
BAY ANCHOVY	0	0	0	0	50	7	316	332	51	42	4	0
BLACK CRAPPIE	0	0	0	0	0	0	0	0	0	0	0	0
BLUEBACK HERRING	0	0	0	7	7	38	8	8	4	6	11	4
BLUEFISH	0	0	0	0	0	0	21	19	5	2	0	0
BLUEGILL	0	0	0	0	1	0	2	0	0	0	0	0
BROWN BULLHEAD	0	1	0	0	0	0	0	0	0	0	0	0
BUTTERFISH	0	0	0	0	0	0	0	4	10	4	0	0
CARP	0	0	0	0	0	0	0	0	0	0	0	0
CENTRARCHID UNIDENTIFIED	0	0	0	0	0	0	2	0	0	0	0	0
CHAIN PICKEREL	0	0	0	0	0	0	0	0	0	0	0	0
CREVALLE JACK	0	0	0	0	0	0	0	0	0	1	1	0
FOURBEARD ROCKLING	0	0	0	0	0	0	0	0	0	0	0	0
FOURSPOT FLOUNDER	0	0	0	0	0	0	0	0	0	0	0	0
GIZZARD SHAD	2	1	0	0	0	0	0	0	0	0	0	0
GOLDEN SHINER	0	1	0	0	0	0	0	0	0	0	0	0
GOLDFISH	1	2	0	0	0	0	0	0	0	0	0	0
HICKORY SHAD	0	0	0	0	0	0	0	0	0	0	0	0
HOGCHOKER	1	0	0	4	44	4	4	11	4	2	1	5
LARGEMOUTH BASS	0	0	0	0	0	0	0	0	0	0	0	0
LOOKDOWN	0	0	0	0	0	0	0	0	0	0	0	0
MUMMICHOG	0	0	0	0	0	0	0	0	0	0	0	0
NORTHERN PIPEFISH	0	0	0	0	0	0	0	0	0	0	0	0
PUMPKINSEED	0	22	5	1	1	2	1	0	0	0	0	0
RAINBOW SMELT	0	0	1	0	0	0	1	1	0	0	2	2
REDBREAST SUNFISH	0	0	0	0	0	0	0	0	0	0	0	0
SHORTNOSE STURGEON	0	0	0	0	0	0	0	0	0	0	0	0
SILVER HAKE	0	0	0	0	0	0	0	0	0	0	0	0
SMALLMOUTH BASS	0	0	0	0	0	0	0	0	0	0	0	0
SPOTTAIL SHINER	1	13	3	1	1	1	0	0	0	0	1	0
STRIPED BASS	8	19	4	10	3	3	8	6	8	2	5	12
SUMMER FLOUNDER	0	0	0	0	0	0	0	0	0	0	0	0
TAUTOG	0	0	0	0	0	0	0	0	0	0	0	0
TESSELATED DARTER	0	0	0	0	0	0	0	0	0	0	0	0
THREESPINE STICKLEBACK	0	1	1	0	0	0	0	0	0	0	0	0
TIDEWATER SILVERSIDE	0	0	0	0	3	0	0	0	0	0	0	0
WEAKFISH	0	0	0	0	0	0	0	55	10	4	14	2
WHITE BASS	0	0	0	0	0	0	0	0	0	0	0	0
WHITE CATFISH	3	15	5	6	41	17	3	1	1	1	2	5
WHITE PERCH	683	818	365	759	131	192	132	49	28	10	77	264
WHITE SUCKER	0	0	0	0	0	0	0	0	0	0	0	0
WINTER FLOUNDER	0	0	0	0	0	0	0	0	0	0	0	0
YELLOW BULLHEAD	0	0	0	0	0	0	0	0	0	0	0	0
YELLOW PERCH	0	2	1	0	0	0	0	0	0	0	0	0
TOTAL ALL TAXA	701	898	385	789	296	378	881	672	133	88	132	307

Table C-8. Mean monthly number of fish impinged per million cubic meters of intake water (sampling volume) at Indian Point Unit 3 during 1984 (adjusted for collection efficiency).

COMMON NAME	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
ALEWIFE	1	0	0	0	3	1	0	0	0	22	17	3
AMERICAN EEL	0	0	0	0	1	1	0	0	0	0	1	3
AMERICAN SHAD	0	0	0	0	0	0	0	0	0	2	1	0
ATLANTIC MENHADEN	0	0	0	0	0	0	0	0	0	0	0	0
ATLANTIC SILVERSIDE	0	0	0	0	0	0	0	0	0	0	0	0
ATLANTIC STURGEON	0	0	0	0	0	0	0	0	0	0	0	0
ATLANTIC TOMCOD	2	0	2	1	12	12	0	0	0	3	1	1
BANDED KILLIFISH	0	1	0	0	0	0	0	0	0	0	0	0
BAY ANCHOVY	0	0	0	0	5	1	0	0	0	25	24	0
BLACK CRAPPIE	0	0	0	0	0	0	0	0	0	0	0	0
BLUEBACK HERRING	1	0	0	0	0	2	0	0	0	15	27	3
BLUEFISH	0	0	0	0	0	0	0	0	0	0	0	0
BLUEGILL	0	0	0	0	0	0	0	0	0	2	1	0
BROWN BULLHEAD	0	0	0	0	0	0	0	0	0	0	0	0
BUTTERFISH	0	0	0	0	0	0	0	0	0	2	0	0
CARP	0	0	0	0	0	0	0	0	0	0	0	0
CENTRARCHID UNIDENTIFIED	0	0	0	0	0	1	0	0	0	0	0	0
CHANNEL CATFISH	0	0	0	0	0	0	0	0	0	0	0	0
CREVALLE JACK	0	0	0	0	0	0	0	0	0	0	0	0
FOURSPINE STICKLEBACK	0	0	0	0	0	0	0	0	0	0	0	0
GIZZARD SHAD	19	1	0	0	0	0	0	0	0	0	0	0
GOLDEN SHINER	0	0	0	0	0	0	0	0	0	0	0	0
GOLDFISH	0	1	0	0	0	0	0	0	0	0	0	0
HOGCHOKER	0	0	0	1	14	0	0	0	0	2	2	1
LARGEMOUTH BASS	0	0	0	0	0	0	0	0	0	0	0	0
LOOKDOWN	0	0	0	0	0	0	0	0	0	0	0	0
MUMMICHOG	0	0	0	0	0	0	0	0	0	0	0	0
NORTHERN PIPEFISH	0	0	0	0	0	0	0	0	0	0	2	0
PUMPKINSEED	2	6	3	0	1	1	0	0	0	0	0	0
RAINBOW SMELT	0	0	1	0	0	0	0	0	0	0	8	2
RED HAKE	4	0	0	0	0	0	0	0	0	0	0	0
REDBREAST SUNFISH	0	0	0	0	0	0	0	0	0	0	0	0
ROCK BASS	0	0	0	0	0	0	0	0	0	0	0	0
SHORTNOSE STURGEON	0	0	0	0	0	0	0	0	0	0	0	0
SILVER HAKE	1	0	0	0	0	0	0	0	0	0	0	0
SMALLMOUTH BASS	0	0	0	0	0	0	0	0	0	0	0	0
SPOTTAIL SHINER	5	6	2	2	1	0	0	0	0	0	0	0
STRIPED BASS	21	21	5	10	0	0	0	0	0	3	9	9
STRIPED SEAROBIN	0	0	0	0	0	0	0	0	0	0	0	0
SUMMER FLOUNDER	0	0	0	0	0	0	0	0	0	0	0	0
TESSELATED DARTER	0	0	0	0	0	0	0	0	0	0	0	0
THREESPINE STICKLEBACK	0	0	0	0	0	0	0	0	0	0	0	0
WEAKFISH	0	0	0	0	0	0	0	0	0	11	7	1
WHITE CATFISH	10	4	2	2	3	2	0	0	0	1	4	4
WHITE PERCH	1599	1979	514	923	32	23	0	0	0	7	68	153
WHITE SUCKER	0	0	0	0	0	0	0	0	0	0	0	0
WINTER FLOUNDER	0	0	0	0	0	0	0	0	0	0	0	0
YELLOW PERCH	0	1	1	1	0	0	0	0	0	0	0	0
TOTAL ALL TAXA	1665	2020	530	940	72	44	0	0	0	95	172	180

Table C-9. Total weight (grams) of fish collected at Indian Point Unit 2 during 1984 (unadjusted for collection efficiency).

COMMON NAME	WINTER	SPRING	SUMMER	FALL	TOTAL
ALEWIFE	127	3523	0	2250	5900
AMERICAN EEL	625	784	0	8033	9442
AMERICAN SHAD	0	0	0	559	559
ATLANTIC MENHADEN	0	0	0	474	474
ATLANTIC SILVERSIDE	0	0	0	1	1
ATLANTIC STURGEON	916	0	0	27	943
ATLANTIC TOMCOD	1485	210	0	1680	3375
BANDED KILLIFISH	112	0	0	18	130
BAY ANCHOVY	5	91	0	1066	1162
BLACK CRAPPIE	0	0	0	2	2
BLUEBACK HERRING	58	1010	0	2126	3194
BLUEFISH	0	0	0	376	376
BLUEGILL	37	70	0	275	382
BROWN BULLHEAD	118	21	0	0	139
BUTTERFISH	0	0	0	936	936
CARP	88	0	0	0	88
CENTRARCHID UNIDENTIFIED	0	4	0	0	4
CHANNEL CATFISH	0	22	0	0	22
CREVALLE JACK	0	0	0	310	310
FOURSPINE STICKLEBACK	7	0	0	0	7
GIZZARD SHAD	7538	0	0	4	7542
GOLDEN SHINER	203	0	0	0	203
GOLDFISH	170	0	0	954	1124
HOGCHOKER	40	1433	0	1630	3103
LARGEMOUTH BASS	14	0	0	0	14
LOOKDOWN	0	0	0	39	39
MUMMICHOG	0	7	0	0	7
NORTHERN PIPEFISH	0	0	0	52	52
PUMPKINSEED	7676	598	0	212	8486
RAINBOW SMELT	447	0	0	217	664
RED HAKE	762	0	0	0	762
REDBREAST SUNFISH	0	0	0	76	76
ROCK BASS	42	0	0	0	42
SHORTNOSE STURGEON	0	673	0	0	673
SILVER HAKE	126	0	0	0	126
SMALLMOUTH BASS	139	0	0	0	139
SPOTTAIL SHINER	900	41	0	24	965
STRIPED BASS	4787	235	0	1707	6729
STRIPED SEAROBIN	0	0	0	24	24
SUMMER FLOUNDER	26	0	0	0	26
TESSELATED DARTER	0	10	0	11	21
THREESPINE STICKLEBACK	30	0	0	0	30
WEAKFISH	0	0	0	3009	3009
WHITE CATFISH	4239	1909	0	7211	13359
WHITE PERCH	448765	60377	0	23133	532275
WHITE SUCKER	0	696	0	0	696
WINTER FLOUNDER	33	0	0	0	33
YELLOW PERCH	1193	155	0	0	1348
TOTAL ALL TAXA	480708	71869	0	56436	609013

Table C-10. Total weight (grams) of fish collected at Indian Point Unit 3 during 1984 (unadjusted for collection efficiency).

COMMON NAME	WINTER	SPRING	SUMMER	FALL	TOTAL
ALEWIFE	186	17049	6970	1326	25531
AMERICAN EEL	3766	9050	10859	23280	46955
AMERICAN SHAD	0	2748	375	605	3728
ATLANTIC MENHADEN	0	0	237	0	237
ATLANTIC NEEDLEFISH	0	0	130	0	130
ATLANTIC SILVERSIDE	0	0	8	0	8
ATLANTIC STURGEON	0	0	1023	0	1023
ATLANTIC TOMCOD	407	3651	38548	3850	46456
BANDED KILLIFISH	160	38	67	7	272
BAY ANCHOVY	0	2797	52654	2475	57926
BLACK CRAPPIE	11	0	0	0	11
BLUEBACK HERRING	9	100295	7503	771	108578
BLUEFISH	0	0	12840	1940	14780
BLUEGILL	1248	955	941	346	3490
BROWN BULLHEAD	2507	1088	22	0	3617
BUTTERFISH	0	0	8636	2614	11250
CARP	54	0	0	4	58
CENTRARCHID UNIDENTIFIED	0	10	94	0	104
CHAIN PICKEREL	274	0	0	0	274
CREVALLE JACK	0	0	17	543	560
FOURBEARD ROCKLING	0	0	0	55	55
FOURSPOT FLOUNDER	0	0	27	0	27
GIZZARD SHAD	425	36	0	68	529
GOLDEN SHINER	1779	76	0	114	1969
GOLDFISH	2651	0	0	276	2927
HICKORY SHAD	0	0	0	5	5
HOGCHOKER	45	15731	6963	2907	25646
LARGEMOUTH BASS	51	0	0	0	51
LOOKDOWN	0	0	18	67	85
MUMMICHOG	0	0	4	0	4
NORTHERN PIPEFISH	0	4	4	6	14
PUMPKINSEED	29616	2817	2015	771	35219
RAINBOW SMELT	838	27	320	122	1307
REDBREAST SUNFISH	82	73	454	148	757
SHORTNOSE STURGEON	0	598	0	0	598
SILVER HAKE	0	64	0	0	64
SMALLMOUTH BASS	231	0	0	0	231
SPOTTAIL SHINER	1643	247	54	35	1979
STRIPED BASS	6331	8037	4098	2944	21410
SUMMER FLOUNDER	0	17	53	0	70
TAUTOG	0	0	146	0	146
TESSELATED DARTER	5	4	23	6	38
THREESPINE STICKLEBACK	109	0	0	0	109
TIDEWATER SILVERSIDE	0	968	0	0	968
WEAKFISH	0	0	1548	1384	2932
WHITE BASS	571	0	0	0	571
WHITE CATFISH	7674	13474	10391	7657	39196
WHITE PERCH	248507	159842	121588	55433	585370
WHITE SUCKER	0	1161	0	0	1161
WINTER FLOUNDER	0	0	82	0	82
YELLOW BULLHEAD	0	0	202	36	238
YELLOW PERCH	3900	306	328	119	4653
TOTAL ALL TAXA	313080	341163	289242	109914	1053399

Table C-11. Total weight (grams) of fish collected at Indian Point Units 2 and 3 during 1984 (unadjusted for collection efficiency).

COMMON NAME	WINTER	SPRING	SUMMER	FALL	TOTAL
ALEWIFE	313	20572	6970	3576	31431
AMERICAN EEL	4391	9834	10859	31313	56397
AMERICAN SHAD	0	2748	375	1164	4287
ATLANTIC MENHADEN	0	0	237	474	711
ATLANTIC NEEDLEFISH	0	0	130	0	130
ATLANTIC SILVERSIDE	0	0	8	1	9
ATLANTIC STURGEON	916	0	1023	27	1966
ATLANTIC TOMCOD	1892	3861	38548	5530	49831
BANDED KILLIFISH	272	38	67	25	402
BAY ANCHOVY	5	2888	52654	3541	59088
BLACK CRAPPIE	11	0	0	2	13
BLUEBACK HERRING	67	101305	7503	2897	111772
BLUEFISH	0	0	12840	2316	15156
BLUEGILL	1285	1025	941	621	3872
BROWN BULLHEAD	2625	1109	22	0	3756
BUTTERFISH	0	0	8636	3550	12186
CARP	142	0	0	4	146
CENTRARCHID UNIDENTIFIED	0	14	94	0	108
CHAIN PICKEREL	274	0	0	0	274
CHANNEL CATFISH	0	22	0	0	22
CREVALLE JACK	0	0	17	853	870
FOURBEARD ROCKLING	0	0	0	55	55
FOURSPINE STICKLEBACK	7	0	0	0	7
FOURSPOT FLOUNDER	0	0	27	0	27
GIZZARD SHAD	7963	36	0	72	8071
GOLDEN SHINER	1982	76	0	114	2172
GOLDFISH	2821	0	0	1230	4051
HICKORY SHAD	0	0	0	5	5
HOGCHOKER	85	17164	6963	4537	28749
LARGEMOUTH BASS	65	0	0	0	65
LOOKDOWN	0	0	18	106	124
MUMMICHOG	0	7	4	0	11
NORTHERN PIPEFISH	0	4	4	58	66
PUMPKINSEED	37292	3415	2015	983	43705
RAINBOW SMELT	1285	27	320	339	1971
RED HAKE	762	0	0	0	762
REDBREAST SUNFISH	82	73	454	224	833
ROCK BASS	42	0	0	0	42
SHORTNOSE STURGEON	0	1271	0	0	1271
SILVER HAKE	126	64	0	0	190
SMALLMOUTH BASS	370	0	0	0	370
SPOTTAIL SHINER	2543	288	54	59	2944
STRIPED BASS	11118	8272	4098	4651	28139
STRIPED SEAROBIN	0	0	0	24	24
SUMMER FLOUNDER	26	17	53	0	96
TAUTOG	0	0	146	0	146
TESSELATED DARTER	5	14	23	17	59
THREESPINE STICKLEBACK	139	0	0	0	139
TIDEWATER SILVERSIDE	0	968	0	0	968
WEAKFISH	0	0	1548	4393	5941
WHITE BASS	571	0	0	0	571
WHITE CATFISH	11913	15383	10391	14868	52555
WHITE PERCH	697272	220219	121588	78566	1117645
WHITE SUCKER	0	1857	0	0	1857
WINTER FLOUNDER	33	0	82	0	115
YELLOW BULLHEAD	0	0	202	36	238
YELLOW PERCH	5093	461	328	119	6001
TOTAL ALL TAXA	793788	413032	289242	166350	1662412

Table C-12. Estimated total weight (grams) of fish impinged at Indian Point Unit 2 during 1984 (adjusted for collection efficiency and scaled up for all operating days).

COMMON NAME	WINTER	SPRING	SUMMER	FALL	TOTAL
ALEWIFE	688	60639	0	9181	70508
AMERICAN EEL	3459	13271	0	30148	46878
AMERICAN SHAD	0	0	0	2332	2332
ATLANTIC MENHADEN	0	0	0	1957	1957
ATLANTIC SILVERSIDE	0	0	0	4	4
ATLANTIC STURGEON	5024	0	0	99	5123
ATLANTIC TOMCOD	8147	3578	0	6698	18423
BANDED KILLIFISH	610	0	0	71	681
BAY ANCHOVY	27	1574	0	4534	6135
BLACK CRAPPIE	0	0	0	8	8
BLUEBACK HERRING	315	16794	0	8443	25552
BLUEFISH	0	0	0	1601	1601
BLUEGILL	218	998	0	1133	2349
BROWN BULLHEAD	696	370	0	0	1066
BUTTERFISH	0	0	0	3953	3953
CARP	471	0	0	0	471
CENTRARCHID UNIDENTIFIED	0	67	0	0	67
CHANNEL CATFISH	0	387	0	0	387
CREVALLE JACK	0	0	0	1241	1241
FOURSPINE STICKLEBACK	37	0	0	0	37
GIZZARD SHAD	40962	0	0	14	40976
GOLDEN SHINER	1126	0	0	0	1126
GOLDFISH	918	0	0	4203	5121
HOGCHOKER	227	24491	0	6443	31161
LARGEMOUTH BASS	75	0	0	0	75
LOOKDOWN	0	0	0	167	167
MUMMICHOG	0	118	0	0	118
NORTHERN PIPEFISH	0	0	0	208	208
PUMPKINSEED	41854	10046	0	803	52703
RAINBOW SMELT	2493	0	0	804	3297
RED HAKE	4095	0	0	0	4095
REDBREAST SUNFISH	0	0	0	263	263
ROCK BASS	234	0	0	0	234
SHORTNOSE STURGEON	0	11848	0	0	11848
SILVER HAKE	676	0	0	0	676
SMALLMOUTH BASS	776	0	0	0	776
SPOTTAIL SHINER	4914	634	0	92	5640
STRIPED BASS	26256	3311	0	6468	36035
STRIPED SEAROBIN	0	0	0	102	102
SUMMER FLOUNDER	145	0	0	0	145
TESSELATED DARTER	0	156	0	39	195
THREESPINE STICKLEBACK	165	0	0	0	165
WEAKFISH	0	0	0	12275	12275
WHITE CATFISH	23176	31547	0	26924	81647
WHITE PERCH	2459864	863252	0	84374	3407490
WHITE SUCKER	0	11773	0	0	11773
WINTER FLOUNDER	184	0	0	0	184
YELLOW PERCH	6616	2189	0	0	8805
TOTAL ALL TAXA	2634448	1057043	0	214582	3906073

Table C-13. Estimated total weight (grams) of fish impinged at Indian Point Unit 3 during 1984 (adjusted for collection efficiency and scaled up for all operating days).

COMMON NAME	WINTER	SPRING	SUMMER	FALL	TOTAL
ALEWIFE	656	148105	40496	3679	192936
AMERICAN EEL	13322	78878	63401	61572	217173
AMERICAN SHAD	0	24370	2102	1771	28243
ATLANTIC MENHADEN	0	0	1362	0	1362
ATLANTIC NEEDLEFISH	0	0	750	0	750
ATLANTIC SILVERSIDE	0	0	47	0	47
ATLANTIC STURGEON	0	0	5923	0	5923
ATLANTIC TOMCOD	1452	33105	226402	10256	271215
BANDED KILLIFISH	567	331	400	21	1319
BAY ANCHOVY	0	24683	308188	7341	340212
BLACK CRAPPIE	38	0	0	0	38
BLUEBACK HERRING	32	880877	43951	2142	927002
BLUEFISH	0	0	74983	5733	80716
BLUEGILL	4447	8179	5629	965	19220
BROWN BULLHEAD	8917	9385	132	0	18434
BUTTERFISH	0	0	49055	7735	56790
CARP	188	0	0	12	200
CENTRARCHID UNIDENTIFIED	0	88	567	0	655
CHAIN PICKEREL	963	0	0	0	963
CREVALLE JACK	0	0	96	1561	1657
FOURBEARD ROCKLING	0	0	0	144	144
FOURSPOT FLOUNDER	0	0	158	0	158
GIZZARD SHAD	1508	277	0	176	1961
GOLDEN SHINER	6291	585	0	300	7176
GOLDFISH	9390	0	0	713	10103
HICKORY SHAD	0	0	0	13	13
HOGCHOKER	160	134803	40556	7844	183363
LARGEMOUTH BASS	178	0	0	0	178
LOOKDOWN	0	0	101	199	300
MUMMICHOG	0	0	25	0	25
NORTHERN PIPEFISH	0	35	24	17	76
PUMPKINSEED	104983	24248	11798	2038	143067
RAINBOW SMELT	3017	237	1871	320	5445
REDBREAST SUNFISH	296	562	2657	388	3903
SHORTNOSE STURGEON	0	5113	0	0	5113
SILVER HAKE	0	565	0	0	565
SMALLMOUTH BASS	859	0	0	0	859
SPOTTAIL SHINER	5833	2107	320	92	8352
STRIPED BASS	22490	66935	23840	7770	121035
SUMMER FLOUNDER	0	146	314	0	460
TAUTOG	0	0	826	0	826
TESSELATED DARTER	18	35	134	16	203
TIDEWATER SILVERSIDE	0	8244	0	0	8244
THREESPINE STICKLEBACK	388	0	0	0	388
WEAKFISH	0	0	9096	3870	12966
WHITE BASS	2124	0	0	0	2124
WHITE CATFISH	27262	117556	60513	20283	225614
WHITE PERCH	882703	1322284	711192	145344	3061523
WHITE SUCKER	0	10222	0	0	10222
WINTER FLOUNDER	0	0	462	0	462
YELLOW BULLHEAD	0	0	1162	105	1267
YELLOW PERCH	13809	2513	1926	306	18554
TOTAL ALL TAXA	1111891	2904468	1690459	292726	5999544

Table C-14. Estimated total weight (grams) of fish impinged at Indian Point Units 2 and 3 during 1984 (adjusted for collection efficiency and scaled up for all operating days).

COMMON NAME	WINTER	SPRING	SUMMER	FALL	TOTAL
ALEWIFE	1344	208744	40496	12860	263444
AMERICAN EEL	16781	92149	63401	91720	264051
AMERICAN SHAD	0	24370	2102	4103	30575
ATLANTIC MENHADEN	0	0	1362	1957	3319
ATLANTIC NEEDLEFISH	0	0	750	0	750
ATLANTIC SILVERSIDE	0	0	47	4	51
ATLANTIC STURGEON	5024	0	5923	99	11046
ATLANTIC TOMCOD	9599	36683	226402	16954	289638
BANDED KILLIFISH	1177	331	400	92	2000
BAY ANCHOVY	27	26257	308188	11875	346347
BLACK CRAPPIE	38	0	0	8	46
BLUEBACK HERRING	347	897671	43951	10585	952554
BLUEFISH	0	0	74983	7334	82317
BLUEGILL	4665	9177	5629	2098	21569
BROWN BULLHEAD	9613	9755	132	0	19500
BUTTERFISH	0	0	49055	11688	60743
CARP	659	0	0	12	671
CENTRARCHID UNIDENTIFIED	0	155	567	0	722
CHAIN PICKEREL	963	0	0	0	963
CHANNEL CATFISH	0	387	0	0	387
CREVALLE JACK	0	0	96	2802	2898
FOURBEARD ROCKLING	0	0	0	144	144
FOURSPINE STICKLEBACK	37	0	0	0	37
FOURSPOT FLOUNDER	0	0	158	0	158
GIZZARD SHAD	42470	277	0	190	42937
GOLDEN SHINER	7417	585	0	300	8302
GOLDFISH	10308	0	0	4916	15224
HICKORY SHAD	0	0	0	13	13
HOGCHOKER	387	159294	40556	14287	214524
LARGEMOUTH BASS	253	0	0	0	253
LOOKDOWN	0	0	101	366	467
MUMMICHOG	0	118	25	0	143
NORTHERN PIPEFISH	0	35	24	225	284
PUMPKINSEED	146837	34294	11798	2841	195770
RAINBOW SMELT	5510	237	1871	1124	8742
RED HAKE	4095	0	0	0	4095
REDBREAST SUNFISH	296	562	2657	651	4166
ROCK BASS	234	0	0	0	234
SHORTNOSE STURGEON	0	16961	0	0	16961
SILVER HAKE	676	565	0	0	1241
SMALLMOUTH BASS	1635	0	0	0	1635
SPOTTAIL SHINER	10747	2741	320	184	13992
STRIPED BASS	48746	70246	23840	14238	157070
STRIPED SEAROBIN	0	0	0	102	102
SUMMER FLOUNDER	145	146	314	0	605
TAUTOG	0	0	826	0	826
TESSELATED DARTER	18	191	134	55	398
THREESPINE STICKLEBACK	553	0	0	0	553
TIDEWATER SILVERSIDE	0	8244	0	0	8244
WEAKFISH	0	0	9096	16145	25241
WHITE BASS	2124	0	0	0	2124
WHITE CATFISH	50438	149103	60513	47207	307261
WHITE PERCH	3342567	2185536	711192	229718	6469013
WHITE SUCKER	0	21995	0	0	21995
WINTER FLOUNDER	184	0	462	0	646
YELLOW BULLHEAD	0	0	1162	105	1267
YELLOW PERCH	20425	4702	1926	306	27359
TOTAL ALL TAXA	3746339	3961511	1690459	507308	9905617

Table C-15. Scientific names of species collected from intake screens at Indian Point Units 2 and 3 during 1984.

Common Name[a]	Scientific Name[a]
Alewife	Alosa pseudoharengus
American eel	Anguilla rostrata
American shad	Alosa sapidissima
Atlantic menhaden	Brevoortia tyrannus
Atlantic needlefish	Strongylura marina
Atlantic silverside	Menidia menidia
Atlantic sturgeon	Acipenser oxyrhynchus
Atlantic tomcod	Microgadus tomcod
Banded killifish	Fundulus diaphanus
Bay anchovy	Anchoa mitchilli
Black crappie	Pomoxis nigromaculatus
Blueback herring	Alosa aestivalis
Bluefish	Pomatomus saltatrix
Bluegill	Lepomis macrochirus
Brown bullhead	Ictalurus nebulosus
Butterfish	Peprilus triacanthus
Chain pickerel	Esox niger
Channel catfish	Ictalurus punctatus
Common carp	Cyprinus carpio
Crevalle jack	Caranx hippos
Fourbeard rockling	Enchelyopus cimbrius

[a]Names recognized by the American Fisheries Society (Robins et al. 1980)

Table C-15. Continued

Common Name[a]	Scientific Name[a]
Fourspine stickleback	Apeltes quadracus
Fourspot flounder	Paralichthys oblongus
Gizzard shad	Dorosoma cepedianum
Golden shiner	Notemigonus crysoleucas
Goldfish	Carassius auratus
Hickory shad	Alosa mediocris
Hogchoker	Trinectes maculatus
Largemouth bass	Micropterus salmoides
Lookdown	Selene volmer
Mummichog	Fundulus heteroclitus
Northern pipefish	Syngnathus fuscus
Pumpkinseed	Lepomis gibbosus
Rainbow smelt	Osmerus mordax
Redbreast sunfish	Lepomis auritus
Red hake	Urophycis chuss
Rock bass	Ambloplites rupestris
Shortnose sturgeon	Acipenser brevirostrum
Silver hake	Merluccius bilinearis
Smallmouth bass	Micropterus dolomieui
Spottail shiner	Notropis hudsonius
Striped bass	Morone saxatilis
Striped searobin	Prionotus evolans
Summer flounder	Paralichtys dentatus

Table C-15. Continued

Common Name[a]	Scientific Name[a]
Tautog	*Tautoga onitis*
Tessellated darter	*Etheostoma olmstedi*
Threespine stickleback	*Gasterosteus aculeatus*
Tidewater silverside	*Menidia beryllina*
Weakfish	*Cynoscion regalis*
White bass	*Morone chrysops*
White catfish	*Ictalurus catus*
White perch	*Morone americana*
White sucker	*Catastomus commersoni*
Winter flounder	*Pseudopleuronectes americanus*
Yellow bullhead	*Ictalurus natalis*
Yellow perch	*Perca flavescens*

APPENDIX D

IMPINGEMENT DATA FOR BLUE CRABS

Table D-1. Total number (by sex, survival status, and condition) of blue crabs collected from intake screens at Indian Point Units 2 and 3 during 1984.

UNIT	SEX	SURVIVAL	CONDITION	MONTH					
				JUN	JUL	AUG	SEP	OCT	NOV
2	MALE	ALIVE	INTACT	0	0	0	0	0	2
			NOT INTACT	0	0	0	0	2	1
		DEAD	INTACT	0	0	0	0	1	0
			NOT INTACT	0	0	0	0	3	1
	FEMALE	ALIVE	INTACT	0	0	0	0	4	5
			NOT INTACT	0	0	0	0	1	0
3	MALE	ALIVE	INTACT	1	1	20	38	27	0
			NOT INTACT	2	6	18	47	37	0
		DEAD	INTACT	0	1	5	0	0	0
			NOT INTACT	0	8	12	24	25	0
	FEMALE	ALIVE	INTACT	0	1	5	1	15	0
			NOT INTACT	0	0	5	1	16	0
		DEAD	NOT INTACT	0	0	2	4	6	0
TOTAL	MALE	ALIVE	INTACT	1	1	20	38	27	2
			NOT INTACT	2	6	18	47	39	1
		DEAD	INTACT	0	1	5	0	1	0
			NOT INTACT	0	8	12	24	28	1
	FEMALE	ALIVE	INTACT	0	1	5	1	19	5
			NOT INTACT	0	0	5	1	16	0
		DEAD	NOT INTACT	0	0	2	4	7	0

Table D-2. Size (carapace width in mm) distribution of blue crabs collected from intake screens at Indian Point Unit 2 during 1984.

UNIT	SIZECLASS	MONTH						
		JUN	JUL	AUG	SEP	OCT	NOV	TOTAL
2	40	0	0	0	0	0	1	1
	50	0	0	0	0	0	2	2
	60	0	0	0	0	0	2	2
	70	0	0	0	0	0	2	2
	80	0	0	0	0	3	1	4
	90	0	0	0	0	1	0	1
	100	0	0	0	0	0	1	1
	110	0	0	0	0	1	0	1
	120	0	0	0	0	1	0	1
	140	0	0	0	0	1	0	1
	150	0	0	0	0	1	0	1
	160	0	0	0	0	2	0	2
	170	0	0	0	0	1	0	1

Table D-3. Size (carapace width in mm) distribution of blue crabs collected from intake screens at Indian Point Unit 3 during 1984.

UNIT	SIZECLASS	MONTH						
		JUN	JUL	AUG	SEP	OCT	NOV	TOTAL
3	20	0	0	0	0	1	0	1
	30	0	0	0	0	2	0	2
	40	0	0	0	0	4	0	4
	50	0	1	0	2	9	0	12
	60	0	1	3	3	12	0	19
	70	0	4	2	2	7	0	15
	80	0	4	6	4	2	0	16
	90	0	3	10	2	2	0	17
	100	0	1	10	7	1	0	19
	110	0	0	8	9	6	0	23
	120	0	0	10	18	2	0	30
	130	0	0	5	13	7	0	25
	140	0	1	6	14	15	0	36
	150	3	1	1	13	22	0	40
	160	0	0	5	9	13	0	27
	170	0	0	0	12	14	0	26
	180	0	1	0	5	6	0	12
	190	0	0	1	1	1	0	3
	210	0	0	0	1	0	0	1

Table D-4. Size (carapace width in mm) distribution of blue crabs collected from intake screens at Indian Point Units 2 and 3 during 1984.

UNIT	SIZECLASS	MONTH JUN	JUL	AUG	SEP	OCT	NOV	TOTAL
TOTAL	20	0	0	0	0	1	0	1
	30	0	0	0	0	2	0	2
	40	0	0	0	0	4	1	5
	50	0	1	0	2	9	2	14
	60	0	1	3	3	12	2	21
	70	0	4	2	2	7	2	17
	80	0	4	6	4	5	1	20
	90	0	3	10	2	3	0	18
	100	0	1	10	7	1	1	20
	110	0	0	8	9	7	0	24
	120	0	0	10	18	3	0	31
	130	0	0	5	13	7	0	25
	140	0	1	6	14	16	0	37
	150	3	1	1	13	23	0	41
	160	0	0	5	9	15	0	29
	170	0	0	0	12	15	0	27
	180	0	1	0	5	6	0	12
	190	0	0	1	1	1	0	3
	210	0	0	0	1	0	0	1