EA Report 10156.04

FINAL

HUDSON RIVER ECOLOGICAL STUDY IN THE AREA OF INDIAN POINT 1987 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
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.

Prepared by

EA Science and Technology
R.D. 2, Goshen Turnpike
Middletown, New York 10940

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EA SCIENCE AND TECHNOLOGY
A Division of EA Engineering, Science, and Technology, Inc.

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1. SUMMARY

Impingement monitoring of fish and blue crabs was conducted at the Indian Point Generating Station in 1987, continuing sampling efforts that began in 1972. Sampling was performed at Units 2 and 3 following the stratified random design first introduced during the last six months of 1981. The stratified sampling design consisted of 110 sampling days per year, divided into four strata (seasons). A November and December 1987 outage at Unit 2 resulted in 12 fewer sampling days during the winter stratum than were allocated in the stratified design. In all other cases, the number of impingement collections allocated in the stratified design was met.

The estimated total number of fish impinged, adjusted for collection efficiency, was 1,276,856 fish at Unit 2 and 262,306 fish at Unit 3 for a combined total of 1,539,162 fish weighing an estimated 11,048 kg. Impingement abundance in previous years ranged from 850,000 to 6,470,000 (adjusted for collection efficiency). The estimated number of fish impinged per unit volume of water circulated in 1987 totaled $848/10^6 m^3$ and was within the range reported from past years ($496-2,910/10^6 m^3$).

Sixty-two (62) species of fish were recorded in impingement collections during 1987, which was within the range from past years (43-79). The three most numerous species impinged at Units 2 and 3 in 1987 were, in order of abundance: Atlantic tomcod, white perch, and blueback herring, which together comprised 90 percent of the total estimated impingement abundance. Seasonal impingement patterns and rates of these and other selected species were generally consistent with past years.

The total impingement count of blue crabs in 1987 was 971 crabs at Unit 2 and 987 crabs at Unit 3 for a combined total of 1,958 crabs at both units, which was within the range of past years. The blue crab collection was characterized by a male to female ratio of approximately 3 to 1, a survival rate of 85.3 percent, and a condition status of 66.2 percent intact crabs. Most (97 percent) of the blue crabs collected ranged from 30 to 179 mm with higher numbers from 40 to 49 mm and from 150 to 169 mm. Blue crab impingement rates ($no./10^6 m^3$) unadjusted for collection efficiency were higher at Unit 2 than Unit 3. Peak blue crab impingement rates occurred during June, July, August, and October, and ranged from $10.8/10^6 m^3$ at Unit 2 to $4.4/10^6 m^3$ at Unit 3.

2. INTRODUCTION

This report is the 16th in a series of annual reports entitled "Hudson River Ecological Study in the Area of Indian Point." Previous annual reports have presented the results of various studies conducted at or in the vicinity of the Indian Point Generating Station, including impingement sampling, fisheries surveys, mitigation studies, and ichthyoplankton entrainment sampling (TI 1973, 1974, 1975, 1976, 1977, 1979, 1980a, 1980b; Con Edison 1982a, 1982b, 1983; NAI, Inc. 1984a, 1986, 1987; MMES 1985). This report discusses the 1987 impingement data and interprets these latest study results in conjunction with the findings of previous years. Estimates are provided for the total number of fish and blue crabs impinged at each unit and for all individual species. Seasonal impingement trends at Units 2 and 3 are also discussed.

With the implementation of the Settlement Agreement, the Hudson River Utilities (Consolidated Edison Company of New York, Inc., New York Power Authority, Central Hudson Gas and Electric Corporation, Orange and Rockland Utilities, Inc., and Niagara Mohawk Power Corporation) re-examined each of the programs they had been conducting to determine whether the effort allocated was sufficient. For the Indian Point impingement program, it became evident after extensive data analysis and literature review that daily collections were unnecessary to maintain acceptable levels of accuracy and precision (TI 1980b; NAI 1984b). Three potential sampling strategies were evaluated in terms of the accuracy and precision afforded by each in estimating total fish impingement at the Indian Point Generating Station. One design randomly allocated the sampling effort throughout the year. The other two designs were both stratified, one on a seasonal basis, and the other based on distinct periods of high and low impingement variation at each unit (TI 1980b). The design that was ultimately selected utilized seasonal stratification and involved sampling on 110 days annually. Simulated sampling at this yearly level of intensity (30 percent) was found to be very accurate, i.e., the 95 percent confidence intervals about the simulated mean of daily impingement counts enclosed the true mean (the mean of all daily impingement counts for each unit in the 1976 through 1979 period) at Units 2 and 3 more than 92 percent and 93 percent of the time, respectively (TI 1980b). Increasing the sampling intensity beyond 30 percent resulted in only marginal improvements in accuracy (TI 1980b).

Precision and accuracy of the reduced sampling design (110 days per year) implemented in 1981 was reevaluated after 1983 by examining the combined impingement database from 1976 to 1983 (NAI 1984b). Species-specific impingement rate changes during 1981, 1982, and 1983 did not affect the precision or accuracy of impingement estimates. Similarly, mandated changes in plant operating flows have not detracted from the validity of the reduced sampling design. The inclusion of post-1979 collections in the evaluation produced a slight revision in the way in which the 110 sampling days were allocated among seasonal strata, and this revised allocation was used beginning in 1985 (NAI 1984a). Impingement monitoring during 1987 at Units 2 and 3 of the Indian Point Generating Station was conducted for the entire year on random, pre-selected days according to the stratified random sampling design.

Chapter 3 of this report, Materials and Methods, presents a description of the Indian Point Generating Station, field and laboratory methods, the 1987 sampling design, and the collection efficiency estimates and regression models used to adjust impingement counts. Chapter 4, Results and Discussions, provides estimates of the number of fish impinged during 1987, evaluates the effects of collection efficiency adjustments, presents species composition and relative abundances, describes seasonal and yearly impingement patterns, and describes blue crab impingement patterns. Literature citations are presented in Chapter 5. Data calculations procedures are presented in Appendix A. Appendix B provides summary tables for water quality and impingement collection results.

3. MATERIALS AND METHODS

Impingement collections at Indian Point Units 2 and 3 were taken in four seasonal strata according to the stratified random sampling design introduced in Chapter 2. On all days when the plant operated, whether or not sampling was scheduled for impinged fish, the traveling screens were washed to remove fish, crabs, and debris. On all days when the plant operated, samples of impinged blue crabs were collected when present. The field and laboratory procedures used in collecting and processing samples are presented below, and the formulas used in the data calculations are presented in Appendix A.

3.1 THE INDIAN POINT GENERATING STATION

The Indian Point Generating Station is located on the east bank of the Hudson River, about 69 km (43 mi) above the Battery in New York City (Figure 3-1). The Indian Point Generating Station began operating within the completion of Unit 1 in 1962. Unit 2, which is operated by Consolidated Edison Company of New York, Inc. (Con Edison), and Unit 3, which is operated by the New York Power Authority (NYPA), began operation in 1973 and 1976, respectively. Each unit of this nuclear plant utilizes a once-through cooling system that can entrain the early life stages of various fish species into and through the cooling system, and can impinge juvenile and older fishes on screening devices located at the opening of each water intake bay.

The combined pumping capacity of the three units for cooling purposes is 7,790 m^3/min (2,058,000 gal/min). Unit 1, which has two 530 m^3/min (140,000 gal/min) circulator pumps, was retired from commercial operation in October 1974. The two units currently operating each have six 530 m^3/min circulating pumps. Each unit also has service water pumps, which also withdraw river water. Unit 1 has two service pumps with a total pumping rate of 144 m^3/min (38,000 gal/min). Units 2 and 3 each have six service pumps with a total pumping rate of 114 m^3/min (30,000 gal/min) at each unit.

Unit 1 intakes and Unit 2 Intakes 21-25 have fixed intake screens at the river's edge and conventional vertical traveling screens within each intake bay (Figure 3-2). Unit 2, Intake 26 has a Ristroph-modified vertical traveling screen; the fixed screen was not in place during 1987. Unit 3 has vertical traveling screens at the river's edge, but no fixed screens (Figure 3-3). Details of the plant and associated intake structures have been presented previously (Con Edison 1977; NAI 1986).

In December 1980, Con Edison, NYPA, and other Hudson River Utilities consented to certain restrictions in operating conditions, including the flow rates for the circulating water pumps, as part of an agreement reached with government agencies. To achieve the flow rate schedule specified by the Agreement (Table 3-1), which became effective 14 May 1981, dual speed circulating water pumps were to be installed at both Indian Point Units 2 and 3 by 14 November 1984. During the interim, alternative flow rates (Table 3-2) were required to be met.

HUDSON RIVER ESTUARY

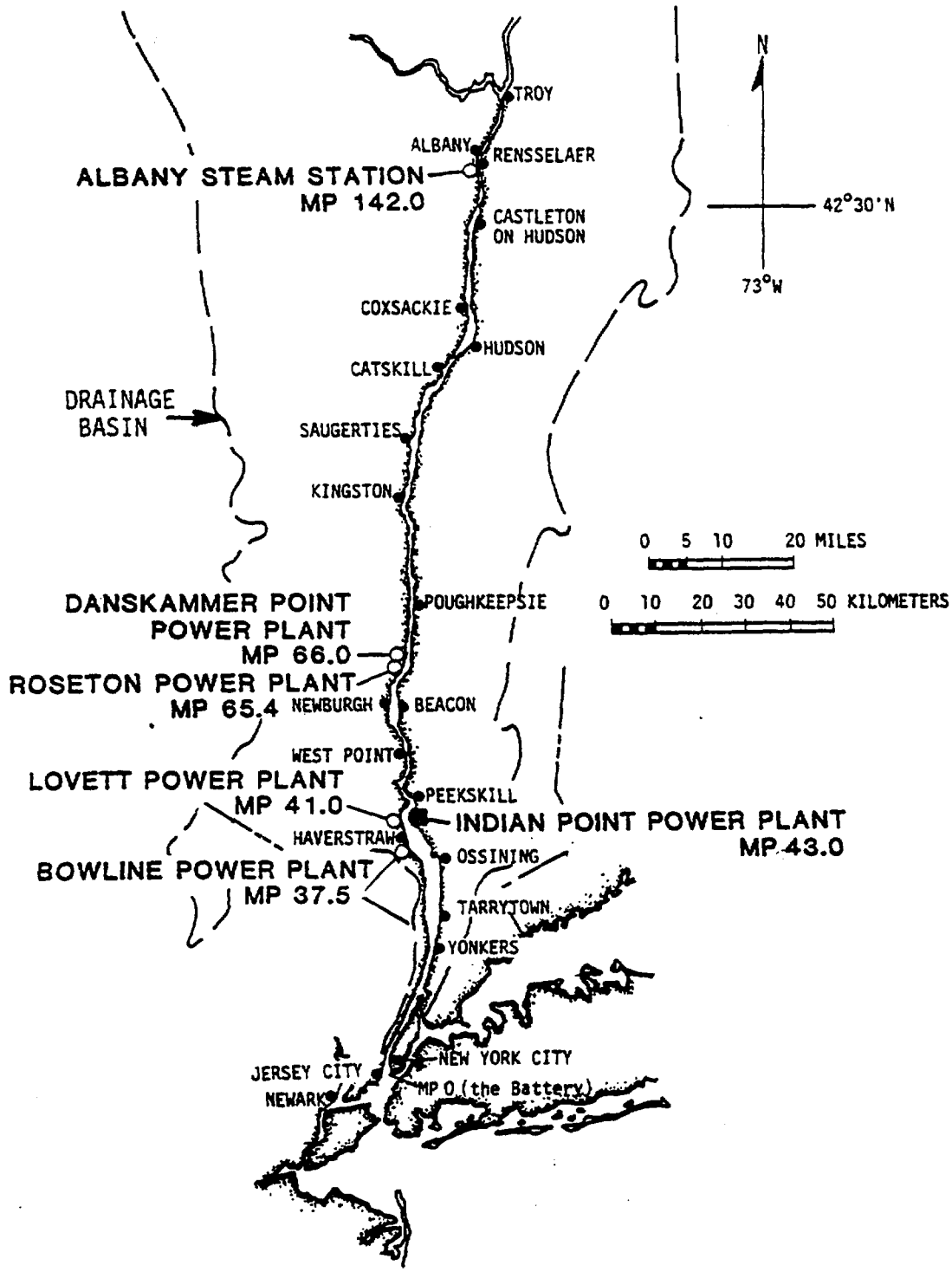

Figure 3-1. Location of Indian Point Generating Station relative to other Hudson River stations.

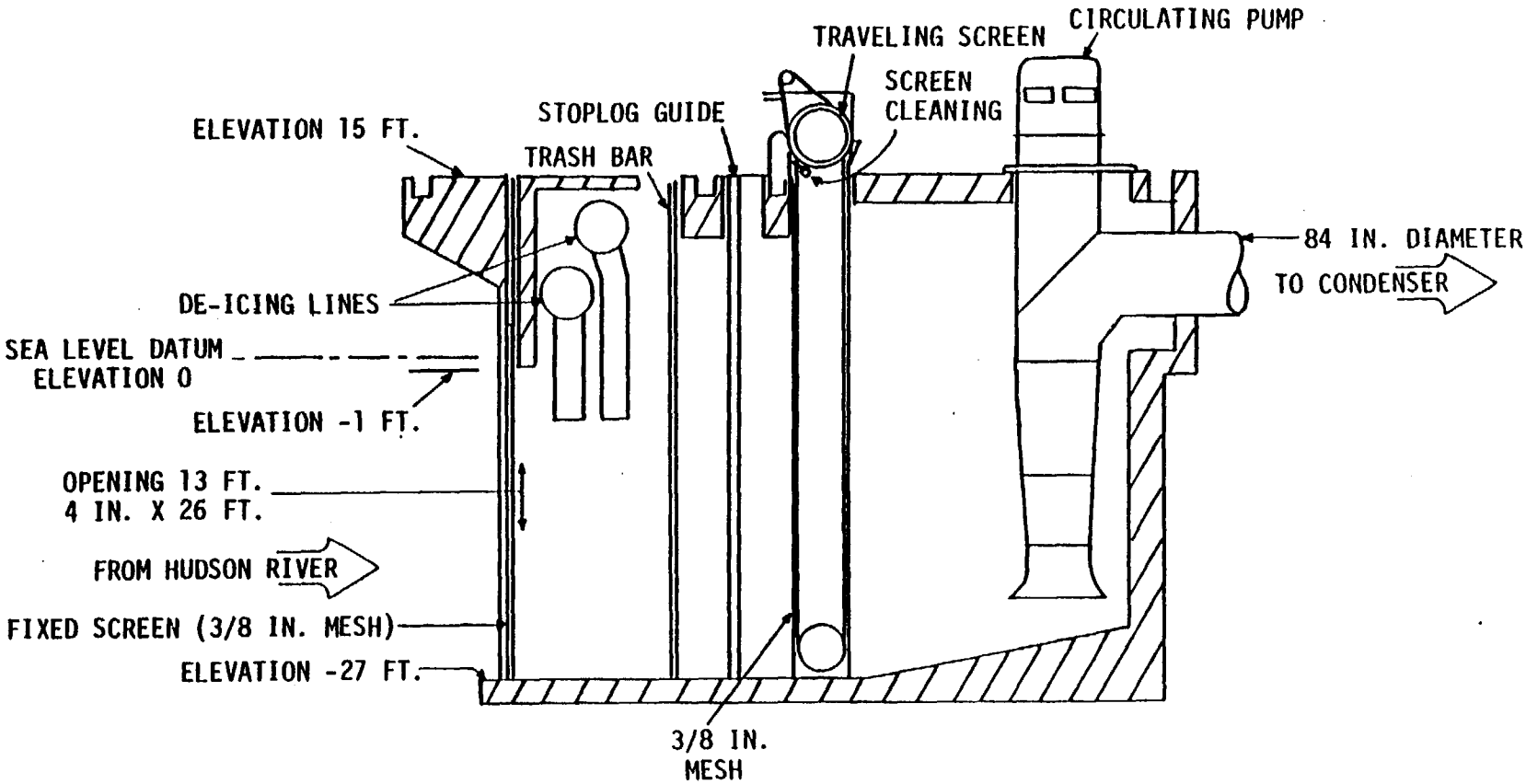

Figure 3-2. Schematic intake bay cross-section of Indian Point Unit 2.

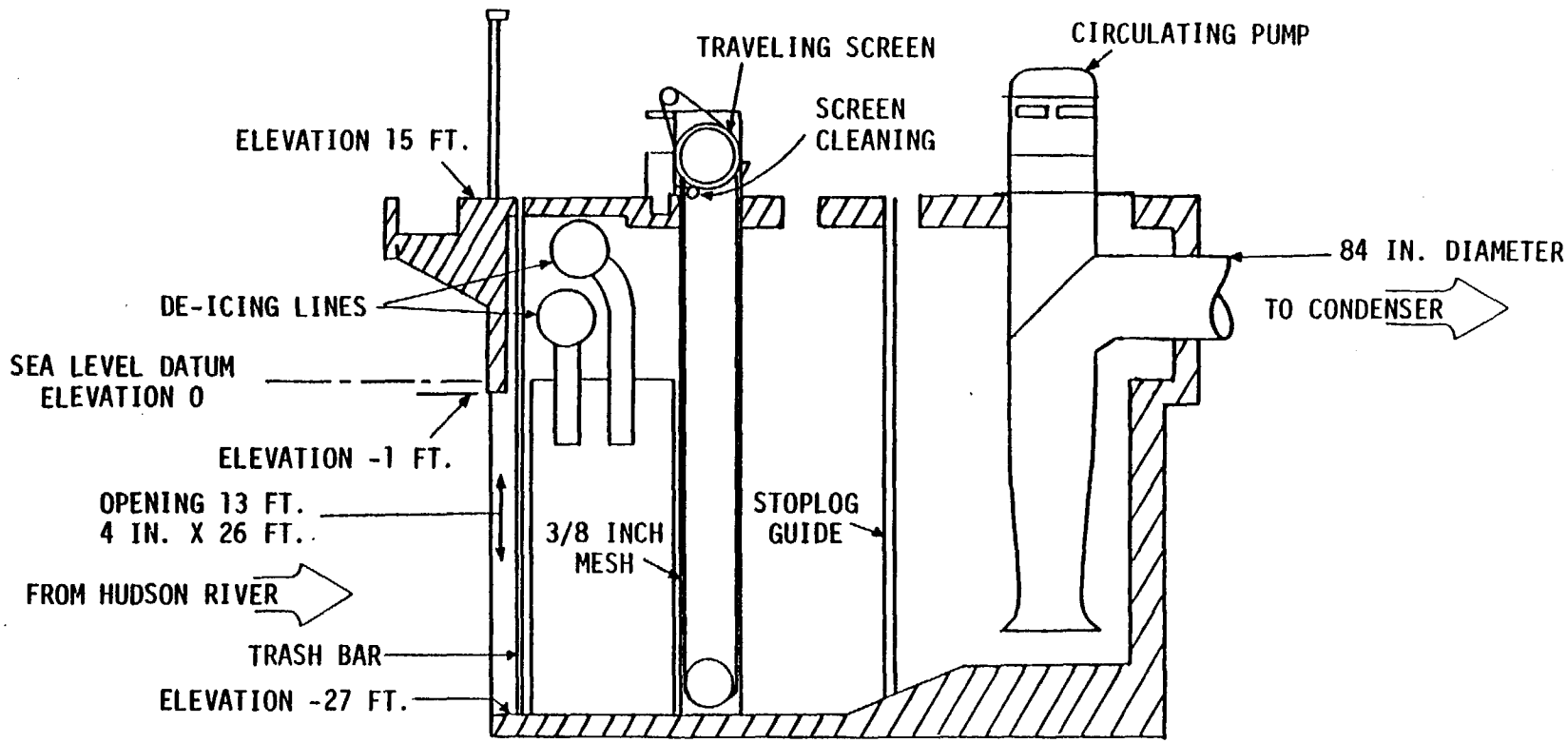

Figure 3-3. Schematic intake bay cross-section of Indian Point Unit 3.

TABLE 3-1 FLOW RATE SCHEDULE FOR DUAL SPEED/VARIABLE SPEED CIRCULATING WATER PUMPS AT INDIAN POINT UNITS 2 AND 3 IN EFFECT AFTER 14 NOVEMBER 1984

Approximate Period	Approximate Flow (gpm/Unit)	Approximate Flow $10^6 m^3$/min/Unit
01 JAN - 15 MAY	504,000	1.9
16 MAY - 22 MAY	560,000	2.1
23 MAY - 31 MAY	672,000	2.5
01 JUN - 08 JUN	731,000	2.8
09 JUN - 30 SEP	840,000	3.2
01 OCT - 31 OCT	731,000	2.8
01 NOV - 31 DEC	504,000	1.9

TABLE 3-2 INTERIM CIRCULATING WATER FLOW RATE SCHEDULE FOR INDIAN POINT UNITS 2 AND 3, BEWTEEN 14 MAY 1981 AND 14 NOVEMBER 1984

Approximate Period	Approximate Flow (gpm/Unit)
01 JAN - 01 MAY	505,000 gpm (60 percent flow)
01 MAY - 01 JUN	Change: From 505,000 gpm to 840,000 gpm (100 percent flow)
01 JUN - 01 OCT	840,000 gpm
01 OCT - 01 NOV	Change: From 840,000 gpm to 505,000 gpm (60 percent flow)
01 NOV - 31 DEC	505,000 gpm

These flow rates were specified as a measure to reduce a minimum water withdrawal from the Hudson River to rates necessary for efficient operation of the plants. The operation of Unit 2 with dual speed pumps commenced on 20 September 1984. Variable speed pumps were installed at Unit 3 and were available for service in September 1985.

3.2 FIELD AND LABORATORY METHODS

3.2.1 Sample Design and Schedule

The stratified sampling design for impingement and water quality data collection, that was initiated in July 1981, was continued throughout 1987 at Units 2 and 3. Sample days were assigned to randomly selected dates within four seasonal strata, in contrast to the daily sampling which was conducted before July 1981.

Fish and blue crab impingement samples were collected on the randomly selected sample days and analyzed. On days not selected for sample collection (non-sample days), only blue crabs were collected and analyzed; fish and debris were discarded when the traveling screens were washed. Blue crab impingement counts and biocharacteristics data were collected on all days in 1987 when blue crabs were present in impingement collections. Water quality data were collected at Units 2 and 3 intakes on days when either fish or blue crabs were collected.

Allocation quotas of sampling days were met among all seasonal strata except for fall at Unit 2, which was short 12 days due to a November-December outage (Table 3-3). The standard procedure that was used to minimize the effect of missed collection days was to randomly replace each lost day with one from the unallocated days (i.e., not initially selected for collection) remaining within that stratum. However, due to the extended outage at Unit 2 during the fall stratum, there were not enough unallocated days left in the stratum to make up the missed samples.

Screens were washed daily, generally between 0800 and 1200 hours. Each sample day began at the time of a scheduled daily wash on one day and concluded at the time of the subsequent scheduled wash. On preselected random sampling days, fish were collected from the screenwash of Unit 2 Intakes 21-25 combined, Unit 2 Intake 26 (Ristroph screen), and Unit 3 Intakes 31-36 combined. On non-sample days, fish and debris were disposed of without enumeration. On occasion when sampling could not be carried out due to outages, abnormal screenwash procedures, or unexpected operating conditions, an additional sampling day was randomly selected from the remaining non-sample days in the stratum (if any remained) to replace the one lost. If unscheduled screen washes or continuous washing was necessary during a sampling day because of heavy trash loading, screen malfunction, etc., then sampling was also conducted during those unscheduled washes to make the date representative of the full sampling period.

The method used to calculate an estimate of the total number of fish impinged during the year (Appendix A) assumes that the volume of cooling water pumped by the plant on sample days is representative of the volume pumped for all operating days in a stratum, since each operating day is weighted equally in computing the estimate. That this was a valid assumption is shown by the close

TABLE 3-3 NUMBERS OF IMPINGMENT COLLECTION DAYS AND DAYS OF PLANT OPERATION AT INDIAN POINT UNITS 2 AND 3 DURING 1987

Unit	Seasonal Stratum	Days of Plant Operation*	Days of Impingement Collections**	Days Allocated in Stratified Design
2	Winter (JAN-MAR)	86	23	23
	Spring (APR-JUN)	91	8	8
	Summer (JUL-SEP)	92	11	11
	Fall (OCT-DEC)**	77	52	68
	Total	346	94	110
3	Winter (JAN-MAR)	90	35	35
	Spring (APR-JUN)***	34	20	20
	Summer (JUL-SEP)***	49	31	31
	Fall (OCT-DEC)	92	24	24
	Total	265	110	110

* A unit was considered operating on a day if any circulator pump operated for any time on that day.
** Partial to complete outage from early November through December.
*** Partial to complete outage from early May through late August.

correspondence between sample and operating days in the average daily circulating volumes observed in each month at Unit 2 (Table 3-4) and Unit 3 (Table 3-5).

3.2.2 Sample Collection

Impingement samples were obtained from collection areas at the end of the Unit 2 and Unit 3 sluiceways and at a separate collection area for the Ristroph Screen 26. Each sample effort began with a screenwash and thorough cleaning of the sluiceways and debris pits. The fixed screens at Intakes 21-25 were washed manually with a hose prior to washing each traveling screen. Each fixed screen was raised and washed in 4-ft increments until the entire screen broke water and impinged material passed into the intake forebay to be removed from the condenser cooling water by the conventional vertical traveling screens. Unit 2 Intake 26 (Ristroph modified screen) and all of the Unit 3 intakes were equipped only with traveling screens in 1987 so that there was no fixed screen to be washed before washing each traveling screen. Each sample ended with the start of the next scheduled screenwash, usually on the following day. If unscheduled washes occurred before the end time of the sample day, the fish, crabs, and debris was sorted, retained, and added to the contents of the scheduled wash that completed that sample day.

On sample days, all fish and blue crabs washed from the intake screens of the unit(s) being sampled were taken to the laboratory for processing. On non-sample days, only blue crabs were kept for processing. Temperature (C) and conductivity (micro-siemens/cm) were measured at the intake of Units 2 and 3 at 0.3 m (1 ft) below the water surface on days when fish or blue crabs were collected, as close as was practical to the time of flood or high tide (Appendix Table B-1). Plant operating data were recorded for each day that fish or blue crabs were collected: time of screenwash, screenwash order, head loss at each screen, and operating condition of each screen.

3.2.3 Sample Processing

Fish were identified and enumerated by four general size classes for each species, based on total length in millimeters:

Length Class 1 = 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

The Division 1 cutoff used to define Length Class 1 represents the upper length limits of young-of-the-year for all species. The Division 2 cutoff represents the upper length limit for yearling alewife, American shad, blueback herring, striped bass, Atlantic tomcod, and white perch. Consequently, Length Class 2 individuals for these species are all yearlings. For all other species, Division 2 is arbitrarily set to 150 mm TL. Values for the division cutoffs were determined from historical and current data obtained from impingement collections. These values were updated weekly during the period of rapid growth for young-of-the- year Atlantic tomcod, white perch, and striped bass. During the remainder of the year, updates were prepared on a biweekly basis.

TABLE 3-4 COMPARISON OF SAMPLING DATES, AVERAGE DAILY SAMPLING VOLUMES, OPERATING DATES, AND AVERAGE DAILY OPERATING VOLUMES AT INDIAN POINT UNIT 2 BY MONTH DURING 1987

Month	Sampling Dates	Average Daily Sampling Volume ($10^6 m^3$)	Standard Deviation	Operating Dates	Average Daily Operating Volume ($10^6 m^3$)*	Standard Deviation
JAN	2-3, 6-7, 11, 13-14, 25, 28	2.67	0.27	1-31	2.76	0.13
FEB	11-14, 26	2.30	0.22	1, 6-28	2.43	0.67
MAR	1-2, 8, 11, 13, 18, 20, 25-26	2.69	0.15	1-31	2.82	0.04
APR	2, 21, 25, 28	2.40	0.21	1-30	2.83	0.06
MAY	5, 19, 29	2.98	0.70	1-31	3.16	0.41
JUN	20	4.50	---	1-30	4.33	0.56
JUL	19	4.53	---	1-31	4.61	0.15
AUG	16, 19-20, 23, 31	4.42	0.19	1-31	4.63	0.14
SEP	19, 21-23, 30	4.22	0.51	1-30	4.59	0.18
OCT**	1-3, 5-10, 12-18, 20-23, 25-31	1.41	1.05	1-31	1.49	0.29
NOV	1-5, 7-10, 14, 18-20, 25-27	0.62	0.23	1-11, 13-22, 24-30	0.60	0.29
DEC	3-4, 9-12, 16-18	0.71	0.17	3-12, 14-19, 25-26	0.64	0.22

* Includes service water, except days when no circulating pump operated.
** The 4 October 1987 Ristroph only sample not included in analysis.

TABLE 3-5 COMPARISON OF SAMPLING DATES, AVERAGE DAILY SAMPLING VOLUMES, OPERATING DATES, AND AVERAGE DAILY OPERATING VOLUMES AT INDIAN POINT UNIT 3 BY MONTH DURING 1987

Month	Sampling Dates	Average Daily Sampling Volume ($10^6 m^3$)	Standard Deviation	Operating Dates	Average Daily Operating Volume ($10^6 m^3$)*	Standard Deviation
JAN	1-3, 6-7, 11, 14-15, 21-26	2.61	0.20	1-31	2.82	0.06
FEB	3-5, 12-13, 20-21, 26	2.20	0.64	1.28	2.70	0.34
MAR	1-2, 8, 11-13, 16, 20, 23-25, 28, 30	2.64	0.19	1-31	2.78	0.23
APR	2-4, 6-9, 11-13, 15, 17, 19, 23, 25, 27-29	2.51	0.54	1-30	2.71	0.32
MAY	1-2	2.66	0.44	1-4	1.65	1.03
JUN	---	---	---	---	---	---
JUL	---	---	---	---	---	---
AUG	20-25, 27, 29, 31	0.83	0.65	12-17, 19-31	0.85	0.78
SEP	1-3, 5, 7-11, 15-27	3.78	1.29	1-30	4.00	1.12
OCT	1, 3, 7-9, 14, 17, 19, 22-23, 31	4.13	0.33	1-31	4.03	0.04
NOV	4, 6-8, 14, 18-19, 21, 24	2.83	0.18	1-30	2.84	0.06
DEC	2, 9, 13, 23	2.79	0.07	1-31	2.84	0.02

* Includes service water, except days when no circulating pump operated.

Subsamples were taken for any species if the total number of fish in Length Class 1 or 2 exceeded 100. In those cases, 100 fish were randomly selected within the length class and weighed. The total count for that species in the subsampled length class was estimated as 100 multiplied by the ratio of the total weight of the length class to the subsample weight. Total counts (sum of four length classes) for each species are summarized in Tables B-2 through B-7. For each species, weights were recorded to the nearest gram for Length Class 1, Length Class 2, and the total of all four length classes (Tables B-8 through B-10).

Blue crabs were examined for total count (Table B-11) and total weight, and the following data were recorded for each specimen: carapace width to the nearest millimeter (Table B-12), weight (nearest 0.1 g), survival (alive or dead), condition (intact or missing body parts), and sex. All blue crabs were also examined for the presence of tags applied during a 1986 mark/recapture study. If more than 50 blue crabs were present in a sample, then a subsample of 50 whole blue crabs were randomly selected and weighed. The total number of blue crabs in the sample was estimated as 50 multiplied by the ratio of total weight of the blue crabs in the sample to the subsample weight. In case of subsampling, sex, alive-dead status, and condition were determined only for the 50 crabs in the subsample. After processing, all living crabs were returned to the river away from the intake structure.

Any shortnose or Atlantic sturgeon collected were measured (total length in mm), weighed, and the data were entered in a Sturgeon Log. Living sturgeon were returned to the river. All striped bass collected on both sampling and non-sampling days were checked for hatchery implanted magnetic tags. Any suspected recaptures were preserved by freezing for later verification.

Water quality data were collected on scheduled sample days and days when blue crabs were collected. Water temperatures and conductivity were measured in situ with a YSI Model 33 SCT Meter at a depth of 1 ft below the surface. The water quality sample for Unit 2 was taken off the gangway in front of Screen No. 2. The sample for Unit 3 was taken at the south side of the Unit 1 pier. Temperature was measured to the nearest 0.5 C and conductivity to the nearest 10 scale units (2.5 percent).

Quality control (QC) checks were performed on fish identifications, counts, weights, crab measurements, and examination of suspected recaptures. The selection of samples for QC checks followed Military Standard 1235 (Single and Multiple Level Continuous Sampling Procedures), which assured that 90 percent or more of the data were within specified tolerance limits. Data were recorded on standard data coding forms developed for this study. Calibration checks on the conductivity and temperature measurement systems were performed using standard KCI solutions and NBS traceable thermometers obtained from EA's Middletown laboratory. Calibrations were performed prior to each collection of conductivity/temperature data.

3.3 COLLECTION EFFICIENCY

While collections from the intake screens at Indian Point provide an indication of seasonal and yearly impingement patterns, they do not account for 100 percent of the fish impinged. Some impinged fish may be lost prior to collection because of (1) scavenging by crabs, fish, and birds, (2) river

currents and wave action, or (3) the screenwash collection procedures. Deterioration and disintegration of impinged fish on the screens can also contribute to these losses.

Extensive collection efficiency studies were performed at Indian Point from 1977 to 1980 and in 1982 (Con Edison 1983). The observed values of collection efficiency in those studies, as summarized by Con Edison (1983), were used to develop the following regression models:

$$E_2 = -0.00871\ T_2 + 0.51858 \qquad \text{(Equation 1)}$$
$$E_3 = -0.00792\ T_3 + 0.71640 \qquad \text{(Equation 2)}$$

where

E_2 and E_3 = collection efficiency at Units 2 and 3, respectively.
T_2 and T_3 = intake water temperature (C) at Units 2 and 3, respectively.

Although individual observations of collection efficiency were highly variable at all temperatures, the above relationships were found to be statistically significant (efficiency decreased significantly with increasing temperature), and therefore, useful for estimating actual impingement rates from impingement collections (Con Edison 1983). These estimates of collection efficiency were used to adjust impingement collections at Unit 2, Screens 21-25, and at Unit 3 to estimate total impingement.

For the Ristroph screen (Screen 26) at Unit 2, the following screen-specific collection efficiency values were determined based on the results of Ristroph Screen Special Studies (1 January - 19 April 1985) and the Ristroph Screen Survival Studies (16 July - 31 December):

Month	Ristroph Screen Collection Efficiency
JAN	74.4 percent
FEB	74.4 percent
MAR	74.4 percent
JUL	18.7 percent
AUG	18.7 percent
SEP	29.6 percent
OCT	
NOV	

These screen-specific collection efficiency estimates were used to adjust impingement collections during months for which estimates were available. The design of the Ristroph screen is such that there is little opportunity for impinged fish to be washed off the screen and not be collected. The collection efficiency estimates of 18.7 percent for July and August and 29.6 percent for September were obtained during 1985, a year of unusually high abundance of blue crabs at Indian Point. During that year, approximately 11,000 blue crabs were collected at Unit 2 as compared to less than 1,000 during 1987 (Table 4-10). This high crab abundance and associated predation in 1985 may explain the relatively low collection efficiency estimates from that year. If true, then the actual collection efficiency at Unit 2 in 1987 was higher than that used and the estimated numbers impinged for July-September were overestimated. Since the Ristroph screen at Unit 2 does not include the use of fixed screens and is operated continuously with the fish being retained in collection

buckets, it is reasonable to assume that Ristroph collection efficiencies are at least as high as at Unit 3 and most likely in the range of 70-80 percent throughout the year.

For other months, the collection efficiency for Screen 26 was assumed to be the same as for Screens 21-25 at Unit 2. Again, due to the design of the Ristroph screen was most likely conservative resulting in overestimates of impingement for Screen 26.

4. RESULTS AND DISCUSSION

4.1 WATER QUALITY

Daily intake water temperature averaged for both units rose from a seasonal low in late January of 0.5 C to a high of 29.5 C in late August and subsequently declined to 5-6 C by December (Figure 4-1, Table B-1). Daily intake conductivity fluctuated during the year in a characteristic seasonal pattern. Lowest conductivity levels were recorded during spring when values less than 100 uS/cm were recorded with occasional periods of 1,000-3,000 uS/cm. Conductivity was at its highest during summer and fall with values of 4,000-7,000 uS/cm. During fall, conductivity once again dropped to levels generally below 1,000 uS/cm.

4.2 ESTIMATED NUMBERS OF FISH IMPINGED DURING 1987

A combined total of 149,569 fish were collected at Indian Point Units 2 and 3 in 1987 (Table B-4). When adjusted for collection efficiency and scaled to the number of operational days, the estimated total number impinged was 1,276,856 fish at Unit 2 and 262,306 at Unit 3 (Tables 4-1 and 4-2) for a combined total of 1,539,162 fish weighing an estimated 11,048 kg (Table A-11). The levels of precision (standard errors) were 28.6 and 10.4 percent of the total estimates for Unit 2 and Unit 3, respectively. The level of precision for Unit 2 (28.6 percent) was considerably less than the levels projected for Unit 2 by Texas Instruments (1980b) (9.5 percent) and Normandeau Associates, Inc. (1984b) (7.8 percent) for the stratified random design. This appeared to be the result of having higher variance at Unit 2 during both spring and summer 1987 which required more samples than had been allocated in the stratified design, thus providing a less precise estimate of the number of fish impinged (Table 4-3). The level of precision at Unit 3 (10.4 percent) was similar to the precision levels projected for Unit 3 (8.2 percent, TI 1980b; 7.7 percent, NAI 1984b).

The total number of fish impinged by Units 2 and 3 combined in 1987, estimated at 1.54 million (Tables 4-1 and 4-2), was within the range of other yearly estimates in the 1976-1986 historical database (range 0.85-6.47 million; Table 4-4) and slightly higher than last year's estimate of 1.09 million. The volume of water circulated through Indian Point Generating Station during 1987, 1,815 x $10^6 m^3$, was well within the range of values from previous years (Table 4-4) and included partial to complete outages from early November through December at Unit 2 and from early May through late August at Unit 3.

Total estimated impingement abundance at Unit 2 was highest during the spring stratum followed by summer, winter, and fall (Table 4-1). The high estimated impingement during spring at Unit 2 was a result of unusually high impingement of young-of-the-year Atlantic tomcod during May and June 1987. On the other hand, the relatively low impingement during the fall when compared to previous years' estimates may be a result of the unit outage during November and December. Mean daily impingement rate for each seasonal strata followed a similar seasonal pattern with higher rates during spring and summer (Table 4-3). At Unit 3, total estimated impingement abundance followed a different pattern, being highest during winter followed by fall, spring, and summer (Table 4-2), a pattern similar to that observed during 1986. The relatively low spring and summer impingement undoubtedly reflects the unit outage from early May to mid-August in 1987. Mean daily impingement rates at Unit 3

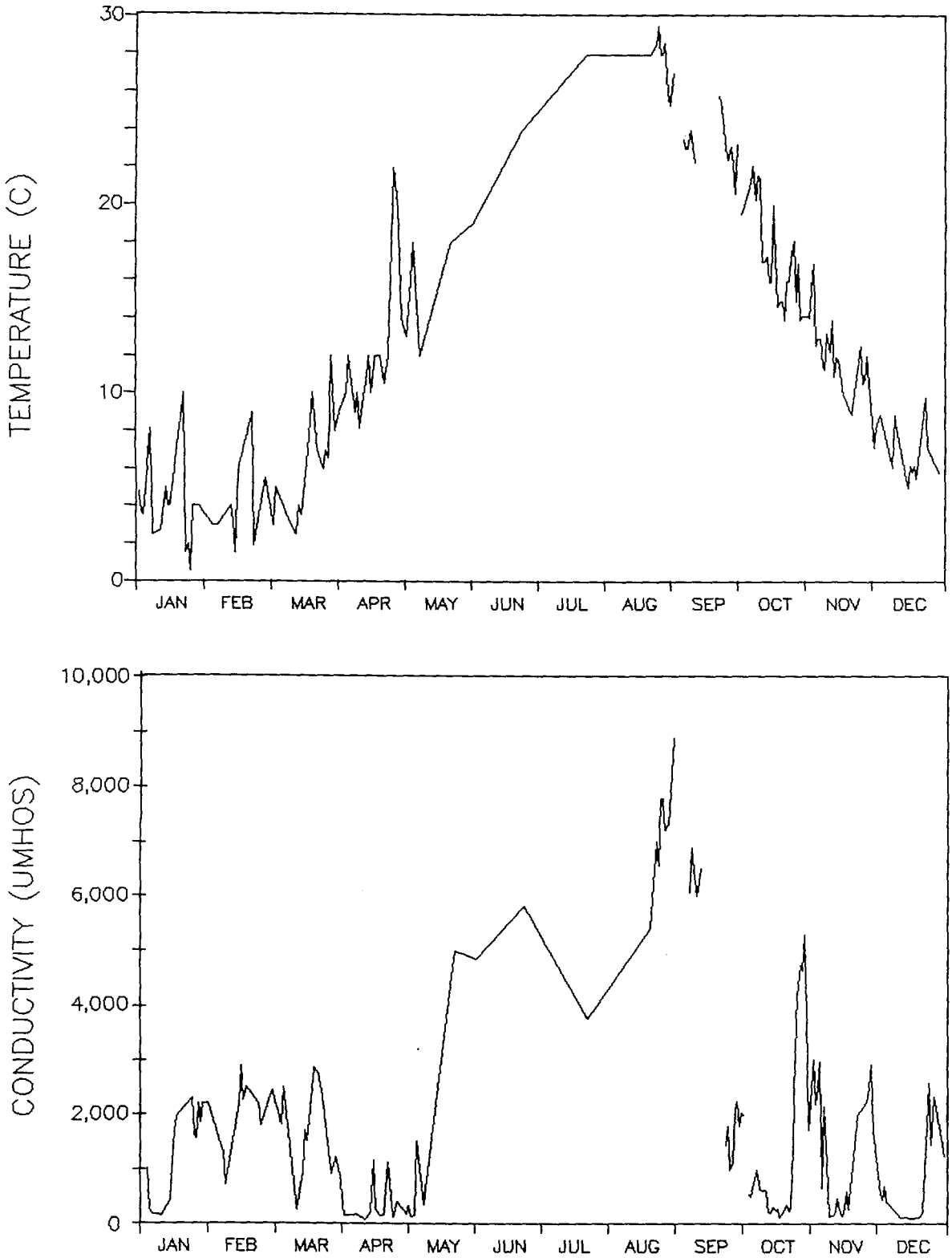

Figure 4-1. Seasonal pattern in water temperature and conductivity during impingement collections at Indian Point, 1987.

TABLE 4-1 ESTIMATED NUMBER OF FISH IMPINGED AT INDIAN POINT UNIT 2 DURING 1987 BY TAXON AND SEASONAL STRATUM (ADJUSTED FOR COLLECTION EFFICIENCY)

Taxon	Winter	Spring	Summer	Fall	1987 Total	Standard Error	Coefficient of Variation
Alewife	11	319	3,019	213	3,562	539	15.1
Bay anchovy	49	193	20,641	3,903	24,786	9,503	38.3
American shad	7	57	2,308	267	2,639	833	31.6
Bluefish	0	1,399	4,558	71	6,028	2,245	37.2
Bluegill	30	102	560	121	813	333	41.0
Brown bullhead	52	57	134	0	243	90	37.0
Pumpkinseed	729	46	209	133	1,117	202	18.1
Black crappie	0	0	209	9	218	135	61.9
Carp	11	0	0	0	11	10	90.9
American eel	232	1,911	1,999	99	4,241	713	16.8
Goldfish	79	0	0	0	79	27	34.2
Golden shiner	123	0	0	0	123	43	35.0
Hogchoker	366	17,495	12,771	4,186	34,818	7,106	20.4
Tessellated darter	127	159	0	3	289	101	34.9
Banded killifish	1,885	114	0	68	2,067	655	31.7
Largemouth bass	7	0	0	3	10	7	70.0
Mummichog	0	68	84	0	152	102	67.1
Atlantic menhaden	7	216	552	25	800	298	37.2
Blueback herring	7	1,103	21,210	12,939	35,259	16,190	45.9
Atlantic silverside	11	0	0	13	24	9	37.5
Rainbow smelt	1,948	4,641	611	80	7,280	2,064	28.4
Smallmouth bass	7	0	59	0	66	55	83.3
Shortnose sturgeon	4	0	0	0	4	3	75.0
Spottail shiner	2,109	80	0	9	2,198	429	19.5
Atlantic sturgeon	0	0	0	0	0	0	0.0
Striped bass	2,561	557	14,369	7,392	24,879	6,039	24.3
Fourspine stickleback	52	546	0	0	598	258	43.1
Atlantic tomcod	1,406	364,387	318,303	472	684,568	358,694	52.4
White catfish	318	341	435	386	1,480	206	13.9
White perch	257,663	111,145	45,289	18,325	432,422	59,284	13.7
Yellow perch	288	0	50	12	350	70	20.0
Rock bass	0	0	0	167	167	95	56.9
Northern pipefish	0	91	176	9	276	98	35.5
Redbreast sunfish	4	0	0	0	4	3	75.0
Crevalle jack	0	0	0	0	0	0	0.0
Weakfish	0	0	2,593	95	2,688	960	35.7
Lookdown	0	0	0	0	0	0	0.0
Clupeid larvae	0	0	50	0	50	47	94.0
Tautog	0	0	0	0	0	0	0.0
Four bearded rockling	0	0	0	0	0	0	0.0
Striped cuskeel	0	34	0	0	34	33	97.1
Winter flounder	56	171	251	0	478	267	55.9
Tidewater silverside	0	0	0	4	4	2	50.0
Gizzard shad	153	0	100	27	280	78	27.9

TABLE 4-1 (Cont.)

Taxon	Winter	Spring	Summer	Fall	1987 Total	Standard Error	Coefficient of Variation
Silver hake	0	68	0	0	68	65	95.6
Threespine stickleback	583	0	0	0	583	157	26.9
Brown trout	0	34	0	0	34	33	97.1
Butterfish	0	0	611	13	624	145	23.2
White crappie	0	0	75	9	84	51	60.7
Green sunfish	0	0	0	0	0	0	0.0
Centrarchid unid.	0	0	0	0	0	0	0.0
Red hake	11	0	0	0	11	7	63.6
Eastern mudminnow	0	0	50	4	54	32	59.3
Summer flounder	0	0	25	0	25	24	96.0
Black bullhead	0	0	0	0	0	0	0.0
Striped searobin	0	0	0	0	0	0	0.0
Hickory shad	0	0	0	0	0	0	0.0
Warmouth	0	0	0	61	61	21	34.4
Yellow bullhead	0	0	25	0	25	24	96.0
Naked goby	30	0	59	25	114	62	54.4
Windowpane	0	34	0	0	34	33	97.1
Cunner	0	34	0	0	34	33	97.1
Total	270,926	505,402	451,385	49,143	1,276,856	365,006	28.6

TABLE 4-2 ESTIMATED NUMBER OF FISH IMPINGED AT INDIAN POINT UNIT 3 DURING 1987 BY TAXON AND SEASONAL STRATUM (ADJUSTED FOR COLLECTION EFFICIENCY)

Taxon	Winter	Spring	Summer	Fall	1987 Total	IP2	Standard Error	Coefficient of Variation
Alewife	26	43	392	705	1,166		211	18.1
Bay anchovy	82	0	4,467	1,533	6,082	247	1,375	22.6
American shad	5	27	329	1,369	1,730	2.6	363	21.0
Bluefish	0	0	615	130	745		125	16.8
Bluegill	10	29	35	242	316		80	25.3
Brown bullhead	33	7	3	0	43		12	27.9
Pumpkinseed	532	85	9	161	787		146	18.6
Black crappie	3	0	6	8	17		8	47.1
Carp	31	0	0	0	31		11	35.5
American eel	95	15	84	65	259		31	12.0
Goldfish	51	3	0	0	54		14	25.9
Golden shiner	23	7	0	8	38		9	23.7
Hogchoker	255	2,154	3,642	3,534	9,585		1,736	18.1
Tessellated darter	3	0	0	4	7		4	57.1
Banded killifish	339	14	0	96	449		109	24.3
Largemouth bass	10	0	0	19	29		11	37.9
Mummichog	0	0	0	0	0		0	0.0
Atlantic menhaden	0	41	82	23	146		24	16.4
Blueback herring	13	177	955	61,322	62,467	35.2	16,666	26.7
Atlantic silverside	5	9	3	0	17		6	35.3
Rainbow smelt	512	360	120	790	1,782		339	19.0
Smallmouth bass	0	0	0	0	0		0	0.0
Shortnose sturgeon	0	3	0	0	3		2	66.7
Spottail shiner	329	65	0	27	421		49	11.6
Atlantic sturgeon	0	0	3	0	3		2	66.7
Striped bass	1,322	87	553	1,832	3,794	24.9	428	11.3
Fourspine stickleback	13	36	0	8	57		12	21.1
Atlantic tomcod	517	99	285	196	1,097	684.5	147	13.4
White catfish	275	56	27	529	887		132	14.9
White perch	126,172	19,572	1,981	20,290	168,015	432.4	18,877	11.2
Yellow perch	54	29	0	15	98		17	17.3
Rock bass	0	0	3	0	3		2	66.7
Northern pipefish	0	5	40	8	53		14	26.4
Redbreast sunfish	10	0	6	0	16		8	50.0
Crevalle jack	0	0	3	130	133		54	40.6
Weakfish	0	0	30	280	310		109	35.2
Lookdown	0	0	0	8	8		7	87.5
Clupeid larvae	0	0	0	0	0		0	0.0
Tautog	0	0	0	8	8		7	87.5
Four bearded rockling	0	0	0	4	4		3	75.0
Striped cuskeel	0	0	0	0	0		0	0.0
Winter flounder	3	3	6	0	12		4	33.3
Tidewater silverside	3	0	0	0	3		2	66.7

TABLE 4-2 (Cont.)

Taxon	Winter	Spring	Summer	Fall	1987 Total	Standard Error	Coefficient of Variation
Gizzard shad	489	0	0	567	1,056	211	20.0
Silver hake	0	0	0	0	0	0	0.0
Threespine stickleback	239	3	0	0	242	41	16.9
Brown trout	0	3	0	0	3	2	66.7
Butterfish	0	0	36	50	86	27	31.4
White crappie	0	0	52	42	94	34	36.2
Green sunfish	0	0	70	0	70	38	54.3
Centrarchid unid.	0	0	3	0	3	2	66.7
Red hake	3	0	0	12	15	10	66.7
Eastern mudminnow	0	0	0	8	8	7	87.5
Summer flounder	0	0	6	0	6	3	50.0
Black bullhead	0	0	3	0	3	2	66.7
Striped searobin	0	0	0	19	19	12	63.2
Hickory shad	0	0	3	0	3	2	66.7
Warmouth	0	0	0	23	23	11	47.8
Yellow bullhead	0	0	0	0	0	0	0.0
Naked goby	0	0	0	0	0	0	0.0
Windowpane	0	0	0	0	0	0	0.0
Cunner	0	0	0	0	0	0	0.0
Total	131,457	22,932	13,852	94,065	262,306	27,280	10.4

TABLE 4-3 ESTIMATED MEAN DAILY NUMBER OF FISH IMPINGED IN EACH SEASONAL STRATUM AT INDIAN POINT UNITS 2 AND 3 DURING 1987

Unit	Seasonal Stratum	Number of Sampling Days	Days Allocated in Stratified Design	Mean Daily Estimate*	Standard Deviation
2	Winter (JAN-MAR)	23	23	3,150.4	2,860.0
	Spring (APR-JUN)	8	8	5,553.9	6,711.5
	Summer (JUL-SEP)	11	11	4,906.4	11,436.8
	Fall (OCT-DEC)	52	68	638.3	2,107.6
	Total	94	110	3,690.3**	
3	Winter (JAN-MAR)	35	35	1,460.6	1,535.8
	Spring (APR-JUN)	20	20	674.5	801.0
	Summer (JUL-SEP)	31	31	282.7	432.2
	Fall (OCT-DEC)	24	24	1,022.4	1,223.3
	Total	110	110	989.8**	

* Adjusted for collection efficiency.
** Stratified mean daily estimate.

TABLE 4-4 TOTAL VOLUME CIRCULATED AT INDIAN POINT UNITS 2 AND 3 COMBINED, ESTIMATED NUMBER OF FISH IMPINGED, IMPINGEMENT RATE, AND NUMBER OF SPECIES COLLECTED DURING 1976-1987

Year	Volume ($10^6 m^3$)*	Estimated Number Impinged (10^6)**	Impingement Rate (No./$10^6 m^3$)	Number Species Collected
1976	1,329	1.63	1,190	58
1977	2,159	6.47	2,910	72
1978	2,030	3.91	1,870	72
1979	1,935	4.48	2,230	74
1980	1,822	3.21	1,710	76
1981	1,617	4.57	2,830	72
1982	1,273	1.60	1,260	43
1983	1,286	0.85	661	49
1984	1,710	0.85	496	56
1985	1,977	1.08	556	79
1986	1,892	1.09	577	65
1987	1,815	1.54	848	62

* Including service water.
** Adjusted for collection efficiency.

demonstrated that the winter stratum contained the highest daily impingement rates followed by the fall and spring strata, and lastly the summer stratum (Table 4-3).

The precision of estimated total impingement for individual fish species at Units 2 and 3 varied greatly (11-97 percent). As expected, most species with high coefficients of variation (>80 percent) occurred infrequently in the Indian Point area (striped cuskeel, silverhake, brown trout, summer flounder, yellow bullhead, windowpane flounder, cunner, lookdown, eastern mudminnow, and tautog) or were common in the area but only subject to minimal impingement in 1987 (carp and smallmouth bass). Conversely, many fish species with a relatively high degree of precision (coefficients of variation <20 percent) for impingement abundance estimates were impinged in relatively uniform numbers among the four seasonal strata or in high but relatively uniform numbers among the days within one or two seasonal strata (American eel, bluefish, hogchoker, pumpkinseed, spottail shiner, striped bass, white perch, white catfish, alewife, and yellow perch). A number of species also occurred periodically and in low numbers, but had relatively precise estimates of impingement (Atlantic menhaden, rainbow smelt, and threespine stickleback). For these species, the high precision levels were the result of impingement occurring at Unit 2 during the fall stratum, and to a less extent winter stratum, which had very large allocations of sampling dates. This effect was not as apparent at Unit 3 where allocation of sampling dates was more uniform among strata.

The relatively high coefficient of variation (52.4 percent) for Atlantic tomcod, the dominant species at Unit 2 (Table 4-1), results from the relatively high impingement of young-of-the-year tomcod during late spring and summer when there were relatively few sample days. The stratified sampling design developed for Indian Point was based on typical impingement patterns where impingement is highest in winter and early spring. Consequently, when high late spring and summer impingement occurs (such as in 1987 at Unit 2), the stratified design results in estimated impingement with lower precision.

4.3 SPECIES COMPOSITION AND RELATIVE ABUNDANCE

Fish collected in impingement samples during 1987 totaled 149,569 and comprised 62 species for Units 2 and 3 combined (Table 4-5). Among these species, 24 were primarily freshwater inhabitants, 14 were primarily marine species tolerant of moderate freshwater influences, and 24 were euryhaline species tolerant at one time or another of a wide range of salinity conditions. The number of species caught in 1987 (62) was well within the range of the previous 10 years (43-79 species).

The three numerically dominant species impinged at Indian Point Units 2 and 3 in 1987 were Atlantic tomcod, white perch, and blueback herring (Table 4-6). Collectively, these fishes comprised nearly 90 percent of the total estimated impingement abundance at the Indian Point Generating Station in 1987 and were among the top 10 species impinged in previous monitoring programs. Atlantic tomcod was the most abundant species, accounting for 44.5 percent of the number of fish impinged (Table 4-6). Unit 2 collections accounted for about all (99.8 percent) of the estimated impingement of Atlantic tomcod. White perch were also abundant, accounting for 39.0 percent of the fish impinged. Unit 2 collections accounted for 72 percent of the estimated white perch impingement.

TABLE 4-5 FISH SPECIES COLLECTED IN IMPINGEMENT SAMPLING AT INDIAN POINT UNITS 2 AND 3 IN 1987

Common Name	Scientific Name	Salinity Preference
Alewife	*Alosa pseudoharengus*	e
American eel	*Anguilla rostrata*	e
American shad	*Alosa sapidissima*	e
Atlantic menhaden	*Brevoortia tyrannus*	m
Atlantic silverside	*Menidia menidia*	e
Atlantic sturgeon	*Acipenser oxyrhynchus*	e
Atlantic tomcod	*Microgadus tomcod*	e
Banded killifish	*Fundulus diaphanus*	f
Bay anchovy	*Anchoa mitchilli*	e
Black bullhead	*Ictalurus melas*	f
Black crappie	*Pomoxis nigromaculatus*	f
Blueback herring	*Alosa aestivalis*	e
Bluefish	*Pomatomus saltatrix*	m
Bluegill	*Lepomis macrochirus*	f
Brown bullhead	*Ictalurus nebulosus*	f
Brown trout	*Salmo trutta*	f
Butterfish	*Peprilus triacanthus*	m
Carp	*Cyprinus carpio*	f
Centrarchid unid.	*Centrarchid* unid.	f
Clupeid larvae	*Clupea* spp. larvae	e
Crevalle jack	*Caranx hippos*	e
Cunner	*Tautogolabrus adspersus*	m
Eastern mudminnow	*Umbra pygmaea*	f
Four bearded rockling	*Enchelyopus cimbrius*	m
Fourspine stickleback	*Apeletes quadracus*	e
Gizzard shad	*Dorosoma cepedianum*	f
Golden shiner	*Notemigonus crysoleucas*	f
Goldfish	*Carassius auratus*	f
Green sunfish	*Lepomis cyanellis*	f
Hickory shad	*Alosa mediocris*	e
Hogchoker	*Trinectes maculata*	e
Largemouth bass	*Micropterus salmoides*	f
Lookdown	*Selene vomer*	e
Mummichog	*Fundulus heteroclitus*	e
Naked goby	*Gobiosoma bosci*	e
Northern pipefish	*Syngnathus fuscus*	e
Pumpkinseed	*Lepomis gibbosus*	f
Rainbow smelt	*Osmerus mordax*	e
Red hake	*Urophycis chuss*	m
Redbreast sunfish	*Lepomis auritus*	f
Rock bass	*Ambloplites rupestris*	f
Shortnose sturgeon	*Acipenser brevirostrum*	e
Silver hake	*Merluccius bilinearis*	m
Smallmouth bass	*Micropterus dolomieu*	f
Spottail shiner	*Notropis hudsonius*	f
Striped bass	*Morone saxatilis*	e

TABLE 4-5 (Cont.)

Common Name	Scientific Name	Salinity Preference
Striped cuskeel	*Ophidion marginatum*	
Striped searobin	*Prionotus evolans*	m
Summer flounder	*Paralichthys dentatus*	m
Tautog	*Tautoga onitis*	m
Tessellated darter	*Etheostoma olmstedi*	f
Threespine stickleback	*Gasterosteus aculeatus*	e
Tidewater silverside	*Menidia peninsulae*	e
Warmouth	*Lepomis gulosis*	f
Weakfish	*Cyanoscion regalis*	m
White catfish	*Ictalurus catus*	f
White crappie	*Poxmoxis annularis*	f
White perch	*Morone americana*	e
Windowpane	*Scophthalmus aquosus*	m
Winter flounder	*Pseudopleuronectes americanus*	m
Yellow bullhead	*Ictalurus natalis*	f
Yellow perch	*Perca flavescens*	f

TABLE 4-6 ESTIMATED NUMBER IMPINGED AT INDIAN POINT IN 1987 AND TOTAL PERCENT COMPOSITION OF THE 15 MOST ABUNDANT SPECIES* AND ALL SPECIES COMBINED

Species	Unit 2		Unit 3		Both Units		
	Number	Percent	Number	Percent	Number	Percent	Cum. Percent
Atlantic tomcod	684,568	53.6	1,097	0.4	685,665	44.5	44.5
White perch	432,422	33.9	168,015	64.1	600,437	39.0	83.5
Blueback herring	35,259	2.8	62,467	23.8	97,726	6.3	89.8
Hogchoker	34,818	2.7	9,585	3.7	44,403	2.9	92.7
Bay anchovy	24,786	1.9	6,082	2.3	30,868	2.0	94.7
Striped bass	24,879	1.9	3,794	1.4	28,673	1.9	96.6
Rainbow smelt	7,280	0.6	1,782	0.7	9,062	0.6	97.2
Bluefish	6,028	0.5	745	0.3	6,773	0.4	97.6
Alewife	3,562	0.3	1,166	0.4	4,728	0.3	97.9
American eel	4,241	0.3	259	0.1	4,500	0.3	98.2
American shad	2,639	0.2	1,730	0.7	4,369	0.3	98.5
Weakfish	2,688	0.2	310	0.1	2,998	0.2	98.7
Spottail shiner	2,198	0.2	421	0.2	2,619	0.2	98.9
Banded killifish	2,067	0.2	449	0.2	2,516	0.2	99.1
White catfish	1,480	0.1	887	0.3	2,367	0.2	99.3
All species combined	1,276,856		262,306		1,539,162		

* Includes all species comprising over 0.2 percent of the total at the two units combined, and includes 13 of the 15 selected species.

The schedule of plant operation at Unit 2 did not appear to greatly influence estimates of species composition or yearly impingement abundance since Unit 2 operated most of the year. Unit 3, however, had a partial or complete outage from early May through August during which little or no circulating water was sampled (Table 4-7). The outage resulted in less impingement of spring and summer seasonally abundant fishes at Unit 3 (such as Atlantic tomcod, bay anchovy, bluefish, and weakfish) than if the plant had been operating during this period.

4.4 SEASONAL AND YEARLY IMPINGEMENT PATTERNS

Seasonal trends were examined using mean monthly impingement rates (daily count of a taxon adjusted for collection efficiency divided by the daily volume pumped, averaged over each month). Due to a partial or complete outage at Unit 3 from mid-May through August, impingement rates were not available for Unit 3 for June and July. Seasonal patterns and rates for 1987 were compared to the 1982-1986 data which were based on the same stratified sampling design used in the 1987 program.

Impingement patterns in 1987 were substantially different between Unit 2 and Unit 3 (Figure 4-2). Unit 2 exhibited maximum impingement rates during late spring and early summer, principally a result of Atlantic tomcod abundance. These impingement rates were substantially higher than observed during recent years (MMES 1985; NAI 1986, 1987). During this period, Unit 3 was offline and, consequently, Atlantic tomcod collections were almost non-existent. Impingement rates at Unit 3 were highest during winter, principally a result of white perch collections. Overall rates at Unit 3 were similar to that of recent years.

Fifteen species were previously selected for more detailed examination of impingement patterns, based on abundance in impingement collections, designation as representative important species by the U.S. Environmental Protection Agency, and current or potential importance to commercial or sport fisheries (TI 1980b):

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

Monthly impingement rates for 13 of the above species were high enough to warrant description of seasonal patterns. Only three shortnose sturgeon and three Atlantic sturgeon were collected during impingement monitoring in 1987.

Atlantic tomcod were the most numerous fish species impinged in 1987 (Table 4-6). Young-of-the-year fish were considerably more abundant in impingement collections than typical of previous years and occurred in highest numbers during May, June, and July, and subsequently declined in abundance during late summer and fall (Figure 4-3). Atlantic tomcod yearling and older fish were impinged during the winter stratum in very low numbers. This pattern was similar to patterns of tomcod impingement observed in previous years and is consistent with the described life history of the tomcod in which older fish spawn in shoal areas in the winter and young-of-the-year fish are first large

TABLE 4-7 CIRCULATING WATER VOLUME PUMPED ($10^6 M^3$) IN ASSOCIATION WITH IMPINGEMENT SAMPLING AT INDIAN POINT IN 1987

Month	Unit 2	Unit 3	Units 2 and 3
JAN	24.0	36.8	60.8
FEB	11.5	17.6	29.1
MAR	24.2	34.3	58.5
APR	9.6	45.3	54.9
MAY	8.9	5.3	14.2
JUN	4.5	---*	4.5
JUL	4.5	---*	4.5
AUG	22.1	7.5	29.6
SEP	21.1	83.2	104.3
OCT	38.8**	45.4	84.2
NOV	9.8	25.4	35.2
DEC	6.3	11.2	17.5
Total	185.3	312.0	497.3

* No sampling due to unit shutdown.
** Includes 4 October 1987 Ristroph.

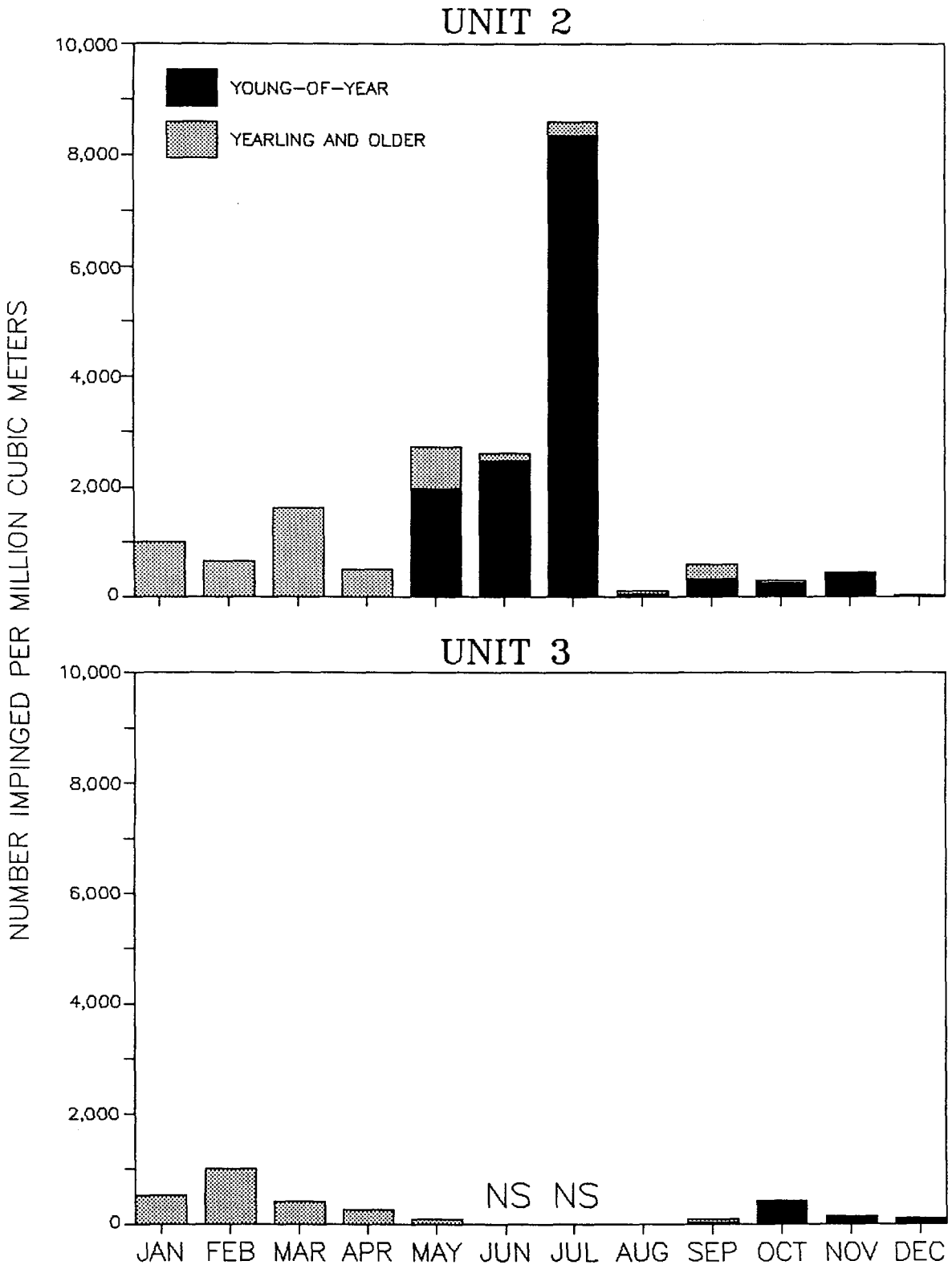

Figure 4-2. Monthly adjusted impingement rates for all taxa combined at Indian Point Units 2 and 3 in 1987, adjusted for collection efficiency.

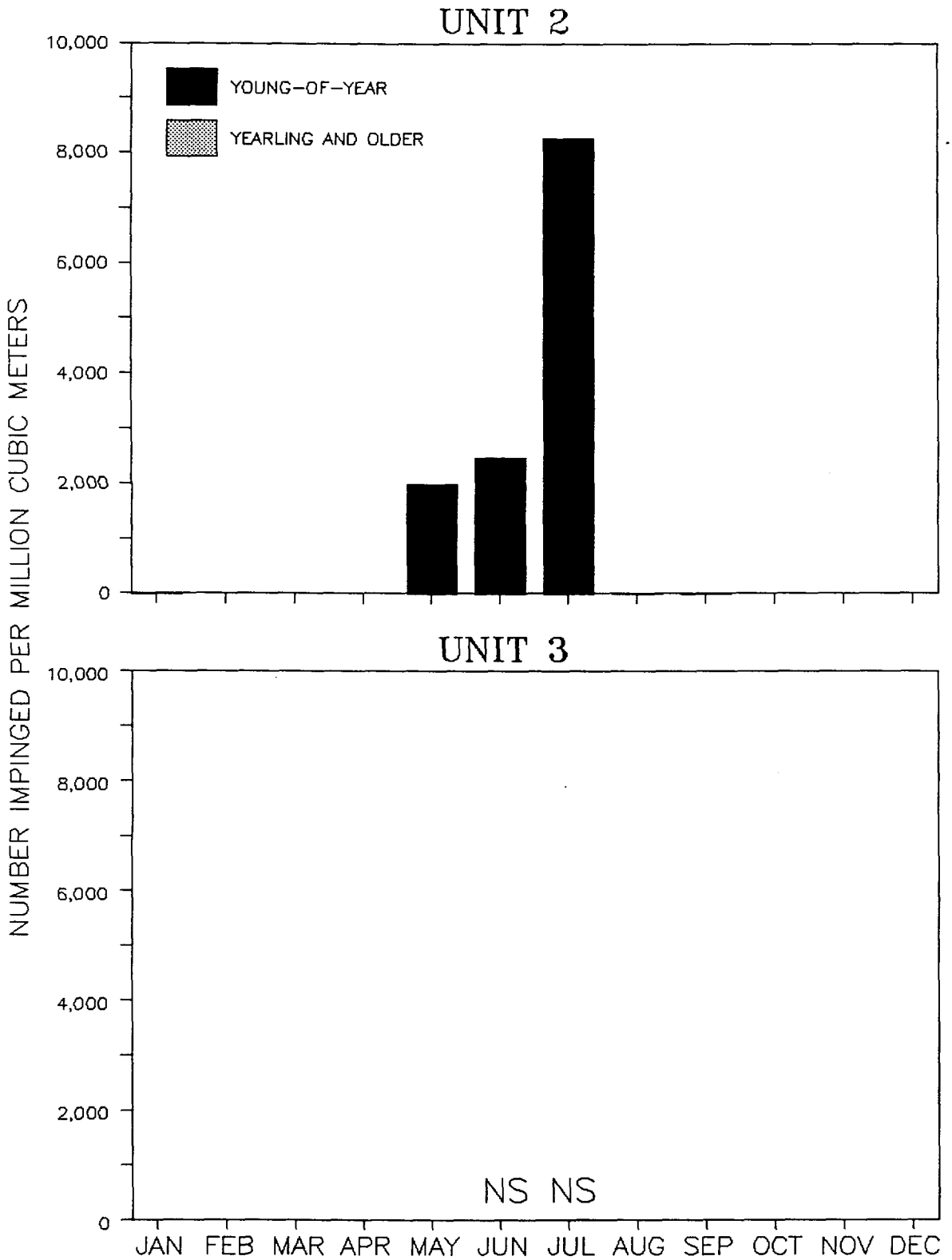

Figure 4-3. Monthly adjusted impingement rates for Atlantic tomcod at Indian Point Units 2 and 3 in 1987, adjusted for collection efficiency.

enough to be impinged by late spring and early summer (TI 1980a). Peak monthly impingement rates for 1987 were much higher than peak rates recorded in previous years (Con Edison 1983; MMES 1984; NAI 1984a, 1986).

White perch were the second most numerous fish impinged in 1987 (Table 4-6). Impingement rates were highest during winter and early spring at both Units 2 and 3, and collections consisted mostly of yearling fish (Figure 4-4). Impingement rates decreased in the spring stratum and were low during summer. Impingement rates increased again in fall as young-of-the-year white perch became abundant during December. This seasonal pattern and the magnitude of monthly impingement rates were consistent with patterns and rates presented in previous years' reports (Con Edison 1983; MMES 1985; NAI 1984a, 1986, 1987).

Bay anchovies were impinged from May through October with yearling and older fish most numerous during July and young-of-the-year fish becoming more numerous during August through October (Figure 4-5). Bay anchovies spawn in the high salinity waters of the lower estuary primarily from June through August (NAI 1985). The yearling and older fish that were impinged beginning in May probably represent a portion of the bay anchovy population that utilize the Indian Point region as a feeding ground prior to spawning (NAI 1985). The young-of-the-year fish impinged from August through October most likely represent the dispersion of early life stages upstream into the lower salinity waters of the lower and middle estuary that are the bay anchovy's nursery grounds. Peak monthly impingement rates and the seasonal pattern of impingement during 1987 were comparable to most previous years (Con Edison 1983; MMES 1985; NAI 1984a, 1986, 1987).

Hogchokers were impinged during most months in 1987 with peak impingement rates from April through October (Figure 4-6). Yearling and older fish comprised the majority of the total hogchoker impingement abundance with young-of-the-year recorded only from September through November. The seasonal pattern of hogchoker impingement was similar to previous years with the exception of 1986 (Con Edison 1983; MMES 1985; NAI 1984a, 1986, 1987).

Blueback herring were impinged primarily from September through November (Figure 4-7). This fall peak consisted principally of young-of-the-year, whereas the limited spring impingement was yearling and older fish. This pattern was similar to that observed in most previous years (Con Edison 1983; MMES 1985; NAI 1984a, 1986, 1987). Yearling and older fish migrate upriver during spring to spawn in the freshwater areas of the river above Catskill and are subject to impingement by Indian Point and other cooling water intakes which they pass on route. During fall, as young-of-the-year fish migrate downriver toward high salinity waters, they too become vulnerable to impingement by these same cooling water intakes. Peak monthly impingement rates in 1987 were within the range reported for previous years.

Rainbow smelt were impinged throughout the year at Indian Point (Figure 4-8). Yearling and older fish were impinged throughout the year with peak rates during April. Young-of-the-year fish were impinged from September through December with peak impingement rates during November. Impingement patterns have been variable for this species in previous years with maximum impingement rates occurring in several different months (NAI 1984a). Peak monthly impingement rates in 1987 (up to $26/10^6 m^3$) were higher than peak monthly rates observed in past years.

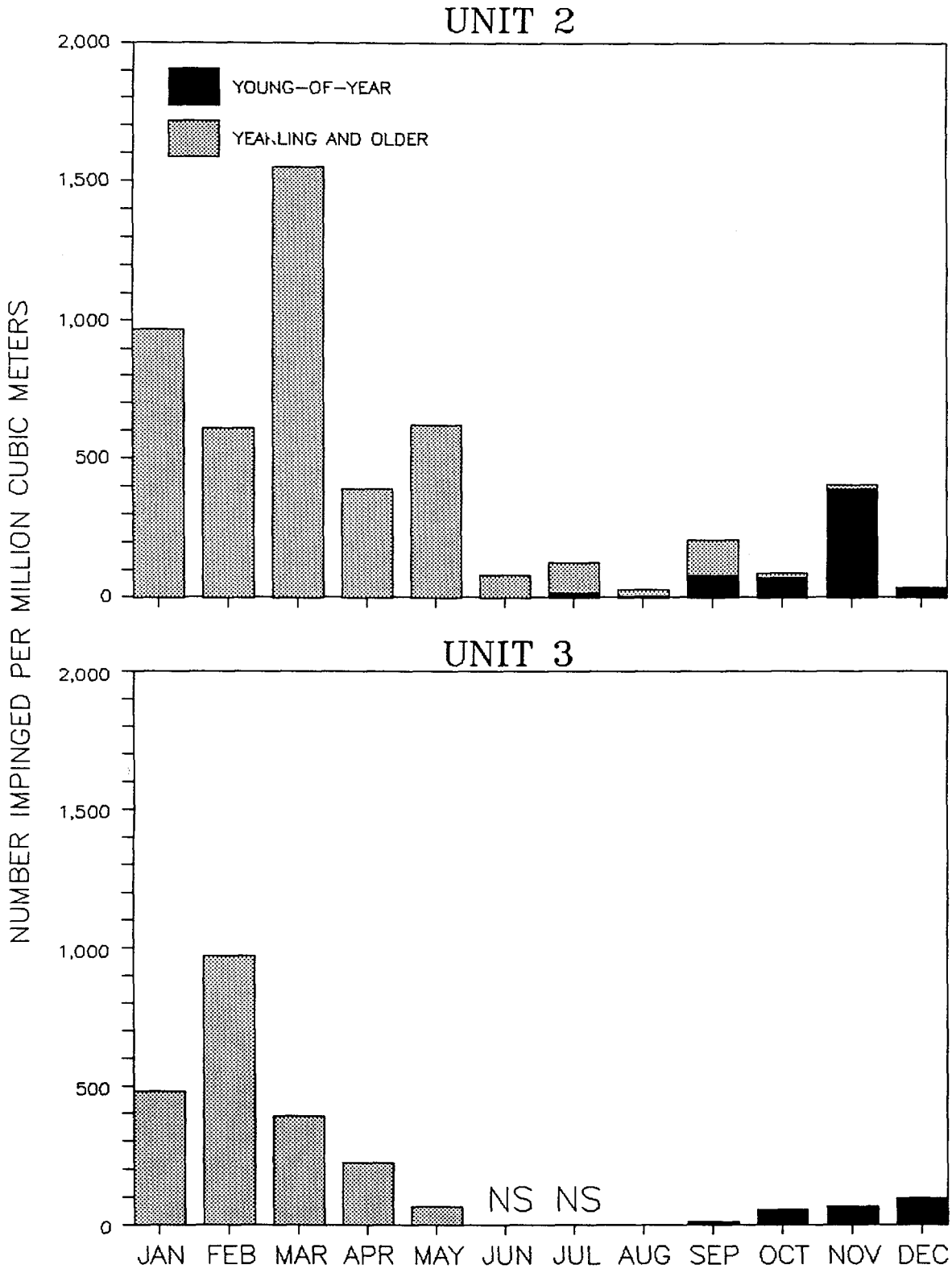

Figure 4-4. Monthly adjusted impingement rates for white perch at Indian Point Units 2 and 3 in 1987, adjusted for collection efficiency.

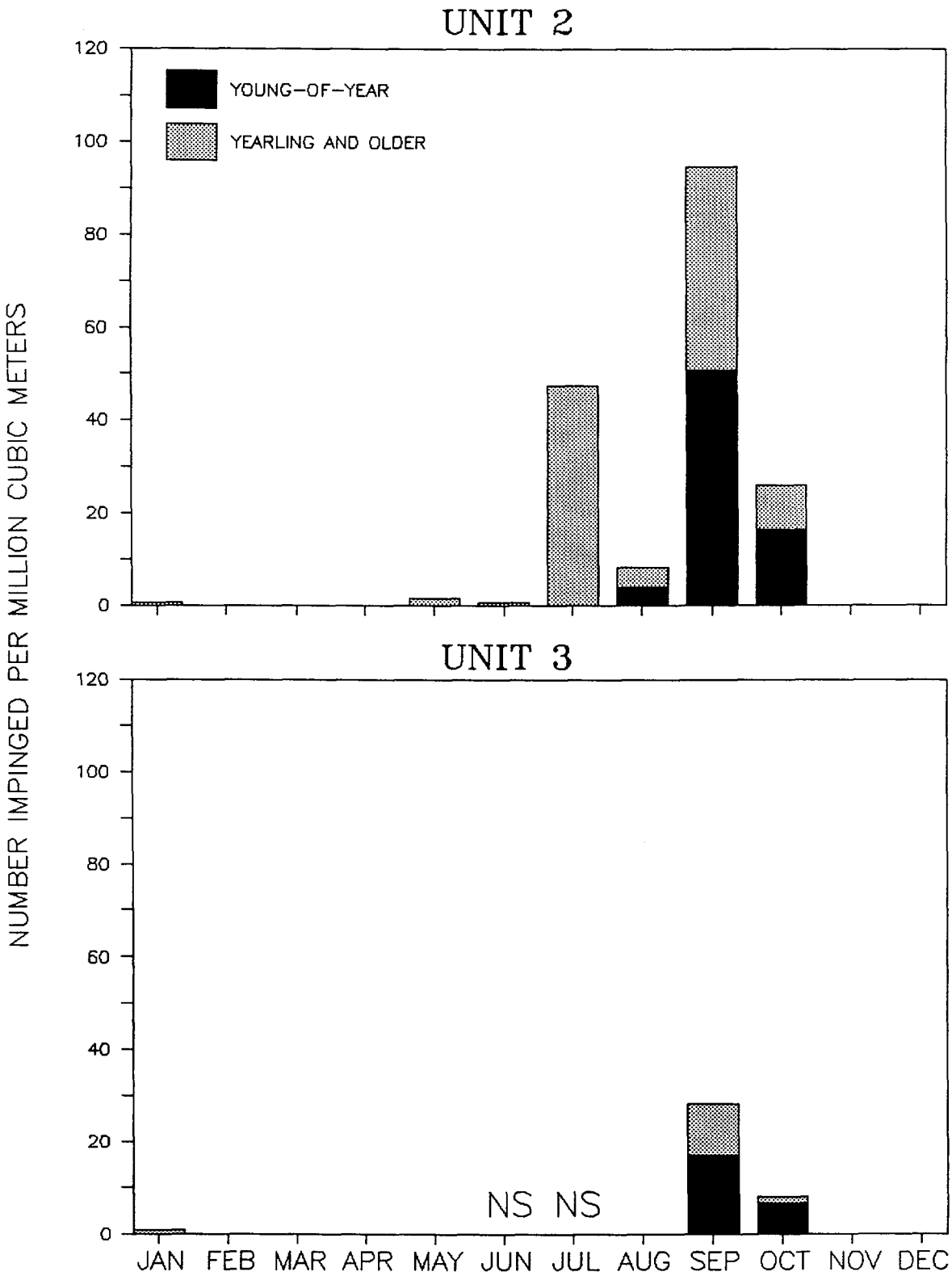

Figure 4-5. Monthly adjusted impingement rates for bay anchovy at Indian Point Units 2 and 3 in 1987, adjusted for collection efficiency.

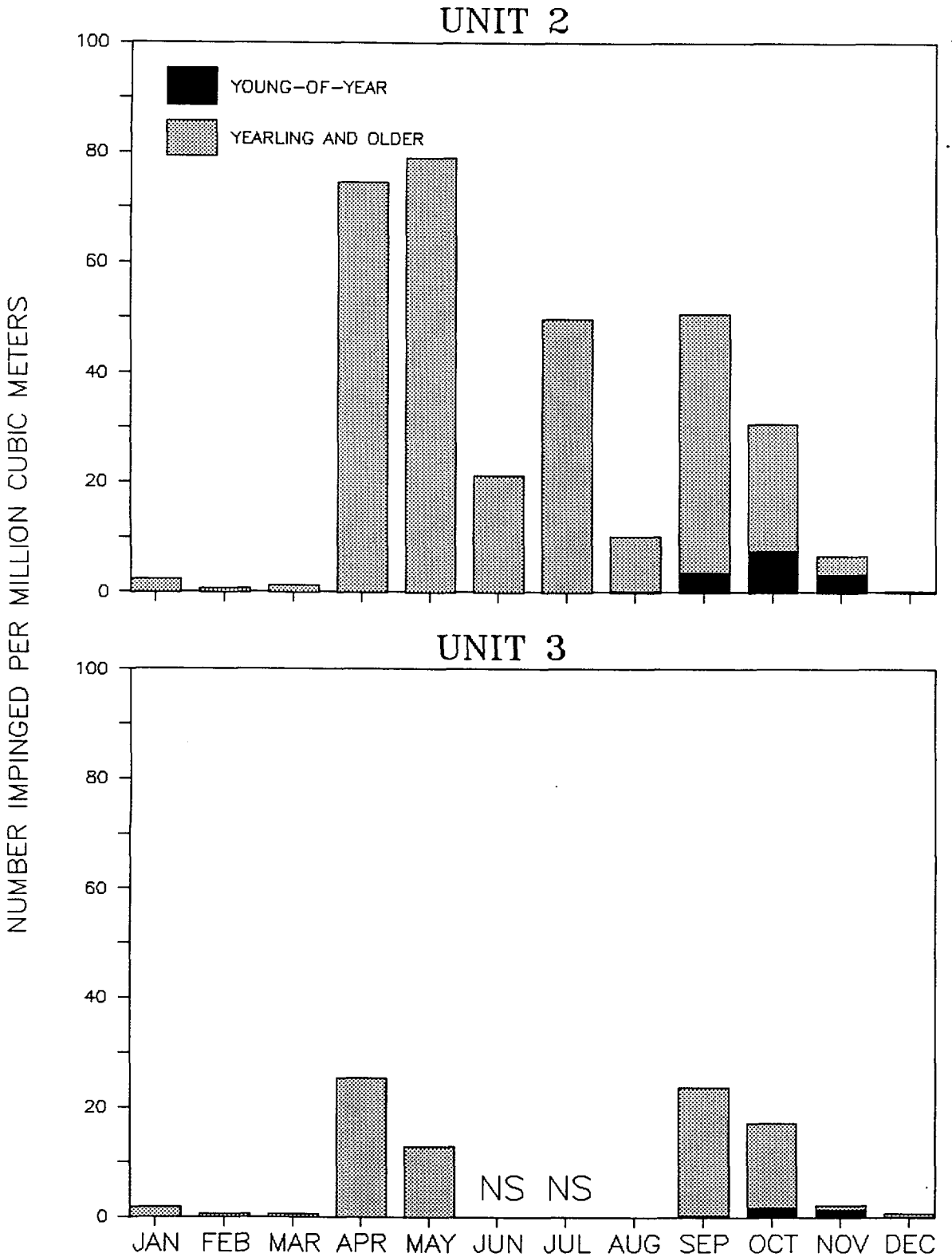

Figure 4-6. Monthly adjusted impingement rates for hogchoker at Indian Point Units 2 and 3 in 1987, adjusted for collection efficiency.

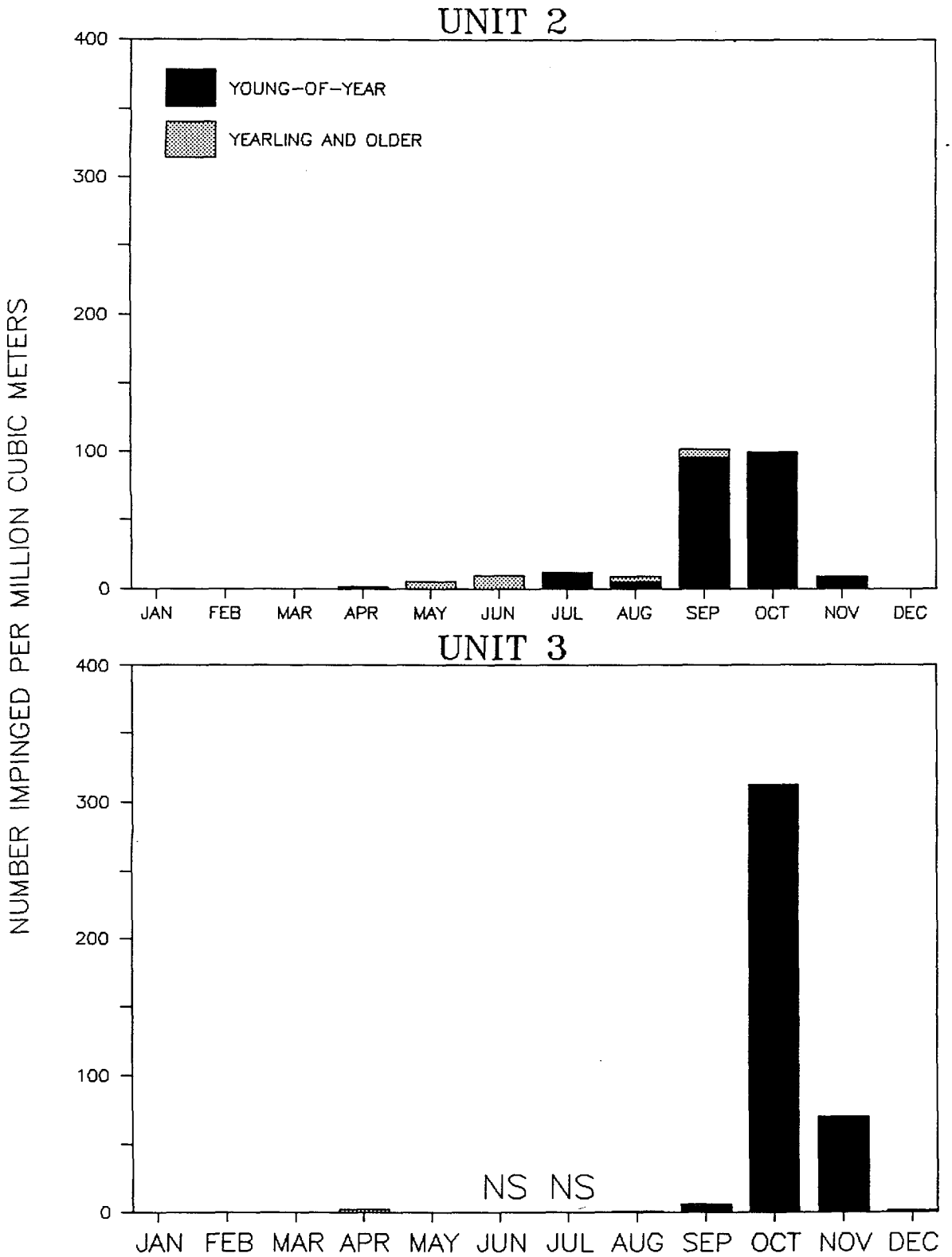

Figure 4-7. Monthly adjusted impingement rates for blueback herring at Indian Point Units 2 and 3 in 1987, adjusted for collection efficiency.

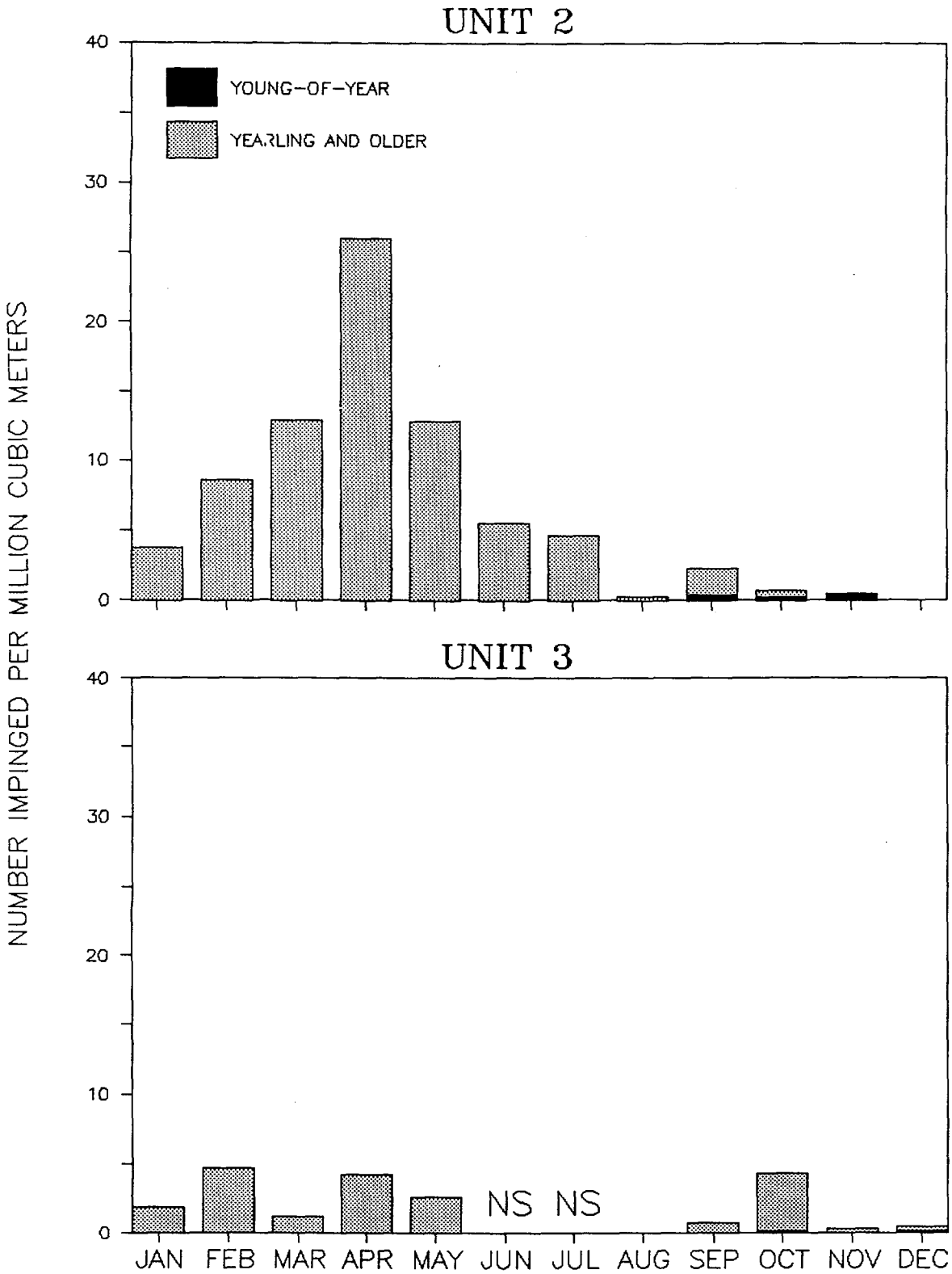

Figure 4-8. Monthly adjusted impingement rates for rainbow smelt at Indian Point Units 2 and 3 in 1987, adjusted for collection efficiency.

American shad yearling and older fish were impinged in low numbers during many months of the year with the peak in September. Young-of-the-year fish were impinged from August through November with peak numbers in September and October (Figure 4-9). This seasonal occurrence pattern was within the range reported for previous years (Con Edison 1983; MMES 1985; NAI 1984a, 1986, 1987). American shad spawn in the fresh water of the upper estuary, and shad eggs and larvae are concentrated in this region (NAI 1985). Transformation of the American shad post yolk-sac larvae to the juvenile stage begins around late June at about 25 C and juveniles subsequently become much more dispersed throughout the estuary. During fall, as water temperatures drop, young-of-the-year shad actively emigrate from the estuary. Variability in the timing of peak impingement of American shad at Indian Point reflects differences in growth and emmigration. Peak monthly impingement rates in 1987 were within the range of peak monthly rates presented in previous reports (Con Edison 1983; MMES 1985; NAI 1984a, 1986, 1987).

Striped bass exhibited a bimodal seasonal impingement pattern (Figure 4-10) similar to that of previous years. Peak impingement occurred during September and October when most collected were young of the year. Impingement during winter and early spring was due to the overwintering of yearling and older striped bass in the deep waters of the lower estuary such as that in the Indian Point area (TI 1980b). Impingement rates for both young-of-the-year and yearling and older striped bass were within the range reported for previous years (Con Edison 1983; MMES 1985; NAI 1984a, 1986, 1987).

Weakfish were impinged at Units 2 and 3 in 1987 only as young-of-the-year fish (Figure 4-11). Impingement occurred from July through December with the peak impingement rate during September. Weakfish spawn at the mouths of estuaries and the juveniles subsequently move upstream to utilize the low salinity water of the estuary as a nursery area (NAI 1985). Peak monthly impingement rates in 1987 (up to $10/10^6 m^3$) were lower than impingement rates observed in other years (Con Edison 1983; MMES 1985; NAI 1984a, 1986, 1987).

Bluefish were impinged at Indian Point from June through October only as young-of-the-year (Figure 4-12). Peak impingement occurred during July. Monthly impingement rates at Indian Point in 1987 were generally within the range presented in previous reports (Con Edison 1983; MMES 1985; NAI 1984a, 1986, 1987).

White catfish impingement was greatest during late fall and winter as in past years (Figure 4-13). Yearling and older white catfish predominated during winter and early spring while young-of-the-year catfish were most abundant during fall. Adult white catfish overwinter in deep water areas of the lower Hudson River such as Indian Point and during spring move upstream into the low salinity and shallow water regions of the middle and upper estuary to spawn (TI 1981). Spawning occurs during spring in waters with salinities below 2 ppt and young-of-the-year fish are first present beginning around July and continuing through December with peak densities upstream of Indian Point (NAI 1985). Monthly adjusted impingement rates in 1987 were within the range observed in previous years.

Alewives were impinged from February through November (Figure 4-14). Yearling and older fish were recorded primarily from February through September and young of the year from July through November. This was similar to previous

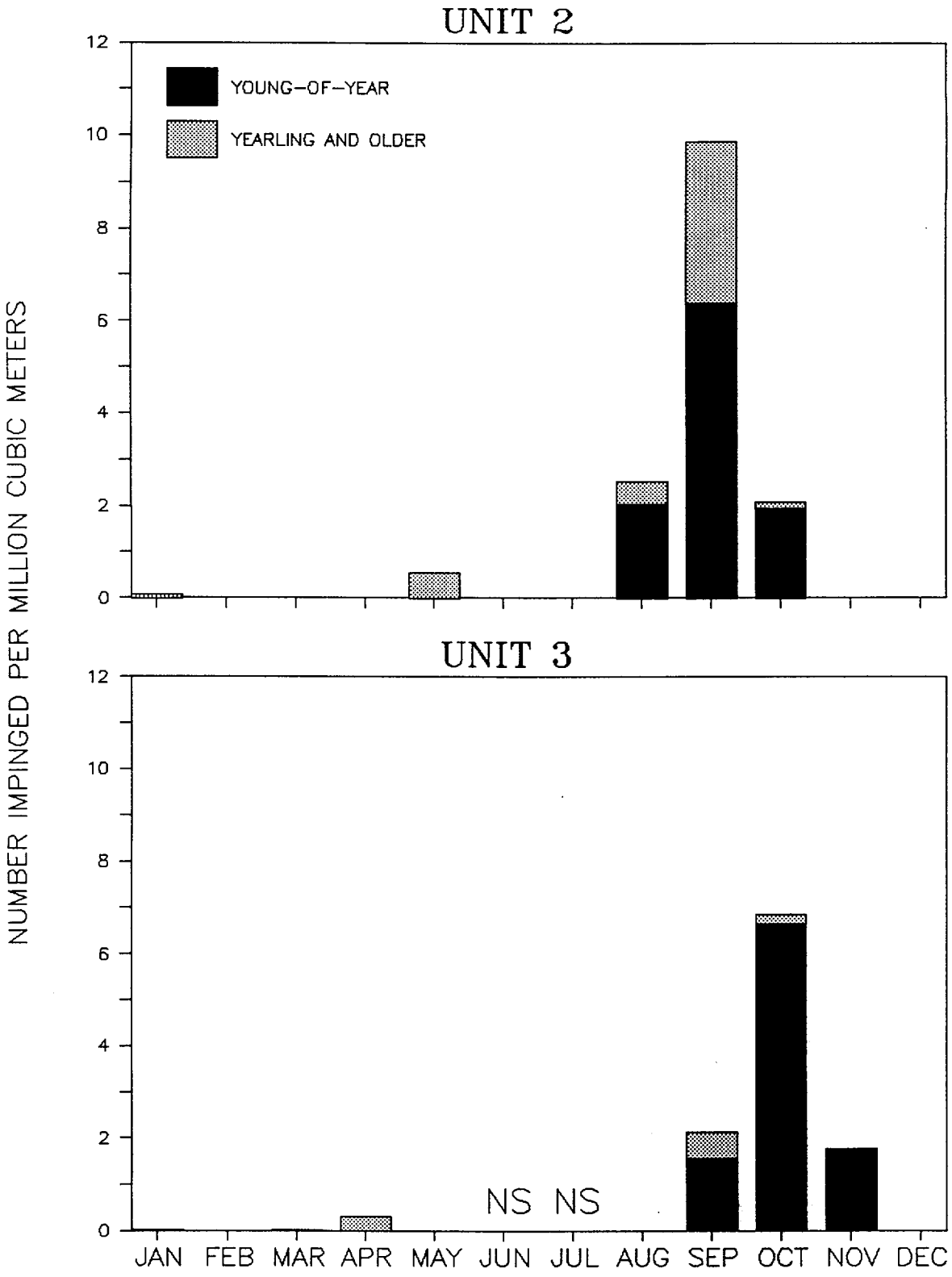

Figure 4-9. Monthly adjusted impingement rates for American shad at Indian Point Units 2 and 3 in 1987, adjusted for collection efficiency.

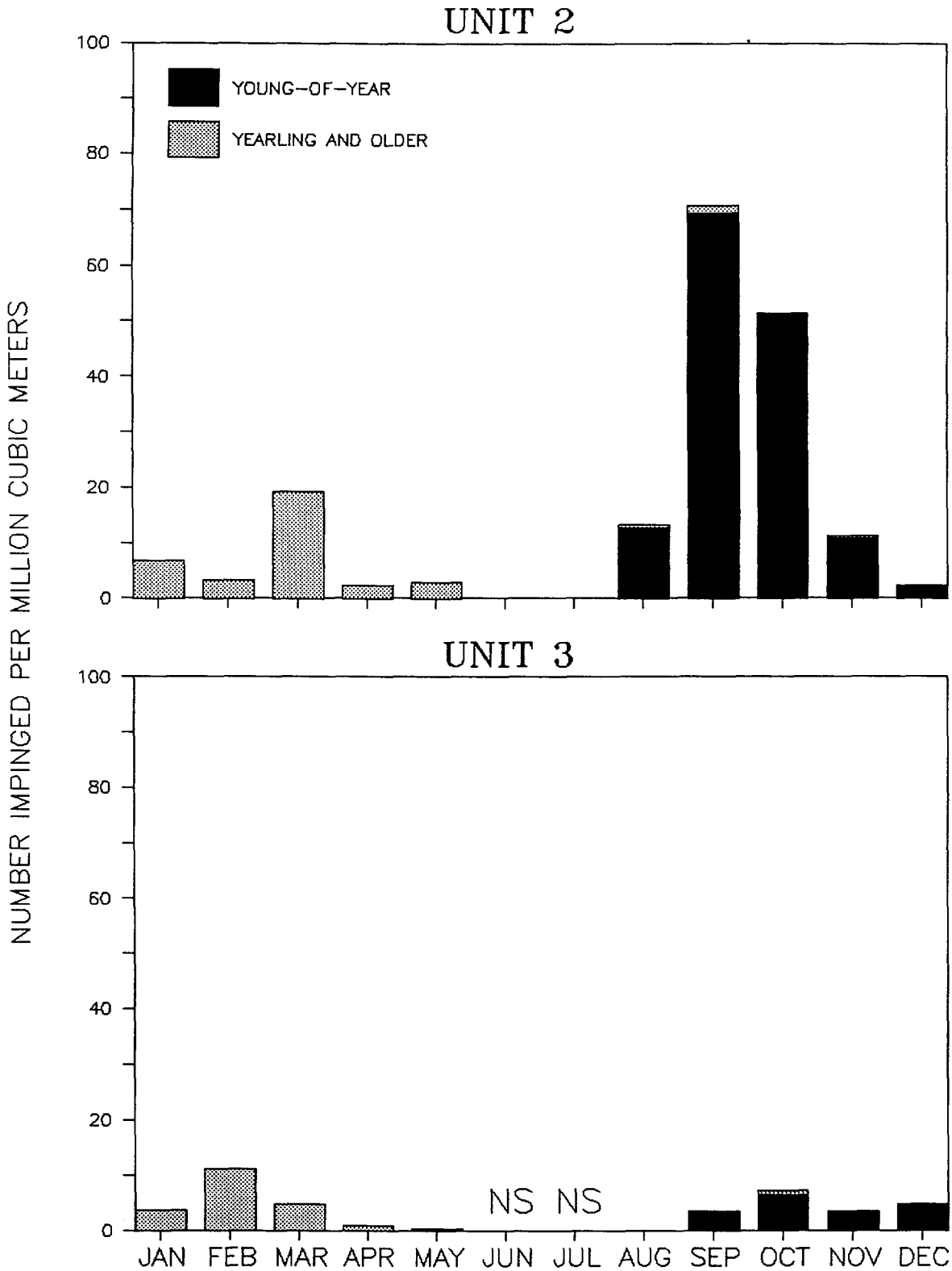

Figure 4-10. Monthly adjusted impingement rates for striped bass at Indian Point Units 2 and 3 in 1987, adjusted for collection efficiency.

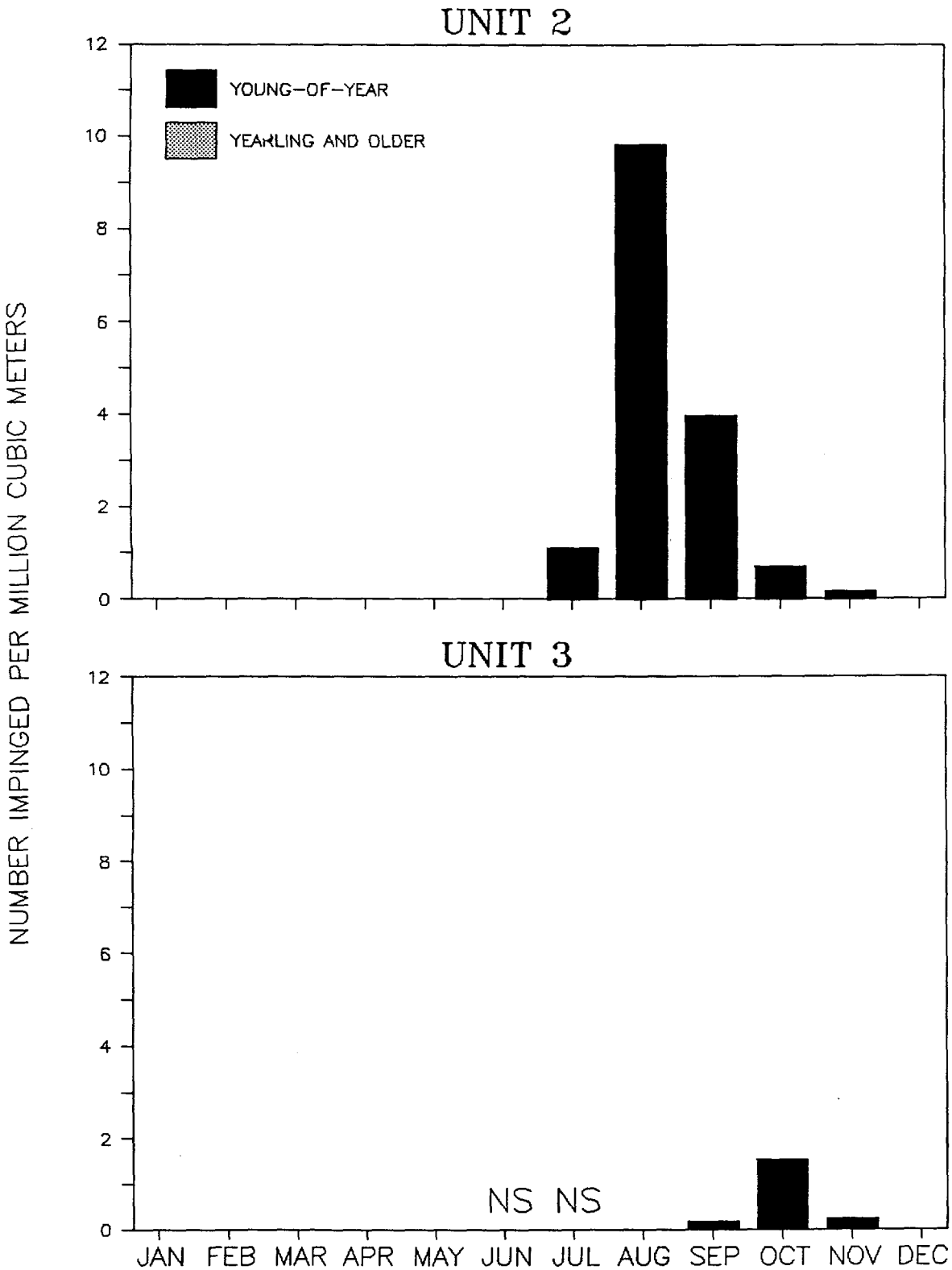

Figure 4-11. Monthly adjusted impingement rates for weakfish at Indian Point Units 2 and 3 in 1987, adjusted for collection efficiency.

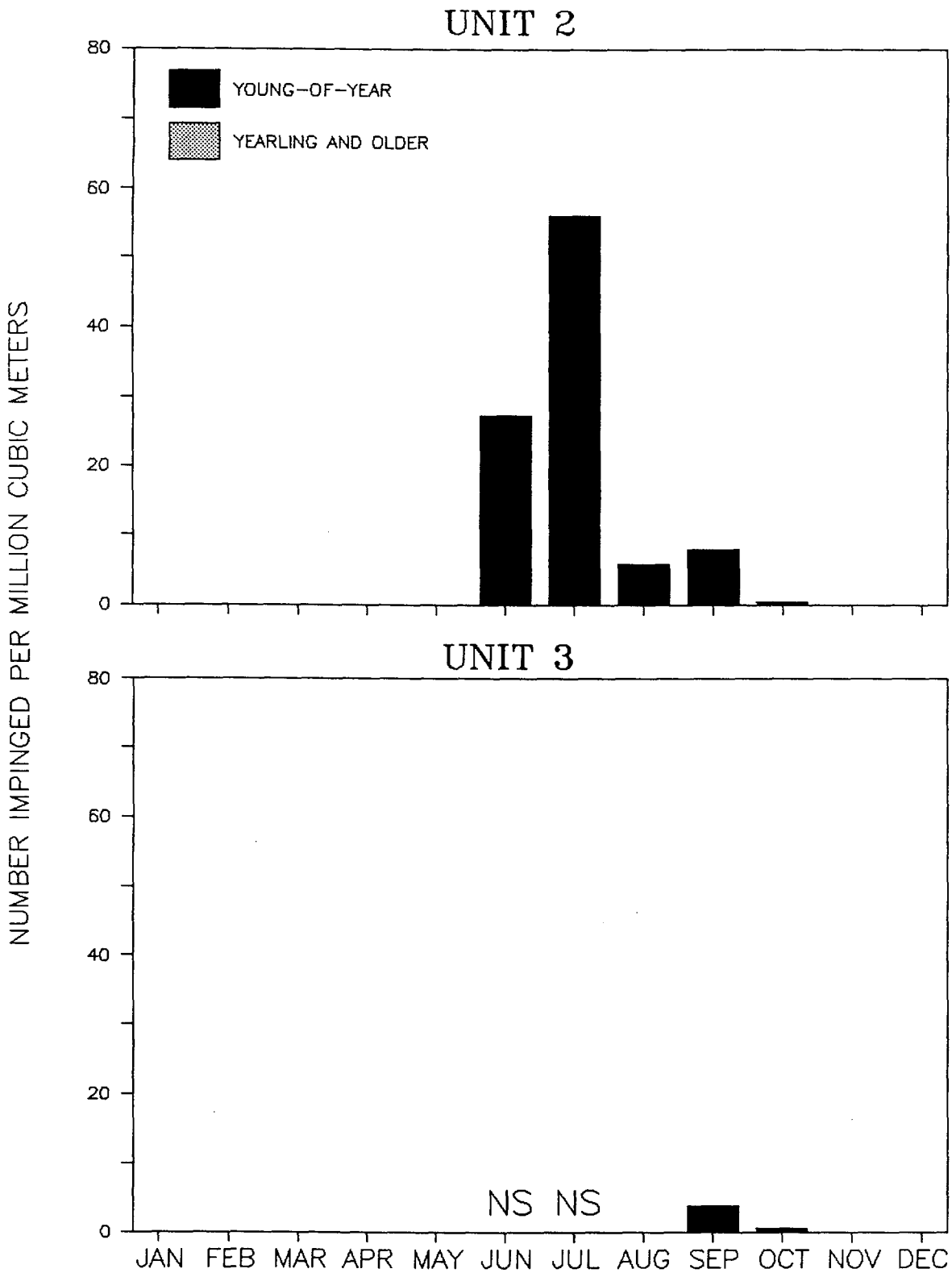

Figure 4-12. Monthly adjusted impingement rates for bluefish at Indian Point Units 2 and 3 in 1987, adjusted for collection efficiency.

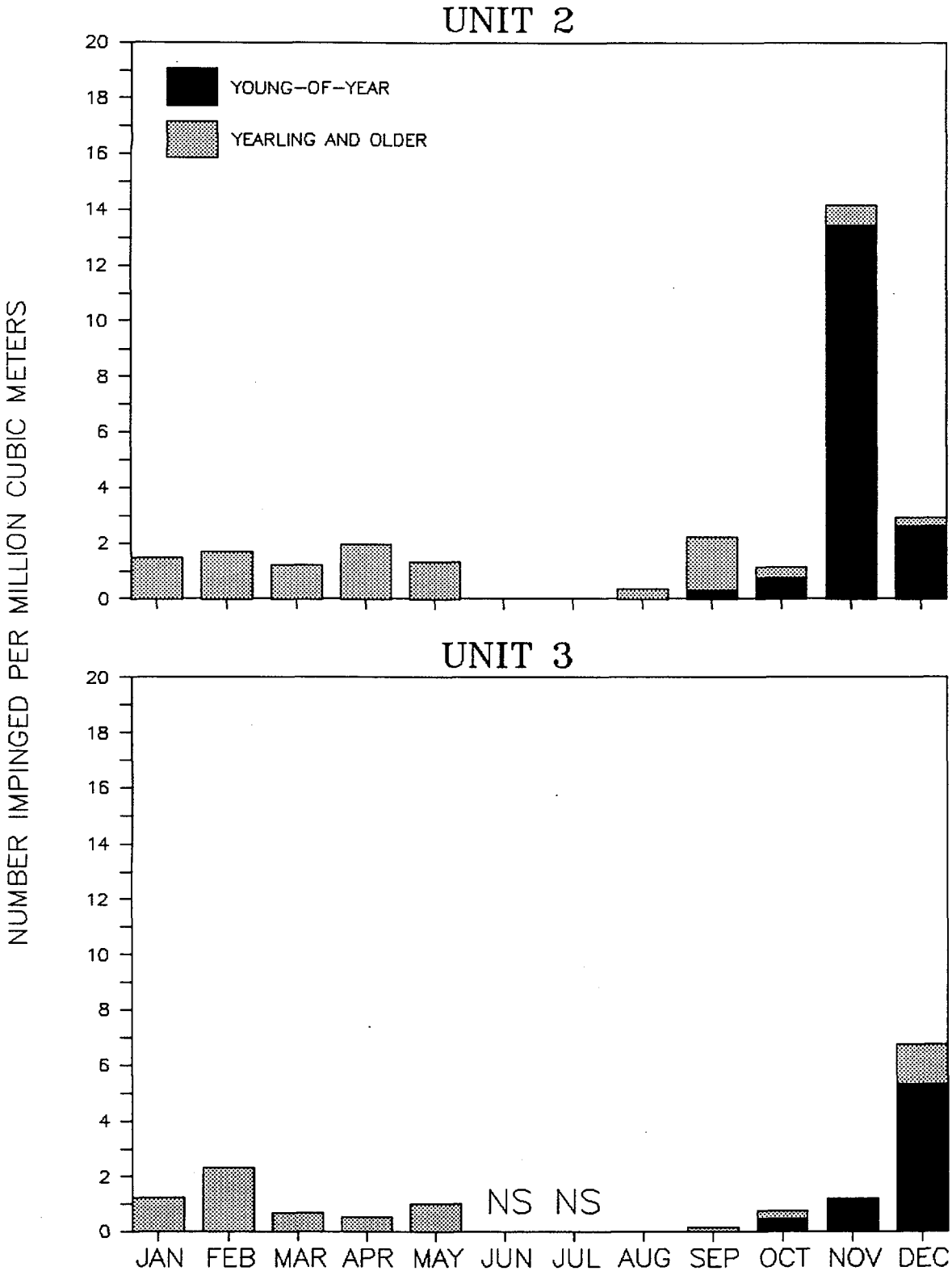

Figure 4-13. Monthly adjusted impingement rates for white catfish at Indian Point Units 2 and 3 in 1987, adjusted for collection efficiency.

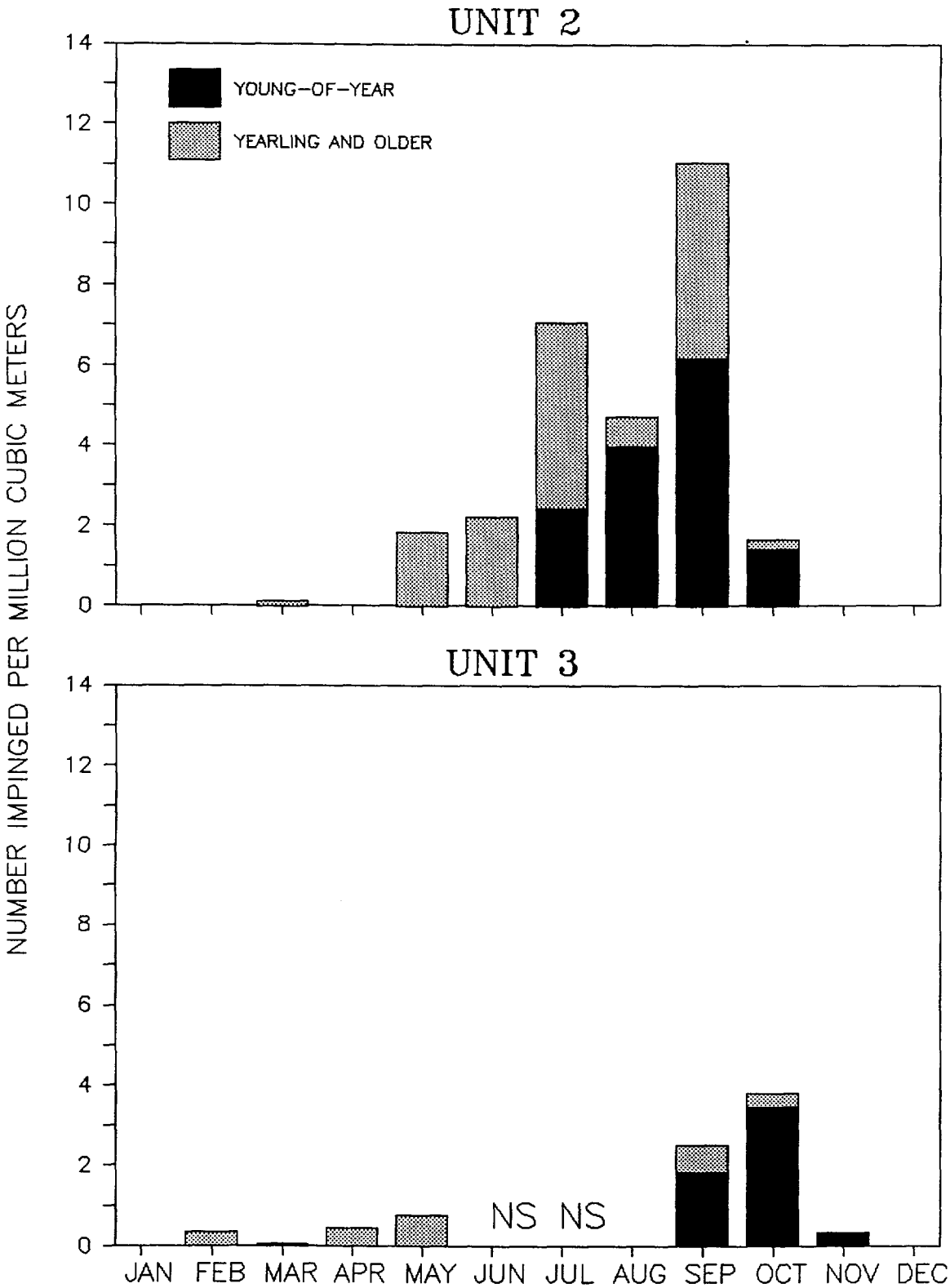

Figure 4-14. Monthly adjusted impingement rates for alewife at Indian Point Units 2 and 3 in 1987, adjusted for collection efficiency.

years and corresponded with the generalized life history of the alewife in which spawning adults migrate upriver in the spring past Indian Point to spawn in fresh water, and both adults and young-of-the-year fish migrate downriver past Indian Point to the ocean in the fall (NAI 1985). Peak monthly impingement rates were within the range observed in past years.

Spottail shiners were impinged principally during the winter and early spring (Figure 4-15). The majority of the spottail shiners impinged were yearling and older fish that were probably overwintering in deeper water areas such as Indian Point (NAI 1985). The young-of-the-year fish impinged during fall were presumably the product of the spring and early summer spawning in the upper estuary. The seasonal pattern and magnitudes of monthly impingement rates were consistent with previous years (Con Edison 1983; MMES 1985; NAI 1984a, 1986, 1987).

A total of three Atlantic sturgeon and shortnose sturgeon were impinged at Indian Point during 1987 (Table 4-8). The fish ranged in total length from 320 to 710 mm and in weight from 94 to 1,845 gm. Of the six fish impinged, one was collected alive and released back to the river.

4.5 BLUE CRAB IMPINGEMENT

Blue crabs were impinged at Indian Point from May through December 1987 (Table 4-9). A total of 1,958 crabs were collected, with a total weight of 187 kg. This number of crabs was within the range of numbers impinged at Indian Point since blue crab impingement monitoring began in 1983 (348-12,316). Monthly impingement rates unadjusted for collection efficiency were calculated to facilitate comparison of blue crab impingement between Units 2 and 3. Impingement rates were notably higher at Unit 2 than Unit 3 with peak rates occurring during October, and ranged from $10.8/10^6 m^3$ at Unit 2 to $4.4/10^6 m^3$ at Unit 3 (Figure 4-16).

As anticipated, no blue crabs were impinged during the first four months of 1987 (Table 4-9). Impingement abundance and total weight increased through summer, peaked during October, and subsequently declined to near zero by December. Blue crabs undergo extensive seasonal migrations related to mating and spawning (Lippson et al. 1980; Williams 1965) and the pattern of impingement abundance at Indian Point probably reflects this migration. Mature male and female crabs migrate into shallow and low salinity water during spring and early summer months to mate. Juvenile crabs hatched during the previous years spawning also move upstream and into the shallows. During fall as temperatures cool, females move downriver to the higher salinity waters (20-32 ppt) to spawn (Lippson et al. 1980), while males remain upriver in the low salinity waters throughout the year (Williams 1965). Females can spawn 2-9 months after mating but most often wait until the following spring. By late fall and winter, the male and juvenile crabs in the upriver regions move offshore into deeper waters where they burrow into the bottom and become inactive.

Blue crab males accounted for approximately 76 percent of blue crabs impinged at the Indian Point Generating Station in 1987 (Tables 4-10, B-11, and B-13). A ratio of 3 males to 1 female is fairly typical of blue crab populations in low salinity areas like Indian Point (Williams 1965), since mature females enter these areas only to mate and subsequently return to high salinity waters in the lower estuary to spawn, while males remain in the low salinity waters

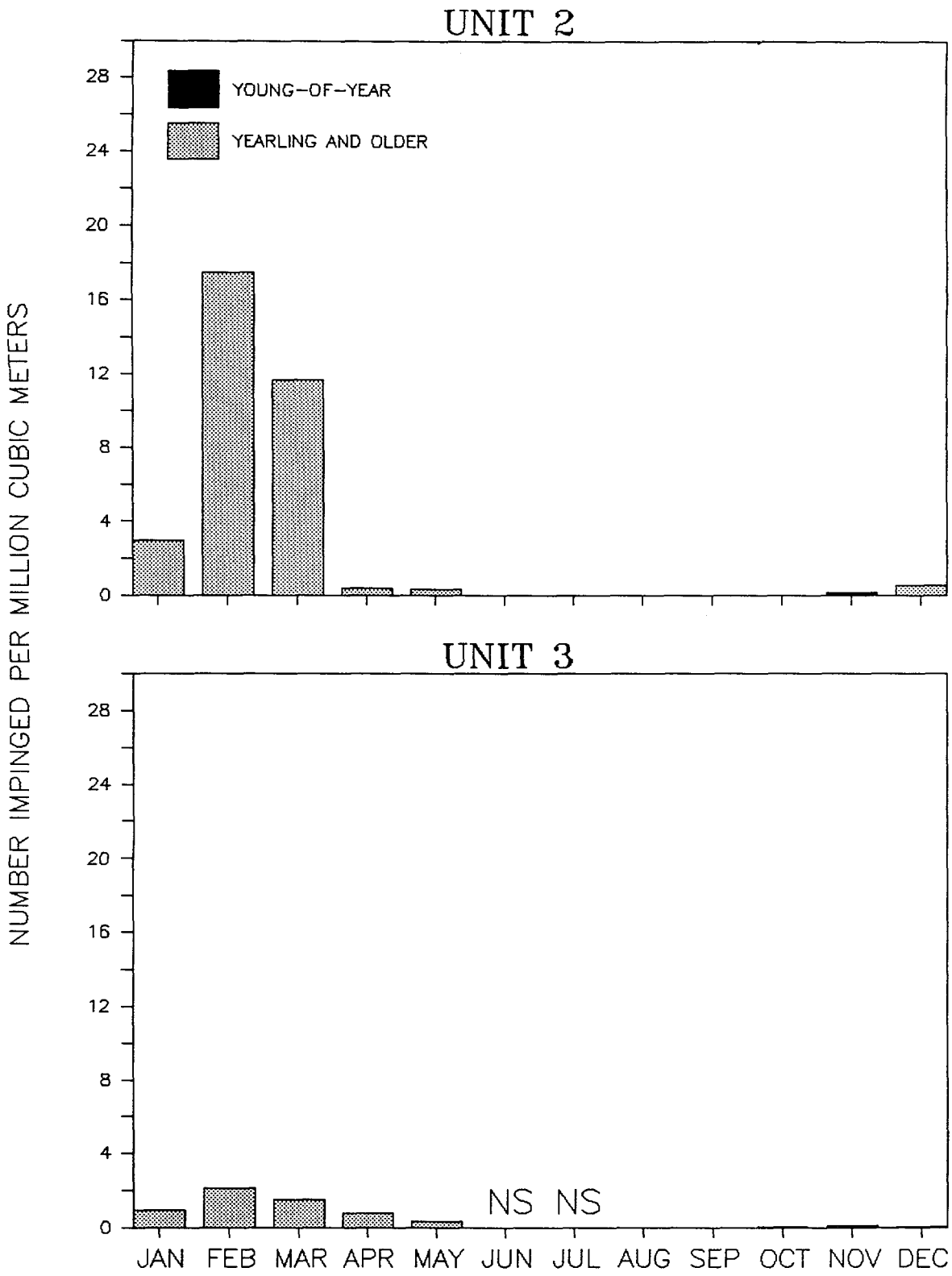

Figure 4-15. Monthly adjusted impingement rates for spottail shiner at Indian Point Units 2 and 3 in 1987, adjusted for collection efficiency.

TABLE 4-8 STURGEON IMPINGED AT INDIAN POINT UNITS 2 AND 3 DURING 1987

Species	Date	Unit	Length (mm TL)	Weight (grams)	Condition
Shortnose	27 FEB	2*	710	1,845	Alive**
Shortnose	08 MAR	2	320	127	Dead
Shortnose	29 APR	3	433	325	Dead
Atlantic	02 MAY	2	326	181	Dead
Atlantic	08 AUG	2	432	251	Dead
Atlantic	27 SEP	3	---	94	Dead

* Screen 26.
** Alive fish were released to the river away from intake screens.

TABLE 4-9 TOTAL NUMBERS AND WEIGHTS OF BLUE CRABS IMPINGED EACH MONTH AT INDIAN POINT DURING JANUARY-DECEMBER 1987

COUNT

Unit	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	Total
2	0	0	0	0	6	21	79	306	241	305	10	3	971
3	0	0	0	0	0	NS	NS	0	287	542	157	1	987
Total	0	0	0	0	6	21	79	306	528	847	167	4	1,958

WEIGHT (G)

Unit	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	Total
2	0	0	0	0	532	3,235	7,651	46,456	40,641	14,057	170	507	113,249
3	0	0	0	0	0	NS	NS	0	51,377	20,987	1,183	2	73,549
Total	0	0	0	0	532	3,235	7,651	46,456	92,018	35,044	1,353	509	186,798

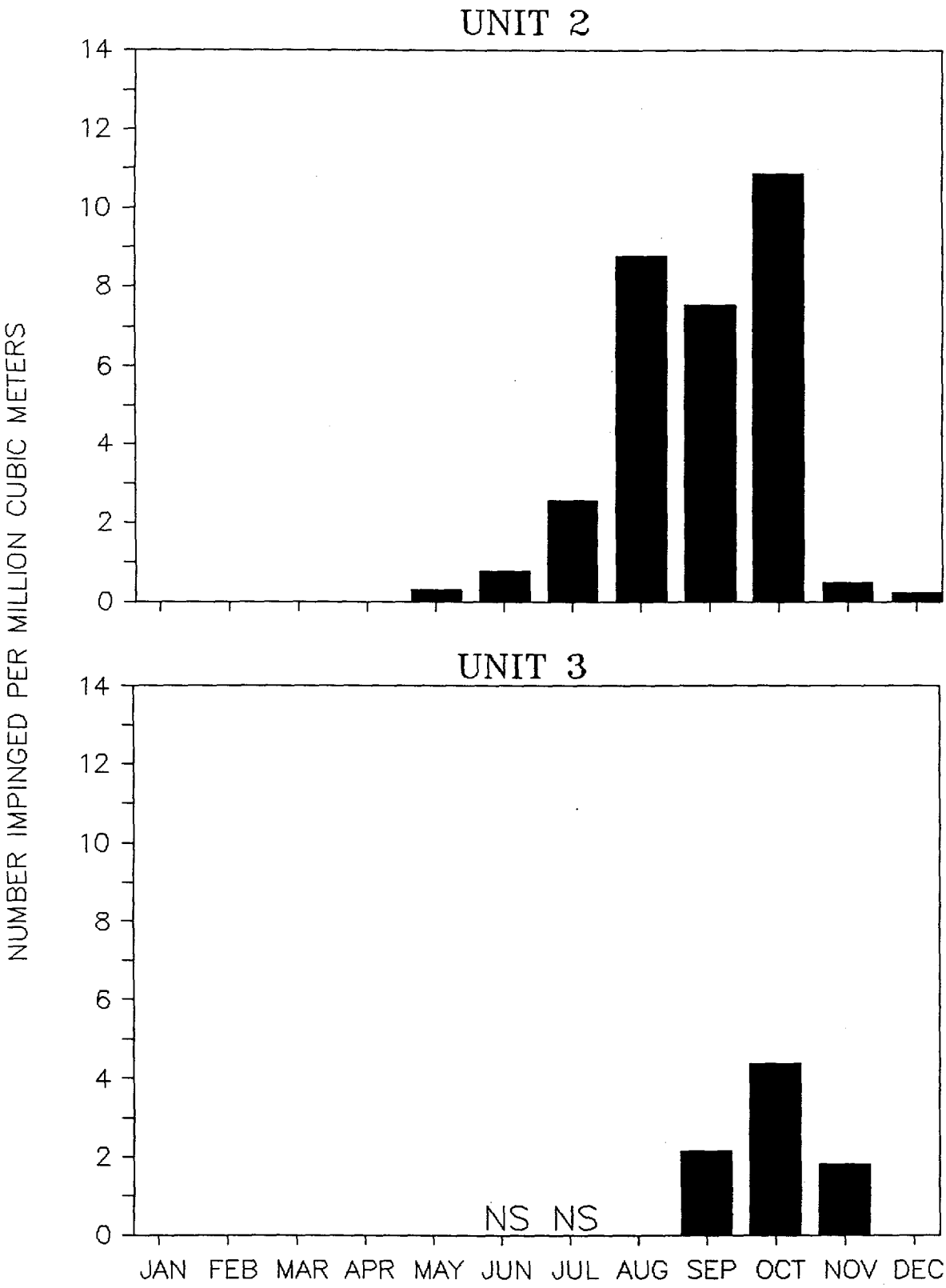

Figure 4-16. Monthly impingement rates for blue crab at Indian Point Units 2 and 3 in 1987, unadjusted for collection efficiency.

TABLE 4-10 MONTHLY COUNTS BY SEX, SURVIVAL, AND CONDITION OF BLUE CRABS IMPINGED AT INDIAN POINT JANUARY-DECEMBER 1987

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	Total
Sex													
Male	0	0	0	0	6	21	66	222	360	664	126	4	1,469
Female	0	0	0	0	0	0	13	80	167	171	41	0	472
Undetermined	0	0	0	0	0	0	0	4	0	0	0	0	4
Total	0	0	0	0	6	21	79	306	527*	835*	167	4	1,945
Survival													
Alive	0	0	0	0	4	18	76	243	398	757	148	4	1,648
Dead	0	0	0	0	2	3	3	63	129	78	5	0	283
Total	0	0	0	0	6	21	79	306	527*	835*	153*	4	1,931
Condition													
Intact	0	0	0	0	5	12	28	156	282	646	147	3	1,279
Missing parts	0	0	0	0	1	9	51	150	245	189	6	1	652
Total	0	0	0	0	6	21	79	306	527*	835*	153*	4	1,931

* Note: Data for this category not recorded for all crabs caught during this month.

after mating for the remainder of their lives. Males were more abundant than females during every month collected with no females being collected at all at the beginning (May and June) and end (December) of their period of occurrence (Table 4-10). The increased number and proportion of female crabs in August and September may reflect the period during which mating occurs.

The blue crabs collected in impingement samples exhibited a bimodal distribution in carapace width (Figure 4-17). The higher mode, first evident in July samples at 80-99 mm carapace width, increased through late summer and fall such that by October, the mode was at 140-169 mm (Table B-12). This mode undoubtedly reflects utilization of the Indian Point region by adult crabs with the increases in modal size resulting in the rapid growth and molting which occurs in estuaries during summer. The second and smaller mode was first evident in impingement collections in September at 30-50 mm carapace width. These individuals continued to be abundant in impingement collections through October. This mode is clearly a result of young-of-the-year blue crabs utilizing the estuary as a late summer nursery area.

Survival averaged 85.3 percent for crabs subsampled for survival (Table 4-10). This was higher than the average survival rates observed in 1983, 1985, and 1986 (72 percent) (NAI 1984a, 1986, 1987) but was within the range of monthly rates observed in 1984 (47-100 percent) (MMES 1985). Survival increased from a low of approximately 66 percent in May to 100 percent in December. The higher survival rates during fall was similar to the pattern observed in 1983-1985. During the period of peak blue crab impingement, survival was more than 90 percent.

The highest proportion of intact crabs occurred in November (96.1 percent) and the lowest proportion in July (35.4 percent; Table 4-10). Overall, the proportion of intact crabs at Units 2 and 3 averaged 66.2 percent.

None of the 2,280 blue crabs tagged and released during 1986 (NAI 1987) were recaptured during impingement collections at Indian Point during 1987. This result indicates that the same individual crabs may not return to the Indian Point vicinity in subsequent years.

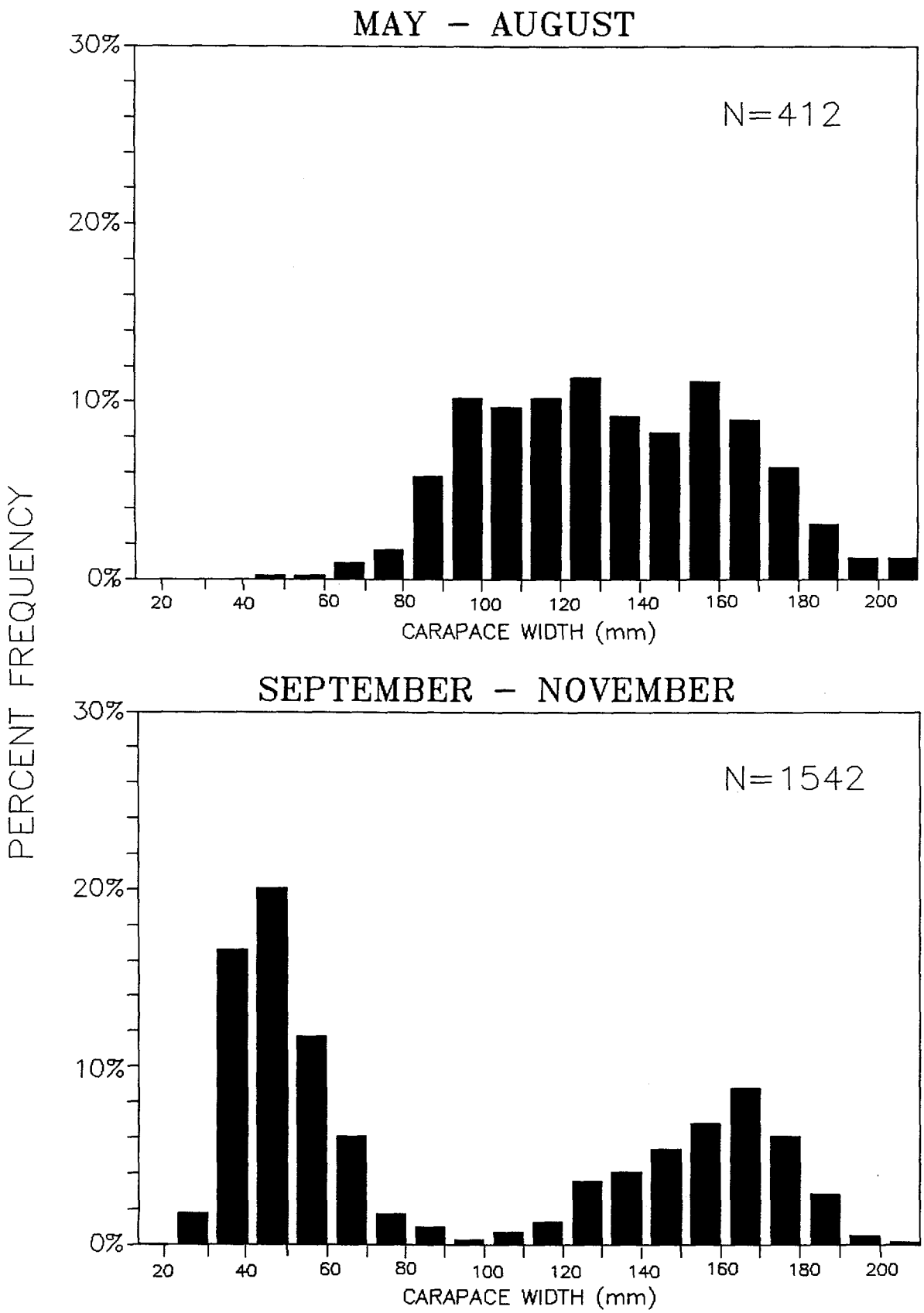

Figure 4-17. Frequency distribtuion of carapace width (mm) for blue crab collected at Indian Point Units 2 and 3 in 1987.

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APPENDIX A

DATA CALCULATION PROCEDURES

APPENDIX A

DATA CALCULATION PROCEDURES

Impingement data were collected separately at intake Screens 21-25, 26, and 31-36. In order to provide standard, unit-wide sample data for Unit 2, impingement data from Screens 21-25 and 26 were combined within each sample day. The impingement statistics calculated from Units 2 and 3 1987 data are:

- Number of fish impinged on each sampling day at each unit (Equation 1).
- Total number of fish impinged over the whole year (Equation 2).
- Standard error of the total estimated number of fish impinged (Equation 3) and the coefficient of variation (Equation 4).
- Total estimated weight of fish impinged in each stratum and at each unit (Equation 5).
- Mean daily fish impingement rates standardized to the volume of water sampled (Equation 6).
- Mean daily blue crab impingement rates standardized to the volume of water sampled (Equation 7).

Calculations

To estimate the number of fish actually impinged on a sampling day, the count from the day's impingement collection was divided by the corresponding collection efficiency (Equation 1):

$$Y_{im} = \sum_{L=1}^{4} \left(C_{Lim} / E_{im} \right) \qquad \text{(Equation 1)}$$

where

Y_{im} = Estimated number of fish impinged on day i at Unit m.

C_{Lim} = Count for length class L on day i at Unit m.

E_{im} = Collection efficiency estimate for day i at Unit m (calculated as shown in Section 3.2).

At Unit 2, the non-Ristroph (Screens 21-25) and the Ristroph screens were treated separately through Equation 1. The adjusted daily estimates (Y_{im}) for each screen type were then summed to produce the overall adjusted daily estimate for Unit 2.

Within each seasonal stratum (h), a mean (Y_{hm}) and a variance S^2_{hm}) were calculated for the n_{hm} values of the daily estimate Y_{im} (where n_{hm} = the number of sampling days in stratum h at Unit m). The total number of fish impinged over the whole year was estimated by Equation 2:

$$T_m = \sum_{h=1}^{4} \left(N_{hm} \times Y_{hm} \right) \qquad \text{(Equation 2)}$$

where

T_m = Total estimated number of fish impinged at Unit m.

N_{hm} = Number of days in stratum h that Unit m operated (a unit was considered to be operating if any circulating water was being pumped).

Y_{hm} = Mean daily estimate for stratum h at Unit m.

This estimate of the total number of fish impinged (T_m) is equivalent to the number which would result from generating an annual estimate from each of the daily estimates and then averaging them using the appropriate stratified sampling formula. Therefore, its standard error can be calculated from the within-stratum variances as a measure of the estimate's precision (Equation 3);

$$S.E._m = \sqrt{\sum_{h=1}^{4} \left(\left(N_{hm} \quad (N_{hm} - n_{hm})/n_{hm} \right) S^2_{hm} \right)} \qquad \text{(Equation 3)}$$

where

$S.E._m$ = Standard error of the total estimated number of fish impinged at Unit m.

N_{hm}, n_{hm}, S^2_{hm} = as defined on the previous page.

The stratified mean daily impingement estimate and standard error of the stratified mean can be calculated by dividing T_m or $S.E._m$ by the total number of operating days at Unit m. The coefficient of variation was calculated to relate the precision to the total estimate (Equation 4):

$$C.V. = \frac{S.E._m}{T_{hm}} \times 100\% \qquad \text{(Equation 4)}$$

where

C.V. = Coefficient of variation.

$S.E._m$ = As defined above.

T_{hm} = Estimated number of fish impinged in stratum h at Unit m.

The total weight of fish impinged for each stratum was estimated using Equation 5:

$$W_{hm} = \left(w_{hm} / \sum_{L=1}^{4} C_{Lhm} \right) Y_{hm} N_{hm} \qquad \text{(Equation 5)}$$

where

W_{hm} = Total estimated weight of fish impinged in stratum h at Unit m.

w_{hm} = Total weight of fish actually impinged in stratum h at Unit m.

C_{Lhm} = Total count of fish actually collected in length class L in stratum h at Unit m.

N_{hm}, Y_{hm} = As defined above.

Mean daily impingement rates were calculated by standardizing the daily impingement estimates (adjusted for collection efficiency) by dividing by each sample day's circulating water volume:

$$A_{km} = 1/n_{km} \sum_{i=1}^{n_{km}} \left[\left(\sum_{L=1}^{4} C_{Likm}/E_{ikm} \right) /V_{ikm} \right] \qquad \text{(Equation 6)}$$

Mean daily impingement rates standardized to the volume of water sampled were calculated by summing within each month the quotient of the adjusted daily impingement estimate divided by the corresponding volume of circulating water sampled and dividing this sum by the total number of sample days.

where

A_{km} = Mean daily adjusted impingement rate for month k at Unit m.

n_{km} = Number of sampling days in month k at Unit m.

C_{Likm} = Count for length class L on day i of month k at Unit m.

V_{ikm} = Volume of circulating water sampled on day i of month k at Unit m.

E_{ikm} = Collection efficiency on day i of month k at Unit m.

Mean daily impingement rates unadjusted for collection efficiency were calculated for blue crabs by summing within each month the quotient of the daily count divided by the daily sampling volume and dividing this sum by the number of plant operating days:

$$A_{km} = 1/n_{km} \sum_{i=1}^{n_{km}} (C_{ikm}/V_{ikm}) \qquad \text{(Equation 7)}$$

where

A_{km} = Mean daily adjusted impingement rate for month k at Unit m.

n_{km} = Number of plant operating days in month k at Unit m.

C_{ikm} = Count of blue crabs on day i of month k at Unit m.

V_{ikm} = Volume of circulating water sampled on day i of month k at Unit m.

The number of operating days was used rather than the number of sample days since a blue crab sample day was defined as any day that the plant operated. Collection efficiency data were not available for blue crabs impinged at the Indian Point Generating Station. Consequently, blue crab impingement rates were not adjusted.

APPENDIX B

SUMMARY TABLES FOR WATER QUALITY AND IMPINGEMENT COLLECTION RESULTS

APPENDIX B
LIST OF TABLES

Number	Title
B-1	Daily intake water quality recorded at the Indian Point Generating Station during 1987 (unadjusted for collection efficiency).
B-2	Total numbers actually collected by taxon and month at Indian Point Unit 2 during 1987 (unadjusted for collection efficiency).
B-3	Total numbers actually collected by taxon and month at Indian Point Unit 3 during 1987 (unadjusted for collection efficiency).
B-4	Total numbers actually collected by taxon and month at Indian Point Units 2 and 3 combined during 1987 (unadjusted for collection efficiency).
B-5	Total numbers actually collected by taxon and seasonal sampling stratum at Indian Point Unit 2 during 1987 (unadjusted for collection efficiency).
B-6	Total numbers actually collected by taxon and seasonal sampling stratum at Indian Point Unit 3 during 1987 (unadjusted for collection efficiency).
B-7	Total numbers actually collected by taxon and seasonal sampling stratum at Indian Point Units 2 and 3 during 1987 (unadjusted for collection efficiency).
B-8	Total estimated weight (grams) of fish impinged at Indian Point Unit 2 during 1987, by taxon and seasonal stratum (adjusted for collection efficiency).
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B-10	Total estimated weight (grams) of fish impinged at Indian Point Units 2 and 3 combined during 1987, by taxon and seasonal stratum (adjusted for collection efficiency).
B-11	Total number of blue crabs collected each month at the Indian Point Generating Station during 1987.
B-12	Carapace width (mm) distribution of blue crabs in impingement collections at the Indian Point Generating Station during 1987, by month.
B-13	The proportion of blue crabs impinged in 1987 by sex, survival, and condition at the Indian Point Generating Station.

TABLE B-1 DAILY INTAKE WATER QUALITY RECORDED AT THE INDIAN POINT GENERATING STATION DURING 1987

Date	Temperature			Conductivity		
	Unit 2	Unit 3	Mean	Unit 2	Unit 3	Mean
01/01/87		4.8	4.8		1000	1000
01/02/87	4.0	3.5	3.7	320	180	250
01/03/87	3.5	3.5	3.5	175	185	180
01/06/87	6.2	10.0	8.1	155	180	168
01/07/87	2.5	2.5	2.5	135	135	135
01/11/87	0.5	5.0	2.7	410	420	415
01/13/87	5.0		5.0	1700		1700
01/14/87	4.0	4.1	4.0	1900	1950	1925
01/15/87		4.1	4.1		2000	2000
01/21/87		10.0	10.0		2300	2300
01/22/87		1.5	1.5		1600	1600
01/23/87		2.0	2.0		1550	1550
01/24/87		0.5	0.5		2200	2200
01/25/87	4.0	4.0	4.0	1850	1850	1850
01/26/87		4.0	4.0		2200	2200
01/28/87	4.0		4.0	2200		2200
02/03/87		3.0	3.0		1400	1400
02/04/87		3.0	3.0		1300	1300
02/05/87		3.0	3.0		700	700
02/11/87	4.0		4.0	2200		2200
02/12/87	2.5	4.0	3.2	3100	2700	2900
02/13/87	0.0	3.0	1.5	2300	2200	2250
02/14/87	6.0		6.0	2500		2500
02/20/87		9.0	9.0		2200	2200
02/21/87		1.9	1.9		1790	1790
02/26/87	2.0	9.0	5.5	2400	2500	2450
03/01/87	3.0	3.1	3.0	1800	1800	1800
03/02/87	4.0	6.0	5.0	2500	2500	2500
03/08/87	3.0	3.2	3.1	200	300	250
03/11/87	4.0	1.0	2.5	900	1000	950
03/12/87		4.0	4.0		1700	1700
03/13/87	2.0	5.0	3.5	1500	1500	1500
03/16/87		7.0	7.0		2850	2850
03/18/87	10.0		10.0	2750		2750
03/20/87	7.0	7.0	7.0	2400	2250	2325
03/23/87		6.0	6.0		1150	1150
03/24/87		7.0	7.0		900	900
03/25/87	7.0	6.0	6.5	900	1200	1050
03/26/87	12.0		12.0	1200		1200
03/28/87		8.0	8.0		900	900
03/30/87		9.0	9.0		150	150
04/02/87	10.0	10.0	10.0	160	160	160
04/03/87		12.0	12.0		160	160
04/04/87		11.0	11.0		180	180
04/06/87		9.0	9.0		105	105
04/07/87		10.0	10.0		105	105
04/08/87		8.1	8.1		85	85

TABLE B-1 (Cont.)

Date	Temperature Unit 2	Temperature Unit 3	Temperature Mean	Conductivity Unit 2	Conductivity Unit 3	Conductivity Mean
04/09/87		9.0	9.0		99	99
04/11/87		11.0	11.0		220	220
04/12/87		12.0	12.0		1150	1150
04/13/87		10.0	10.0		250	250
04/15/87		12.0	12.0		150	150
04/17/87		12.0	12.0		160	160
04/19/87		10.5	10.5		1120	1120
04/21/87	12.0		12.0	112		112
04/23/87		22.0	22.0		400	400
04/25/87	19.0	21.0	20.0	300	310	305
04/27/87		14.0	14.0		180	180
04/28/87	13.0	13.5	13.3	330	320	325
04/29/87		13.0	13.0		140	140
05/01/87		16.0	16.0		151	151
05/02/87		18.0	18.0		1510	1510
05/05/87	12.0		12.0	350		350
05/19/87	18.0		18.0	5000		5000
05/29/87	19.0		19.0	4850		4850
06/20/87	24.0		24.0	5800		5800
07/19/87	28.0		28.0	3754		3754
08/16/87	28.0		28.0	5400		5400
08/19/87	28.5		28.5	7000		7000
08/20/87	28.0	31.0	29.5	6100	7000	6550
08/21/87		28.0	28.0		7800	7800
08/22/87		28.0	28.0		7800	7800
08/23/87	29.1	28.0	28.6	6500	7900	7200
08/24/87		26.0	26.0		7300	7300
08/25/87		25.3	25.3		7300	7300
08/27/87		27.0	27.0		8900	8900
08/29/87						
08/31/87	22.9	24.0	23.5	4900	7200	6050
09/01/87		23.0	23.0		6900	6900
09/02/87		23.0	23.0		6300	6300
09/03/87		24.0	24.0		6000	6000
09/05/87		22.3	22.3		6500	6500
09/07/87						
09/08/87		25.0	25.0		5000	5000
09/09/87						
09/10/87						
09/11/87						
09/15/87						
09/16/87		25.8	25.8		1450	1450
09/17/87		25.2	25.2		1800	1800
09/18/87		24.1	24.1		1000	1000
09/19/87	22.0	24.0	23.0	800	1400	1100
09/20/87		22.4	22.4		2100	2100
09/21/87	23.6	22.6	23.1	2300	2200	2250
09/22/87	20.9	23.5	22.2	1300	2300	1800

TABLE B-1 (Cont.)

Date	Temperature			Conductivity		
	Unit 2	Unit 3	Mean	Unit 2	Unit 3	Mean
09/23/87	20.1	21.0	20.6	1100	3000	2050
09/24/87		23.2	23.2		2000	2000
09/25/87						
09/26/87		19.5	19.5		550	550
09/27/87		20.0	20.0		500	500
09/30/87	21.2		21.2	1000		1000
10/01/87	23.7	20.5	22.1	770	510	640
10/02/87	20.3		20.3	630		630
10/03/87	22.0	21.1	21.6	640	620	630
10/04/87	21.4		21.4	600		600
10/05/87	17.0		17.0	220		220
10/06/87	17.0		17.0	200		200
10/07/87	17.2	17.3	17.3	440	191	316
10/08/87	15.8	15.9	15.9	261	260	261
10/09/87	14.9	17.0	16.0	227	329	278
10/10/87	20.0		20.0	130		130
10/12/87	14.6		14.6	247		247
10/13/87	14.9		14.9	352		352
10/14/87	15.2	14.5	14.9	270	231	251
10/15/87	13.9		13.9	322		322
10/16/87	16.0		16.0	1450		1450
10/17/87	16.2	15.7	16.0	3200	3100	3150
10/18/87	17.1		17.1	4200		4200
10/19/87		18.1	18.1		4750	4750
10/20/87	14.9		14.9	4650		4650
10/21/87	16.9		16.9	5300		5300
10/22/87	13.3	14.5	13.9	3710	4000	3855
10/23/87		14.1	14.1		1720	1720
10/25/87	14.1		14.1	3010		3010
10/26/87	14.0		14.0	2200		2200
10/27/87	15.6		15.6	2510		2510
10/28/87	16.9		16.9	2980		2980
10/29/87	12.5		12.5	650		650
10/30/87	12.9		12.9	2150		2150
10/31/87	13.0	12.8	12.9	1200	1000	1100
11/01/87	11.5		11.5	155		155
11/02/87	11.3		11.3	170		170
11/03/87	13.2		13.2	163		163
11/04/87	12.5	11.9	12.2	200	252	226
11/05/87	13.9		13.9	472		472
11/06/87		10.9	10.9		202	202
11/07/87	10.8	13.0	11.9	141	162	152
11/08/87	11.0	12.6	11.8	153	478	316
11/09/87	11.1		11.1	600		600
11/10/87	9.9		9.9	294		294
11/14/87	7.9	9.9	8.9	2050	1950	2000
11/18/87	12.9	12.0	12.5	2960	1489	2225
11/19/87	11.2	9.8	10.5	2330	2680	2505

TABLE B-1 (Cont.)

Date	Temperature			Conductivity		
	Unit 2	Unit 3	Mean	Unit 2	Unit 3	Mean
11/20/87	10.7		10.7	2920		2920
11/21/87		12.0	12.0		1720	1720
11/24/87		7.1	7.1		560	560
11/25/87	8.2		8.2	446		446
11/26/87	8.8		8.8	700		700
11/27/87	8.9		8.9	412		412
12/02/87		6.1	6.1		191	191
12/03/87	8.9		8.9	130		130
12/04/87	8.1		8.1	130		130
12/09/87	5.1	4.9	5.0	120	115	118
12/10/87	6.2		6.2	125		125
12/11/87	5.9		5.9	125		125
12/12/87	6.2		6.2	145		145
12/13/87		5.5	5.5		238	238
12/16/87	8.9		8.9	2590		2590
12/17/87	9.8		9.8	1450		1450
12/18/87	7.1		7.1	2330		2330
12/23/87		5.8	5.8		1250	1250

TABLE B-2 TOTAL NUMBERS ACTUALLY COLLECTED BY TAXON AND MONTH AT INDIAN POINT UNIT 2 DURING 1987 (UNADJUSTED FOR COLLECTION EFFICIENCY)

Taxon	Month												
	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	Total
Alewife	--	--	2	--	7	3	6	23	72	68	--	--	181
Bay anchovy	7	--	--	--	5	1	44	37	663	1175	--	--	1932
American shad	1	--	--	--	2	--	--	13	69	104	--	--	189
Bluefish	--	--	--	--	--	39	49	28	51	21	--	--	188
Bluegill	3	1	1	4	--	--	--	--	20	33	--	3	65
Brown bullhead	1	3	4	1	1	--	--	--	5	--	--	--	15
Pumpkinseed	39	46	34	2	--	--	1	--	7	46	2	--	177
Black crappie	--	--	--	--	--	--	--	--	8	--	--	3	11
Carp	--	--	2	--	--	--	--	--	--	--	--	--	2
American eel	15	8	16	15	34	14	6	19	33	33	2	1	196
Goldfish	4	3	8	--	--	--	--	--	--	--	--	--	15
Golden shiner	--	2	19	--	--	--	--	--	--	--	--	--	21
Hogchoker	33	4	18	304	277	30	42	45	327	1129	36	1	2246
Tessellated darter	2	--	22	3	3	--	--	--	--	--	--	1	31
Banded killifish	86	64	179	3	--	1	--	--	--	12	6	4	355
Largemouth bass	1	--	--	--	--	--	--	--	--	--	1	--	2
Mummichog	--	--	--	--	--	2	--	--	3	--	--	--	5
Atlantic menhaden	1	--	--	--	--	6	--	7	11	7	--	--	32
Blueback herring	--	--	2	4	17	14	10	42	697	4052	41	--	4879
Atlantic silverside	2	--	--	--	--	--	--	--	--	3	--	--	5
Rainbow smelt	55	63	186	115	44	8	4	1	14	26	3	--	519
Smallmouth bass	--	1	--	--	--	--	2	--	--	--	--	--	3
Shortnose sturgeon	--	--	1	--	--	--	--	--	--	--	--	--	1
Spottail shiner	40	133	193	2	1	--	--	--	--	--	1	2	372
Striped bass	94	23	292	10	10	--	--	60	434	2181	52	8	3164
Fourspine stickleback	4	3	2	13	7	--	--	--	--	--	--	--	29
Atlantic tomcod	160	8	36	--	7834	3491	7070	48	98	117	10	4	18876
White catfish	19	13	18	8	4	--	--	2	13	51	69	10	207
White perch	12845	4103	22644	1687	2114	113	110	137	1355	3455	1993	105	50661
Yellow perch	8	14	30	--	--	--	--	--	2	2	3	1	60
Rock bass	--	--	--	--	--	--	--	--	--	41	--	--	41

TABLE B-2 (Cont.)

Taxon	Month												
	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	Total
Northern pipefish	--	--	--	--	3	--	--	--	7	3	--	--	13
Redbreast sunfish	--	1	--	--	--	--	--	--	--	--	--	--	1
Crevalle jack	--	--	--	--	--	--	--	--	--	1	--	--	1
Weakfish	--	--	--	--	--	--	1	44	26	23	1	--	95
Clupeid larvae	--	--	--	--	--	--	--	--	2	--	--	--	2
Striped cuskeel	--	--	--	--	1	--	--	--	--	--	--	--	1
Winter flounder	--	4	6	--	--	5	5	--	1	--	--	--	21
Tidewater silverside	--	--	--	--	--	--	--	--	--	1	--	--	1
Gizzard shad	16	5	1	--	--	--	--	1	2	--	4	5	34
Silver hake	--	--	--	--	2	--	--	--	--	--	--	--	2
Threespine stickleback	5	15	84	--	--	--	--	--	--	--	--	--	104
Brown trout	--	--	--	--	1	--	--	--	--	--	--	--	1
Butterfish	--	--	--	--	--	--	--	9	9	3	--	--	21
White crappie	--	--	--	--	--	--	--	--	3	2	--	--	5
Red hake	--	1	1	--	--	--	--	--	--	--	--	--	2
Eastern mudminnow	--	--	--	--	--	--	--	--	2	1	--	--	3
Summer flounder	--	--	--	--	--	--	--	--	1	--	--	--	1
Warmouth	--	--	--	--	--	--	--	--	--	18	--	--	18
Yellow bullhead	--	--	--	--	--	--	--	--	1	--	--	--	1
Naked goby	--	--	4	--	--	--	--	--	2	18	--	--	24
Windowpane	--	--	--	--	1	--	--	--	--	--	--	--	1
Cunner	--	--	--	--	1	--	--	--	--	--	--	--	1
Total	13441	4518	23805	2171	10369	3727	7350	516	3938	12626	2224	148	84833

TABLE B-3 TOTAL NUMBERS ACTUALLY COLLECTED BY TAXON AND MONTH AT INDIAN POINT UNIT 3 DURING 1987 (UNADJUSTED FOR COLLECTION EFFICIENCY)

Taxon	Month										
	JAN	FEB	MAR	APR	MAY	AUG	SEP	OCT	NOV	DEC	Total
Alewife	1	6	2	12	2	--	139	103	6	--	271
Bay anchovy	24	--	--	--	--	--	1574	230	--	--	1828
American shad	1	--	1	10	--	--	115	185	29	--	341
Bluefish	--	--	--	--	--	--	214	20	--	--	234
Bluegill	2	1	--	10	--	--	12	24	16	--	65
Brown bullhead	3	6	1	2	--	--	1	--	--	--	13
Pumpkinseed	111	26	15	27	5	--	3	17	9	1	214
Black crappie	1	--	--	--	--	--	2	--	1	--	4
Carp	9	2	--	--	--	--	--	--	--	--	11
American eel	17	7	4	5	--	1	27	4	3	4	72
Goldfish	11	2	4	--	1	--	--	--	--	--	18
Golden shiner	4	2	3	1	1	--	--	--	1	--	12
Hogchoker	49	9	16	745	48	--	1277	498	39	6	2687
Tessellated darter	--	--	1	--	--	--	--	--	1	--	2
Banded killifish	78	10	11	4	--	--	--	1	14	--	118
Largemouth bass	3	--	--	--	--	--	--	--	3	--	6
Atlantic menhaden	--	--	--	15	--	1	26	3	--	--	45
Blueback herring	--	4	--	64	1	1	333	8411	1138	10	9962
Atlantic silverside	2	--	--	3	--	--	1	--	--	--	6
Rainbow smelt	52	60	31	124	9	--	41	116	6	4	443
Shortnose sturgeon	--	--	--	1	--	--	--	--	--	--	1
Spottail shiner	28	27	38	22	1	--	--	1	3	1	121
Atlantic sturgeon	--	--	--	--	--	--	1	--	--	--	1
Striped bass	101	140	123	30	1	--	195	197	61	38	886
Fourspine stickleback	1	3	--	11	1	--	--	--	1	--	17
Atlantic tomcod	122	19	4	34	2	2	98	23	4	3	311
White catfish	34	28	18	16	4	--	9	19	20	51	199
White perch	12685	12394	9784	7134	229	2	695	1514	1147	737	46321
Yellow perch	11	7	--	9	1	--	--	--	2	1	31
Rock bass	--	--	--	--	--	--	1	--	--	--	1

TABLE B-3 (Cont.)

Taxon	Month										
	JAN	FEB	MAR	APR	MAY	AUG	SEP	OCT	NOV	DEC	Total
Northern pipefish	--	--	--	--	2	--	13	1	--	--	16
Redbreast sunfish	3	--	--	--	--	--	2	--	--	--	5
Crevalle jack	--	--	--	--	--	--	1	16	4	--	21
Weakfish	--	--	--	--	--	--	10	40	4	--	54
Lookdown	--	--	--	--	--	--	--	1	--	--	1
Tautog	--	--	--	--	--	--	--	--	1	--	1
Four bearded rockling	--	--	--	--	--	--	--	--	--	1	1
Winter flounder	--	1	--	--	1	--	2	--	--	--	4
Tidewater silverside	--	1	--	--	--	--	--	--	--	--	1
Gizzard shad	109	30	--	--	--	--	--	12	38	49	238
Threespine stickleback	11	13	43	1	--	--	--	--	--	--	68
Brown trout	--	--	--	--	1	--	--	--	--	--	1
Butterfish	--	--	--	--	--	1	11	7	1	--	20
White crappie	--	--	--	--	--	--	18	--	7	--	25
Green sunfish	--	--	--	--	--	--	24	--	--	--	24
Centrarchid unid.	--	--	--	--	--	--	1	--	--	--	1
Red hake	--	1	--	--	--	--	--	--	--	2	3
Eastern mudminnow	--	--	--	--	--	--	--	1	--	--	1
Summer flounder	--	--	--	--	--	--	2	--	--	--	2
Black bullhead	--	--	--	--	--	--	1	--	--	--	1
Striped searobin	--	--	--	--	--	--	--	3	--	--	3
Hickory shad	--	--	--	--	--	--	1	--	--	--	1
Warmouth	--	--	--	--	--	--	--	2	1	--	3
Total	13473	12799	10099	8280	310	8	4850	11449	2560	908	64736

TABLE B-4 TOTAL NUMBERS ACTUALLY COLLECTED BY TAXON AND MONTH AT INDIAN POINT UNITS 2 AND 3 COMBINED DURING 1987 (UNADJUSTED FOR COLLECTION EFFICIENCY)

Taxon	Month												
	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	Total
Alewife	1	6	4	12	9	3	6	23	211	171	6	--	452
Bay anchovy	31	--	--	--	5	1	44	37	2237	1405	--	--	3760
American shad	2	--	1	10	2	--	--	13	184	289	29	--	530
Bluefish	--	--	--	--	--	39	49	28	265	41	--	--	422
Bluegill	5	2	1	14	--	--	--	--	32	57	16	3	130
Brown bullhead	4	9	5	3	1	--	--	--	6	--	--	--	28
Pumpkinseed	150	72	49	29	5	--	1	--	10	63	11	1	391
Black crappie	1	--	--	--	--	--	--	--	10	--	1	3	15
Carp	9	2	2	--	--	--	--	--	--	--	--	--	13
American eel	32	15	20	20	34	14	6	20	60	37	5	5	268
Goldfish	15	5	12	--	1	--	--	--	--	--	--	--	33
Golden shiner	4	4	22	1	1	--	--	--	--	--	1	--	33
Hogchoker	82	13	34	1049	325	30	42	45	1604	1627	75	7	4933
Tessellated darter	2	--	23	3	3	--	--	--	--	--	1	1	33
Banded killifish	164	74	190	7	--	1	--	--	--	13	20	4	473
Largemouth bass	4	--	--	--	--	--	--	--	--	--	4	--	8
Mummichog	--	--	--	--	--	2	--	--	3	--	--	--	5
Atlantic menhaden	1	--	--	15	--	6	--	8	37	10	--	--	77
Blueback herring	--	4	2	68	18	14	10	43	1030	12463	1179	10	14841
Atlantic silverside	4	--	--	3	--	--	--	--	1	3	--	--	11
Rainbow smelt	107	123	217	239	53	8	4	1	55	142	9	4	962
Smallmouth bass	--	1	--	--	--	--	2	--	--	--	--	--	3
Shortnose sturgeon	--	--	1	1	--	--	--	--	--	--	--	--	2
Spottail shiner	68	160	231	24	2	--	--	--	--	1	4	3	493
Atlantic sturgeon	--	--	--	--	--	--	--	--	1	--	--	--	1
Striped bass	195	163	415	40	11	--	--	60	629	2378	113	46	4050
Fourspine stickleback	5	6	2	24	8	--	--	--	--	--	1	--	46
Atlantic tomcod	282	27	40	34	7836	3491	7070	50	196	140	14	7	19187
White catfish	53	41	36	24	8	--	--	2	22	70	89	61	406
White perch	25530	16497	32428	8821	2343	113	110	139	2050	4969	3140	842	96982
Yellow perch	19	21	30	9	1	--	--	--	2	2	5	2	91

TABLE B-4 (Cont.)

Taxon	Month												
	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	Total
Rock bass	--	--	--	--	--	--	--	--	1	41	--	--	42
Northern pipefish	--	--	--	--	5	--	--	--	20	4	--	--	29
Redbreast sunfish	3	1	--	--	--	--	--	--	2	--	--	--	6
Crevalle jack	--	--	--	--	--	--	--	--	1	17	4	--	22
Weakfish	--	--	--	--	--	--	1	44	36	63	5	--	149
Lookdown	--	--	--	--	--	--	--	--	--	1	--	--	1
Clupeid larvae	--	--	--	--	--	--	--	--	2	--	--	--	2
Tautog	--	--	--	--	--	--	--	--	--	--	1	--	1
Four bearded rockling	--	--	--	--	--	--	--	--	--	--	--	1	1
Striped cuskeel	--	--	--	--	1	--	--	--	--	--	--	--	1
Winter flounder	--	5	6	--	1	5	5	--	3	--	--	--	25
Tidewater silverside	--	1	--	--	--	--	--	--	--	1	--	--	2
Gizzard shad	125	35	1	--	--	--	--	1	2	12	42	54	272
Silver hake	--	--	--	--	2	--	--	--	--	--	--	--	2
Threespine stickleback	16	28	127	1	--	--	--	--	--	--	--	--	172
Brown trout	--	--	--	--	2	--	--	--	--	--	--	--	2
Butterfish	--	--	--	--	--	--	--	10	20	10	1	--	41
White crappie	--	--	--	--	--	--	--	--	21	2	7	--	30
Green sunfish	--	--	--	--	--	--	--	--	24	--	--	--	24
Centrarchid unid.	--	--	--	--	--	--	--	--	1	--	--	--	1
Red hake	--	2	1	--	--	--	--	--	--	--	--	2	5
Eastern mudminnow	--	--	--	--	--	--	--	--	2	2	--	--	4
Summer flounder	--	--	--	--	--	--	--	--	3	--	--	--	3
Black bullhead	--	--	--	--	--	--	--	--	1	--	--	--	1
Striped searobin	--	--	--	--	--	--	--	--	--	3	--	--	3
Hickory shad	--	--	--	--	--	--	--	--	1	--	--	--	1
Warmouth	--	--	--	--	--	--	--	--	--	20	1	--	21
Yellow bullhead	--	--	--	--	--	--	--	--	1	--	--	--	1
Naked goby	--	--	4	--	--	--	--	--	2	18	--	--	24
Windowpane	--	--	--	--	1	--	--	--	--	--	--	--	1
Cunner	--	--	--	--	1	--	--	--	--	--	--	--	1
Total	26914	17317	33904	10451	10679	3727	7350	524	8788	24075	4784	1056	149569

TABLE B-5 TOTAL NUMBERS ACTUALLY COLLECTED BY TAXON AND SEASONAL SAMPLING STRATUM AT INDIAN POINT UNIT 2 DURING 1987 (UNADJUSTED FOR COLLECTION EFFICIENCY)

Taxon	Stratum				Total
	Winter	Spring	Summer	Fall	
Alewife	2	10	101	68	181
Bay anchovy	7	6	744	1,175	1,932
American shad	1	2	82	104	189
Bluefish	--	39	128	21	188
Bluegill	5	4	20	36	65
Brown bullhead	8	2	5	--	15
Pumpkinseed	119	2	8	48	177
Black crappie	--	--	8	3	11
Carp	2	--	--	--	2
American eel	39	63	58	36	196
Goldfish	15	--	--	--	15
Golden shiner	21	--	--	--	21
Hogchoker	55	611	414	1,166	2,246
Tessellated darter	24	6	--	1	31
Banded killifish	329	4	--	22	355
Largemouth bass	1	--	--	1	2
Mummichog	--	2	3	--	5
Atlantic menhaden	1	6	18	7	32
Blueback herring	2	35	749	4,093	4,879
Atlantic silverside	2	--	--	3	5
Rainbow smelt	304	167	19	29	519
Smallmouth bass	1	--	2	--	3
Shortnose sturgeon	1	--	--	--	1
Spottail shiner	366	3	--	3	372
Striped bass	409	20	494	2,241	3,164
Fourspine stickleback	9	20	--	--	29
Atlantic tomcod	204	11,325	7,216	131	18,876
White catfish	50	12	15	130	207
White perch	39,592	3,914	1,602	5,553	50,661
Yellow perch	52	--	2	6	60

TABLE B-5 (Cont.)

Taxon	Stratum				
	Winter	Spring	Summer	Fall	Total
Rock bass	--	--	--	41	41
Northern pipefish	--	3	7	3	13
Redbreast sunfish	1	--	--	--	1
Crevalle jack	--	--	--	1	1
Weakfish	--	--	71	24	95
Clupeid larvae	--	--	2	--	2
Striped cuskeel	--	1	--	--	1
Winter flounder	10	5	6	--	21
Tidewater silverside	--	--	--	1	1
Gizzard shad	22	--	3	9	34
Silver hake	--	2	--	--	2
Threespine stickleback	104	--	--	--	104
Brown trout	--	1	--	--	1
Butterfish	--	--	18	3	21
White crappie	--	--	3	2	5
Red hake	2	--	--	--	2
Eastern mudminnow	--	--	2	1	3
Summer flounder	--	--	1	--	1
Warmouth	--	--	--	18	18
Yellow bullhead	--	--	1	--	1
Naked goby	4	--	2	18	24
Windowpane	--	1	--	--	1
Cunner	--	1	--	--	1
Total	41,764	16,267	11,804	14,998	84,833

TABLE B-6 TOTAL NUMBERS ACTUALLY COLLECTED BY TAXON AND SEASONAL SAMPLING STRATUM AT INDIAN POINT UNIT 3 DURING 1987 (UNADJUSTED FOR COLLECTION EFFICIENCY)

Taxon	Stratum				Total
	Winter	Spring	Summer	Fall	
Alewife	9	14	139	109	271
Bay anchovy	24	--	1,574	230	1,828
American shad	2	10	115	214	341
Bluefish	--	--	214	20	234
Bluegill	3	10	12	40	65
Brown bullhead	10	2	1	--	13
Pumpkinseed	152	32	3	27	214
Black crappie	1	--	2	1	4
Carp	11	--	--	--	11
American eel	28	5	28	11	72
Goldfish	17	1	--	--	18
Golden shiner	9	2	--	1	12
Hogchoker	74	793	1,277	543	2,687
Tessellated darter	1	--	--	1	2
Banded killifish	99	4	--	15	118
Largemouth bass	3	--	--	3	6
Atlantic menhaden	--	15	27	3	45
Blueback herring	4	65	334	9,559	9,962
Atlantic silverside	2	3	1	--	6
Rainbow smelt	143	133	41	126	443
Shortnose sturgeon	--	1	--	--	1
Spottail shiner	93	23	--	5	121
Atlantic sturgeon	--	--	1	--	1
Striped bass	364	31	195	296	886
Fourspine stickleback	4	12	--	1	17
Atlantic tomcod	145	36	100	30	311
White catfish	80	20	9	90	199
White perch	34,863	7,363	697	3,398	46,321
Yellow perch	18	10	--	3	31
Rock bass	--	--	1	--	1

TABLE B-6 (Cont.)

Taxon	Stratum				
	Winter	Spring	Summer	Fall	Total
Northern pipefish	--	2	13	1	16
Redbreast sunfish	3	--	2	--	5
Crevalle jack	--	--	1	20	21
Weakfish	--	--	10	44	54
Lookdown	--	--	--	1	1
Tautog	--	--	--	1	1
Four bearded rockling	--	--	--	1	1
Winter flounder	1	1	2	--	4
Tidewater silverside	1	--	--	--	1
Gizzard shad	139	--	--	99	238
Threespine stickleback	67	1	--	--	68
Brown trout	--	1	--	--	1
Butterfish	--	--	12	8	20
White crappie	--	--	18	7	25
Green sunfish	--	--	24	--	24
Centrarchid unid.	--	--	1	--	1
Red hake	1	--	--	2	3
Eastern mudminnow	--	--	--	1	1
Summer flounder	--	--	2	--	2
Black bullhead	--	--	1	--	1
Striped searobin	--	--	--	3	3
Hickory shad	--	--	1	--	1
Warmouth	--	--	--	3	3
Total	36,371	8,590	4,858	14,917	64,736

TABLE B-7 TOTAL NUMBERS ACTUALLY COLLECTED BY TAXON AND SEASONAL SAMPLING STRATUM AT INDIAN POINT UNITS 2 & 3 COMBINED DURING 1987 (UNADJUSTED FOR COLLECTION EFFICIENCY)

Taxon	Stratum				
	Winter	Spring	Summer	Fall	Total
Alewife	11	24	240	177	452
Bay anchovy	31	6	2,318	1,405	3,760
American shad	3	12	197	318	530
Bluefish	--	39	342	41	422
Bluegill	8	14	32	76	130
Brown bullhead	18	4	6	--	28
Pumpkinseed	271	34	11	75	391
Black crappie	1	--	10	4	15
Carp	13	--	--	--	13
American eel	67	68	86	47	268
Goldfish	32	1	--	--	33
Golden shiner	30	2	--	1	33
Hogchoker	129	1,404	1,691	1,709	4,933
Tessellated darter	25	6	--	2	33
Banded killifish	428	8	--	37	473
Largemouth bass	4	--	--	4	8
Mummichog	--	2	3	--	5
Atlantic menhaden	1	21	45	10	77
Blueback herring	6	100	1,083	13,652	14,841
Atlantic silverside	4	3	1	3	11
Rainbow smelt	447	300	60	155	962
Smallmouth bass	1	--	2	--	3
Shortnose sturgeon	1	1	--	--	2
Spottail shiner	459	26	--	8	493
Atlantic sturgeon	--	--	1	--	1
Striped bass	773	51	689	2,537	4,050
Fourspine stickleback	13	32	--	1	46
Atlantic tomcod	349	11,361	7,316	161	19,187
White catfish	130	32	24	220	406
White perch	74,455	11,277	2,299	8,951	96,982

TABLE B-7 (Cont.)

Taxon	Stratum				
	Winter	Spring	Summer	Fall	Total
Yellow perch	70	10	2	9	91
Rock bass	--	--	1	41	42
Northern pipefish	--	5	20	4	29
Redbreast sunfish	4	--	2	--	6
Crevalle jack	--	--	1	21	22
Weakfish	--	--	81	68	149
Lookdown	--	--	--	1	1
Clupeid larvae	--	--	2	--	2
Tautog	--	--	--	1	1
Four bearded rockling	--	--	--	1	1
Striped cuskeel	--	1	--	--	1
Winter flounder	11	6	8	--	25
Tidewater silverside	1	--	--	1	2
Gizzard shad	161	--	3	108	272
Silver hake	--	2	--	--	2
Threespine stickleback	171	1	--	--	172
Brown trout	--	2	--	--	2
Butterfish	--	--	30	11	41
White crappie	--	--	21	9	30
Green sunfish	--	--	24	--	24
Centrarchid unid.	--	--	1	--	1
Red hake	3	--	--	2	5
Eastern mudminnow	--	--	2	2	4
Summer flounder	--	--	3	--	3
Black bullhead	--	--	1	--	1
Striped searobin	--	--	--	3	3
Hickory shad	--	--	1	--	1
Warmouth	--	--	--	21	21
Yellow bullhead	--	--	1	--	1
Naked goby	4	--	2	18	24
Windowpane	--	1	--	--	1
Cunner	--	1	--	--	1
Total	78,135	24,857	16,662	29,915	149,569

TABLE B-8 TOTAL ESTIMATED WEIGHT (GRAMS) OF FISH IMPINGED AT INDIAN POINT UNIT 2 DURING 1987, BY TAXON AND SEASONAL STRATUM (ADJUSTED FOR COLLECTION EFFICIENCY)

Taxon	Stratum				
	Winter	Spring	Summer	Fall	Total
Alewife	64	30,462	76,477	2,153	109,156
Bay anchovy	60	648	44,687	7,550	52,945
American shad	37	705	49,479	1,719	51,940
Bluefish	0	3,208	37,511	717	41,436
Bluegill	370	1,581	1,539	348	3,838
Brown bullhead	6,338	535	10,664	0	17,537
Pumpkinseed	26,944	2,889	8,364	1,020	39,217
Black crappie	0	0	753	37	790
Carp	512	0	0	0	512
American eel	34,430	137,956	302,504	12,783	487,673
Goldfish	1,836	0	0	0	1,836
Golden shiner	4,861	0	0	0	4,861
Hogchoker	6,431	147,932	179,341	44,114	377,818
Tessellated darter	729	705	0	12	1,446
Banded killifish	9,011	478	0	477	9,966
Largemouth bass	123	0	0	24	147
Mummichog	0	216	17,831	0	18,047
Atlantic menhaden	931	28,756	519,783	2,821	552,291
Blueback herring	355	86,655	182,871	31,554	301,435
Atlantic silverside	11	0	0	34	45
Rainbow smelt	6,401	22,511	4,525	412	33,849
Smallmouth bass	150	0	552	0	702
Shortnose sturgeon	639	0	0	0	639
Spottail shiner	11,015	307	0	92	11,414
Atlantic sturgeon	0	0	0	0	0
Striped bass	33,233	3,936	121,716	33,689	192,574
Fourspine stickleback	52	330	0	0	382
Atlantic tomcod	30,048	605,776	1,102,352	9,164	1,747,340
White catfish	59,456	4,539	80,692	6,327	151,014
White perch	1,745,463	1,043,838	1,648,255	174,752	4,612,308
Yellow perch	10,571	0	335	98	11,004
Rock bass	0	0	0	615	615
Northern pipefish	0	148	309	13	470
Redbreast sunfish	363	0	0	0	363
Crevalle jack	0	0	0	0	0
Weakfish	0	0	13,399	335	13,734
Lookdown	0	0	0	0	0
Clupeid larvae	0	0	0	0	0
Tautog	0	0	0	0	0
Four bearded rockling	0	0	0	0	0
Striped cuskeel	0	455	0	0	455
Winter flounder	871	1,365	8,397	0	10,633
Tidewater silverside	0	0	0	21	21
Gizzard shad	2,535	0	560	190	3,285
Silver hake	0	557	0	0	557
Threespine stickleback	1,787	0	0	0	1,787
Brown trout	0	38,459	0	0	38,459

TABLE B-8 (Cont.)

Taxon	Stratum				
	Winter	Spring	Summer	Fall	Total
Butterfish	0	0	7,945	135	8,080
White crappie	0	0	360	36	396
Green sunfish	0	0	0	0	0
Centrarchid unid.	0	0	0	0	0
Red hake	213	0	0	0	213
Eastern mudminnow	0	0	5,420	536	5,956
Summer flounder	0	0	8,472	0	8,472
Black bullhead	0	0	0	0	0
Striped searobin	0	0	0	0	0
Hickory shad	0	0	0	0	0
Warmouth	0	0	0	172	172
Yellow bullhead	0	0	1,648	0	1,648
Naked goby	75	0	117	49	241
Windowpane	0	57	0	0	57
Cunner	0	592	0	0	592
Total	1,995,915	2,165,596	4,436,858	331,999	8,930,368

TABLE B-9 TOTAL ESTIMATED WEIGHT (GRAMS) OF FISH IMPINGED AT INDIAN POINT UNIT 3 DURING 1987, BY TAXON AND SEASONAL STRATUM (ADJUSTED FOR COLLECTION EFFICIENCY)

Taxon	Stratum				
	Winter	Spring	Summer	Fall	Total
Alewife	566	5,316	6,112	6,210	18,204
Bay anchovy	123	0	8,177	3,626	11,926
American shad	95	34,838	5,749	10,358	51,040
Bluefish	0	0	6,569	1,752	8,321
Bluegill	782	2,429	234	1,162	4,607
Brown bullhead	3,631	491	242	0	4,364
Pumpkinseed	26,036	2,870	498	1,464	30,868
Black crappie	355	0	14	12	381
Carp	3,405	0	0	0	3,405
American eel	20,625	792	13,644	16,702	51,763
Goldfish	2,044	82	0	0	2,126
Golden shiner	1,785	143	0	341	2,269
Hogchoker	4,454	32,584	54,294	44,287	135,619
Tessellated darter	18	0	0	12	30
Banded killifish	2,705	88	0	636	3,429
Largemouth bass	360	0	0	261	621
Mummichog	0	0	0	0	0
Atlantic menhaden	0	10,044	12,071	3,304	25,419
Blueback herring	49	36,118	17,700	160,268	214,135
Atlantic silverside	10	60	11	0	81
Rainbow smelt	2,343	2,531	656	6,018	11,548
Smallmouth bass	0	0	0	0	0
Shortnose sturgeon	0	882	0	0	882
Spottail shiner	2,124	347	0	261	2,732
Atlantic sturgeon	0	0	269	0	269
Striped bass	15,876	2,394	2,621	13,643	34,534
Fourspine stickleback	13	29	0	12	54
Atlantic tomcod	12,968	311	8,110	3,362	24,751
White catfish	47,739	5,214	7,078	36,171	96,202
White perch	796,968	340,923	58,136	144,547	1,340,574
Yellow perch	4,572	1,168	0	916	6,656
Rock bass	0	0	6	0	6
Northern pipefish	0	5	47	19	71
Redbreast sunfish	1,155	0	639	0	1,794
Crevalle jack	0	0	232	1,997	2,229
Weakfish	0	0	106	1,618	1,724
Lookdown	0	0	0	226	226
Clupeid larvae	0	0	0	0	0
Tautog	0	0	0	1,392	1,392
Four bearded rockling	0	0	0	150	150
Striped cuskeel	0	0	0	0	0
Winter flounder	18	170	258	0	446
Tidewater silverside	8	0	0	0	8
Gizzard shad	9,892	0	0	4,589	14,481
Silver hake	0	0	0	0	0

TABLE B-9 (Cont.)

Taxon	Stratum				
	Winter	Spring	Summer	Fall	Total
Threespine stickleback	658	5	0	0	663
Brown trout	0	308	0	0	308
Butterfish	0	0	357	1,484	1,841
White crappie	0	0	144	115	259
Green sunfish	0	0	511	0	511
Centrarchid unid.	0	0	3	0	3
Red hake	296	0	0	245	541
Eastern mudminnow	0	0	0	1,763	1,763
Summer flounder	0	0	1,443	0	1,443
Black bullhead	0	0	300	0	300
Striped searobin	0	0	0	173	173
Hickory shad	0	0	41	0	41
Warmouth	0	0	0	81	81
Yellow bullhead	0	0	0	0	0
Naked goby	0	0	0	0	0
Windowpane	0	0	0	0	0
Cunner	0	0	0	0	0
Total	961,673	480,142	206,272	469,177	2,117,264

TABLE B-10 TOTAL ESTIMATED WEIGHT (GRAMS) OF FISH IMPINGED AT INDIAN POINT UNITS 2 & 3 COMBINED DURING 1987, BY TAXON AND SEASONAL STRATUM (ADJUSTED FOR COLLECTION EFFICIENCY)

Taxon	Stratum				
	Winter	Spring	Summer	Fall	Total
Alewife	630	35,778	82,589	8,363	127,360
Bay anchovy	183	648	52,864	11,176	64,871
American shad	132	35,543	55,228	12,077	102,980
Bluefish	0	3,208	44,080	2,469	49,757
Bluegill	1,152	4,010	1,773	1,510	8,445
Brown bullhead	9,969	1,026	10,906	0	21,901
Pumpkinseed	52,980	5,759	8,862	2,484	70,085
Black crappie	355	0	767	49	1,171
Carp	3,917	0	0	0	3,917
American eel	55,055	138,748	316,148	29,485	539,436
Goldfish	3,880	82	0	0	3,962
Golden shiner	6,646	143	0	341	7,130
Hogchoker	10,885	180,516	233,635	88,401	513,437
Tessellated darter	747	705	0	24	1,476
Banded killifish	11,716	566	0	1,113	13,395
Largemouth bass	483	0	0	285	768
Mummichog	0	216	17,831	0	18,047
Atlantic menhaden	931	38,800	531,854	6,125	577,710
Blueback herring	404	122,773	200,571	191,822	515,570
Atlantic silverside	21	60	11	34	126
Rainbow smelt	8,744	25,042	5,181	6,430	45,397
Smallmouth bass	150	0	552	0	702
Shortnose sturgeon	639	882	0	0	1,521
Spottail shiner	13,139	654	0	353	14,146
Atlantic sturgeon	0	0	269	0	269
Striped bass	49,109	6,330	124,337	47,332	227,108
Fourspine stickleback	65	359	0	12	436
Atlantic tomcod	43,016	606,087	1,110,462	12,526	1,772,091
White catfish	107,195	9,753	87,770	42,498	247,216
White perch	2,542,431	1,384,761	1,706,391	319,299	5,952,882
Yellow perch	15,143	1,168	335	1,014	17,660
Rock bass	0	0	6	615	621
Northern pipefish	0	153	356	32	541
Redbreast sunfish	1,518	0	639	0	2,157
Crevalle jack	0	0	232	1,997	2,229
Weakfish	0	0	13,505	1,953	15,458
Lookdown	0	0	0	226	226
Clupeid larvae	0	0	0	0	0
Tautog	0	0	0	1,392	1,392
Four bearded rockling	0	0	0	150	150
Striped cuskeel	0	455	0	0	455
Winter flounder	889	1,535	8,655	0	11,079
Tidewater silverside	8	0	0	21	29
Gizzard shad	12,427	0	560	4,779	17,766

TABLE B-10 (Cont.)

Taxon	Stratum				
	Winter	Spring	Summer	Fall	Total
Silver hake	0	557	0	0	557
Threespine stickleback	2,445	5	0	0	2,450
Brown trout	0	38,767	0	0	38,767
Butterfish	0	0	8,302	1,619	9,921
White crappie	0	0	504	151	655
Green sunfish	0	0	511	0	511
Centrarchid unid.	0	0	3	0	3
Red hake	509	0	0	245	754
Eastern mudminnow	0	0	5,420	2,299	7,719
Summer flounder	0	0	9,915	0	9,915
Black bullhead	0	0	300	0	300
Striped searobin	0	0	0	173	173
Hickory shad	0	0	41	0	41
Warmouth	0	0	0	253	253
Yellow bullhead	0	0	1,648	0	1,648
Naked goby	75	0	117	49	241
Windowpane	0	57	0	0	57
Cunner	0	592	0	0	592
Total	2,957,588	2,645,738	4,643,130	801,176	11,047,632

TABLE B-11 TOTAL NUMBER OF BLUE CRABS COLLECTED EACH MONTH AT INDIAN POINT GENERATING STATION DURING 1987

	Month												
Unit 2	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	Total
Male/Alive													
Intact	0	0	0	0	4	10	23	104	88	170	4	2	405
Missing parts	0	0	0	0	0	8	40	75	45	37	0	1	206
Male/Dead													
Intact	0	0	0	0	1	2	0	12	10	8	0	0	33
Missing parts	0	0	0	0	1	1	3	31	36	20	1	0	93
Female/Alive													
Intact	0	0	0	0	0	0	5	31	24	38	4	0	102
Missing parts	0	0	0	0	0	0	8	30	23	9	0	0	70
Female/Dead													
Intact	0	0	0	0	0	0	0	6	4	1	1	0	12
Missing parts	0	0	0	0	0	0	0	13	11	10	0	0	34
Undetermined/Alive													
Intact	0	0	0	0	0	0	0	3	0	0	0	0	3
Missing parts	0	0	0	0	0	0	0	0	0	0	0	0	0
Undetermined/Dead													
Intact	0	0	0	0	0	0	0	0	0	0	0	0	0
Missing parts	0	0	0	0	0	0	0	1	0	0	0	0	1
Unit 3													
Male/Alive													
Intact	0	0	0	0	0	NS	NS	0	88	316	117	1	522
Missing parts	0	0	0	0	0	NS	NS	0	43	80	2	0	125
Male/Dead													
Intact	0	0	0	0	0	NS	NS	0	7	10	0	0	17
Missing parts	0	0	0	0	0	NS	NS	0	43	23	2	0	68
Female/Alive													
Intact	0	0	0	0	0	NS	NS	0	57	100	20	0	177
Missing parts	0	0	0	0	0	NS	NS	0	30	7	1	0	38
Female/Dead													
Intact	0	0	0	0	0	NS	NS	0	4	3	1	0	8
Missing parts	0	0	0	0	0	NS	NS	0	14	3	0	0	17

NOTE: Excludes crabs for which information for all categories was not recorded.
NS = not sampled.

TABLE B-11 (Cont.)

Units 2 and 3 Combined	Month												
	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	Total
Male/Alive													
Intact	0	0	0	0	4	10	23	104	176	486	121	3	927
Missing parts	0	0	0	0	0	8	40	75	88	117	2	1	331
Male/Dead													
Intact	0	0	0	0	1	2	0	12	17	18	0	0	50
Missing parts	0	0	0	0	1	1	3	31	79	43	3	0	161
Female/Alive													
Intact	0	0	0	0	0	0	5	31	81	138	24	0	279
Missing parts	0	0	0	0	0	0	8	30	53	16	1	0	108
Female/Dead													
Intact	0	0	0	0	0	0	0	6	8	4	2	0	20
Missing parts	0	0	0	0	0	0	0	13	25	13	0	0	51
Undetermined/Alive													
Intact	0	0	0	0	0	0	0	3	0	0	0	0	3
Missing parts	0	0	0	0	0	0	0	0	0	0	0	0	0
Undetermined/Dead													
Intact	0	0	0	0	0	0	0	0	0	0	0	0	0
Missing parts	0	0	0	0	0	0	0	1	0	0	0	0	1

TABLE B-12 CARAPACE WIDTH (mm) DISTRIBUTION OF BLUE CRABS IN IMPINGEMENT COLLECTIONS AT INDIAN POINT DURING 1987, BY MONTH

	Unit 2										
Month	10.0-19.0	20.0-29.0	30.0-39.0	40.0-49.0	50.0-59.0	60.0-69.0	70.0-79.0	80.0-89.0	90.0-99.0	100.0-109.0	110.0-119.0
JAN	0	0	0	0	0	0	0	0	0	0	0
FEB	0	0	0	0	0	0	0	0	0	0	0
MAR	0	0	0	0	0	0	0	0	0	0	0
APR	0	0	0	0	0	0	0	0	0	0	0
MAY	0	0	0	0	0	0	0	0	2	1	1
JUN	0	0	0	0	0	0	0	1	1	2	0
JUL	0	0	0	1	1	4	6	14	16	3	8
AUG	0	0	0	0	0	0	1	9	23	34	33
SEP	0	0	12	24	0	2	0	2	0	3	4
OCT	1	17	70	93	35	17	1	2	0	2	3
NOV	0	0	6	1	1	1	0	0	0	0	0
DEC	0	0	0	0	0	0	0	0	0	0	0
	1	17	88	119	37	24	8	28	42	45	49

Month	120.0-129.0	130.0-139.0	140.0-149.0	150.0-159.0	160.0-169.0	170.0-179.0	180.0-189.0	190.0-199.0	200.0-209.0
JAN	0	0	0	0	0	0	0	0	0
FEB	0	0	0	0	0	0	0	0	0
MAR	0	0	0	0	0	0	0	0	0
APR	0	0	0	0	0	0	0	0	0
MAY	1	0	1	0	0	0	0	0	0
JUN	4	4	0	4	5	0	0	0	0
JUL	2	4	7	7	1	4	1	0	0
AUG	40	30	26	35	31	22	12	5	5
SEP	20	28	28	39	36	25	16	2	0
OCT	9	7	11	11	16	4	4	1	1
NOV	0	1	0	0	0	0	0	0	0
DEC	1	0	1	0	1	0	0	0	0
	77	74	74	96	90	55	33	8	6

TABLE B-12 (Cont.)

Unit 3

Month	10.0-19.0	20.0-29.0	30.0-39.0	40.0-49.0	50.0-59.0	60.0-69.0	70.0-79.0	80.0-89.0	90.0-99.0	100.0-109.0	110.0-119.0
JAN	0	0	0	0	0	0	0	0	0	0	0
FEB	0	0	0	0	0	0	0	0	0	0	0
MAR	0	0	0	0	0	0	0	0	0	0	0
APR	0	0	0	0	0	0	0	0	0	0	0
MAY	0	0	0	0	0	0	0	0	0	0	0
AUG	0	0	0	0	0	0	0	0	0	0	0
SEP	0	1	9	14	1	2	4	1	0	1	9
OCT	0	8	136	122	94	51	20	11	4	6	4
NOV	0	2	24	56	50	21	2	0	1	0	0
DEC	0	0	1	0	0	0	0	0	0	0	0
	0	11	170	192	145	74	26	12	5	7	13

Month	120.0-129.0	130.0-139.0	140.0-149.0	150.0-159.0	160.0-169.0	170.0-179.0	180.0-189.0	190.0-199.0	200.0-209.0
JAN	0	0	0	0	0	0	0	0	0
FEB	0	0	0	0	0	0	0	0	0
MAR	0	0	0	0	0	0	0	0	0
APR	0	0	0	0	0	0	0	0	0
MAY	0	0	0	0	0	0	0	0	0
AUG	0	0	0	0	0	0	0	0	0
SEP	15	15	34	40	64	54	16	5	2
OCT	10	12	10	15	20	11	8	0	0
NOV	1	0	0	0	0	0	0	0	0
DEC	0	0	0	0	0	0	0	0	0
	26	27	44	55	84	65	24	5	2

TABLE B-12 (Cont.)

Units 2 and 3 Combined

Month	10.0-19.0	20.0-29.0	30.0-39.0	40.0-49.0	50.0-59.0	60.0-69.0	70.0-79.0	80.0-89.0	90.0-99.0	100.0-109.0	110.0-119.0
JAN	0	0	0	0	0	0	0	0	0	0	0
FEB	0	0	0	0	0	0	0	0	0	0	0
MAR	0	0	0	0	0	0	0	0	0	0	0
APR	0	0	0	0	0	0	0	0	0	0	0
MAY	0	0	0	0	0	0	0	0	2	1	1
JUN	0	0	0	0	0	0	0	1	1	2	0
JUL	0	0	0	1	1	4	6	14	16	3	8
AUG	0	0	0	0	0	0	1	9	23	34	33
SEP	0	1	21	38	1	4	4	3	0	4	13
OCT	1	25	206	215	129	68	21	13	4	8	7
NOV	0	2	30	57	51	22	2	0	1	0	0
DEC	0	0	1	0	0	0	0	0	0	0	0
	1	28	258	311	182	98	34	40	47	52	62

Month	120.0-129.0	130.0-139.0	140.0-149.0	150.0-159.0	160.0-169.0	170.0-179.0	180.0-189.0	190.0-199.0	200.0-209.0
JAN	0	0	0	0	0	0	0	0	0
FEB	0	0	0	0	0	0	0	0	0
MAR	0	0	0	0	0	0	0	0	0
APR	0	0	0	0	0	0	0	0	0
MAY	1	0	1	0	0	0	0	0	0
JUN	4	4	0	4	5	0	0	0	0
JUL	2	4	7	7	1	4	1	0	0
AUG	40	30	26	35	31	22	12	5	5
SEP	35	43	62	79	100	79	32	7	2
OCT	19	19	21	26	36	15	12	1	1
NOV	1	1	0	0	0	0	0	0	0
DEC	1	0	1	0	1	0	0	0	0
	103	101	118	151	174	120	57	13	8

TABLE B-13 THE PROPORTION OF BLUE CRABS IMPINGED IN 1987 BY SEX, SURVIVAL, AND CONDITION AT THE INDIAN POINT GENERATING STATION

Unit	Sex	Survival	Condition	Total	(a) I/M, A/D BY M/F %	(b) I VS M BY A/D %	(c) I VS M $\sum$ A/D %	(d) A VS D BY M/F %	(e) M VS F %
2	Male	Alive	Intact	405	55.0	66.3	59.4	82.9	77.2
			Missing Parts	206	28.0	33.7			
		Dead	Intact	33	4.5	26.2		17.1	
			Missing Parts	93	12.6	73.8	40.6		
	Female	Alive	Intact	102	46.8	59.3	52.3	78.9	22.8
			Missing Parts	70	32.1	40.7			
		Dead	Intact	12	5.5	26.1		21.1	
			Missing Parts	34	15.6	73.9	47.7		
3	Male	Alive	Intact	522	71.3	80.7	73.6	88.4	75.3
			Missing Parts	125	17.1	19.3			
		Dead	Intact	17	2.3	20.0		11.6	
			Missing Parts	68	9.3	80.0	26.4		
	Female	Alive	Intact	177	73.8	82.3	77.1	89.6	24.7
			Missing Parts	38	15.8	17.7			
		Dead	Intact	8	3.3	32.0		10.4	
			Missing Parts	17	7.1	68.0	22.9		
2 & 3	Male	Alive	Intact	927	63.1	73.7	66.5	85.6	76.2
			Missing Parts	331	22.5	26.3			
		Dead	Intact	50	3.4	23.7		14.4	
			Missing Parts	161	11.0	76.3	33.5		
	Female	Alive	Intact	279	60.9	72.1	65.3	84.5	23.8
			Missing Parts	108	23.6	27.9			
		Dead	Intact	20	4.4	28.2		15.5	
			Missing Parts	51	11.1	11.8	34.7		

(a) Percent of total number by sex and unit.
(b) Percent of crabs intact and missing parts by survival status, sex, and unit.
(c) Percent of crabs intact and missing parts, summed over survival status, by sex and unit.
(d) Percent of alive and dead crabs by sex and unit.
(e) Percent of male and female crabs by unit.

NOTE: Excluding those for which information was not recorded for all pertinent categories.