HUDSON RIVER ECOLOGICAL STUDY

IN THE AREA OF INDIAN POINT

1985 ANNUAL REPORT

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1.0 SUMMARY

Impingement monitoring was conducted at the Indian Point Station in 1985. This program is a continuation of sampling efforts which began in 1972.

Impingement collections were made on an almost daily basis at Unit 2 due to the special studies conducted in 1985 relating to the evaluation of the Ristroph Screen installed at intake 26, and the pneumatic fish avoidance devices. Unit 3 sampling followed the stratified random design first introduced during the last six months of 1981. The stratified design consisted of 110 sampling days per year, divided into four strata (seasons).

Approximately 349,000 fish were collected from the intake screens at Units 2 and 3 during 1985. After adjustment for collection efficiency, an estimated 1.08 million fish weighing 31,000 kg were impinged. This estimate is greater than estimates from the previous two years, but less than estimates from any year between 1972 and 1982. However, these adjusted estimates may be low due to unusually high blue crab scavenging of impinged fish during the summer months which could not be accurately estimated by the collection efficiency adjustments historically used. The coefficient of variation for estimated numbers of fish impinged was 4.2% for Unit 2 and 11.7% for Unit 3.

A total of 81 species were collected at Indian Point during 1985. This is the greatest species richness observed since Indian Point Unit 2 began operating in 1973 and includes five species not previously reported from Indian Point.

Seasonal patterns of impingement were similar to previous years, with white perch being the most common species, and impingement rates (all species combined) being highest in the winter. Individual species impingement rates were similar to previous years.

Blue crab impingement monitoring resulted in a total of 12,316 crabs collected with a total weight of 1,352 kg. Blue crab impingement varied seasonally in a manner similar to previous years, with minimum numbers impinged in spring and winter, and maximum numbers in summer. The number of blue crabs impinged in 1985 was approximately 35 times higher than in 1984 (348 blue crabs) and approximately 15 times greater than 1983 (821 blue crabs). Low fresh water flows in 1985 caused the salt front to extend above Indian Point during the summer and blue crabs in saline water were probably exposed to Indian Point impingement for a longer period of time than in 1983 or 1984, resulting in higher numbers impinged.

2.0 INTRODUCTION

This report is the fourteenth 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 Station, including impingement sampling, fisheries surveys, mitigation studies and ichthyoplankton entrainment sampling (Texas Instruments, TI: 1973; 1974; 1975; 1976; 1977; 1979; 1980a; 1980b; Con Edison: 1982a; 1982b; 1983; Normandeau Associates Inc., NAI: 1984a; 1984b; Martin Marrietta Environmental Systems, MMES: 1985). This report discusses the 1985 impingement data and interprets these latest study results in conjunction with the findings of previous years. Estimates of the total number of fish impinged at each unit as well as estimates for all individual species are provided. Seasonal impingement trends at Units 2 and 3 are also discussed.

With the implementation of the Settlement Agreement, the Utilities 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 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%) was found to be very accurate --i.e., the 95% 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% and 93% of the time, respectively (TI 1980b). Increasing the sampling intensity beyond 30% 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 data base from 1976-1983 (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 in 1985 (NAI 1984a).

The 1985 impingement monitoring program at Indian Point Station consisted of the regular (stratified random) sampling design described above, and two modified designs associated with special studies at Unit 2; Ristroph Screen Special Studies and Ristroph Survival Studies. Impingement monitoring at Unit 3 was conducted for the entire year on random, pre-selected days according to the stratified random sampling design. The stratified design was also used at Unit 2 during the period 19 April through 15 July 1985. Ristroph Screen Special Studies were conducted at Indian Point between 1 January and 18 April 1985 to evaluate the mechanical and biological effectiveness of a Ristroph-modified vertical travelling screen installed in one intake forebay at Indian Point Unit 2 (Con Edison 1985). The specific objectives of the biological study were to evaluate post-impingement survival of fish, and determine whether installing the screen inside the intake forebay would increase the number of fish impinged compared to a screen located at the intake bay entrance. Ristroph Survival Studies were also conducted between 16 July and 31 December 1985 to provide additional data on post-impingement survival of fish during the summer and fall seasons.

3.0 MATERIALS AND METHODS

Impingement collections at Indian Point Unit 3 were taken in four seasonal strata according to the stratified random sampling design introduced in Section 2.0. Collections of fishes impinged by Indian Point Unit 2 resulted from three different sampling regimes as outlined in Section 2.0. On all days when the plant operated, whether or not sampling was scheduled for impinged fish, the traveling screens were washed to remove fish and debris. On all days when the plant operated, samples of impinged blue crabs were collected. 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 miles) above the Battery in New York City (Figure 3-1). The Station began operating with the completion of Unit 1 in 1962. Unit 2, which is operated by 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.

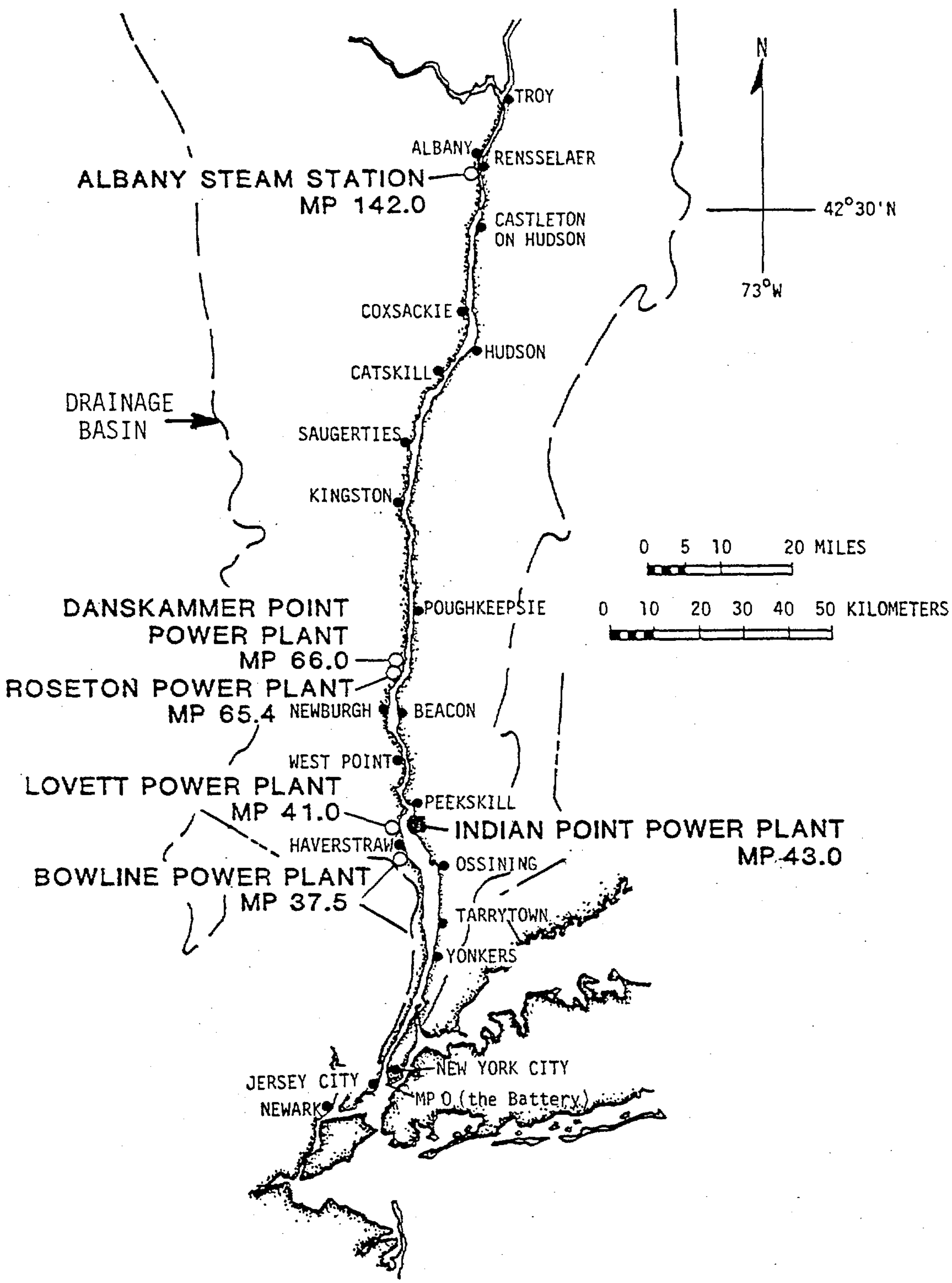

Figure 3-1. Location of Indian Point Station Relative to other Hudson River Stations.

The combined pumping capacity of the three units for cooling purposes is 7790 m^3/minute (2,058,000 gal/min). Unit No. 1, which has two 530 m^3/minute (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 withdraw river water. Unit 1 has two pumps with a total pumping rate of 144 m^3/min or (38,000 gal/min). Units 2 and 3 each have six pumps with a total pumping rate of 114 m^3/min or (30,000 gal/min) at each unit.

Units 1 and 2 each have fixed intake screens at the river's edge and traveling screens within each intake bay (Figure 3-2). Unit 3 has 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).

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 (Table 3-1) specified by the Agreement which became effective May 14, 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.

These flow rates were specified as a measure to reduce to a minimum the 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.

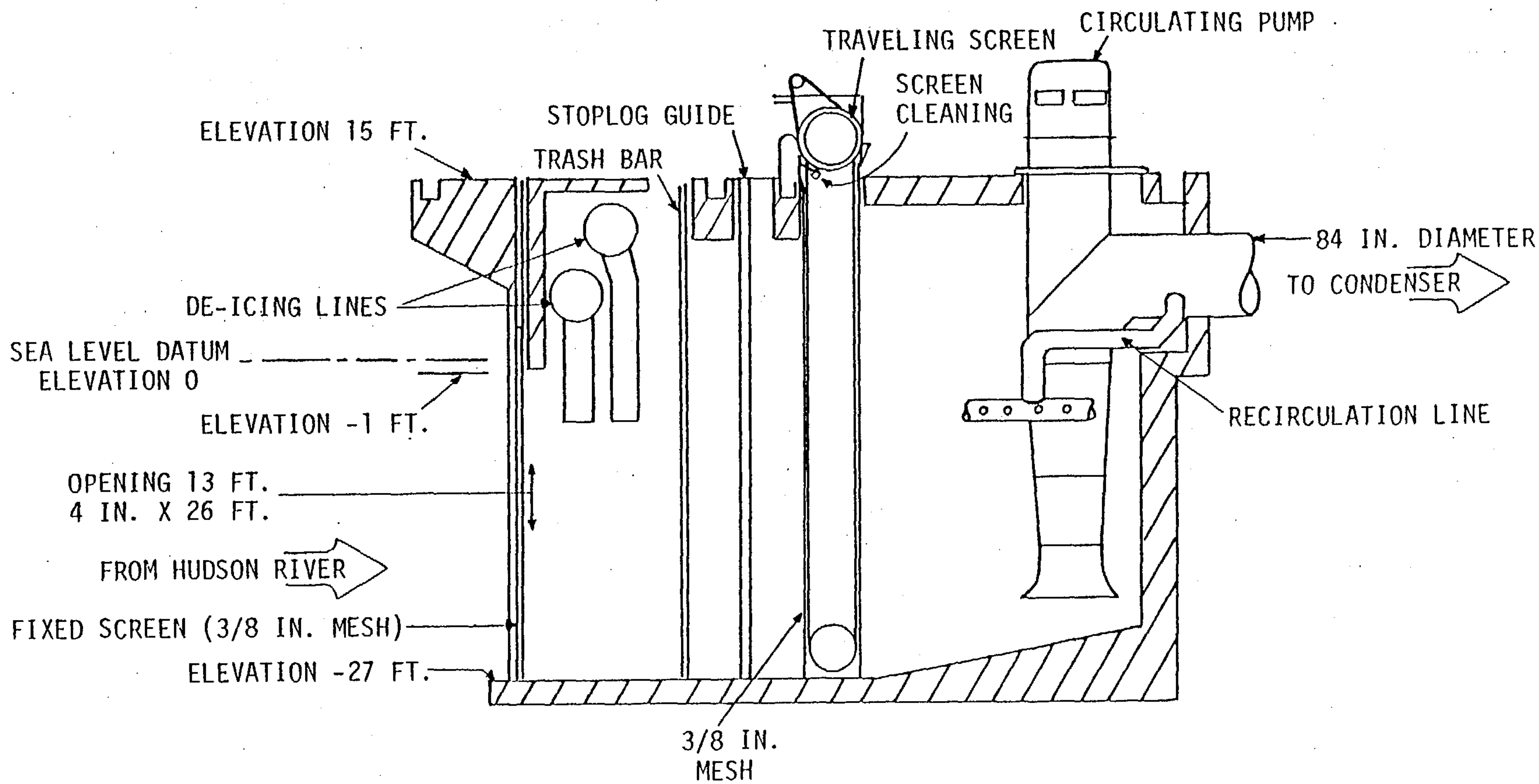

Figure 3-2. Schematic intake bay cross-section of Indian Point Unit No. 2.

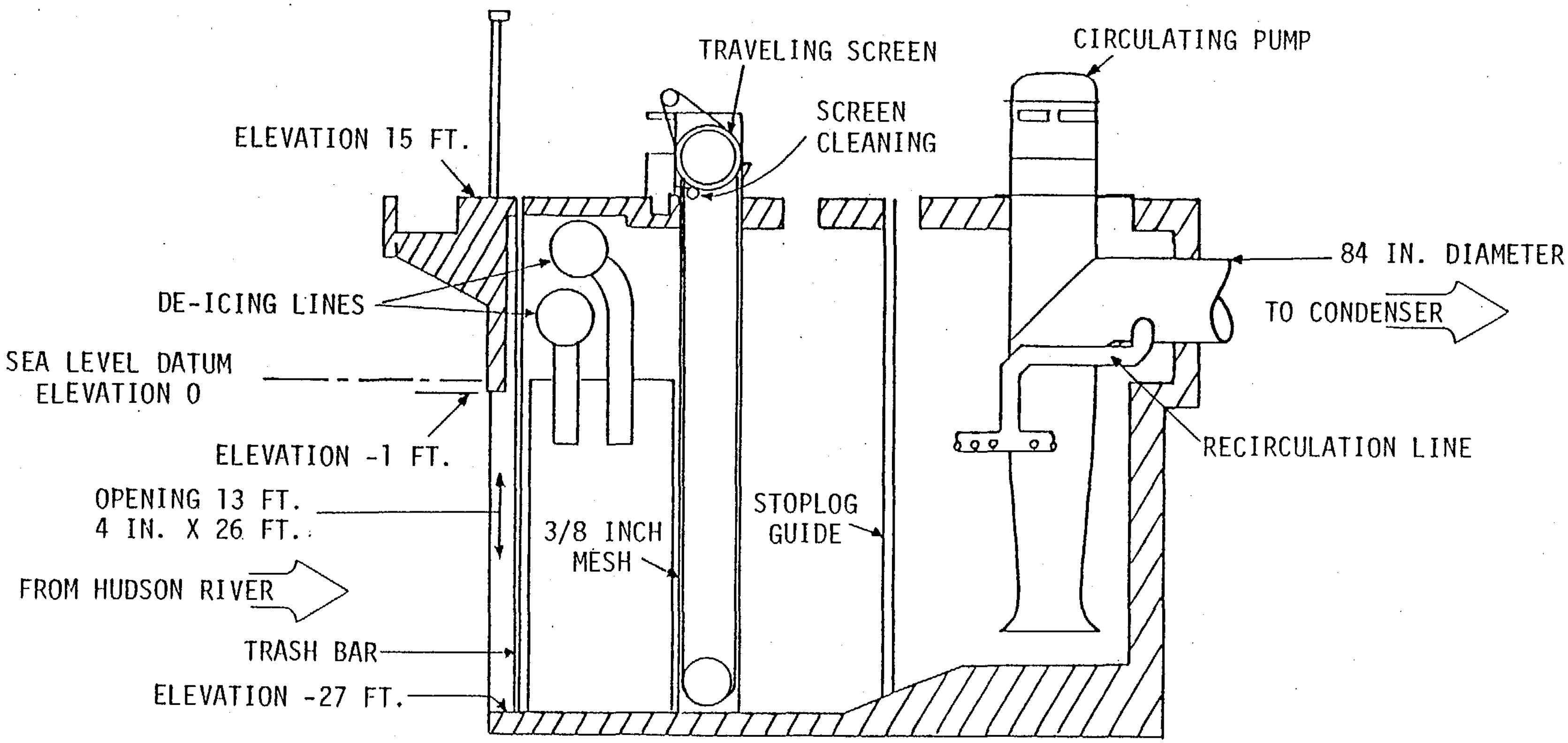

Figure 3-3. Schematic intake bay cross-section of Indian Point Unit No. 3.

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)
Jan 1 - May 15	504,000
May 16 - May 22	560,000
May 23 - May 31	672,000
June 1 - June 8	731,000
June 9 - Sept 30	840,000
Oct 1 - Oct 31	731,000
Nov 1 - Dec 31	504,000

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

APPROXIMATE PERIOD	APPROXIMATE FLOW (gpm/Unit)
Jan 1 - May 1	505,000 gpm (60% Flow)
May 1 - June 1	Change: From 505,000 gpm to 840,000 gpm (100% Flow)
June 1 - Oct 1	840,000 gpm
Oct 1 - Nov 1	Change: From 840,000 gpm to 505,000 gpm (60% Flow)
Nov 1 - Dec 31	505,000 gpm

3.2 FIELD AND LABORATORY METHODS

The stratified sampling design for impingement and water quality data collection, which was initiated in July 1981, was continued throughout 1985 at Unit 3 and at Unit 2 except as modified in 1985 for Ristroph Screen Special Studies and Ristroph Survival Studies. Sample days were assigned to randomly selected dates within four seasonal strata, in contrast to the daily sampling which was conducted before July 1981. On days not selected for sample collection (non-sample days), fish and debris were discarded when the traveling screens were washed. Impingement counts and biocharacteristics data were collected for blue crabs on all days in 1985 when blue crabs were present in impingement collections. Collection efficiency tests were not conducted in 1985 except during the Ristroph Screen Special Studies (Con Edison 1985) and Ristroph Survival Studies.

Screens were washed daily, generally between 0800 and 1200 hours, and on preselected random sampling days, fish collected at Unit 2 intakes 21-26 or Unit 3 intakes 31-36 were sampled and enumerated. The fish impinged on each screen were pooled for each unit to create one sample consisting of fish impinged on screens at all operating cooling water intakes for the preceding 24-hour period. On non-sample days, fish and debris were disposed of without enumeration.

The Ristroph Screen Special Studies took place from 1 January 1985 through 18 April 1985. Sampling during this period called for screen-specific collections of impinged fish at each of the six screening devices (Figure 3-4) serving the cooling water intakes at Unit 2 (NAI 1986). The Ristroph screen was installed at intake 26 (Figures 3-4 and 3-5). Samples were usually taken twice daily, between 0800 and 1200 hours and again between 2000 and 2400 hours. Screens 21-25 were usually sampled once daily between 0800 and 1200 hours.

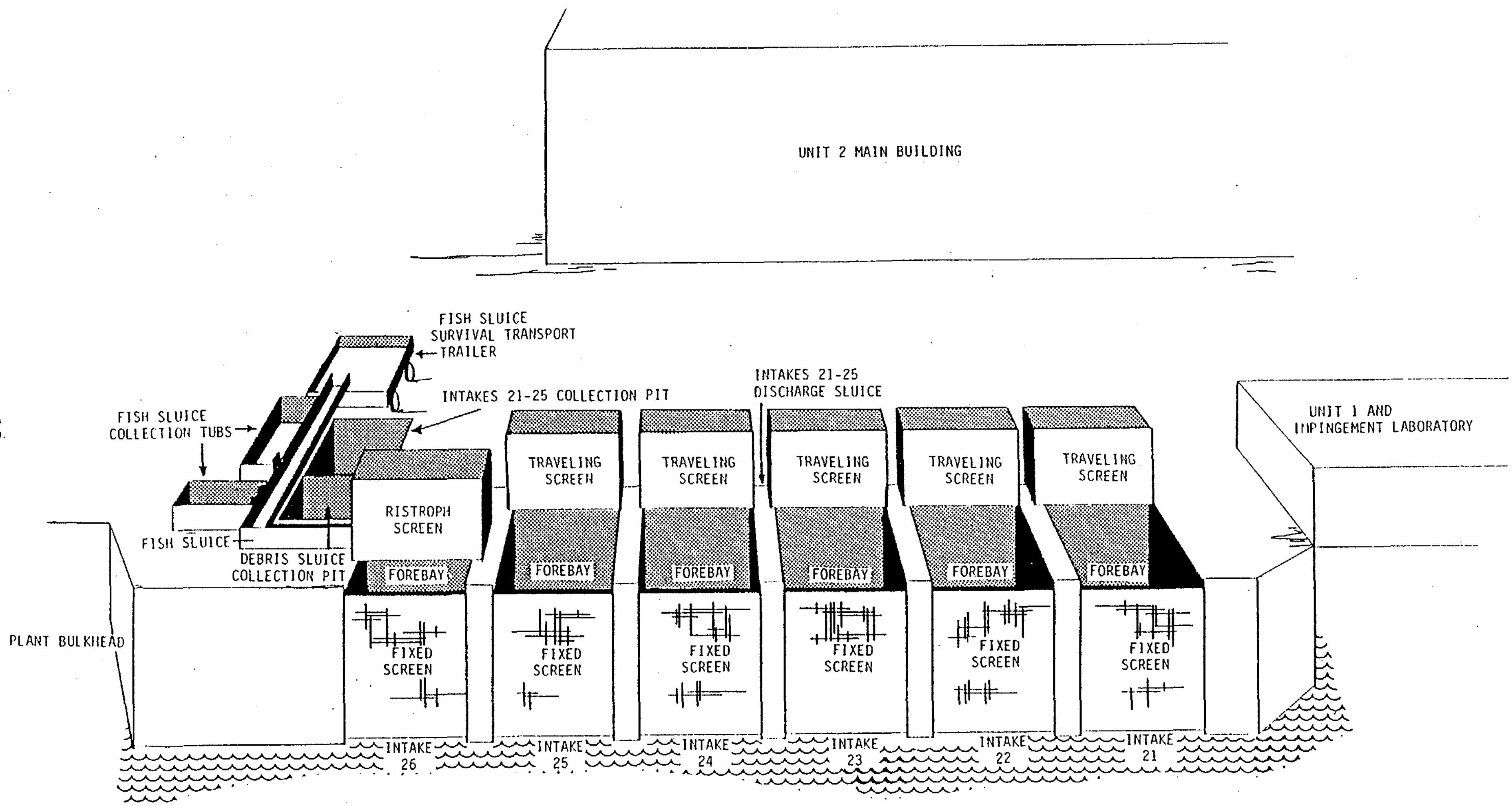

Figure 3-4. Indian Point Unit 2 cooling water intake bay configuration.

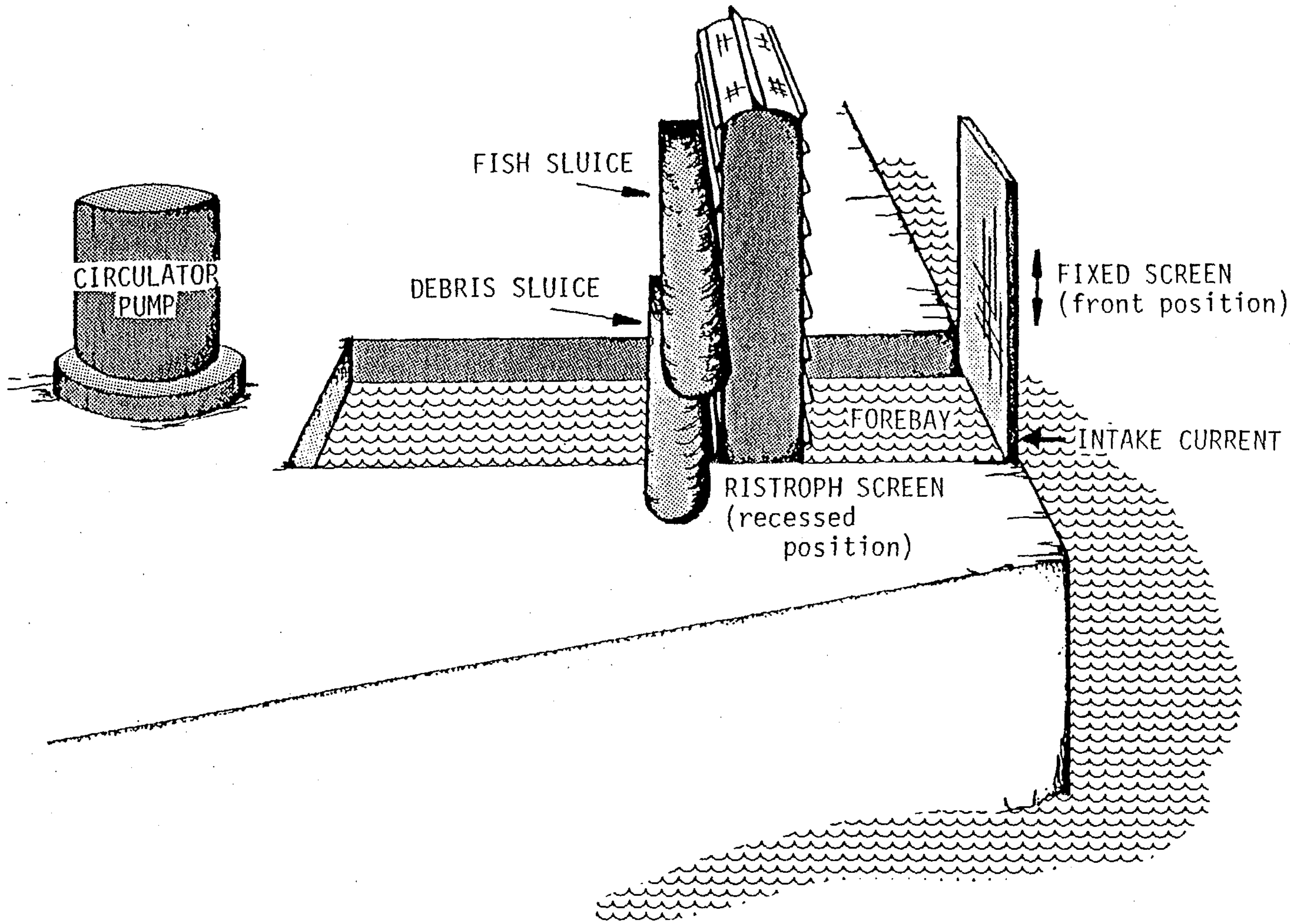

Figure 3-5. Cut-away schematic view of fish conveyance mechanisms at intake at Indian Point Intake 26.

Three types of impingement collections were taken at intake 26 during the Ristroph Screen Special Studies (Figure 3-5): a "front position" sample consisted of fish collected from the outer (fixed) screen; a "recessed position" sample consisted of fish collected from the recessed Ristroph screen with the outer screen in an up position; and an "entrapment sample" consisted of fish collected from the Ristroph screen while the outer screen was lowered. Each sample described above consisted of two subsamples: debris sluice and fish sluice subsamples. These subsamples resulted from the design of the Ristroph screen which, through a system of water sprays and sluiceways, separated the incoming sample into either fish or debris (Figure 3-5). As the Ristroph screen rotated in a counterclockwise direction away from the river, impinged fish on the screening material encountered a low pressure spray located above the fish sluice which washed fish into the sluice (Figure 3-5). The remaining material on the screen passed through a high pressure spray located below the fish sluice which washed all remaining debris into the debris sluice (Figure 3-5). The separation between fish and debris was not complete, however, so debris sluice subsamples were also enumerated for fish.

For the period, 16 July through the end of the year, Ristroph Survival Studies were conducted at intake 26 to supplement data from the Ristroph Screen Special Studies. Two samples were generally taken daily. One sample consisted of fish impinged on screens 21-25, and the second consisted of fish impinged on screen 26. Both samples were generally taken between 0800 and 1200 hours and represented fish impinged for the previous 24-hour period.

3.2.1 Schedule

Fish and blue crab impingement samples were collected on the randomly selected sample days. On non-sample days, only blue crab samples were collected. On occasions when sampling could not be carried out due to unit 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 there were any) 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, whenever possible, to make the date representative of the full sampling period.

3.2.2 Sample Collection

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 (^{o}C) and conductivity (micro-siemens) were measured at the intake of Units 2 and 3 at 0.3 m (1 foot) 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 (Tables A-1 and A-2). 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, and
Length Class 4 = 251 mm and larger.

The division cutoffs (Division 1 and Division 2) used to define the length groups represent the upper length limits of young-of-the-year and yearling age classes, respectively. Values for the division cutoffs were determined from length-frequency data obtained from the impingement collections and supplemented when necessary by aging selected specimens by scale analysis. These values were periodically updated throughout the year (usually every two weeks) to allow for growth.

Subsamples were taken for any species, except Atlantic tomcod during January through March and during December, 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 by month in Tables A-3 through A-5 and by seasonal stratum in Tables A-6 through A-8. For each species, weights were recorded to the nearest gram for Length Class 1, Length Class 2, and total of all four length classes (Tables A-9 through A-11).

Blue crabs were examined for total count (Table A-12) and total weight, and the following data were recorded for each specimen: carapace width to the nearest millimeter (Table A-13), weight (nearest 0.1 g), survival (alive or dead), condition (intact or missing body parts), and sex. If more than 50 blue crabs were present in a sample, then a subsample was taken. Fifty whole blue crabs were randomly selected and weighed. The total number of blue crabs in the subsampled 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 subsample. After processing the sample, all live crabs were returned to the river away from the intake structure.

Any shortnose or Atlantic sturgeon collected were measured (total length), weighed, and the data entered in a Sturgeon Log. Alive sturgeon were returned to the river. All yearling and older striped bass, white perch, and Atlantic tomcod, and young-of-the-year tomcod after the first day of marking in December, were examined for fin clips, tags, or tag wounds. Any suspected recaptures were preserved in 10% formalin for later verification. All young-of-the-year, yearling and older striped bass were checked for hatchery-administered (magnetic) tags on both sampling and non-sampling days.

Quality control (QC) checks were performed on fish identifications, counts, weights, crab measurements, and examination for suspected recaptures. The selection of samples for QC checks followed Military Standard 1235 (Single and Multiple Level Continuous Sampling Procedures), which assured that 90% or more of the data were within specified tolerance limits. Data were recorded on standard data coding forms developed for this study.

3.3 SAMPLING DESIGN

To provide data comparable with previous Indian Point impingement reports, it was necessary to combine the impingement data among the various sampling programs during 1985 to provide a daily (circa 24-hour) unit-wide sample. Routine impingement data from Unit 3 (all year) and from Unit 2 (19 April through 15 July) were treated as in previous years since each sample generally consisted of one 24-hour sample with all screens pooled. Impingement data collected during Ristroph Survival Studies (16 July through 31 December) were collapsed into a single 24-hour sample by pooling the data from screen 26 with the data from screens 21-25, since these daily samples were concurrent and generally 24 hours in duration. During the Ristroph Screen Special Studies (1 January through 18 April) screen specific collections were made. Fish were collected daily from screens 21-25 and at least every twelve hours from screen 26. To provide a single daily count of fish impinged, concurrent debris sluice and fish sluice subsamples were pooled at screen 26. Similarly, the two 12-hour samples at screen 26 were pooled.

The impingement sampling design used in 1985 provided more sampling days than called for in previous years due to the special studies conducted at Unit 2. Seasonal quotas for sampling days were exceeded for all seasonal strata at Unit 2 (Table 3-3). Seasonal quotas at Unit 3 were not met during the Summer and Fall strata due to an extended outage from 7 June through 5 October. The standard procedure that has been used to minimize the effect of missed collection days is 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 3 during the Summer and Fall strata, there were not enough unallocated days left in these strata to make up the missed samples.

The method used to calculated an estimate of the total number of fish impinged during the year (Appendix A) assumes that sample days are representative of all operating days in a stratum, because each day is weighted equally in computing the estimate. With respect to the volume of water circulated, this assumption was justified as shown by the close 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).

3.4 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% 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.

TABLE 3-3. NUMBERS OF IMPINGEMENT COLLECTION DAYS AND DAYS OF PLANT OPERATION AT INDIAN POINT UNITS 2 AND 3 DURING 1985.

		DAYS OF PLANT OPERATION[a]	DAYS OF IMPINGEMENT COLLECTIONS	DAYS ALLOCATED IN STRATIFIED DESIGN
Unit 2	Winter (Jan-Mar)	90	82	23
	Spring (Apr-Jun)	91	27	8
	Summer (Jul-Sep)	91	76	11
	Fall (Oct-Dec)	92	92	68
	TOTAL	364	277	110
Unit 3	Winter (Jan-Mar)	90	35	35
	Spring (Apr-Jun)	70	14	20
	Summer (Jul-Sept)	14	4	31
	Fall (Oct-Dec)	92	24	24
	TOTAL	266	77	110

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

TABLE 3-4. COMPARISON OF SAMPLING DATES AND AVERAGE DAILY SAMPLING VOLUMES WITH OPERATING DATES AND AVERAGE DAILY OPERATING VOLUMES AT INDIAN POINT UNIT 2 BY MONTH DURING 1985.

	SAMPLING DATES	AVERAGE DAILY SAMPLING VOLUME ($10^6 m^3$)	STANDARD DEVIATION	OPERATING DATES	AVERAGE DAILY OPERATING VOLUME ($10^6 m^3$)[a]	STANDARD DEVIATION
January	3,4,11-31	2.72	0.18	1-31	2.81	0.12
February	1-28	2.81	0.38	1-28	2.81	0.16
March	1-31	2.52	0.51	1-31	2.81	0.10
April	1-18,20,28	2.28	1.17	1-30	2.81	0.12
May	2,5,6,10-15, 20,24-27,30	2.73	0.59	1-31	3.17	0.38
June	1-8,10-15, 17-25,28-30	4.23	0.94	1-30	4.45	0.29
July	1-3,5,7-9, 11,13-31	4.63	0.85	1-31	4.63	0.10
August	1,3-19, 21-31	4.39	0.69	1-31	4.51	0.22
September	2-21,23-30	3.54	1.36	1-21 23-30	3.93	0.93
October	1-31	3.93	0.97	1-31	4.11	0.75
November	1-30	2.66	0.69	1-30	2.75	0.09
December	1-31	2.59	0.29	1-31	2.69	0.06

[a] Includes service water, except days when no circulating pump operated

TABLE 3-5. COMPARISON OF SAMPLING DATES AND AVERAGE DAILY SAMPLING VOLUMES WITH OPERATING DATES AND DAILY OPERATING VOLUMES AT INDIAN POINT UNIT 3 BY MONTH DURING 1985.

	SAMPLING DATES	AVERAGE DAILY SAMPLING VOLUME ($10^6 m^3$)	STANDARD DEVIATION	OPERATING DATES	AVERAGE DAILY OPERATING VOLUME ($10^6 m^3$)[a]	STANDARD DEVIATION
January	4,14,15,22	2.71	0.09	1-31	2.83	0.06
February	1,3,7,9,13, 15-19,21,25-28	2.42	0.26	1-28	2.60	0.22
March	1,2,5,9,10,14, 15,20,21,23,25, 27-31	2.66	0.21	1-31	2.85	0.02
April	1,3,7,28	2.56	0.44	1-30	2.52	0.35
May	1-3,6-28,30,31	3.31	0.61	1-31	3.53	0.41
June	1-7	3.66	0.17	1-9	3.16	1.24
July	___[b]	___	___	___	___	___
August	___	___	___	11,13-15	___	___
September	27-30	1.32	1.32	20,22-36	1.56	0.93
October	1,6,7,11-13, 15-17,21-27	2.02	0.53	1-31	2.12	0.59
November	2,5,10,11,13, 19,20,26	2.30	0.24	1-30	2.40	<0.01
December	1,5,16,17,25, 29,31	2.32	0.49	1-31	2.61	0.21

[a]Includes service water, except days when no circulating pump operated

[b]Outage

Extensive collection efficiency studies were performed at Indian Point from 1977-1980 and in 1982 (Con Edison 1983). The observed values of collection efficiency in those studies, as summarized by Con Edison (1983: Figures 3-2 and 3-3), 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 and T_2 and T_3 = intake water temperature (^{o}C) at Units 2 and 3.

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).

During the Ristroph Screen Special Studies (1 January through 19 April 1985), collection efficiency studies were conducted at each of the six intake screens (Figure 3-4) at Unit 2 (Con Edison 1985). At intake 26, approximately 100 dead, marked, yearling fish were released in front of either the fixed screen or the Ristroph screen at 12 hour intervals (twice daily) corresponding with the beginning of each sampling interval. At each of intakes 21-25, approximately 100 dead, marked, yearling fish were released in front of the fixed screen once daily corresponding with the beginning of each 24-hour sampling interval. Fish were generally white perch and were marked with colored tags and dyes in combinations permitting tracking of fish if they were washed from screen to screen at all sampling intervals for 96 hours. During the Ristroph Screen Survival Studies (16 July through 31 December) collection efficiency studies were conducted as described above with approximately two releases per day of 30 fish at each of screens 21, 25 and 26 for the period 16 July through 25 September (Con Edison unpublished). These data were used to qualitatively evaluate the effectiveness of applying regression equations derived from historical data (Equations 1 and 2) to adjust impingement rates during periods when empirical collection efficiency data was available.

4.0 RESULTS AND DISCUSSION

4.1 ESTIMATED NUMBERS OF FISH IMPINGED DURING 1985

A combined total of 349,002 fish were collected at Indian Point Units 2 and 3 in 1985 (Table A-5). When adjusted for collection efficiency using the regression equations (Equations 1 and 2) and scaled to the number of collection days, the estimated total number impinged was 716,805 fish at Unit 2, and 361,372 at Unit 3 (Tables 4-1 and 4-2) for a combined total of 1,078,177 fish weighing an estimated 31,097 kg (Table A-11). The levels of precision (standard errors) were 4.2 and 11.7 percent of the total estimates for Unit 2 and Unit 3, respectively. The level of precision for Unit 2 (4.2%) was more precise than the levels projected by TI (8.2%, 1980b) and NAI (8.1%, 1984b) for the stratified random design. This was due to the daily sampling at Unit 2 during most of the year providing a more accurate and precise estimate of the number of fish impinged (Table 4-3). The level of precision at Unit 3 (11.7%) was only slightly less precise than the levels projected for the complete stratified random design (8.2%: TI 1980b), and very close to the levels projected for the 1985 impingement monitoring program sample size (10.4%: NAI 1984b).

The total number of fish impinged by Units 2 and 3 combined in 1985, estimated at 1.1 million (Tables 4-1 and 4-2), was within the range of other yearly estimates in the 1976-1982 historical data base (range 0.85-6.47 million; Table 4-4) and was greater than either of the previous two years. The volume of water circulated through the plant and average impingement rate was also within the range of values from previous years (Table 4-4).

The precision of estimated totals for individual species varied greatly. Several species had high coefficients of variation due to seasonal rare appearances (lined seahorse, tautog, striped cuskeel,

TABLE 4-1.
ESTIMATED NUMBER OF FISH IMPINGED AT INDIAN POINT UNIT 2 DURING 1985
BY TAXON AND SEASONAL STRATUM
(ADJUSTED FOR COLLECTION EFFICIENCY)

COMMON NAME	WINTER	SPRING	SUMMER	FALL	1985 TOTAL	STANDARD ERROR	COEFFICIENT OF VARIATION
ALEWIFE	487	381	646	828	2343	214	9.1
AMERICAN EEL	544	1044	137	548	2274	184	8.1
AMERICAN SHAD	9	16	58	1258	1340	13	0.9
ATLANTIC CROAKER	0	0	0	2	2	<1	0.0
ATLANTIC CUTLASSFISH	0	0	4	0	4	2	40.9
ATLANTIC MENHADEN	0	21	167	178	367	23	6.4
ATLANTIC NEEDLEFISH	0	0	8	0	8	2	28.7
ATLANTIC SILVERSIDE	5	0	16	7	27	4	14.8
ATLANTIC STURGEON	13	0	0	3	16	2	11.5
ATLANTIC TOMCOD	7758	11993	19264	543	39558	6846	17.3
BANDED KILLIFISH	74	16	4	432	525	10	2.0
BAY ANCHOVY	7	1596	5323	1760	8686	1024	11.8
BLACK BULLHEAD	0	0	0	5	5	<1	0.0
BLACK CRAPPIE	7	8	0	46	61	7	10.7
BLACK SEA BASS	0	0	0	18	18	<1	0.0
BLUEBACK HERRING	121	224	576	7416	8337	88	1.1
BLUEFISH	0	82	420	80	582	50	8.5
BLUEGILL	83	27	387	798	1296	132	10.2
BROWN BULLHEAD	107	54	0	7	168	19	11.2
BUTTERFISH	0	141	1749	11	1901	251	13.2
CARP	2	0	0	18	20	<1	3.4
CENTRAL MUDMINNOW	0	0	0	3	3	<1	0.0
CENTRARCHID UNID.	9	0	0	3	12	2	13.7
CLUPEID UNID.	5	0	8	52	66	4	5.7
COMMON SHINER	0	0	0	5	5	<1	0.0
CONGER EEL	0	0	4	0	4	2	40.9
CREVALLE JACK	0	0	17	105	121	3	2.8
CUNNER	2	8	0	0	10	6	64.3
FOUR BEARDED ROCKLING	11	0	0	3	14	1	10.6
FOURSPINE STICKLEBACK	9	16	0	7	32	9	29.0
FOURSPOT FLOUNDER	0	50	130	0	180	30	16.6
FRECKLED BLENNY	0	0	0	2	2	<1	0.0
GIZZARD SHAD	816	0	0	830	1646	45	2.7
GOLDEN SHINER	71	0	0	0	71	5	7.2
GOLDFISH	9	0	0	4	13	1	9.8
GRAY SNAPPER	0	0	0	107	107	<1	0.0
GREEN SUNFISH	0	0	0	2	2	<1	0.0
GRUBBY	13	0	0	0	13	2	11.8
HOGCHOKER	586	2814	16853	6062	26314	1198	4.6
LARGEMOUTH BASS	20	0	20	11	51	7	14.3
LOOKDOWN	0	0	93	48	141	10	6.8
MACKEREL SCAD	0	0	4	0	4	2	40.9
MOONFISH	0	0	8	72	80	2	2.9
MUMMICHOG	16	0	0	5	21	3	13.8
NAKED GOBY	0	0	0	136	136	<1	0.0
NORTHERN PIPEFISH	5	217	527	238	988	50	5.1
NORTHERN PUFFER	0	0	29	0	29	6	20.5
NORTHERN SEAROBIN	0	0	30	0	30	11	35.6
NORTHERN STARGAZER	0	0	8	0	8	2	28.7

TABLE 4-1 CONTINUED.

COMMON NAME	WINTER	SPRING	SUMMER	FALL	1985 TOTAL	STANDARD ERROR	COEFFICIENT OF VARIATION
PLANEHEAD FILEFISH	0	0	8	0	8	2	28.7
PUMPKINSEED	815	132	76	196	1219	51	4.2
RAINBOW SMELT	2117	693	4	737	3552	235	6.6
RED HAKE	425	0	0	6	431	35	8.0
REDBREAST SUNFISH	4	8	4	8	24	7	27.9
ROCK GUNNEL	7	8	0	0	15	7	44.5
SEA LAMPREY	29	0	0	0	29	3	9.5
SEAHORSE	0	8	0	0	8	6	83.9
SILVER HAKE	40	16	0	21	77	11	14.1
SILVER PERCH	0	0	0	40	40	<1	0.0
SMALLMOUTH BASS	4	0	17	0	21	3	16.5
SPOT	0	0	0	3	3	<1	0.0
SPOTFIN BUTTERFLYFISH	0	0	0	3	3	<1	0.0
SPOTTAIL SHINER	1611	226	8	128	1974	90	4.5
SPOTTED HAKE	2	209	8	0	220	47	21.4
STRIPED BASS	46803	3136	912	2600	53451	1945	3.6
STRIPED CUSKEEL	0	31	0	0	31	16	50.0
STRIPED SEAROBIN	0	0	83	21	104	18	17.0
SUMMER FLOUNDER	0	0	77	60	137	12	8.7
TAUTOG	0	8	0	2	11	7	65.0
TESSELLATED DARTER	99	582	0	13	694	122	17.6
THREESPINE STICKLEBACK	621	111	0	0	732	46	6.4
TIDEWATER SILVERSIDE	13	0	4	0	18	2	13.1
WEAKFISH	0	0	6958	1441	8399	743	8.8
WHITE CATFISH	2788	1017	103	1072	4980	204	4.1
WHITE CRAPPIE	3	0	0	0	3	<1	29.8
WHITE PERCH	278525	67469	6649	190631	543274	28069	5.2
WHITE SUCKER	2	0	0	0	2	<1	29.8
WINDOWPANE	0	65	34	3	102	23	22.6
WINTER FLOUNDER	32	0	37	47	116	6	5.6
YELLOW PERCH	70	109	0	15	194	29	14.9
TOTAL ALL TAXA	345142	91489	61472	218702	716805	30376	4.2

STANDARD ERROR----------STANDARD ERROR OF 1985 TOTAL
COEFFICIENT OF VARIATION-STANDARD ERROR/1985 TOTAL *100

TABLE 4-2.
ESTIMATED NUMBER OF FISH IMPINGED AT INDIAN POINT UNIT 3 DURING 1985
BY TAXON AND SEASONAL STRATUM
(ADJUSTED FOR COLLECTION EFFICIENCY)

COMMON NAME	WINTER	SPRING	SUMMER	FALL	1985 TOTAL	STANDARD ERROR	COEFFICIENT OF VARIATION
ALEWIFE	468	1769	0	587	2824	634	22.4
AMERICAN EEL	317	850	0	190	1358	210	15.4
AMERICAN SHAD	8	25	0	1624	1656	456	27.6
ATLANTIC MENHADEN	0	0	0	47	47	15	32.9
ATLANTIC SILVERSIDE	0	0	0	6	6	5	86.0
ATLANTIC STURGEON	11	16	0	0	27	12	43.1
ATLANTIC TOMCOD	1294	8146	0	282	9723	3711	38.2
BANDED KILLIFISH	18	0	0	97	115	56	48.4
BAY ANCHOVY	23	3082	0	1638	4743	1028	21.7
BLACK CRAPPIE	11	0	0	46	58	35	61.3
BLACK SEA BASS	0	0	0	26	26	17	67.0
BLUEBACK HERRING	127	2834	0	44589	47551	15190	31.9
BLUEFISH	0	0	0	27	27	14	50.7
BLUEGILL	49	189	0	147	384	100	25.9
BOTHID UNID.	0	27	0	0	27	13	47.5
BROWN BULLHEAD	51	26	0	0	77	21	26.8
BUTTERFISH	0	107	0	27	134	52	38.9
CARP	12	0	0	34	46	19	41.5
CREVALLE JACK	0	0	0	92	92	33	36.1
CUNNER	0	9	0	0	9	8	89.4
FOUR BEARDED ROCKLING	11	0	0	0	11	5	43.8
FOURSPINE STICKLEBACK	0	9	0	0	9	8	89.4
FOURSPOT FLOUNDER	0	18	0	0	18	11	60.8
GIZZARD SHAD	1307	0	0	2686	3993	1333	33.4
GOLDEN SHINER	19	8	0	12	39	14	35.4
GOLDFISH	8	0	0	0	8	4	54.5
GRAY SNAPPER	0	0	0	38	38	18	47.6
HOGCHOKER	551	11180	0	1414	13145	3589	27.3
LARGEMOUTH BASS	8	0	0	12	19	11	56.1
LOOKDOWN	0	0	0	26	26	11	40.1
MOONFISH	0	0	0	91	91	42	46.8
MUMMICHOG	4	0	0	0	4	3	78.2
NAKED GOBY	0	0	0	7	7	6	86.0
NORTHERN PIPEFISH	0	157	0	257	414	124	30.0
NORTHERN SEAROBIN	0	8	0	0	8	8	89.4
PIGFISH	0	0	0	7	7	6	86.0
PUMPKINSEED	402	73	0	109	584	70	11.9
RAINBOW SMELT	1448	224	0	134	1806	323	17.9
RED HAKE	460	0	0	6	465	153	32.9
REDBREAST SUNFISH	4	0	0	0	4	3	78.2
SEAHORSE	0	17	0	0	17	10	60.8
SILVER HAKE	11	86	0	33	130	38	29.0
SILVER PERCH	0	0	0	13	13	11	86.0
SPOTTAIL SHINER	338	88	0	133	558	103	18.4
SPOTTED HAKE	0	92	0	0	92	31	34.2
STRIPED BASS	24690	1543	0	779	27011	3888	14.4
STRIPED CUSKEEL	0	361	0	0	361	95	26.4
STRIPED SEAROBIN	0	0	0	26	26	13	50.7
SUMMER FLOUNDER	0	0	0	13	13	8	59.5

TABLE 4-2 CONTINUED.

COMMON NAME	WINTER	SPRING	SUMMER	FALL	1985 TOTAL	STANDARD ERROR	COEFFICIENT OF VARIATION
TAUTOG	0	9	0	0	9	8	89.4
TESSELLATED DARTER	52	50	0	12	113	24	21.4
THREESPINE STICKLEBACK	551	49	0	0	600	111	18.4
TIDEWATER SILVERSIDE	11	0	0	0	11	5	43.8
WEAKFISH	0	0	0	510	510	180	35.4
WHITE CATFISH	1230	133	0	243	1606	222	13.9
WHITE PERCH	152405	18962	7	68538	239912	38094	15.9
WHITE SUCKER	5	0	0	0	5	4	78.2
WINDOWPANE	0	639	0	0	639	216	33.8
WINTER FLOUNDER	22	8	0	0	30	11	34.7
YELLOW PERCH	40	48	0	6	94	26	27.4
TOTAL ALL TAXA	185964	50841	7	124560	361372	42103	11.7

STANDARD ERROR-----------STANDARD ERROR OF 1985 TOTAL
COEFFICIENT OF VARIATION-STANDARD ERROR/1985 TOTAL *100

TABLE 4-3. ESTIMATED MEAN DAILY NUMBER OF FISH IMPINGED IN EACH SEASONAL STRATUM BY INDIAN POINT UNITS 2 AND 3 DURING 1985.

		NUMBER OF SAMPLING DAYS	MEAN DAILY ESTIMATE[a]	STANDARD DEVIATION
Unit 2	Winter (Jan-Mar)60	82	4,209.0	4,429.7
	Spring (Apr-Jun)	27	3,388.5	1,843.6
	Summer (Jul-Sep)	76	808.8	6,390.0
	Fall (Oct-Dec)	92	2,377.2	0.0[b]
	1985 Total	277	2,587.7	109.7
Unit 3	Winter (Jan-Mar)	35	5,313.3	2,039.3
	Spring (Apr-Jun)	14	3,631.5	541.6
	Summer (Jul-Sep)	4	1.6	1.1
	Fall (Oct-Dec)	24	5,190.0	7,901.6
	1985 Total	77	4,693.1	546.8

[a] Adjusted for collection efficiency

[b] Standard deviation = 0 because every operating day was sampled.

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 THROUGH 1983.

	VOLUME ($10^6 m^3$)[a]	ESTIMATED NO. IMPINGED (10^6)[b]	IMPINGEMENT RATE (No./$10^6 m^3$)	NO. SPECIES COLLECTED
1976	1329	1.63	1190	58
1977	2159	6.47	2910	72
1978	2030	3.91	1870	72
1979	1935	4.48	2230	74
1980	1822	3.21	1710	76
1981	1617	4.57	2830	72
1982	1273	1.60	1260	43
1983	1286	0.85	661	49
1984	1710	0.85	496	56
1985	1977	1.08	556	79

[a] Including service water

[b] Adjusted for collection efficiency

Atlantic cutlassfish). Species present year round, but with seasonal peaks in abundance (Atlantic tomcod, hogchoker, bay anchovy) also had relatively imprecise estimates of abundance.

4.2 EFFECTS OF COLLECTION EFFICIENCY ADJUSTMENTS

The combined effects of application of the Unit 2 and Unit 3 collection efficiency regression equations (Equations 1 and 2) can be seen by comparing the increase in monthly impingement rates before and after adjustment (Figure 4-1; Tables 4-1, 4-2, A-6, A-7, A-8). During winter months, adjusted rates were approximately double the unadjusted rates. In the summer months, adjusted rates were approximately three times unadjusted impingement rates, which reflected lower summertime collection efficiency. However, unusually high blue crab scavenging (Section 4.5) during 1985 and the operation of Unit 2 intake 26 for part of the year without a fixed screen (Ristroph screen only) may have affected the accuracy of the regression-adjusted total impingement estimates. Unusually high blue crab predation would cause extremely low collection efficiency and therefore impingement estimates derived from application of historical regression equations would result in an underestimate for that seasonal stratum. Conversely, the high collection efficiency of the Ristroph screen and relatively high proportion of unit 2 fish impinged at intake 26 (Con Edison 1985) would result in impingement estimates derived from the historical regression equation being comparatively high.

Data were available from the Ristroph Screen Special Studies and Ristroph Survival Studies at Unit 2 which permitted empirical estimation of collection efficiency during the winter and summer strata. These data were used to calculate adjusted total impingement estimates in the winter and summer strata for comparison with unadjusted estimates and adjusted estimates derived from the regression equations (Table 4-5). As described above, regression adjustment for collection efficiency approximately doubled (2.0) unadjusted total impingement

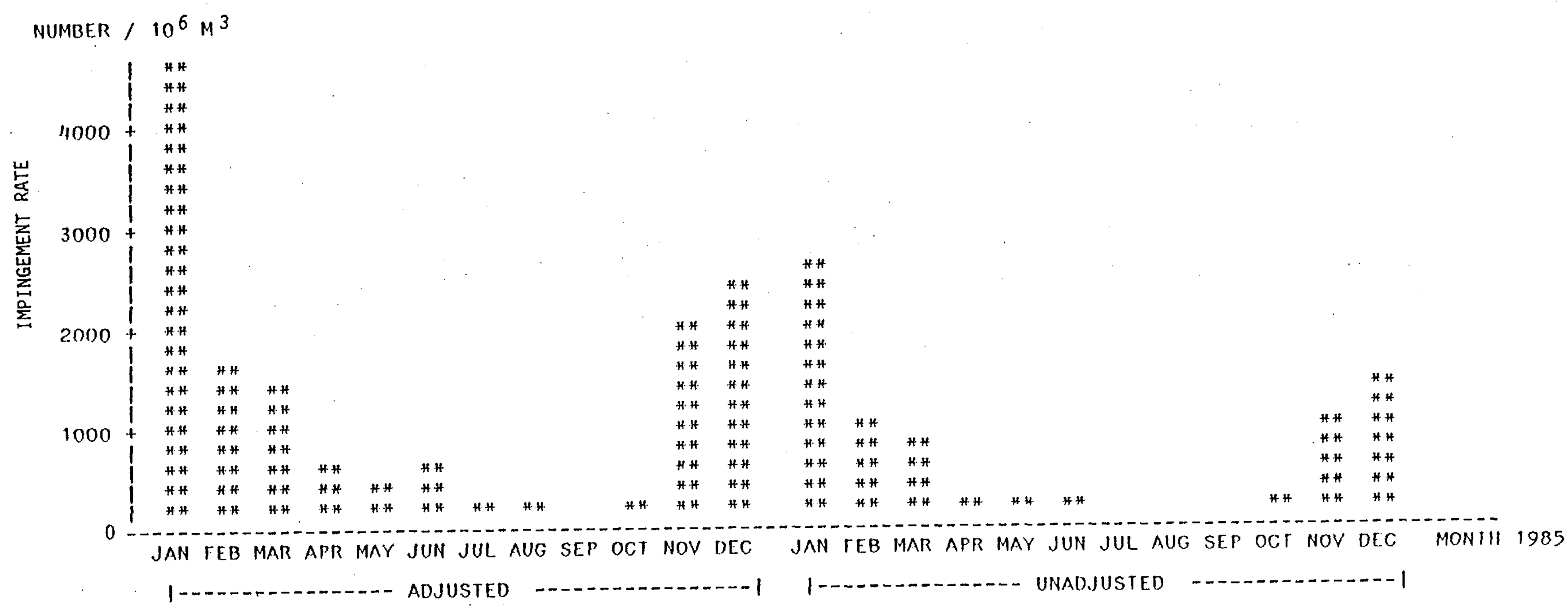

FIGURE 4-1. COMPARISON OF IMPINGEMENT RATES FOR ALL TAXA AT INDIAN POINT UNITS 2 AND 3 COMBINED IN 1985, ADJUSTED AND UNADJUSTED FOR COLLECTION EFFICIENCY.

TABLE 4-5. EFFECT OF REGRESSION OR SCREEN-SPECIFIC COLLECTION EFFICIENCY ADJUSTMENTS ON UNADJUSTED TOTAL COUNTS OF FISH IMPINGED AT INDIAN POINT UNIT 2 DURING THE 1985 WINTER AND SUMMER STRATA.

SEASONAL STRATUM	UNADJUSTED[1]	COLLECTION EFFICIENCY ADJUSTMENT REGRESSION[2]	SCREEN-SPECIFIC[3]
Winter (Jan-Mar)	168,632	345,142	292,000
Summer (Jul-Sep)	17,585	61,472	298,000

[1]Unadjusted total number of fish impinged at Unit 2, Screens 21-16 (Appendix Table A-6) in the winter or summer stratum, scaled from the number of days sampled to the total number of days in the stratum (Table 3-3): Number of Fish x 90 ÷ 82.

[2]Total number of fish impinged at Unit 2, Screens 21-26 in the winter or summer stratum, adjusted for collection efficiency using the temperature regression equation 1 (Table 4-1).

[3]Total number of fish impinged at Unit 2, Screens 21-16 in the winter or summer stratum, empirically adjusted for screen-specific collection efficiency as follows (data from Con Edison 1985 and Con Edison unpublished):

a) Winter, fixed screens 21-25; stratum mean collection efficiency = 50.2%,

b) Winter, fixed screen 26; stratum mean collection efficiency = 50.2%,

c) Winter, Ristroph screen 26; stratum mean collection efficiency = 70.8%,

d) Summer, fixed screens 21-25; monthly mean collection efficiency = 5.0% for July, 2.8% for August, and 3.0% for September, and

e) Summer, screen 26; monthly mean collection efficiency = 8.4% for fixed screen in July, 18.7% for Ristroph screen in August, and 29.6% for Ristroph screen in September.

estimates during the winter stratum and approximately tripled (3.5) total estimates during the summer stratum. However, screen specific adjustments increased unadjusted total impingement estimates approximately 1.7 times for the winter stratum and nearly 17 times for the summer stratum. The disproportionate increase in adjusted total impingement estimates during the summer stratum indicates blue crab scavenging or some other loss of impinged fish at Unit 2 may have resulted in a substantial underestimate of the adjusted number of fish impinged. The annual impingement at Unit 2 using screen-specific adjusted total estimates for the winter and summer strata, and regression adjusted total estimates for spring and fall strata, would be approximately 900,000 fish compared to 716,805 fish by the regression method. Outage at Unit 3 during the period of peak blue crab impingement suggests that regression adjusted total impingement estimates were reasonably accurate and minimally affected by blue crab scavenging. Therefore, annual total impingement estimates for both units combined were most influenced by changes in collection efficiency adjustments at Unit 2, and may be underestimated by approximately 200,000 fish.

4.3 SPECIES COMPOSITION AND RELATIVE ABUNDANCE

The 349,002 fishes collected in 1985 impingement sampling represented 79 species (Table 4-6). Of these species, 23 were primarily freshwater, 32 marine, and 26 were tolerant of estuarine conditions. The number of species caught in 1985 was greater than any of the previous nine years. In addition, five species had never been reported at Indian Point before, and may be new species to the Hudson River estuary: Atlantic cutlassfish (*Trichiurus lepturus*), freckled blenny (*Hypsoblennius ionthas*), guaguanche (*Sphyraena guachanche*), planehead filefish (*Monocanthus hispidus*), and pigfish (*Orthopristis chrysoptera*). These species are primarily strays from southern waters and were generally collected in late summer or early fall when water temperatures were greatest. In previous years, strays from southern marine waters

TABLE 4-6. SPECIES COLLECTED IN IMPINGEMENT SAMPLING AT INDIAN POINT UNITS 2 AND 3 IN 1985.

COMMON NAME[a]	SCIENTIFIC NAME[a]	SALINITY PREFERENCE[b]
Alewife	*Alosa pseudoharengus*	e
American eel	*Anguilla rostrata*	e
American shad	*Alosa sapidissima*	e
Atlantic croaker	*Micropogonias undulatus*	e
Atlantic cutlassfish	*Trichiurus lepturus*	m
Atlantic menhaden	*Brevoortia tyrannus*	m
Atlantic needlefish	*Strongylura marina*	e
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
Black sea bass	*Centropristis striata*	m
Blueback herring	*Alosa aestivalis*	e
Bluefish	*Pomatomus saltatrix*	m
Bluegill	*Lepomis macrochirus*	f
Bothid unid.	*Bothus sp.*	m
Brown bullhead	*Ictalurus nebulosus*	f
Butterfish	*Peprilus triacanthus*	m
Common carp	*Cyprinus carpio*	f

TABLE 4-6. (Continued)

COMMON NAME[a]	SCIENTIFIC NAME[a]	SALINITY PREFERENCE[b]
Central mudminnow	*Umbra limi*	f
Centrarchid unid		e
Clupeid unid.		e
Common shiner	*Notropis cornutus*	f
Conger eel	*Conger oceanicus*	m
Crevalle jack	*Caranx hippos*	e
Cunner	*Tautogolabrus adspersus*	m
Fourbeard rockling	*Enchelyopus cimbrius*	m
Fourspine stickleback	*Apeltes quadracus*	e
Freckled blenny	*Hypsoblennius ionthas*	e
Gizzard shad	*Dorosoma cepedianum*	f
Golden shiner	*Notemigonus crysoleucas*	f
Goldfish	*Carassius auratus*	f
Gray snapper	*Lutjanus griseus*	m
Green sunfish	*Lepomis cyanellus*	f
Grubby	*Myoxocephalus aenaeus*	m
Guaguanche	*Sphyraena guachancho*	m
Hogchoker	*Trinectes maculatus*	e
Largemouth bass	*Micropterus salmoides*	f
Lined seahorse	*Hippocampus erectus*	e
Lookdown	*Selene vomer*	e
Mackerel scad	*Decapterus macarellus*	m
Moonfish	*Selene setapinnis*	m

TABLE 4-6. (Continued)

COMMON NAME[a]	SCIENTIFIC NAME[a]	SALINITY PREFERENCE[b]
Mummichog	*Fundulus heteroclitus*	e
Northern pipefish	*Syngnathus fuscus*	e
Northern puffer	*Sphoeroides maculatus*	m
Northern searobin	*Prionotus carolinus*	m
Northern stargazer	*Astroscopus guttatus*	m
Pigfish	*Orthopistis chrysoptera*	m
Planehead Filefish	*Monocanthus hispidus*	m
Pumpkinseed	*Lepomis gibbosus*	f
Rainbow smelt	*Osmerus mordax*	e
Redbreast sunfish	*Lepomis auritus*	f
Red hake	*Urophycis chuss*	m
Rock gunnel	*Pholis gunnellus*	m
Sea lamprey	*Petromyzon marinus*	m
Silver hake	*Merluccius bilinearis*	m
Silver Perch	*Bairdiella chrysoura*	e
Smallmouth bass	*Micropterus dolomieu*	f
Spot	*Leiostomus xanthurus*	e
Spotfin butterflyfish	*Chaetodon ocellatus*	m
Spottail shiner	*Notropis hudsonius*	f
Spotted hake	*Urophycis regia*	m
Striped bass	*Morone saxatilis*	e
Striped cuskeel	*Ophidion marginatum*	m
Striped searobin	*Prionotus evolans*	m

TABLE 4-6. (Continued)

COMMON NAME[a]	SCIENTIFIC NAME[a]	SALINITY PREFERENCE[b]
Summer flounder	*Paralichthys dentatus*	m
Tautog	*Tautoga onitis*	m
Tesselated darter	*Etheostoma olmstedi*	f
Threespine stikleback	*Gasterosteus aculeatus*	e
Tidewater silverside	*Menidia peninsulae*	e
Weakfish	*Cynoscion regalis*	m
White catfish	*Ictalurus catus*	f
White crappie	*Pomoxis annularis*	f
White perch	*Morone americana*	e
White sucker	*Catostomus commersoni*	f
Windowpane	*Scophthalmus aquosus*	f
White flounder	*Pseudopleuronectes americanus*	m
Yellow perch	*Perca flavescens*	f

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

b m = marine, e = euryhaline, f = freshwater were also impinged most often in the fall perhaps due to the high salinities and high water temperatures at that time of year (NAI 1984a). Freshwater runoff to the Hudson River in 1985 was below the 1947-1983 median monthly discharge. Discharge of the Hudson River at Green Island during the 1985 fall stratum was below the 1947-1983 median discharge for those months (USGS 1986). This allowed penetration of the salt wedge further upstream than usual. Southern species from marine waters may have been transported further upstream with the salt wedge than normal. The greater species richness observed in 1985 and occurrence of five species not previously reported was probably due to this greater upriver extent of the salt wedge and to the greater sampling frequency at Unit 2 compared to 1981-1984, particularly during the fall stratum. Daily sampling would allow a greater probability of observance of a "rare event", such as a rare species, compared to a stratified random sampling design with a less than daily sampling interval.

The three numerically dominate species impinged at Indian Point Units 2 and 3 in 1985 were white perch, striped bass, and blueback herring (Table 4-7). These fishes were among the top ten species impinged in previous monitoring programs, however striped bass were never among the top 3 or 4 fish species impinged in previous years. White perch were by far the most dominant species, as in previous years, accounting for 72.6% of the number of fish impinged (Table 4-7).

Plant operation at Unit 2 did not greatly affect species composition or yearly abundance estimates since Unit 2 operated most of the year. Unit 3 however, had an extended outage between 7 June and 5 October during which no circulating water was sampled (Table 4-8). This outage resulted in reduced impingement of summer and fall seasonally abundant fish at Unit 3 such as weakfish, bluefish, and Atlantic tomcod than if the plant had been operating between June and October.

TABLE 4-7. ESTIMATED NUMBER IMPINGED AT INDIAN POINT IN 1985 AND TOTAL PERCENT COMPOSITION OF THE TEN MOST ABUNDANT SPECIES[a] AND ALL SPECIES COMBINED.

	UNIT 2		UNIT 3		BOTH UNITS		
SPECIES	NUMBER	PERCENT	NUMBER	PERCENT	NUMBER	PERCENT	CUM. PERCENT
White perch	543274	75.8	239912	66.4	783186	72.6	72.6
Striped bass	53451	7.5	27011	7.5	80462	7.5	80.1
Blueback herrings	8337	1.2	47551	13.2	55888	5.2	85.3
Atlantic tomcod	39558	5.5	9723	2.7	49281	4.6	89.9
Hogchoker	26314	3.7	13145	3.6	39459	3.7	93.6
Bay anchovy	8686	1.2	4743	1.3	13429	1.2	94.8
Weakfish	8399	1.2	0	0	8339	0.8	95.6
White catfish	4980	0.7	1606	0.4	6586	0.6	96.1
Rainbow smelt	3552	0.5	1806	0.5	5358	0.5	96.7
Alewife	2434	0.3	2824	0.8	5258	0.5	97.2
All species combined	716805		361372		1078177		

[a]Includes all species comprising over 0.5% of the total at the two units combined, and includes 10 of the 14 selected species.

TABLE 4-8. CIRCULATING WATER VOLUME PUMPED ($10^6 m^3$) IN ASSOCIATION WITH IMPINGEMENT SAMPLING AT INDIAN POINT IN 1985.

	UNIT 2	UNIT 3	UNITS 2 AND 3
Jan	62.6	10.8	73.4
Feb	76.0	36.3	112.3
Mar	78.2	42.6	120.8
Apr	45.6	10.2	55.8
May	41.0	92.8	133.8
Jun	110.0	25.7	135.7
Jul	125.0	a	125.0
Aug	123.0	a	123.0
Sep	102.8	5.3	102.8
Oct	122.0	32.4	154.4
Nov	79.8	18.4	98.2
Dec	80.3	16.3	96.6
Total	1046.3	290.8	1331.8

[a] No sampling due to unit shutdown

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). Impingement rates were not available for Unit 3 for July, August, or September due to the extended outage during those months.

Impingement patterns were similar between Units 2 and 3 in 1985. Both Units exhibited maximum impingement rates in the Winter and Fall strata (Figure 4-2). Impingement rates were highest in January at both units, followed by December. This was primarily due to a large influx of young-of-the-year white perch in December, and yearling white perch in January.

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

The monthly impingement rates for 13 of the above species are presented in Figures 4-3 through 4-15. Young-of-the-year fish (Y) are distinguished from yearling and older fish (O) on each figure. No shortnose sturgeon were collected and only 24 Atlantic sturgeon were collected in 1985.

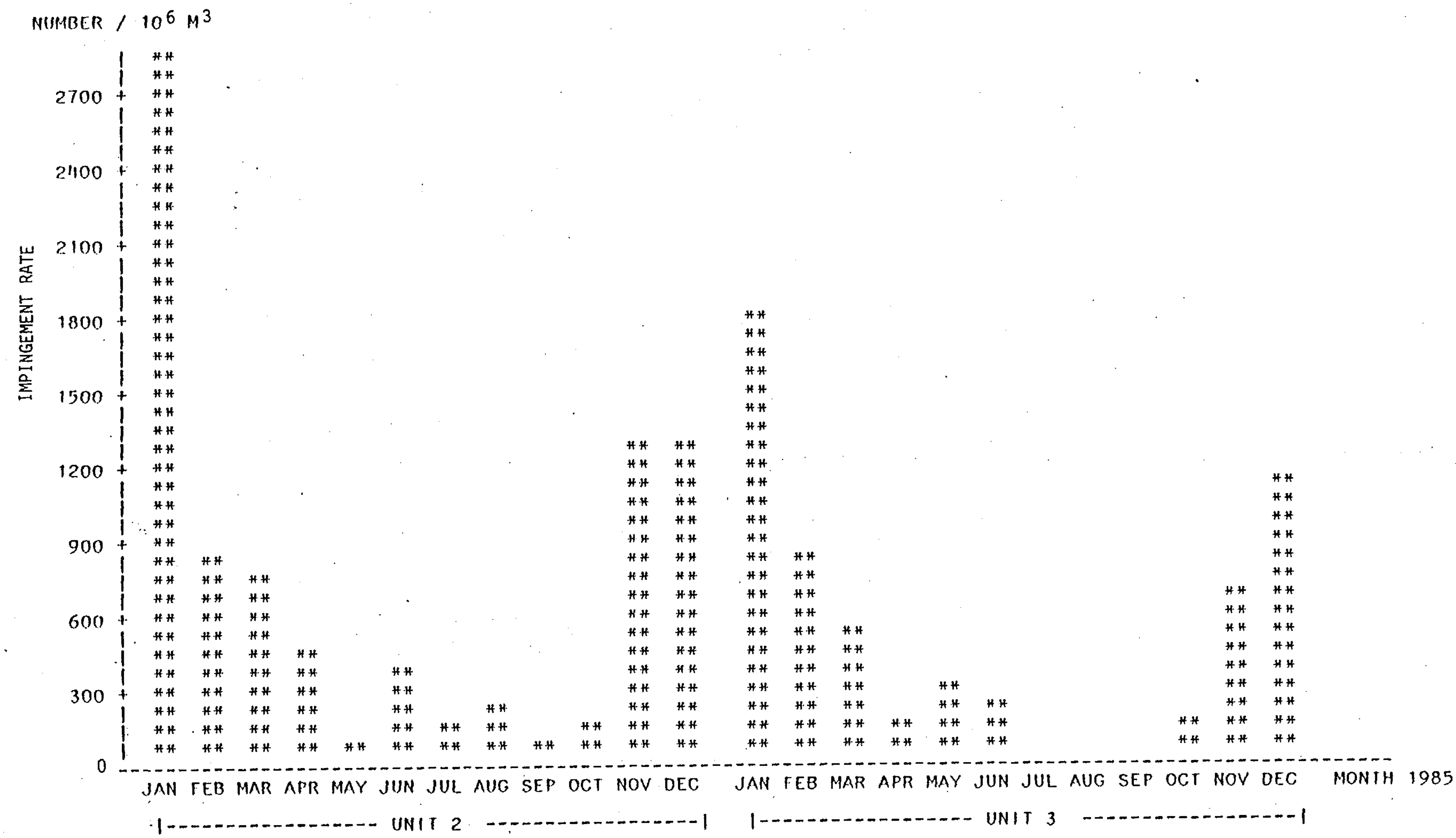

FIGURE 4-2. MONTHLY ADJUSTED IMPINGEMENT RATES FOR ALL TAXA COMBINED AT INDIAN POINT UNITS 2 AND 3 IN 1985, ADJUSTED FOR COLLECTION EFFICIENCY.

White perch was the most numerous species impinged in 1985 (Figure 4-3). Impingement rates were greatest in January at both Units 2 and 3, and collections consisted mostly of yearling fish. Impingement rates decreased in the Spring stratum and were minimal in the Summer stratum. Impingement rates increased again in the Fall stratum as young-of-the year white perch became abundant during November and December. This pattern is consistent with patterns from previous years (MMES 1985; NAI 1984a). White perch generally overwinter in the middle and lower Hudson River estuary making them vulnerable to impingement at Indian Point during fall and winter. In the spring and summer, white perch move upriver and into shallower water to spawn, thus making them less vulnerable to impingement by the Indian Point plant during this period (NAI 1985).

Striped bass exhibited a similar impingement pattern to white perch at Units 2 and 3, however rates were much lower (Figure 4-4). Impingement rates were greatest in January when yearling and older fish predominated. Impingement rates were minimal during spring and summer and increased slightly in the fall, as young-of-the-year striped bass grew to an impingeable size. Young-of-the-year and yearling striped bass may seek deeper water in the fall and winter, such as that in the Indian Point area, thus possibly increasing their vulnerability to impingement during colder months (TI 1980c). The pattern observed in 1985 was similar to the pattern observed in 1984 (MMES 1985) and 1983 (NAI 1984a).

Blueback herring were impinged at significant rates only in October and November at Units 2 and 3 (Figure 4-5). The majority of the blueback herring impinged were young-of-the-year fish. These fish originated from the previous spring spawn in the upper estuary and were probably exposed to the Indian Point cooling water intakes as they migrated out to sea (TI 1980a). Previous years impingement data showed similar results with maximum impingement rates of young-of-the-year blueback herring having occurred in the fall (MMES 1985; NAI 1984a; Con Edison 1983).

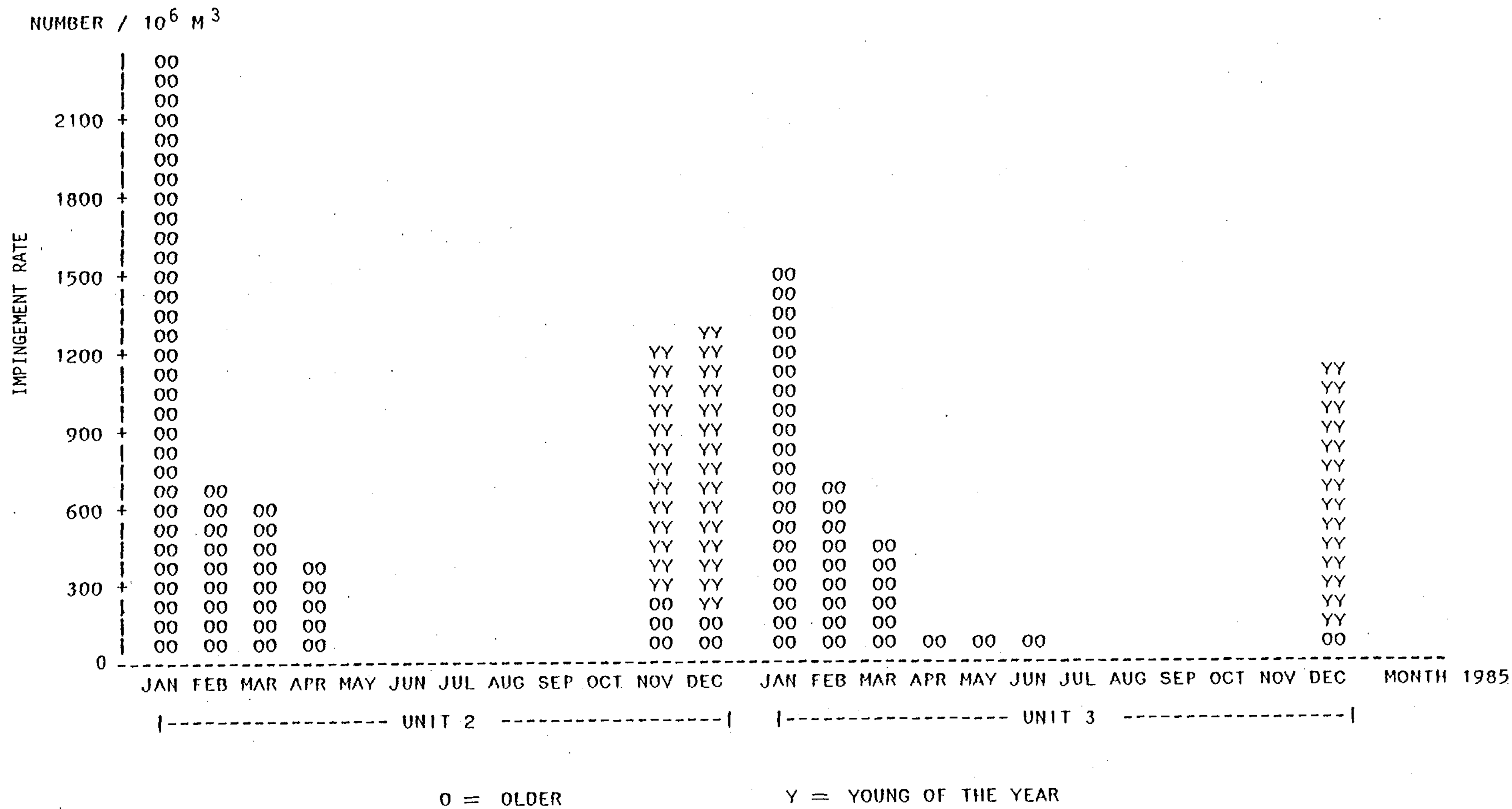

FIGURE 4-3. MONTHLY ADJUSTED IMPINGEMENT RATES FOR WHITE PERCH AT INDIAN POINT UNITS 2 AND 3 IN 1985, ADJUSTED FOR COLLECTION EFFICIENCY.

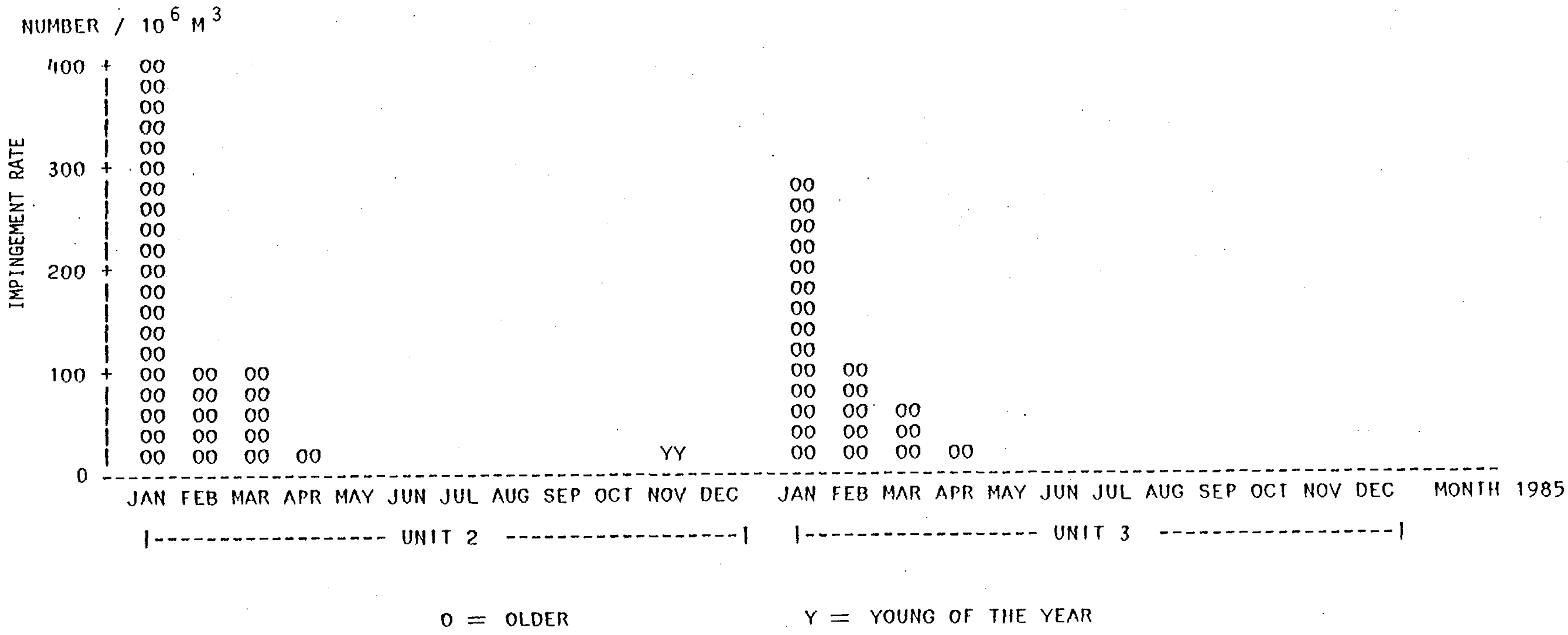

FIGURE 4-4. MONTHLY ADJUSTED IMPINGEMENT RATES FOR STRIPED BASS AT INDIAN POINT UNITS 2 AND 3 IN 1985, ADJUSTED FOR COLLECTION EFFICIENCY.

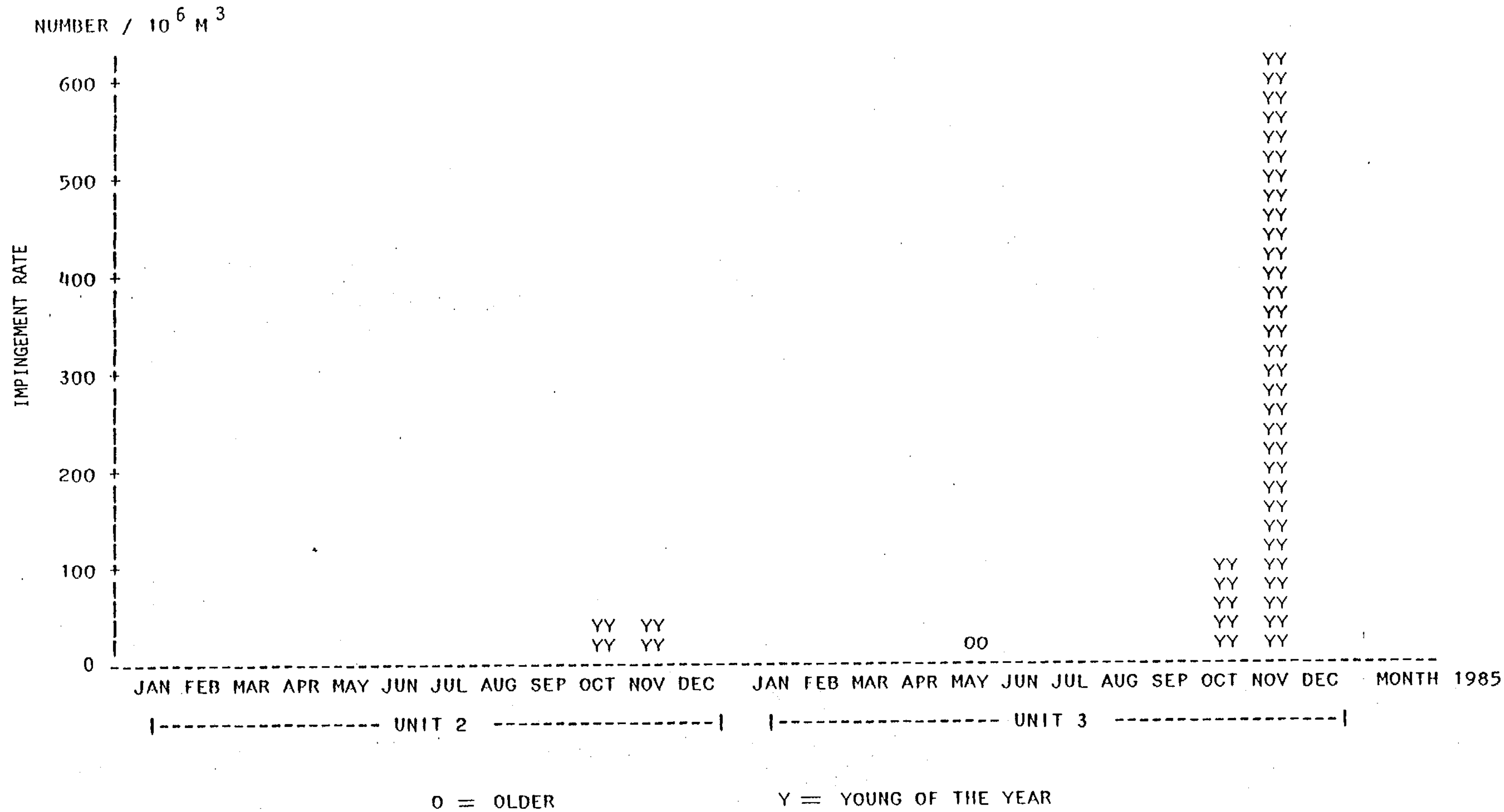

FIGURE 4-5. MONTHLY ADJUSTED IMPINGEMENT RATES FOR BLUEBACK HERRING AT INDIAN POINT UNITS 2 AND 3 IN 1985, ADJUSTED FOR COLLECTION EFFICIENCY.

Atlantic tomcod exhibited a bimodal pattern in impingement rates at Units 2 and 3 with the first peak in January consisting mostly of yearling and older fish, and the second peak in June consisting of young-of-the-year fish (Figure 4-6). The magnitude of each peak was generally lower than seen in previous years. However, compared to 1984, the mean monthly impingement rate for yearling and older tomcod during January 1985 at Unit 2 was substantially higher (January 1984 rate = 2 per million cubic meters; January 1985 rate = 77 per million cubic meters). This pattern was consistent with the described life history of Atlantic tomcod in which older fish spawn in shoal areas in the winter and young-of-the-year fish seek cooler deeper water in the summer as they move downstream (TI 1980a).

Hogchokers were impinged every month at Indian Point Units 2 and 3, with maximum rates recorded in August at Unit 2 and in May at Unit 3 (Unit 3 was not operating in the summer) (Figure 4-7). A large peak in hogchoker impingement rates in May has been reported in previous years, particularly in 1982 (Con Edison 1983) and 1983 (NAI 1984), and has been associated either with increasing activity as water temperatures rise (TI 1980b) or with movement of the salt front.

Bay anchovies were impinged from May through December with peak rates occurring in June at both Units 2 and 3 (Figure 4-8). The majority of the fish impinged during June were yearling and older fish; young-of-the-year fish are too small to be impinged at that time (MMES 1985). Bay anchovy impingement was relatively low in 1985 compared with previous years, and was probably due to high conductivity at Indian Point (Table A-2) during the summer indicating the salt front was displaced further upriver than in previous years.

Weakfish were impinged at Units 2 and 3 in 1985 only as young-of-the-year fish (Figure 4-9). Peak rates were recorded from July through November, and probably reflected their utilization of the estuary

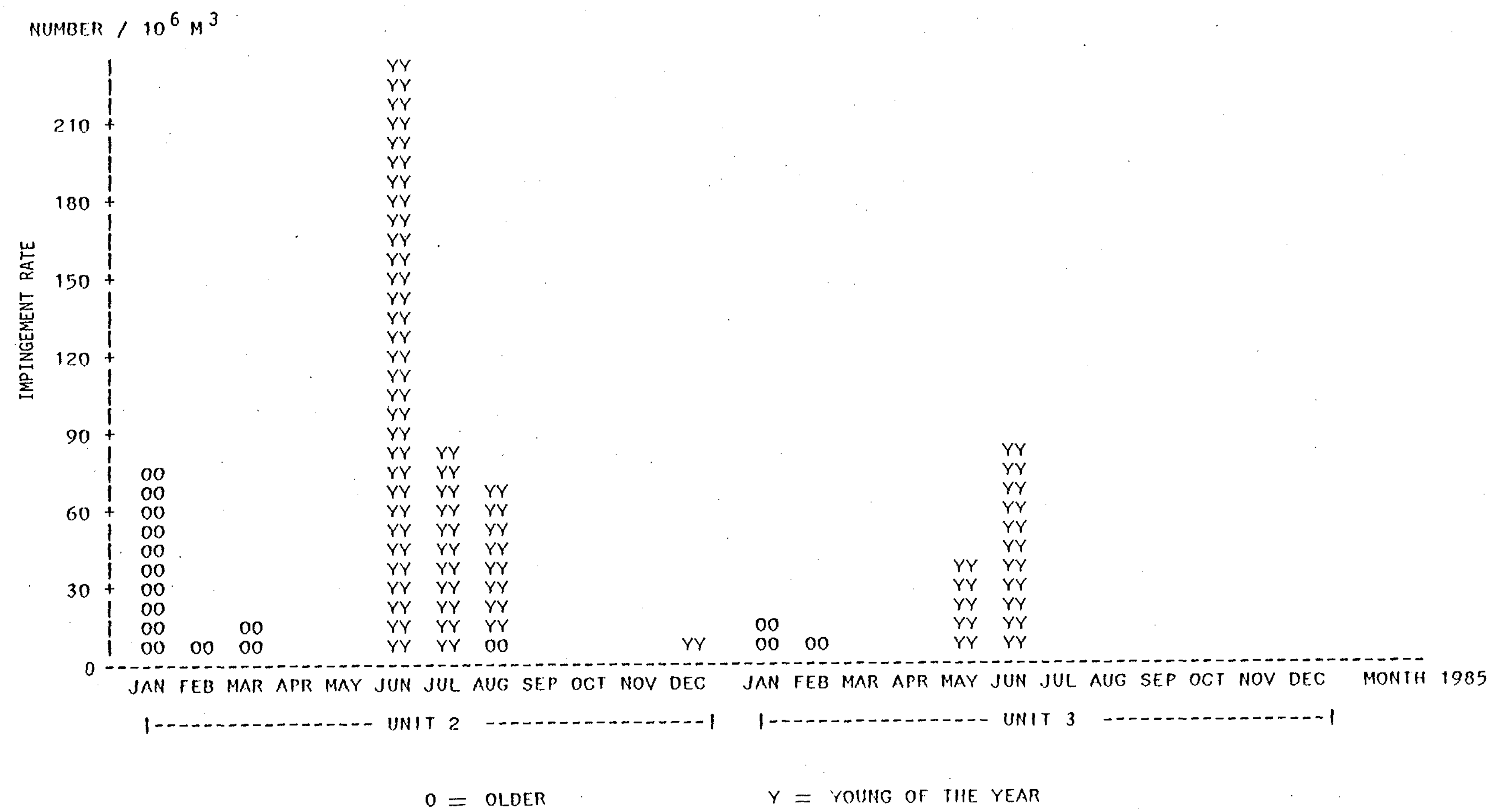

FIGURE 4-6. MONTHLY ADJUSTED IMPINGEMENT RATES FOR ATLANTIC TOMCOD AT INDIAN POINT UNITS 2 AND 3 IN 1985, ADJUSTED FOR COLLECTION EFFICIENCY.

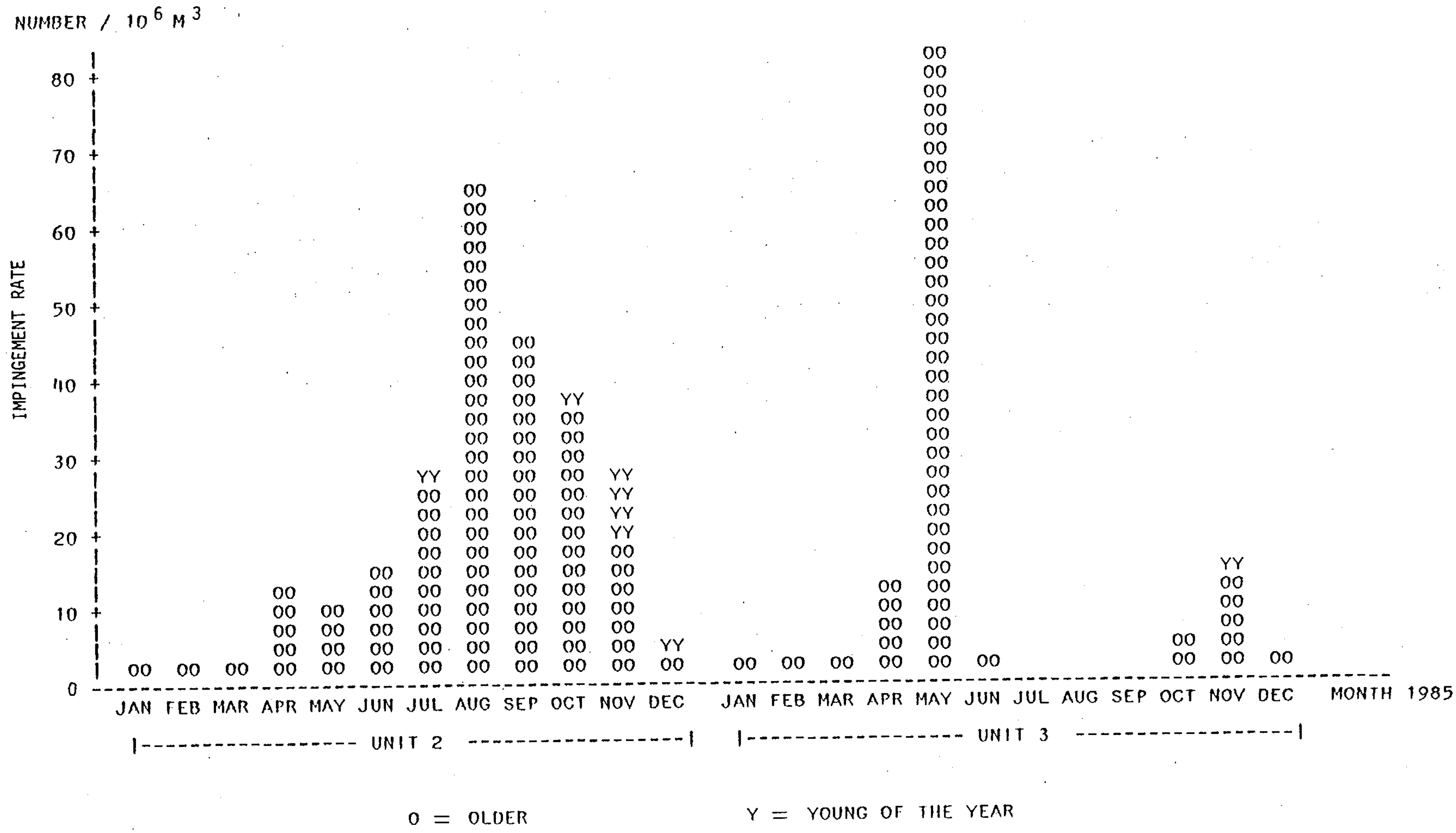

FIGURE 4-7. MONTHLY ADJUSTED IMPINGEMENT RATES FOR HOGCHOKER AT INDIAN POINT UNITS 2 AND 3 IN 1985, ADJUSTED FOR COLLECTION EFFICIENCY.

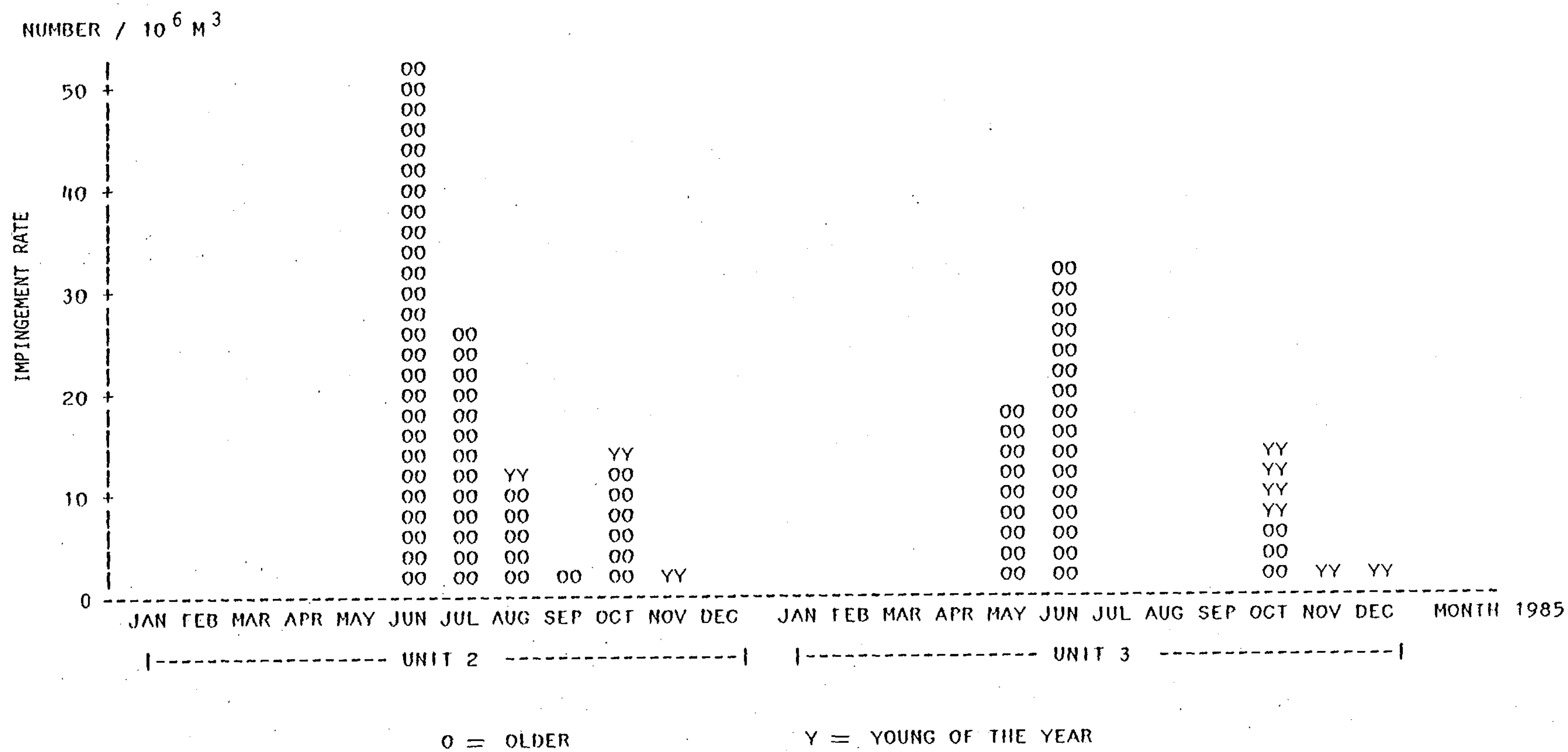

FIGURE 4-8. MONTHLY ADJUSTED IMPINGEMENT RATES FOR BAY ANCHOVY AT INDIAN POINT UNITS 2 AND 3 IN 1985, ADJUSTED FOR COLLECTION EFFICIENCY.

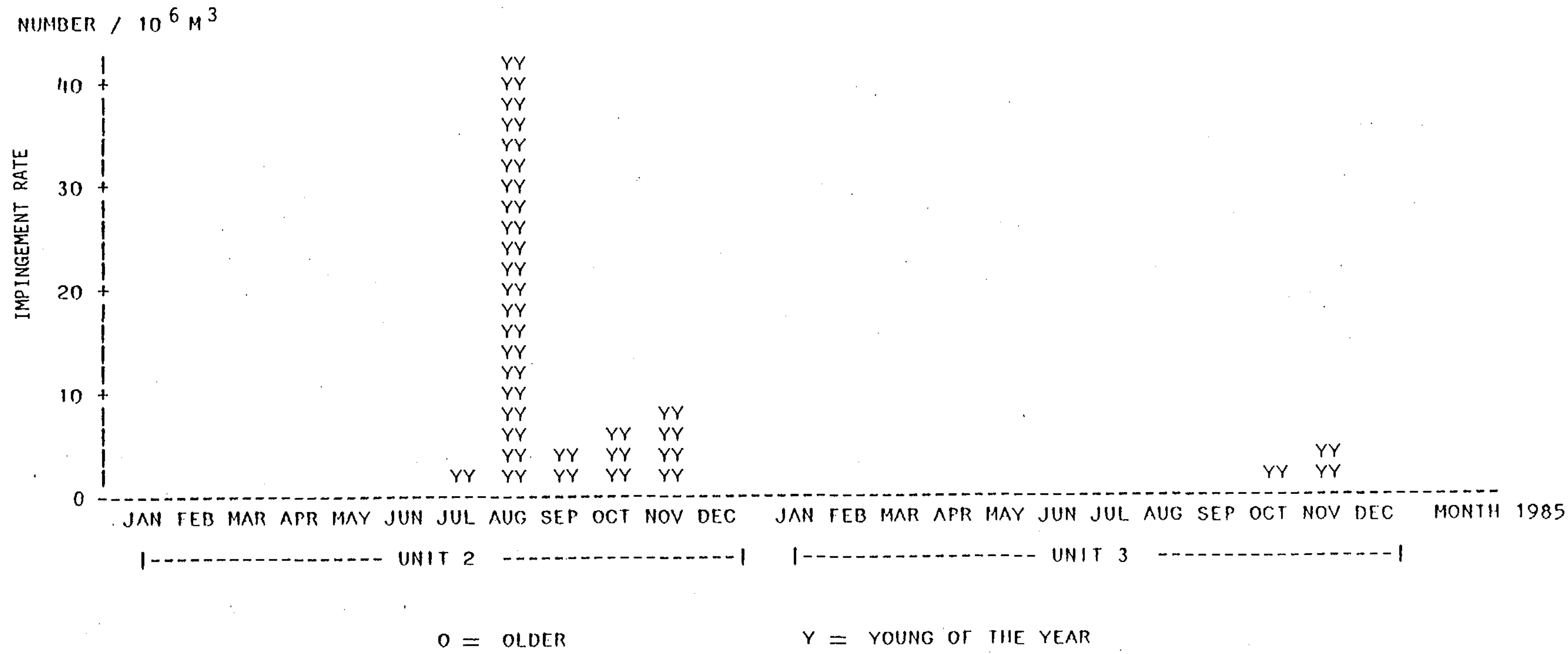

FIGURE 4-9. MONTHLY ADJUSTED IMPINGEMENT RATES FOR WEAKFISH AT INDIAN POINT UNITS 2 AND 3 IN 1985, ADJUSTED FOR COLLECTION EFFICIENCY.

as a nursery area. Maximum impingement rates were lower than the peak observed in 1983 (NAI 1984a) and were more in line with rates observed in other years (less than $200/10^6 m^3$: NAI 1984a).

White catfish were impinged every month at Indian Point Unit 2, and every operating month at Unit 3 except June (Figure 4-10). The small number of samples in June (4) probably accounts for the absence of white catfish in impingement samples during that month. White catfish impingement rates were greatest in the winter and fall and consisted mostly of yearling and older fish. The decrease in impingement rates was probably a result of the movement of white catfish into shallower areas in the summer, and out of the Indian Point area (TI 1980b).

Rainbow smelt were impinged primarily from October through April at Units 2 and 3. The majority of fish impinged were yearling and older with maximum rates in January and February (Figure 4-11). Impingement patterns have been variable for this species in previous years with maximum impingement rates occurring in several different months (NAI 1984a). Rainbow smelt migrate to freshwater to spawn in the early spring (TI 1980b). Maximum impingement rates of yearling and older rainbow smelt in January and February may represent a movement of pre-spawning fish past the Indian Point area.

Alewife exhibited variable impingement patterns at Units 2 and 3 in 1985 (Figure 4-12). Alewife were impinged during every month except May at Unit 2, and during every operational month having a significant number of samples at Unit 3. Yearling and older fish were primarily impinged January through June, while young-of-the-year fish were impinged in the second half of the year. This corresponded with the generalized life history of the alewife in which spawning adults migrate upriver past the Indian Point area to fresh water to spawn in the spring, and the resulting young-of-the-year fish migrate downriver past Indian Point to the ocean in the fall.

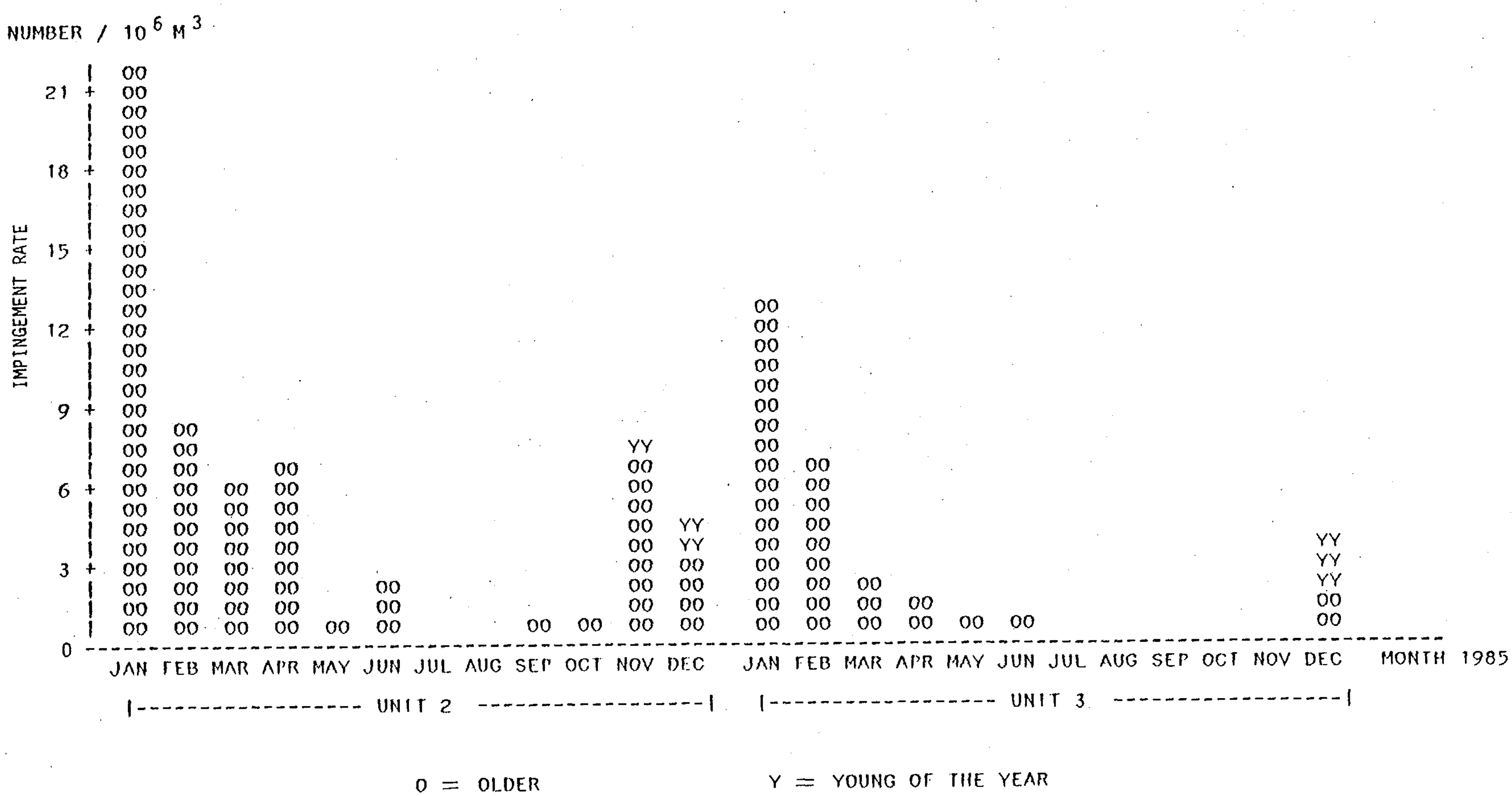

FIGURE 4-10. MONTHLY ADJUSTED IMPINGEMENT RATES FOR WHITE CATFISH AT INDIAN POINT UNITS 2 AND 3 IN 1985, ADJUSTED FOR COLLECTION EFFICIENCY.

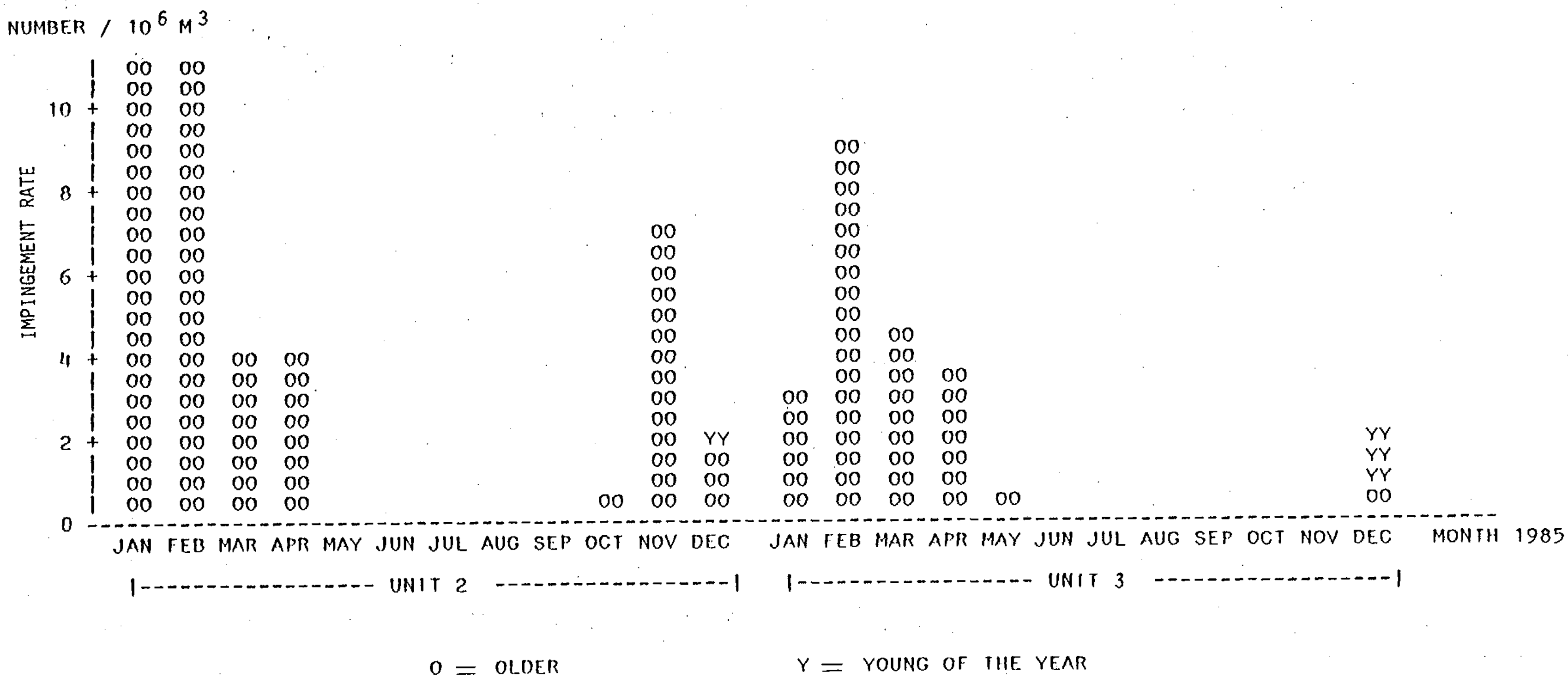

FIGURE 4-11. MONTHLY ADJUSTED IMPINGEMENT RATES FOR RAINBOW SMELT AT INDIAN POINT UNITS 2 AND 3 IN 1985, ADJUSTED FOR COLLECTION EFFICIENCY.

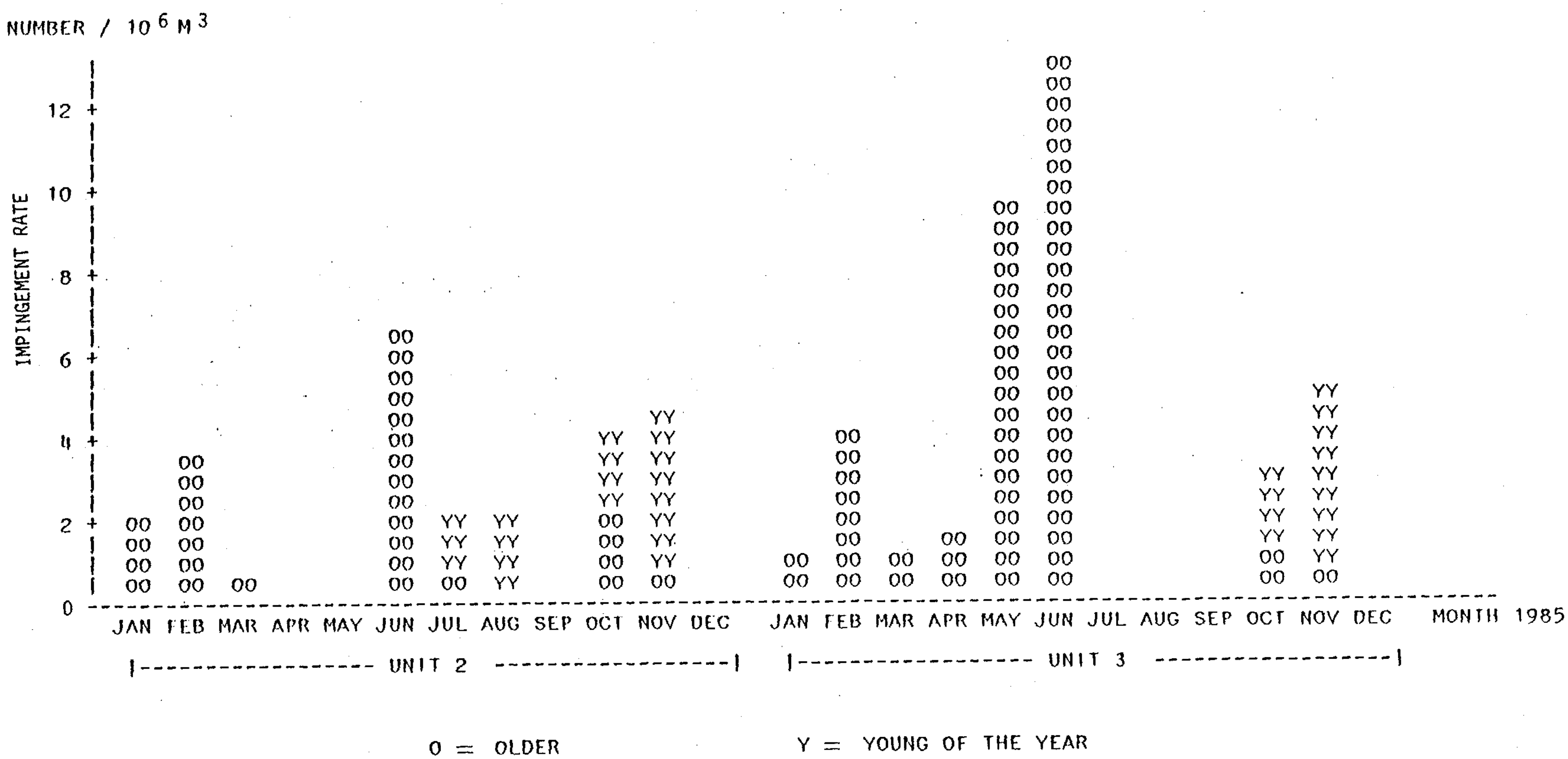

FIGURE 4-12. MONTHLY ADJUSTED IMPINGEMENT RATES FOR ALEWIFE AT INDIAN POINT UNITS 2 AND 3 IN 1985, ADJUSTED FOR COLLECTION EFFICIENCY.

Spottail shiner were most abundant from December through April at Units 2 and 3 (Figures 4-13). Maximum impingement rates occurred in January and February at Unit 2, and February at Unit 3. The majority of the spottail shiners impinged were yearling and older fish that were probably overwintering in deeper water areas such as Indian Point (TI 1976b). Impingement rates of spottail shiners were similar to those observed in previous years (MMES 1985; NAI 1984a; Con Edison 1983).

American shad were impinged primarily as young-of-the-year fish in the Fall stratum (Figure 4-14). Previous years have shown either a fall peak, a summer peak, or a peak in both seasons (NAI 1984a). The reason for these peaks may be that by early summer, young-of-the-year American shad had grown to a size large enough to be impinged in substantial numbers. By late summer, young-of-the-year American shad begin their migration downriver to the sea, thus possibly increasing their vulnerability to impingement at Indian Point.

Bluefish were abundant at Indian Point from June through November, with maximum impingement rates occurring in June at Unit 2, and October at Unit 3 (Figure 4-15). However, the extended outage at Unit 3 resulted in reduced impingement of bluefish during their most abundant season. The overwhelming majority of the bluefish impinged at Indian Point were young-of-the-year fish, indicating possible use of the Hudson River estuary as a feeding and nursery area by these fish (TI 1980b).

A total of 24 Atlantic sturgeon were impinged at Indian Point during 1985 (Table 4-9). No shortnose sturgeon were impinged at either unit in 1985. All but 3 of the impinged sturgeon were collected during the winter stratum (January-March) and only one fish was impinged in the fall. The impinged sturgeon were relatively small, with an average length of 317 mm TL (S.D. = 77 mm TL) and an average weight of 153 grams (S.D. = 103). Sturgeon survival was 46% (11/24). Eight fish were impinged at Unit 2 and 16 fish were impinged at Unit 3. This pattern of

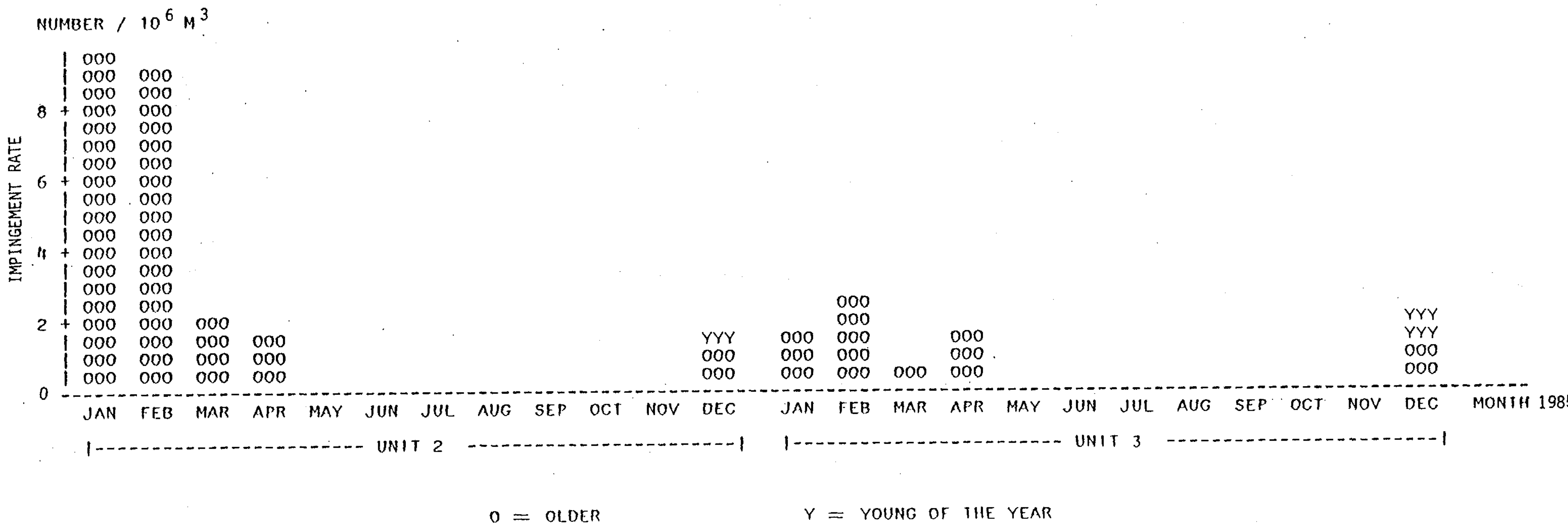

FIGURE 4-13. MONTHLY ADJUSTED IMPINGEMENT RATES FOR SPOTTAIL SHINER AT INDIAN POINT UNITS 2 AND 3 IN 1985, ADJUSTED FOR COLLECTION EFFICIENCY.

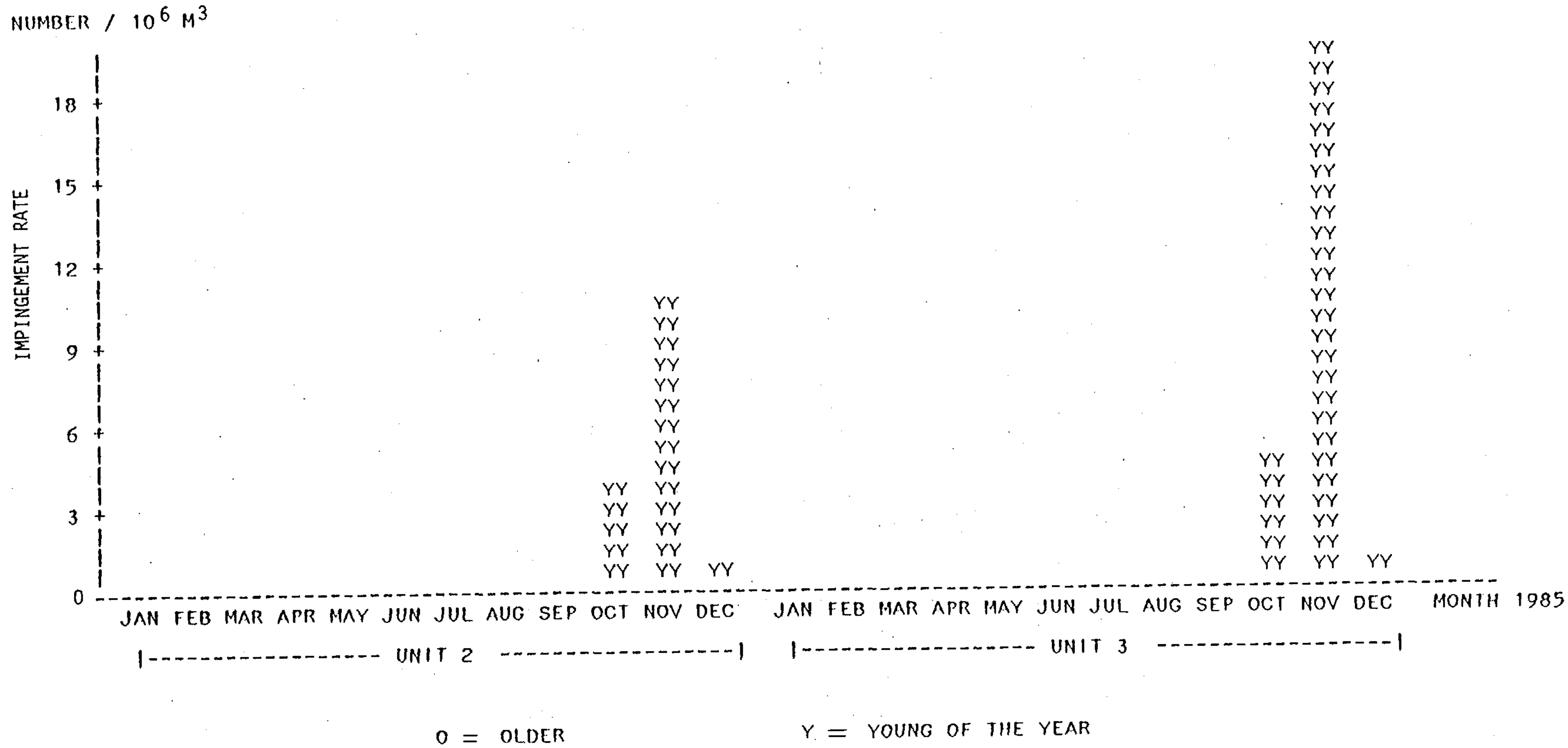

FIGURE 4-14. MONTHLY ADJUSTED IMPINGEMENT RATES FOR AMERICAN SHAD AT INDIAN POINT UNITS 2 AND 3 IN 1985, ADJUSTED FOR COLLECTION EFFICIENCY.

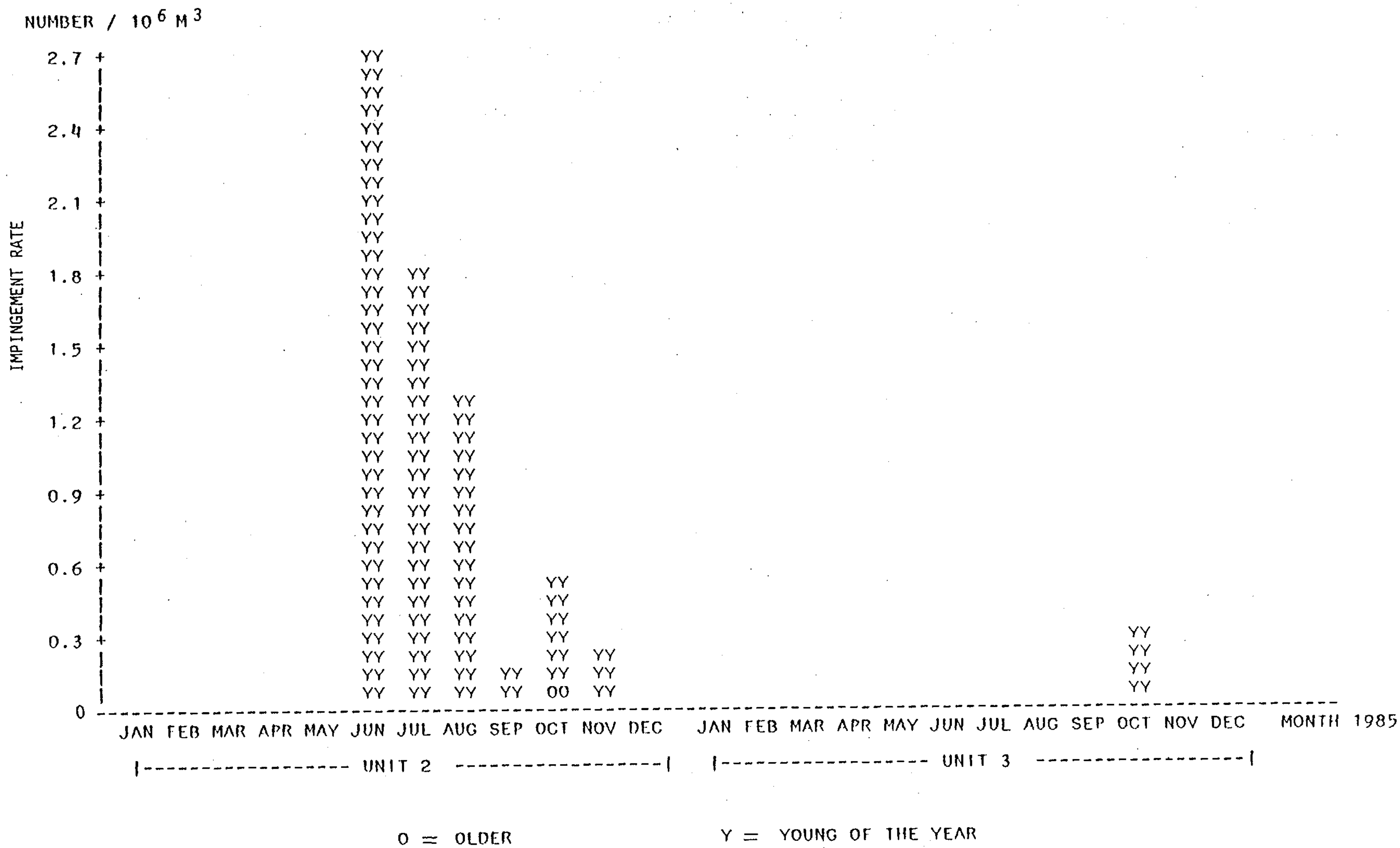

FIGURE 4-15. MONTHLY ADJUSTED IMPINGEMENT RATES FOR BLUEFISH AT INDIAN POINT UNITS 2 AND 3 IN 1985, ADJUSTED FOR COLLECTION EFFICIENCY.

TABLE 4-9. ATLANTIC STURGEON IMPINGED AT INDIAN POINT UNIT 2 AND UNIT 3 ON BOTH SAMPLE AND NON-SAMPLE DAYS DURING 1985[a].

1985 DATE	UNIT	SAMPLE	LENGTH (mmTL)	WEIGHT (grams)	CONDITION
11 Jan	2	2002	268	83	Dead
15 Jan	2	2006	302	95	Dead
30 Jan	2	2070	250	80	Alive[c]
1 Feb	3	3004	280	85	Alive
2 Feb	3	----[b]	140	55	Alive
3 Feb	3	3005	398	320	Alive
3 Feb	3	3005	240	55	Alive
4 Feb	3	----	402	315	Alive
4 Feb	3	----	238	54	Alive
5 Feb	3	----	235	50	Dead
6 Feb	3	----	401	310	Dead
28 Feb	2	2211	351	105	Alive
28 Feb	2	2211	326	130	Alive
8 Mar	3	----	344	135	Dead
8 Mar	3	----	344	145	Dead
11 Mar	3	----	410	345	Alive
12 Mar	3	----	412	330	Dead
12 Mar	3	----	363	180	Dead
18 Mar	3	----	343	146	Dead
18 Mar	3	----	380	200	Dead
19 Mar	2	2302	189	25	Dead
13 Apr	2	----	403	168	Dead
28 Apr	3	3040	240	41	Alive
29 Oct	2	2889	354	210	Dead

[a]No shortnose sturgeon were impinged in 1985

[b]Indicates sturgeon were collected on a non-sample day

[c]Alive fish were released to the river away from intake screens

rare occurrence of sturgeon at Indian Point is consistent with previous years. These large bodied, demersal species are probably less vulnerable to impingement than many other species.

4.5 BLUE CRAB IMPINGEMENT DAILY COLLECTIONS

Blue crabs were impinged at Indian Point Units 2 and 3 beginning in May. A total of 12,316 crabs were collected, with a total weight of 1,352 kg. This was the largest number of blue crabs impinged at Indian Point since blue crab impingement monitoring began in 1983. In 1983 only 821 blue crabs were collected while in 1984 only 348 blue crabs were impinged. Both numbers and total weight were low in the spring, increased in the summer to a maximum in August, and decreased in the fall with the last crab being collected in December (Table 4-10). Since blue crabs were enumerated for both sample and non-sample days (Section 3.2.2) in each year, the unusually high abundance in 1985 was not due to extra sampling effort associated with Ristroph studies. Blue crab abundance was probably related to an extended period when the salt front was above Indian Point (conductivity Table A-2) compared to 1983 and 1984.

Monthly blue crab counts by unit, sex, survival, and condition are presented in Table 4-11 and Appendix Table A-12. The majority of the blue crabs impinged were from Unit 2 since Unit 3 was not operating during most of the period of high blue crab abundance. Males accounted for 66.7% of the blue crabs impinged and sexed resulting in a sex ratio of 2:1 (Table 4-11). The percentage composition of males was relatively constant each month with males most dominant in October (81.1%) and least dominant in August (60.4%). Survival was 71.8% for crabs subsampled for survival. This is very similar to the survival rate observed in 1983 (72%: NAI 1984a) and within the range observed in 1984 (MMES 1985). Survival was greatest in June (89.9%) and decreased in August to 61.5%. High water temperatures in the summer may have contributed to increased mortality in July and August, as survival was

TABLE 4-10.
TOTAL NUMBERS AND WEIGHTS OF BLUE CRAB IMPINGED EACH MONTH
AT INDIAN POINT DURING APRIL - DECEMBER 1985

		APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	DECEMBER	TOTAL
COUNT	UNIT 2	0	41	127	832	6009	3330	1238	227	1	11805
	UNIT 3	0	365	51			4	35	56		511
	TOTAL	0	406	178	832	6009	3334	1273	283	1	12316
WEIGHT	UNIT 2	0	720	4346	51794	607736	494693	169646	10271	28	1339234
(g)	UNIT 3	0	5528	1271			721	3515	1650		12685
	TOTAL	0	6248	5617	51794	607736	495414	173161	11921	28	1351919

TABLE 4-11. MONTHLY COUNTS BY SEX, SURVIVAL, AND CONDITION OF BLUE CRABS IMPINGED AT INDIAN POINT DURING MAY THROUGH DECEMBER 1985.

	MONTH								
	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
Sex:									
Male	313	142	506	2050	1178	981	210	1	5381
Female	93	36	265	1341	659	229	72	0	2695
Undetermined	0	0	3	0	4	1	1	0	8
Total	406	178	774	3391	1841	1210	283	1	8084
Survival:									
Alive	330	160	509	2086	1402	1066	246	0	5799
Dead	73	18	258	1302	438	144	37	1	2271
Undetermined	3	0	7	3	1	0	0	0	14
Total	406	178	774	3391	1841	1210	283	1	8084
Condition:									
Intact	238	65	191	1236	999	581	168	0	3478
Missing Parts	168	113	581	2155	841	629	115	1	4603
Undetermined	0	0	2	0	1	0	0	0	3
Total	406	178	774	3391	1841	1210	283	1	8084

highest in the Spring and Fall strata. Percentage of intact crabs was greatest in June (92.3%) and lowest in July (24.7%) and August (36.4%). Survival may be related to condition, as the lowest levels of survival (July and August) occurred when the greatest percentage of crabs with missing parts were impinged.

Sizes of blue crabs (carapace width) are presented in Appendix Table A-13 by month and 10-mm size class. Blue crabs impinged at Unit 2 showed a relatively constant increase of 40 mm in modal carapace width each month between June (modal width = 35 mm) and September (modal width = 155 mm). No increase in modal carapace width was observed in October, and by November, modal carapace width had decreased to 55 mm. Larger blue crabs apparently became less vulnerable to impingement at that time, probably through migration out of the Indian Point area.

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APPENDIX A
DATA CALCULATION PROCEDURES

To provide data comparable with previous Indian Point impingement reports, it was necessary to combine the impingement data among the various sampling programs during 1985 to provide a daily (circa 24-hour) unit-wide sample. Routine impingement data from Unit 3 (all years) and from Unit 2 (19 April through 15 July) were treated as in previous years since each sample generally consisted of one 24-hour sample with all screens pooled. Impingement data collected during Ristroph Survival Studies (16 July through 31 December) were collapsed into a single 24-hour sample by pooling the data from screen 26 with the data from screens 21-25, since these daily samples were concurrent and generally 24 hours in duration. During the Ristroph Screen Special Studies (1 January through 18 April) screen specific collections were made. Fish were collected daily from screens 21-25 and at least every twelve hours from screen 26. To provide a single daily count of fish impinged, concurrent debris sluice and fish sluice subsamples were pooled at screen 26. Similarly, the two 12-hour samples at screen 26 were pooled.

To combine the pooled data from screen 26 with the screen specific collections at screens 21-25, each sample was given a common variable (DAY) based on the time of sample collection. This DAY variable was used to indicate common collection periods in the process of merging the two databases to provide a single daily (approximately 24-hour) count of fish impinged. The following criteria were used to assign DAY variables:

1. If the screen 26 collection period was enclosed within the collection period for screens 21-25, they were given a common DAY variable.

2. If the screen 26 collection period ended less than 1 hour after the last collection period for screens 21-25, both were given a common DAY variable.

3. If a screen 26 collection period ended more than 1 hour after the last collection period for screens 21-25, and the majority (>50%) of the screen 26 collection period did not overlap with the collection period for screens 21-25, it was given the DAY variable of the next screens 21-25 sample.

4. In case of contradiction among the above guidelines, the samples with the greatest amount of overlap in sample duration were assigned common DAY variables.

For example if impingement collections at screens 21-25 started at 0800 on Tuesday and ended at 0800 on Wednesday, while the two 12-hour collections at screen 26 were 1000 Tuesday through 2200 Tuesday and 2200 Tuesday through 1000 Wednesday, all three samples were assigned a common day variable (DAY 1) and the fish collections were pooled to represent a composite 24-hour sample from Unit 2. However, in the above example if the second collection at screen 26 began at 2200 on Tuesday and ended at 2200 on Wednesday, it was assigned the next day variable because only 10 hours of the 24-hour collection period (less than half) overlapped with the DAY 1 collection period.

Calculations

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

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

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, and

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

Within each seasonal stratum (h), a mean ($\bar{Y}_{hm}$) 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:

$$T_m = \sum_{h=1}^{4} N_{hm} \bar{Y}_{hm} \qquad \text{(Equation 2)}$$

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), and

$\bar{Y}_{hm}$ = 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):

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

where S.E. = standard error of the total estimated number of fish impinged at Unit m, and

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

The coefficient of variation was calculated to relate the precision to the total estimate (Equation 4):

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

where C.V. = coefficient of variation,

S.E. = as defined above, and

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:

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

where W_{hm} = total estimated weight of fish impinged in stratum h at Unit m,

w_{hm} = total weight of fish actually collected in stratum h at Unit m,

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

and N_{hm}, Y_{hm} = as defined above.

Monthly mean impingement rates were calculated by standardizing the daily impingement estimate (adjusted for collection efficiency) by dividing by that day's circulating water volume:

$$A_{km} = \frac{1}{n_{km}} \sum_{i=1}^{n_{km}} \frac{\sum_{L=1}^{4} C_{Likm}}{V_{ikm} \quad E_{ikm}} \qquad \text{(Equation 6)}$$

where

A_{km} = 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, and

V_{ikm}, E_{ikm} = circulating volume, and collection efficiency on day i of month k at Unit m.

TABLE A-1
DAILY INTAKE TEMPERATURE (DEGREES CELSIUS)
AT THE INDIAN POINT GENERATING STATION DURING 1985

DATE	UNIT 2	UNIT 3	MEAN	DATE	UNIT 2	UNIT 3	MEAN
03JAN85	5.0		5.0	26FEB85	6.5	7.5	7.0
04JAN85	5.0	6.5	5.8	27FEB85	5.0	4.5	4.8
11JAN85	4.0		4.0	28FEB85	2.5	2.0	2.3
12JAN85	3.5		3.5	01MAR85	1.5	2.0	1.8
13JAN85	5.5		5.5	02MAR85	4.2	4.1	4.1
14JAN85	5.0	5.0	5.0	03MAR85	4.0		4.0
15JAN85	1.2	1.5	1.3	04MAR85	5.0		5.0
16JAN85	1.0		1.0	05MAR85	8.0	8.5	8.3
17JAN85	2.5		2.5	06MAR85	8.5		8.5
18JAN85	4.0		4.0	07MAR85	4.5		4.5
19JAN85	2.9		2.9	08MAR85	5.5		5.5
20JAN85	1.5		1.5	09MAR85	3.5	3.0	3.3
21JAN85	2.0		2.0	10MAR85	3.5	3.5	3.5
22JAN85	1.5	2.0	1.8	10MAR85	4.0	3.5	3.8
22JAN85	0.0	2.0	1.0	11MAR85	4.0		4.0
23JAN85	0.0		0.0	12MAR85	4.0		4.0
24JAN85	0.5		0.5	13MAR85	5.5		5.5
25JAN85	0.5		0.5	14MAR85	5.0	7.2	6.1
26JAN85	2.0		2.0	15MAR85	7.0	9.0	8.0
27JAN85	4.0		4.0	16MAR85	5.0		5.0
28JAN85	4.0		4.0	17MAR85	7.0		7.0
29JAN85	2.0		2.0	18MAR85	6.5		6.5
30JAN85	2.0		2.0	19MAR85	6.5		6.5
31JAN85	0.5		0.5	20MAR85	5.5	6.0	5.8
01FEB85	0.0	0.5	0.3	21MAR85	5.5	6.0	5.8
03FEB85	0.0	0.0	0.0	21MAR85	4.5	6.0	5.3
04FEB85	0.5		0.5	22MAR85	5.5		5.5
05FEB85	3.0		3.0	23MAR85	14.0	6.0	10.0
06FEB85	4.0		4.0	24MAR85	14.0		14.0
07FEB85	5.0	4.0	4.5	25MAR85	7.0	7.0	7.0
08FEB85	2.5		2.5	25MAR85	21.0	7.0	14.0
09FEB85	2.0	2.0	2.0	26MAR85	7.0		7.0
10FEB85	3.1		3.1	27MAR85	7.0	7.0	7.0
11FEB85	2.0		2.0	29MAR85	7.0	8.1	7.5
12FEB85	3.0		3.0	30MAR85	9.5	8.0	8.8
13FEB85	1.0	1.0	1.0	31MAR85	9.0	9.0	9.0
14FEB85	1.0		1.0	01APR85	13.0	13.0	13.0
15FEB85	3.5	3.9	3.7	02APR85	13.0		13.0
16FEB85	5.0	4.0	4.5	03APR85	8.0		8.0
17FEB85	7.0	6.0	6.5	04APR85	8.0		8.0
18FEB85	6.5	4.5	5.5	05APR85	7.0		7.0
19FEB85	3.5	4.0	3.8	06APR85	8.0		8.0
20FEB85	2.0		2.0	07APR85	9.0	8.0	8.5
21FEB85	3.5	3.0	3.3	08APR85	7.0		7.0
22FEB85	4.3		4.3	09APR85	14.0		14.0
23FEB85	3.0		3.0	10APR85	11.0		11.0
24FEB85	6.0		6.0	11APR85	8.5		8.5
25FEB85	6.0	5.0	5.5	12APR85	10.0		10.0

TABLE A-1. (Continued)

DATE	UNIT 2	UNIT 3	MEAN	DATE	UNIT 2	UNIT 3	MEAN
13APR85	9.5		9.5	02JUN85	20.5	21.0	20.8
14APR85	7.5		7.5	02JUN85	21.0	21.0	21.0
15APR85	8.5		8.5	03JUN85	21.0	21.0	21.0
17APR85	10.0		10.0	03JUN85	21.0	21.0	21.0
18APR85	11.0		11.0	04JUN85	20.7	20.7	20.7
20APR85	12.0	10.0	11.0	04JUN85	20.7	20.7	20.7
28APR85	11.5		11.5	05JUN85	20.0	20.0	20.0
28APR85	14.0		14.0	05JUN85	20.0	20.0	20.0
01MAY85	10.2	10.2	10.2	06JUN85	22.0	22.0	22.0
02MAY85	16.0	15.0	15.5	06JUN85	22.0	22.0	22.0
02MAY85	16.0	15.0	15.5	07JUN85	21.0	21.0	21.0
06MAY85	15.0	16.0	15.5	07JUN85	21.0	21.0	21.0
06MAY85	15.0	16.0	15.5	08JUN85	20.5	20.0	20.3
07MAY85	16.0	15.0	15.5	10JUN85	19.5	20.0	19.8
08MAY85	14.0	14.0	14.0	11JUN85	21.5	21.0	21.3
09MAY85	13.0	14.0	13.5	12JUN85	21.0	21.0	21.0
10MAY85	16.0	15.0	15.5	13JUN85	23.4	22.5	22.9
10MAY85	16.0	15.0	15.5	14JUN85	23.1	23.1	23.1
11MAY85	16.0	16.0	16.0	15JUN85	23.0	23.1	23.0
11MAY85	16.0	16.1	16.0	17JUN85	23.5	23.5	23.5
12MAY85	18.0	18.0	18.0	18JUN85	23.5	23.5	23.5
12MAY85	18.0	18.0	18.0	19JUN85	21.0	21.5	21.3
13MAY85	16.0	16.5	16.3	20JUN85	21.0	21.1	21.0
13MAY85	16.0	16.5	16.3	21JUN85	21.0	21.2	21.1
14MAY85	16.0	17.0	16.5	22JUN85	22.9	23.0	22.9
14MAY85	17.0	16.0	16.5	23JUN85	23.0	23.2	23.1
16MAY85	18.0	19.0	18.5	24JUN85	22.9	22.8	22.8
17MAY85	17.0	18.0	17.5	25JUN85	22.9	22.7	22.8
18MAY85	17.0	17.5	17.3	28JUN85	23.5	23.5	23.5
20MAY85	19.0	19.0	19.0	29JUN85	23.5	23.5	23.5
20MAY85	19.0	19.0	19.0	30JUN85	24.2	24.2	24.2
21MAY85	21.5	21.5	21.5	01JUL85	23.2	23.2	23.2
22MAY85	18.0	18.2	18.1	02JUL85	24.0	24.0	24.0
23MAY85	21.5	21.0	21.3	03JUL85	24.5	24.5	24.5
24MAY85	20.0	20.0	20.0	05JUL85	23.5	23.5	23.5
24MAY85	20.0	20.0	20.0	07JUL85	24.5	24.5	24.5
25MAY85	18.5	18.5	18.5	08JUL85	24.0	24.0	24.0
25MAY85	18.5	18.5	18.5	09JUL85	24.0	24.0	24.0
26MAY85	19.5	19.5	19.5	11JUL85	23.7	23.7	23.7
26MAY85	19.5	19.5	19.5	13JUL85	27.0	27.0	27.0
27MAY85	21.0	21.5	21.3	14JUL85	26.3	26.3	26.3
27MAY85	21.0	21.5	21.3	15JUL85	27.2	27.2	27.2
28MAY85	21.0	21.5	21.3	16JUL85	27.0	27.0	27.0
30MAY85	21.0	21.0	21.0	17JUL85	27.1	27.1	27.1
30MAY85	21.0	21.0	21.0	18JUL85	26.0	26.0	26.0
31MAY85	21.5	21.0	21.3	19JUL85	26.4	26.4	26.4
01JUN85	20.0	19.5	19.8	20JUL85	26.0	26.0	26.0
01JUN85	20.0	19.5	19.8	21JUL85	26.1	26.1	26.1

TABLE A-1. (Continued)

DATE	UNIT 2	UNIT 3	MEAN	DATE	UNIT 2	UNIT 3	MEAN
23JUL85	27.2	27.2	27.2	25SEP85	24.3	24.7	24.5
24JUL85	26.0	26.0	26.0	28SEP85	24.0	24.1	24.0
25JUL85	25.3	25.3	25.3	29SEP85	23.0	24.1	23.5
26JUL85	26.8	26.8	26.8	30SEP85	23.0	23.8	23.4
28JUL85	27.5	27.5	27.5	01OCT85	23.2	23.3	23.2
29JUL85	25.5		25.5	02OCT85	23.0	23.1	23.0
30JUL85	28.0		28.0	03OCT85	20.9	20.9	20.9
31JUL85	27.0		27.0	04OCT85	20.6	22.0	21.3
01AUG85	27.5		27.5	05OCT85	20.5	20.9	20.7
03AUG85	29.0		29.0	06OCT85	20.0	20.2	20.1
04AUG85	28.0		28.0	07OCT85	19.9	19.9	19.9
05AUG85	27.0		27.0	08OCT85	20.0	20.5	20.3
06AUG85	28.2		28.2	09OCT85	21.0	21.3	21.1
11AUG85	26.0		26.0	10OCT85	21.5	20.3	20.9
13AUG85	27.8	28.0	27.9	11OCT85	19.2	19.4	19.3
14AUG85	27.6	29.2	28.4	12OCT85	20.0	19.8	19.9
15AUG85	28.0	28.0	28.0	13OCT85	19.0	19.0	19.0
16AUG85	28.5	28.8	28.6	14OCT85	19.2	19.5	19.3
17AUG85	27.3	27.0	27.1	15OCT85	18.9	18.9	18.9
18AUG85	26.2	26.0	26.1	16OCT85	19.0	19.3	19.1
21AUG85	26.2	26.2	26.2	16OCT85	19.0	19.3	19.1
22AUG85	26.0	25.8	25.9	17OCT85	19.5	19.9	19.7
23AUG85	26.3	26.0	26.1	18OCT85	18.0	18.4	18.2
24AUG85	25.5	25.8	25.6	19OCT85	21.0	20.0	20.5
25AUG85	25.0	25.8	25.4	20OCT85	19.0	18.0	18.5
27AUG85	26.5	27.0	26.8	21OCT85	17.8	17.8	17.8
28AUG85	25.0	25.6	25.3	22OCT85	17.8	17.7	17.7
30AUG85	25.8	27.1	26.4	23OCT85	17.7	17.8	17.7
31AUG85	25.0	26.0	25.5	24OCT85	18.0	18.3	18.1
02SEP85	25.0	25.8	25.4	25OCT85	17.5	18.0	17.8
03SEP85	25.0	24.5	24.8	26OCT85	17.5	17.7	17.6
04SEP85	25.0	25.5	25.3	27OCT85	18.0	18.2	18.1
05SEP85	26.0	26.5	26.3	29OCT85	16.1	16.0	16.0
06SEP85	26.9	27.0	26.9	30OCT85	16.5	17.8	17.1
07SEP85	27.1	25.0	26.0	31OCT85	15.8	16.0	15.9
08SEP85	26.2	27.8	27.0	01NOV85	18.2	17.9	18.0
09SEP85	25.1	29.0	27.0	02NOV85	17.0	17.5	17.3
11SEP85	24.0	24.0	24.0	03NOV85	17.1	16.5	16.8
12SEP85	24.5	24.5	24.5	04NOV85	14.8	14.9	14.8
14SEP85	24.3		24.3	05NOV85	15.8	16.0	15.9
15SEP85	24.0	24.5	24.3	06NOV85	14.0	14.3	14.1
16SEP85	24.0	24.5	24.3	07NOV85	14.0	14.1	14.0
17SEP85	23.0	24.0	23.5	08NOV85	14.0	14.0	14.0
18SEP85	23.5	24.0	23.8	09NOV85	14.2	14.2	14.2
19SEP85	23.0	23.5	23.3	10NOV85	15.0	15.0	15.0
20SEP85	24.0	24.0	24.0	11NOV85	16.5	15.0	15.8
21SEP85	24.0	24.5	24.3	12NOV85	15.0	15.2	15.1
24SEP85	24.0	24.6	24.3	13NOV85	16.0	14.9	15.4

TABLE A-1. (Continued)

DATE	UNIT 2	UNIT 3	MEAN
14NOV85	14.9	16.0	15.4
15NOV85	17.1	15.8	16.4
16NOV85	13.0	13.3	13.1
17NOV85	13.5	13.7	13.6
18NOV85	14.9	15.7	15.3
19NOV85	10.9	11.0	10.9
20NOV85	11.5	13.0	12.3
21NOV85	11.5		11.5
22NOV85	10.1	10.3	10.2
23NOV85	10.1	10.7	10.4
24NOV85	10.2		10.2
25NOV85	11.0	12.0	11.5
26NOV85	10.1	10.1	10.1
26NOV85	10.0	10.0	10.0
27NOV85	10.0	10.0	10.0
28NOV85	10.0	8.0	9.0
29NOV85	8.0	7.9	7.9
30NOV85	7.2	8.9	8.0
01DEC85	7.0	7.9	7.4
02DEC85	9.5	10.5	10.0
03DEC85	9.4	9.9	9.6
04DEC85	6.0	6.4	6.2
05DEC85	7.1	8.0	7.5
06DEC85	7.8	8.0	7.9
07DEC85	6.0	5.8	5.9
08DEC85	6.5	6.8	6.6
09DEC85	7.0	6.2	6.6
10DEC85	7.0	6.8	6.9
11DEC85	7.0	7.0	7.0
12DEC85	6.0	7.0	6.5
13DEC85	7.2	7.1	7.1
14DEC85	7.1	7.3	7.2
15DEC85	6.3	6.4	6.3
16DEC85	7.0	7.0	7.0
17DEC85	7.9	7.5	7.7
18DEC85	4.0	3.8	3.9
19DEC85	4.0	4.0	4.0
20DEC85	3.5	3.8	3.6
21DEC85	4.9	5.1	5.0
22DEC85	4.2	4.5	4.3
23DEC85	5.0	5.3	5.1
24DEC85	5.0	5.8	5.4
25DEC85	6.5	6.8	6.6
26DEC85	2.8	3.2	3.0
27DEC85	5.5	7.2	6.3
28DEC85	6.8	6.9	6.8
29DEC85	1.9	2.2	2.0
30DEC85	3.0	2.8	2.9
31DEC85	3.7	5.3	4.5

TABLE A-2
DAILY INTAKE CONDUCTIVITY (MICRO-SIEMANS ADJUSTED FOR 25 C)
AT THE INDIAN POINT GENERATING STATION DURING 1985

DATE	UNIT 2	UNIT 3	MEAN	DATE	UNIT 2	UNIT 3	MEAN
03JAN85	982		982	26FEB85	2902	3201	3052
04JAN85	1482	1502	1492	27FEB85	2202	2302	2252
11JAN85	1302		1302	28FEB85	1102	1102	1102
12JAN85	842		842	01MAR85	827	852	840
13JAN85	672		672	02MAR85	727	1027	877
14JAN85	1292	1252	1272	03MAR85	702		702
15JAN85	302	302	302	04MAR85	1202		1202
16JAN85	164		164	05MAR85	2001	2101	2051
17JAN85	220		220	06MAR85	2101		2101
18JAN85	692		692	07MAR85	2102		2102
19JAN85	357		357	08MAR85	1927		1927
20JAN85	322		322	09MAR85	1402	1502	1452
21JAN85	200		200	10MAR85	1402	1252	1327
22JAN85	252	235	244	10MAR85	1252	1252	1252
22JAN85	232	235	234	11MAR85	1252		1252
23JAN85	232		232	12MAR85	1002		1002
24JAN85	187		187	13MAR85	902		902
25JAN85	332		332	14MAR85	161	171	166
26JAN85	242		242	15MAR85	171	171	171
27JAN85	332		332	16MAR85	152		152
28JAN85	402		402	17MAR85	151		151
29JAN85	552		552	18MAR85	242		242
30JAN85	700		700	19MAR85	242		242
31JAN85	1252		1252	20MAR85	372	442	407
01FEB85	1802	1852	1827	21MAR85	272	222	247
03FEB85	4102	4102	4102	21MAR85	192	222	207
04FEB85	5202		5202	22MAR85	312		312
05FEB85	6102		6102	23MAR85	351	312	332
06FEB85	6502		6502	24MAR85	351		351
07FEB85	6902	6402	6652	25MAR85	171	261	216
08FEB85	5002		5002	25MAR85	281	261	271
09FEB85	4402	4352	4377	26MAR85	171		171
10FEB85	4102		4102	27MAR85	161	158	160
11FEB85	5202		5202	29MAR85	601	781	691
12FEB85	5202		5202	30MAR85	1301	1451	1376
13FEB85	6002	5902	5952	31MAR85	1101	1001	1051
14FEB85	6002		6002	01APR85	2801	2901	2851
15FEB85	4902	5002	4952	02APR85	2801		2801
16FEB85	5002	5002	5002	03APR85	3601		3601
17FEB85	5501	5002	5252	04APR85	3701		3701
18FEB85	4502	4702	4602	05APR85	3201		3201
19FEB85	4502	4602	4552	06APR85	3501		3501
20FEB85	4452		4452	07APR85	1701	1691	1696
21FEB85	4252	4362	4307	08APR85	231		231
22FEB85	4202		4202	09APR85	501		501
23FEB85	3602		3602	10APR85	321		321
24FEB85	3902		3902	11APR85	351		351
25FEB85	3902	3752	3827	12APR85	111		111

TABLE A-2. (Continued)

DATE	UNIT 2	UNIT 3	MEAN	DATE	UNIT 2	UNIT 3	MEAN
13APR85	221		221	02JUN85	5359	5411	5385
14APR85	216		216	02JUN85	2901	2901	2901
15APR85	231		231	03JUN85	3030	3030	3030
17APR85	751		751	03JUN85	2801	2801	2801
18APR85	2501		2501	04JUN85	3158	3158	3158
20APR85	3233	3212	3223	04JUN85	2901	2901	2901
28APR85	1803		1803	05JUN85	2321	2321	2321
28APR85	1601		1601	05JUN85	2101	2101	2101
01MAY85	5001	5001	5001	06JUN85	3709	3709	3709
02MAY85	6266	6160	6213	06JUN85	3501	3501	3501
02MAY85	5201	5001	5101	07JUN85	3138	3138	3138
06MAY85	4928	4820	4874	07JUN85	2901	2901	2901
06MAY85	4001	4001	4001	08JUN85	2734	2763	2749
07MAY85	3451	3451	3451	10JUN85	3351	3316	3334
08MAY85	2221	2501	2361	11JUN85	3213	3247	3230
09MAY85	2001	2001	2001	12JUN85	4545	4545	4545
10MAY85	2651	3080	2866	13JUN85	4633	4825	4729
10MAY85	2201	2501	2351	14JUN85	4454	4454	4454
11MAY85	3494	3585	3540	15JUN85	4671	4661	4666
11MAY85	2901	2976	2939	17JUN85	4931	4931	4931
12MAY85	4037	4037	4037	18JUN85	6678	6678	6678
12MAY85	3501	3501	3501	19JUN85	5086	5033	5060
13MAY85	3253	3230	3242	20JUN85	5303	5292	5298
13MAY85	2701	2711	2706	21JUN85	4545	4526	4536
14MAY85	2892	2853	2873	22JUN85	2808	2803	2806
14MAY85	2421	2401	2411	23JUN85	2803	2791	2797
16MAY85	4501	4601	4551	24JUN85	3953	3961	3957
17MAY85	4501	4501	4501	25JUN85	4941	5003	4972
18MAY85	3601	3601	3601	28JUN85	5137	5137	5137
20MAY85	4403	4403	4403	29JUN85	5239	5239	5239
20MAY85	3901	3901	3901	30JUN85	6076	6076	6076
21MAY85	4271	4271	4271	01JUL85	6202	6202	6202
22MAY85	3501	3501	3501	02JUL85	5592	5592	5592
23MAY85	4501	4501	4501	03JUL85	6038	6038	6038
24MAY85	3758	3758	3758	05JUL85	5650	5650	5650
24MAY85	3401	3401	3401	07JUL85	5938	5938	5938
25MAY85	3309	3309	3309	08JUL85	5186	5186	5186
25MAY85	2901	2901	2901	09JUL85	6101	6101	6101
26MAY85	3463	3463	3463	11JUL85	6139	6139	6139
26MAY85	3101	3101	3101	13JUL85	5738	5738	5738
27MAY85	6493	6426	6460	14JUL85	6984	6984	6984
27MAY85	6001	6001	6001	15JUL85	8286	8286	8286
28MAY85	6001	6001	6001	16JUL85	8415	8415	8415
30MAY85	6493	6493	6493	17JUL85	8207	8207	8207
30MAY85	6001	6001	6001	18JUL85	6734	6734	6734
31MAY85	6001	6001	6001	19JUL85	8906	8906	8906
01JUN85	4642	5474	5058	20JUL85	7320	7320	7320
01JUN85	4201	4901	4551	21JUL85	6818	6818	6818

TABLE A-2. (Continued)

DATE	UNIT 2	UNIT 3	MEAN	DATE	UNIT 2	UNIT 3	MEAN
23JUL85	7619	7619	7619	25SEP85	8691	8720	8706
24JUL85	6832	6832	6832	28SEP85	9456	9234	9345
25JUL85	6930	6930	6930	29SEP85	7266	7306	7286
26JUL85	8641	8641	8641	30SEP85	7059	7147	7103
28JUL85	6626	6626	6626	01OCT85	5138	4848	4993
29JUL85	7395		7395	02OCT85	4671	4744	4708
30JUL85	7402		7402	03OCT85	3470	3579	3525
31JUL85	7172		7172	04OCT85	3656	3932	3794
01AUG85	6626		6626	05OCT85	4506	4240	4373
03AUG85	6428		6428	06OCT85	2984	3566	3275
04AUG85	6559		6559	07OCT85	2548	2592	2570
05AUG85	6694		6694	08OCT85	3813	3828	3821
06AUG85	6999		6999	09OCT85	5195	5334	5265
11AUG85	5758		5758	10OCT85	5033	5096	5065
13AUG85	8373	8527	8450	11OCT85	5846	5821	5834
14AUG85	8596	10243	9420	12OCT85	6079	5883	5981
15AUG85	937	890	914	13OCT85	7790	7903	7847
16AUG85	8626	8574	8600	14OCT85	6183	6144	6164
17AUG85	9599	9802	9701	15OCT85	4639	4865	4752
18AUG85	8748	8930	8839	16OCT85	5306	5273	5290
21AUG85	9039	9234	9137	16OCT85	5306	5329	5318
22AUG85	8783	9799	9291	17OCT85	4133	4187	4160
23AUG85	7760	7808	7784	18OCT85	3818	4003	3911
24AUG85	8381	9309	8845	19OCT85	3268	3327	3298
25AUG85	7969	8329	8149	20OCT85	3161	3172	3167
27AUG85	9177	8702	8940	21OCT85	3244	3012	3128
28AUG85	8965	9151	9058	22OCT85	3244	3135	3190
30AUG85	8525	8493	8509	23OCT85	2786	2873	2830
31AUG85	8965	9759	9362	24OCT85	2745	2877	2811
02SEP85	8467	8427	8447	25OCT85	3615	3518	3567
03SEP85	7869	7950	7910	26OCT85	3382	3425	3404
04SEP85	7969	8085	8027	27OCT85	3576	4077	3827
05SEP85	8783	9177	8980	29OCT85	2585		2585
06SEP85	958	1052	1005	30OCT85	4052	3348	3700
07SEP85	7157	11953	9555	31OCT85			
08SEP85	8262	8656	8459	01NOV85			
09SEP85	6263	7162	6713	02NOV85	3419	3440	3430
11SEP85	10981	11083	11032	03NOV85	4611	4648	4630
12SEP85	9057	9208	9133	04NOV85	4232	4445	4339
14SEP85	8994		8994	05NOV85	6051	6266	6159
15SEP85	9151	9259	9205	06NOV85	5922	6057	5990
16SEP85	9049	9158	9104	07NOV85	6930	6538	6734
17SEP85	11418	11236	11327	08NOV85	7560	8821	8191
18SEP85	9760	9863	9812	09NOV85			
19SEP85	7785	8013	7899	10NOV85	9610	9856	9733
20SEP85	9355	9456	9406	11NOV85	9415	9856	9636
21SEP85	7626	7649	7638	12NOV85			
24SEP85	8643	8637	8640	13NOV85	8435	9261	8848

TABLE A-2. (Continued)

DATE	UNIT 2	UNIT 3	MEAN	DATE	UNIT 2	UNIT 3	MEAN
14NOV85	6421	7109	6765	31DEC85	3277	3129	3203
15NOV85	4881	5107	4994				
16NOV85	5608	5493	5551				
17NOV85	5697	5696	5697				
18NOV85	1543	1504	1524				
19NOV85	446	581	514				
20NOV85	654	838	746				
21NOV85							
22NOV85	246	272	259				
23NOV85	272	275	274				
24NOV85	269		269				
25NOV85							
26NOV85	476	486	481				
26NOV85	478	487	483				
27NOV85							
28NOV85	485	291	388				
29NOV85	291	292	292				
30NOV85	238	242	240				
01DEC85	266	263	265				
02DEC85	841	821	831				
03DEC85	773	833	803				
04DEC85	227	235	231				
05DEC85							
06DEC85	288	290	289				
07DEC85	230	228	229				
08DEC85	378	353	366				
09DEC85	971	679	825				
10DEC85	385	395	390				
11DEC85	363	373	368				
12DEC85	221	254	238				
13DEC85	254	299	277				
14DEC85	288	298	293				
15DEC85	279	314	297				
16DEC85	194	199	197				
17DEC85	197	192	195				
18DEC85	195	221	208				
19DEC85	187	195	191				
20DEC85	198	196	197				
21DEC85	204	206	205				
22DEC85	1292	1440	1366				
23DEC85	1183	1095	1139				
24DEC85	2651	2654	2653				
25DEC85	2422	2463	2443				
26DEC85	2526	3326	2926				
27DEC85	3547	3566	3557				
28DEC85	2703	2996	2850				
29DEC85	2165	1973	2069				
30DEC85	2878	3081	2980				

TABLE A-3
TOTAL NUMBERS BY MONTH OF EACH TAXON ACTUALLY COLLECTED AT
INDIAN POINT UNIT 2 DURING 1985
(UNADJUSTED FOR COLLECTION EFFICIENCY).

COMMOM NAME	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
ALEWIFE	56	137	24	4		35	66	79	7	179	127	5	719
AMERICAN EEL	89	60	87	102	2	25	4	21	8	53	72	103	626
AMERICAN SHAD	3	1		2				10	4	147	318	25	510
ATLANTIC CROAKER												1	1
ATLANTIC CUTLASSFISH								1					1
ATLANTIC MENHADEN						2	6	17	18	37	26	2	108
ATLANTIC NEEDLEFISH								2					2
ATLANTIC SILVERSIDE	1	1						1	3		2	1	9
ATLANTIC STURGEON	3	3								1			7
ATLANTIC TOMCOD	2515	379	576	35	10	1162	1940	2611	19	43	43	146	9479
BANDED KILLIFISH	14	17	2	2					1	32	63	89	220
BAY ANCHOVY	3				2	154	641	565	57	540	82	4	2048
BLACK BULLHEAD												2	2
BLACK CRAPPIE	1	2		1						1	3	17	25
BLACK SEA BASS											7		7
BLUEBACK HERRING	14	38	2	8	7	10	14	74	53	1360	1421	24	3025
BLUEFISH						8	44	50	6	22	7		137
BLUEGILL	17	15	5	2		1			100	33	62	253	488
BROWN BULLHEAD	11	16	20	7							2	1	57
BUTTERFISH						14	7	383	32	4			440
CARP		1									1	7	9
CENTRAL MUDMINNOW										1			1
CENTRARCHID UNID.	4									1			5
CLUPEID UNID.	2						2			17	1		22
COMMON SHINER											2		2
CONGER EEL									1				1
CREVALLE JACK								3	1	15	25		44
CUNNER			1	1									2
FOUR BEARDED ROCKLING		5									1		6
FOURSPINE STICKLEBACK	1	3		2						1		2	9
FOURSPOT FLOUNDER						5	21	10					36
FRECKLED BLENNY											1		1
GIZZARD SHAD	304	64								3	22	353	746
GOLDEN SHINER	5	14	12										31
GOLDFISH		3	1								1	1	6
GRAY SNAPPER										11	30	1	42
GREEN SUNFISH												1	1
GRUBBY		5	1										6
HOGCHOKER	43	84	125	266	26	51	688	2423	934	1288	838	164	6930

TABLE A-3. (Continued)

COMMOM NAME	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
LARGEMOUTH BASS	5	4					5				2	3	19
LOOKDOWN								14	9	15	2		40
MACKEREL SCAD								1					1
MOONFISH								1	1	2	26		30
MUMMICHOG		7								1		1	9
NAKED GOBY										11	15	32	58
NORTHERN PIPEFISH			3	22	3	1	18	88	21	73	13		242
NORTHERN PUFFER								7					7
NORTHERN SEAROBIN								7					7
NORTHERN STARGAZER								2					2
PLANEHEAD FILEFISH									2				2
PUMPKINSEED	179	154	32	17			1	4	14	25	15	41	482
RAINBOW SMELT	386	437	128	89				1		15	219	76	1351
RED HAKE	2	186	2									3	193
REDBREAST SUNFISH	2			1				1		2		1	7
ROCK GUNNEL		1	2	1									4
SEA LAMPREY	6	4	3										13
SEAHORSE				1									1
SILVER HAKE		18		2						1	7		28
SILVER PERCH										11	4		15
SMALLMOUTH BASS	2						4						6
SPOT											1		1
SPOTFIN BUTTERFLYFISH										1			1
SPOTTAIL SHINER	315	328	77	29			1	1			8	50	809
SPOTTED HAKE			2	22		3	2						29
STRIPED BASS	13214	3439	4258	375	3	15	99	91	29	137	504	458	22622
STRIPED CUSKEEL				4									4
STRIPED SEAROBIN								4	17	2	6		29
SUMMER FLOUNDER								8	11	14	8		41
TAUTOG				1							1		2
TESSELLATED DARTER	1	4	36	74							2	4	121
THREESPINE STICKLEBAC	5	47	215	14									281
TIDEWATER SILVERSIDE	5	1						1					7
WEAKFISH							34	1537	100	305	230	1	2207
WHITE CATFISH	697	330	211	123	1	6	8	8	9	48	227	169	1837
WHITE CRAPPIE			1										1
WHITE PERCH	75313	24385	24360	8305	94	152	249	1079	253	2232	36279	44154	216855
WHITE SUCKER	1												1
WINDOWPANE				6	2		3	5			1		17
WINTER FLOUNDER	2	7	5				3	3	3	14	3		40
YELLOW PERCH	15	8	8	13	1						1	6	52
TOTAL ALL TAXA	93236	30208	30199	9531	151	1644	3860	9113	1713	6698	40731	46201	273285

TABLE A-4
TOTAL NUMBERS BY MONTH OF EACH TAXON ACTUALLY COLLECTED AT
INDIAN POINT UNIT 3 DURING 1985
(UNADJUSTED FOR COLLECTION EFFICIENCY).

COMMOM NAME	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
ALEWIFE	9	91	24	9	162	28				43	45	1	412
AMERICAN EEL	23	20	39	23	67	10				2	5	25	214
AMERICAN SHAD			2	2	1					67	173	9	254
ATLANTIC MENHADEN										4	3		7
ATLANTIC SILVERSIDE												1	1
ATLANTIC STURGEON		3		2									5
ATLANTIC TOMCOD	130	158	57	14	718	188				8	3	36	1312
BANDED KILLIFISH		3	2							3	2	11	21
BAY ANCHOVY	6				279	72				203	22	21	603
BLACK CRAPPIE		3										8	11
BLACK SEA BASS											4		4
BLUEBACK HERRING	9	23	2	4	297	21				1369	5425	67	7217
BLUEFISH										4			4
BLUEGILL	1	11	1	2	19	1				1	3	21	60
BOTHID UNID.					3								3
BROWN BULLHEAD	4	2	7	1	2								16
BUTTERFISH					6	6				3	1		16
CARP	2	1										6	9
CREVALLE JACK										4	10		14
CUNNER					1								1
FOUR BEARDED ROCKLING		2	1										3
FOURSPINE STICKLEBACK					1								1
FOURSPOT FLOUNDER					2								2
GIZZARD SHAD	223	128	2								4	466	823
GOLDEN SHINER		4	1	1								2	8
GOLDFISH		1	1										2
GRAY SNAPPER											6		6
HOGCHOKER	22	39	79	75	1230	5				77	119	21	1667
LARGEMOUTH BASS		1	1									2	4
LOOKDOWN										1	3		4
MOONFISH											14		14
MUMMICHOG		1											1
NAKED GOBY											1		1
NORTHERN PIPEFISH				7	12					36	2		57
NORTHERN SEAROBIN					1								1
PIGFISH											1		1
PUMPKINSEED	20	67	20	5	4					4	2	12	134
RAINBOW SMELT	22	236	129	24	4					1	2	20	438
RED HAKE		123	1									1	125

TABLE A-4. (Continued)

COMMOM NAME	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
REDBREAST SUNFISH		1											1
SEAHORSE					2								2
SILVER HAKE		3			10						5		18
SILVER PERCH											2		2
SPOTTAIL SHINER	13	63	14	9	2							23	124
SPOTTED HAKE				4	7								11
STRIPED BASS	2176	2616	1778	114	65	9				1	8	127	6894
STRIPED CUSKEEL				2	40								42
STRIPED SEAROBIN											4		4
SUMMER FLOUNDER											2		2
TAUTOG					1								1
TESSELLATED DARTER	1		12	2	4							2	21
THREESPINE STICKLEBACK		56	88	5	1								150
TIDEWATER SILVERSIDE	1	2											3
WEAKFISH										30	46	1	77
WHITE CATFISH	93	179	55	8	6	2				1	3	38	385
WHITE PERCH	11386	15931	12912	597	1526	119			1	35	164	11734	54405
WHITE SUCKER			1										1
WINDOWPANE				2	72								74
WINTER FLOUNDER		4	2	1									7
YELLOW PERCH	2	2	6	3	3							1	17
TOTAL ALL TAXA	14143	19774	15237	916	4548	461			1	1897	6084	12656	75717

TABLE A-5
TOTAL NUMBERS BY MONTH OF EACH TAXON ACTUALLY COLLECTED AT
INDIAN POINT UNITS 2 & 3 COMBINED DURING 1985
(UNADJUSTED FOR COLLECTION EFFICIENCY).

COMMOM NAME	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
ALEWIFE	65	228	48	13	162	63	66	79	7	222	172	6	1131
AMERICAN EEL	112	80	126	125	69	35	4	21	8	55	77	128	840
AMERICAN SHAD	3	1	2	4	1			10	4	214	491	34	764
ATLANTIC CROAKER												1	1
ATLANTIC CUTLASSFISH								1					1
ATLANTIC MENHADEN						2	6	17	18	41	29	2	115
ATLANTIC NEEDLEFISH								2					2
ATLANTIC SILVERSIDE	1	1						1	3		2	2	10
ATLANTIC STURGEON	3	6		2						1			12
ATLANTIC TOMCOD	2645	537	633	49	728	1350	1940	2611	19	51	46	182	10791
BANDED KILLIFISH	14	20	4	2					1	35	65	100	241
BAY ANCHOVY	9				281	226	641	565	57	743	104	25	2651
BLACK BULLHEAD												2	2
BLACK CRAPPIE	1	5		1						1	3	25	36
BLACK SEA BASS											11		11
BLUEBACK HERRING	23	61	4	12	304	31	14	74	53	2729	6846	91	10242
BLUEFISH						8	44	50	6	26	7		141
BLUEGILL	18	26	6	4	19	2			100	34	65	274	548
BOTHID UNID.					3								3
BROWN BULLHEAD	15	18	27	8	2						2	1	73
BUTTERFISH					6	20	7	383	32	7	1		456
CARP	2	2									1	13	18
CENTRAL MUDMINNOW										1			1
CENTRARCHID UNID.	4									1			5
CLUPEID UNID.	2						2			17	1		22
COMMON SHINER											2		2
CONGER EEL									1				1
CREVALLE JACK								3	1	19	35		58
CUNNER			1	1	1								3
FOUR BEARDED ROCKLING		7	1								1		9
FOURSPINE STICKLEBACK	1	3		2	1					1		2	10
FOURSPOT FLOUNDER					2	5	21	10					38
FRECKLED BLENNY											1		1
GIZZARD SHAD	527	192	2							3	26	819	1569
GOLDEN SHINER	5	18	13	1								2	39
GOLDFISH		4	2								1	1	8
GRAY SNAPPER										11	36	1	48
GREEN SUNFISH												1	1
GRUBBY		5	1										6

TABLE A-5. (Continued)

COMMOM NAME	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
HOGCHOKER	65	123	204	341	1256	56	688	2423	934	1365	957	185	8597
LARGEMOUTH BASS	5	5	1				5				2	5	23
LOOKDOWN								14	9	16	5		44
MACKEREL SCAD								1					1
MOONFISH								1	1	2	40		44
MUMMICHOG		8								1		1	10
NAKED GOBY										11	16	32	59
NORTHERN PIPEFISH			3	29	15	1	18	88	21	109	15		299
NORTHERN PUFFER								7					7
NORTHERN SEAROBIN					1			7					8
NORTHERN STARGAZER								2					2
PIGFISH											1		1
PLANEHEAD FILEFISH									2				2
PUMPKINSEED	199	221	52	22	4		1	4	14	29	17	53	616
RAINBOW SMELT	408	673	257	113	4			1		16	221	96	1789
RED HAKE	2	309	3									4	318
REDBREAST SUNFISH	2	1		1				1		2		1	8
ROCK GUNNEL		1	2	1									4
SEA LAMPREY	6	4	3										13
SEAHORSE				1	2								3
SILVER HAKE		21		2	10					1	12		46
SILVER PERCH										11	6		17
SMALLMOUTH BASS	2						4						6
SPOT											1		1
SPOTFIN BUTTERFLYFISH										1			1
SPOTTAIL SHINER	328	391	91	38	2		1	1			8	73	933
SPOTTED HAKE			2	26	7	3	2						40
STRIPED BASS	15390	6055	6036	489	68	24	99	91	29	138	512	585	29516
STRIPED CUSKEEL				6	40								46
STRIPED SEAROBIN								4	17	2	10		33
SUMMER FLOUNDER								8	11	14	10		43
TAUTOG				1	1						1		3
TESSELLATED DARTER	2	4	48	76	4						2	6	142
THREESPINE STICKLEBAC	5	103	303	19	1								431
TIDEWATER SILVERSIDE	6	3						1					10
WEAKFISH							34	1537	100	335	276	2	2284
WHITE CATFISH	790	509	266	131	7	8	8	8	9	49	230	207	2222
WHITE CRAPPIE			1										1
WHITE PERCH	86699	40316	37272	8902	1620	271	249	1079	254	2267	36443	55888	271260
WHITE SUCKER	1		1										2
WINDOWPANE				8	74		3	5			1		91
WINTER FLOUNDER	2	11	7	1			3	3	3	14	3		47
YELLOW PERCH	17	10	14	16	4						1	7	69
TOTAL ALL TAXA	107379	49982	45436	10447	4699	2105	3860	9113	1714	8595	46815	58857	349002

TABLE A-6
TOTAL NUMBERS ACTUALLY COLLECTED BY TAXON AND SEASONAL SAMPLING STRATUM
INDIAN POINT UNIT 2 DURING 1985
(UNADJUSTED FOR COLLECTION EFFICIENCY).

COMMOM NAME	WINTER	SPRING	SUMMER	FALL	TOTAL
ALEWIFE	217	39	152	311	719
AMERICAN EEL	236	129	33	228	626
AMERICAN SHAD	4	2	14	490	510
ATLANTIC CROAKER				1	1
ATLANTIC CUTLASSFISH			1		1
ATLANTIC MENHADEN		2	41	65	108
ATLANTIC NEEDLEFISH			2		2
ATLANTIC SILVERSIDE	2		4	3	9
ATLANTIC STURGEON	6			1	7
ATLANTIC TOMCOD	3470	1207	4570	232	9479
BANDED KILLIFISH	33	2	1	184	220
BAY ANCHOVY	3	156	1263	626	2048
BLACK BULLHEAD				2	2
BLACK CRAPPIE	3	1		21	25
BLACK SEA BASS				7	7
BLUEBACK HERRING	54	25	141	2805	3025
BLUEFISH		8	100	29	137
BLUEGILL	37	3	100	348	488
BROWN BULLHEAD	47	7		3	57
BUTTERFISH		14	422	4	440
CARP	1			8	9
CENTRAL MUDMINNOW				1	1
CENTRARCHID UNID.	4			1	5
CLUPEID UNID.	2		2	18	22
COMMON SHINER				2	2
CONGER EEL			1		1
CREVALLE JACK			4	40	44
CUNNER	1	1			2
FOUR BEARDED ROCKLING	5			1	6
FOURSPINE STICKLEBACK	4	2		3	9
FOURSPOT FLOUNDER		5	31		36
FRECKLED BLENNY				1	1
GIZZARD SHAD	368			378	746
GOLDEN SHINER	31				31
GOLDFISH	4			2	6
GRAY SNAPPER				42	42
GREEN SUNFISH				1	1
GRUBBY	6				6
HOGCHOKER	252	343	4045	2290	6930
LARGEMOUTH BASS	9		5	5	19
LOOKDOWN			23	17	40

TABLE A-6. (Continued)

COMMOM NAME	WINTER	SPRING	SUMMER	FALL	TOTAL
MACKEREL SCAD			1		1
MOONFISH			2	28	30
MUMMICHOG	7			2	9
NAKED GOBY				58	58
NORTHERN PIPEFISH	3	26	127	86	242
NORTHERN PUFFER			7		7
NORTHERN SEAROBIN			7		7
NORTHERN STARGAZER			2		2
PLANEHEAD FILEFISH			2		2
PUMPKINSEED	365	17	19	81	482
RAINBOW SMELT	951	89	1	310	1351
RED HAKE	190			3	193
REDBREAST SUNFISH	2	1	1	3	7
ROCK GUNNEL	3	1			4
SEA LAMPREY	13				13
SEAHORSE		1			1
SILVER HAKE	18	2		8	28
SILVER PERCH				15	15
SMALLMOUTH BASS	2		4		6
SPOT				1	1
SPOTFIN BUTTERFLYFISH				1	1
SPOTTAIL SHINER	720	29	2	58	809
SPOTTED HAKE	2	25	2		29
STRIPED BASS	20911	393	219	1099	22622
STRIPED CUSKEEL		4			4
STRIPED SEAROBIN			21	8	29
SUMMER FLOUNDER			19	22	41
TAUTOG		1		1	2
TESSELLATED DARTER	41	74		6	121
THREESPINE STICKLEBACK	267	14			281
TIDEWATER SILVERSIDE	6		1		7
WEAKFISH			1671	536	2207
WHITE CATFISH	1238	130	25	444	1837
WHITE CRAPPIE	1				1
WHITE PERCH	124058	8551	1581	82665	216855
WHITE SUCKER	1				1
WINDOWPANE		8	8	1	17
WINTER FLOUNDER	14		9	17	40
YELLOW PERCH	31	14		7	52
TOTAL ALL TAXA	153643	11326	14686	93630	273285

TABLE A-7
TOTAL NUMBERS ACTUALLY COLLECTED BY TAXON AND SEASONAL SAMPLING STRATUM
INDIAN POINT UNIT 3 DURING 1985
(UNADJUSTED FOR COLLECTION EFFICIENCY).

COMMOM NAME	WINTER	SPRING	SUMMER	FALL	TOTAL
ALEWIFE	124	199		89	412
AMERICAN EEL	82	100		32	214
AMERICAN SHAD	2	3		249	254
ATLANTIC MENHADEN				7	7
ATLANTIC SILVERSIDE				1	1
ATLANTIC STURGEON	3	2			5
ATLANTIC TOMCOD	345	920		47	1312
BANDED KILLIFISH	5			16	21
BAY ANCHOVY	6	351		246	603
BLACK CRAPPIE	3			8	11
BLACK SEA BASS				4	4
BLUEBACK HERRING	34	322		6861	7217
BLUEFISH				4	4
BLUEGILL	13	22		25	60
BOTHID UNID.		3			3
BROWN BULLHEAD	13	3			16
BUTTERFISH		12		4	16
CARP	3			6	9
CREVALLE JACK				14	14
CUNNER		1			1
FOUR BEARDED ROCKLING	3				3
FOURSPINE STICKLEBACK		1			1
FOURSPOT FLOUNDER		2			2
GIZZARD SHAD	353			470	823
GOLDEN SHINER	5	1		2	8
GOLDFISH	2				2
GRAY SNAPPER				6	6
HOGCHOKER	140	1310		217	1667
LARGEMOUTH BASS	2			2	4
LOOKDOWN				4	4
MOONFISH				14	14
MUMMICHOG	1				1
NAKED GOBY				1	1
NORTHERN PIPEFISH		19		38	57
NORTHERN SEAROBIN		1			1
PIGFISH				1	1
PUMPKINSEED	107	9		18	134
RAINBOW SMELT	387	28		23	438
RED HAKE	124			1	125
REDBREAST SUNFISH	1				1
SEAHORSE		2			2

TABLE A-7. (Continued)

COMMOM NAME	WINTER	SPRING	SUMMER	FALL	TOTAL
SILVER HAKE	3	10		5	18
SILVER PERCH				2	2
SPOTTAIL SHINER	90	11		23	124
SPOTTED HAKE		11			11
STRIPED BASS	6570	188		136	6894
STRIPED CUSKEEL		42			42
STRIPED SEAROBIN				4	4
SUMMER FLOUNDER				2	2
TAUTOG		1			1
TESSELLATED DARTER	13	6		2	21
THREESPINE STICKLEBACK	144	6			150
TIDEWATER SILVERSIDE	3				3
WEAKFISH				77	77
WHITE CATFISH	327	16		42	385
WHITE PERCH	40229	2242	1	11933	54405
WHITE SUCKER	1				1
WINDOWPANE		74			74
WINTER FLOUNDER	6	1			7
YELLOW PERCH	10	6		1	17
TOTAL ALL TAXA	49154	5925	1	20637	75717

TABLE A-8
TOTAL NUMBERS ACTUALLY COLLECTED BY TAXON AND SEASONAL SAMPLING STRATUM
INDIAN POINT UNITS 2 & 3 COMBINED DURING 1985
(UNADJUSTED FOR COLLECTION EFFICIENCY).

COMMOM NAME	WINTER	SPRING	SUMMER	FALL	TOTAL
ALEWIFE	341	238	152	400	1131
AMERICAN EEL	318	229	33	260	840
AMERICAN SHAD	6	5	14	739	764
ATLANTIC CROAKER				1	1
ATLANTIC CUTLASSFISH			1		1
ATLANTIC MENHADEN		2	41	72	115
ATLANTIC NEEDLEFISH			2		2
ATLANTIC SILVERSIDE	2		4	4	10
ATLANTIC STURGEON	9	2		1	12
ATLANTIC TOMCOD	3815	2127	4570	279	10791
BANDED KILLIFISH	38	2	1	200	241
BAY ANCHOVY	9	507	1263	872	2651
BLACK BULLHEAD				2	2
BLACK CRAPPIE	6	1		29	36
BLACK SEA BASS				11	11
BLUEBACK HERRING	88	347	141	9666	10242
BLUEFISH		8	100	33	141
BLUEGILL	50	25	100	373	548
BOTHID UNID.		3			3
BROWN BULLHEAD	60	10		3	73
BUTTERFISH		26	422	8	456
CARP	4			14	18
CENTRAL MUDMINNOW				1	1
CENTRARCHID UNID.	4			1	5
CLUPEID UNID.	2		2	18	22
COMMON SHINER				2	2
CONGER EEL			1		1
CREVALLE JACK			4	54	58
CUNNER	1	2			3
FOUR BEARDED ROCKLING	8			1	9
FOURSPINE STICKLEBACK	4	3		3	10
FOURSPOT FLOUNDER		7	31		38
FRECKLED BLENNY				1	1
GIZZARD SHAD	721			848	1569
GOLDEN SHINER	36	1		2	39
GOLDFISH	6			2	8
GRAY SNAPPER				48	48
GREEN SUNFISH				1	1
GRUBBY	6				6
HOGCHOKER	392	1653	4045	2507	8597
LARGEMOUTH BASS	11		5	7	23

TABLE A-8. (Continued)

COMMOM NAME	WINTER	SPRING	SUMMER	FALL	TOTAL
LOOKDOWN			23	21	44
MACKEREL SCAD			1		1
MOONFISH			2	42	44
MUMMICHOG	8			2	10
NAKED GOBY				59	59
NORTHERN PIPEFISH	3	45	127	124	299
NORTHERN PUFFER			7		7
NORTHERN SEAROBIN		1	7		8
NORTHERN STARGAZER			2		2
PIGFISH				1	1
PLANEHEAD FILEFISH			2		2
PUMPKINSEED	472	26	19	99	616
RAINBOW SMELT	1338	117	1	333	1789
RED HAKE	314			4	318
REDBREAST SUNFISH	3	1	1	3	8
ROCK GUNNEL	3	1			4
SEA LAMPREY	13				13
SEAHORSE		3			3
SILVER HAKE	21	12		13	46
SILVER PERCH				17	17
SMALLMOUTH BASS	2		4		6
SPOT				1	1
SPOTFIN BUTTERFLYFISH				1	1
SPOTTAIL SHINER	810	40	2	81	933
SPOTTED HAKE	2	36	2		40
STRIPED BASS	27481	581	219	1235	29516
STRIPED CUSKEEL		46			46
STRIPED SEAROBIN			21	12	33
SUMMER FLOUNDER			19	24	43
TAUTOG		2		1	3
TESSELLATED DARTER	54	80		8	142
THREESPINE STICKLEBACK	411	20			431
TIDEWATER SILVERSIDE	9		1		10
WEAKFISH			1671	613	2284
WHITE CATFISH	1565	146	25	486	2222
WHITE CRAPPIE	1				1
WHITE PERCH	164287	10793	1582	94598	271260
WHITE SUCKER	2				2
WINDOWPANE		82	8	1	91
WINTER FLOUNDER	20	1	9	17	47
YELLOW PERCH	41	20		8	69
TOTAL ALL TAXA	202797	17251	14687	114267	349002

TABLE A-9
TOTAL ESTIMATED WEIGHT (GRAMS) OF FISH IMPINGED AT INDIAN POINT UNIT 2 DURING 1985, BY TAXON AND SEASONAL STRATUM (ADJUSTED FOR COLLECTION EFFICIENCY).

COMMOM NAME	WINTER	SPRING	SUMMER	FALL	TOTAL
ALEWIFE	9706	51731	5267	32751	75446
AMERICAN EEL	82689	67542	16783	75545	289320
AMERICAN SHAD	100	63	825	7743	8588
ATLANTIC CROAKER				2	2
ATLANTIC CUTLASSFISH			16		16
ATLANTIC MENHADEN		2953	20855	23135	46980
ATLANTIC NEEDLEFISH			12		12
ATLANTIC SILVERSIDE	14		40	39	100
ATLANTIC STURGEON	1216			555	1727
ATLANTIC TOMCOD	174673	31805	109502	10432	466406
BANDED KILLIFISH	615	134	8	1447	2176
BAY ANCHOVY	5	6086	17226	5480	28132
BLACK BULLHEAD				479	479
BLACK CRAPPIE	780	2144		1082	2724
BLACK SEA BASS				227	227
BLUEBACK HERRING	13837	19680	24402	35627	76732
BLUEFISH		174	6203	7479	17849
BLUEGILL	3115	649	918	4686	9919
BROWN BULLHEAD	12078	4671		838	18529
BUTTERFISH		241	16351	359	17689
CARP	13			744	759
CENTRAL MUDMINNOW				193	193
CENTRARCHID UNID.	22			6	28
CLUPEID UNID.	16		17	451	494
COMMON SHINER				82	82
CONGER EEL			58		58
CREVALLE JACK			29	2474	2629
CUNNER	29	31			80
FOUR BEARDED ROCKLING	286			43	330
FOURSPINE STICKLEBACK	9	16		7	32
FOURSPOT FLOUNDER		120	1854		2273
FRECKLED BLENNY				5	5
GIZZARD SHAD	22979			5735	28631
GOLDEN SHINER	2129				2129
GOLDFISH	1152			37	1181
GRAY SNAPPER				937	937
GREEN SUNFISH				36	36
GRUBBY	192				192
HOGCHOKER	10503	47000	241036	101630	404380
LARGEMOUTH BASS	2876		85	251	3882
LOOKDOWN			858	1034	2036

TABLE A-9. (Continued)

COMMOM NAME	WINTER	SPRING	SUMMER	FALL	TOTAL
MACKEREL SCAD			85		85
MOONFISH			52	239	282
MUMMICHOG	86			20	107
NAKED GOBY				251	251
NORTHERN PIPEFISH	9	552	1179	427	2082
NORTHERN PUFFER			95		95
NORTHERN SEAROBIN			72		72
NORTHERN STARGAZER			17		17
PLANEHEAD FILEFISH			175		175
PUMPKINSEED	44374	5980	3196	9947	64620
RAINBOW SMELT	4771	2384	4	9400	16835
RED HAKE	14952			179	15128
REDBREAST SUNFISH	225	227	406	468	1406
ROCK GUNNEL	36	62			86
SEA LAMPREY	163				163
SEAHORSE		8			8
SILVER HAKE	723	49		86	1001
SILVER PERCH				183	183
SMALLMOUTH BASS	354		63		627
SPOT				113	113
SPOTFIN BUTTERFLYFISH				9	9
SPOTTAIL SHINER	13487	1147	63	1433	16682
SPOTTED HAKE	22	1960	481		2793
STRIPED BASS	374113	28723	18700	58251	472230
STRIPED CUSKEEL		770			770
STRIPED SEAROBIN			1122	468	1658
SUMMER FLOUNDER			5245	8778	15074
TAUTOG		85		422	992
TESSELLATED DARTER	428	2746		97	3271
THREESPINE STICKLEBACK	1746	341			2068
TIDEWATER SILVERSIDE	34		12		45
WEAKFISH			16098	22666	46797
WHITE CATFISH	120492	26678	39618	93859	285767
WHITE CRAPPIE	166				166
WHITE PERCH	2961345	1462381	187086	2022053	6076915
WHITE SUCKER	1314				1314
WINDOWPANE		81	277	416	1441
WINTER FLOUNDER	1032		234	2972	4580
YELLOW PERCH	6848	14248		1537	20785
TOTAL ALL TAXA	3887434	1800839	738714	2544137	8443533

TABLE A-10
TOTAL ESTIMATED WEIGHT (GRAMS) OF FISH IMPINGED AT INDIAN POINT
UNIT 3 DURING 1985, BY TAXON AND SEASONAL STRATUM
(ADJUSTED FOR COLLECTION EFFICIENCY).

COMMOM NAME	WINTER	SPRING	SUMMER	FALL	TOTAL
ALEWIFE	10971	267284		19246	246034
AMERICAN EEL	60609	79370		26963	187510
AMERICAN SHAD	1083	19695		10706	28119
ATLANTIC MENHADEN				5601	5601
ATLANTIC SILVERSIDE				6	6
ATLANTIC STURGEON	1654	1061			3190
ATLANTIC TOMCOD	28513	13052		7401	76382
BANDED KILLIFISH	140			448	614
BAY ANCHOVY	12	14047		3103	16272
BLACK CRAPPIE	534			162	891
BLACK SEA BASS				313	313
BLUEBACK HERRING	17080	241663		115746	328354
BLUEFISH				1100	1100
BLUEGILL	4021	2033		2946	11567
BOTHID UNID.		204			204
BROWN BULLHEAD	5589	4923			9586
BUTTERFISH		2185		911	3182
CARP	255			2551	2615
CREVALLE JACK				1938	1938
CUNNER		101			101
FOUR BEARDED ROCKLING	413				413
FOURSPINE STICKLEBACK		9			9
FOURSPOT FLOUNDER		3130			3130
GIZZARD SHAD	49173			48494	105602
GOLDEN SHINER	1009	853		399	2125
GOLDFISH	3339				3339
GRAY SNAPPER				281	281
HOGCHOKER	10576	191850		23651	227071
LARGEMOUTH BASS	1774			146	2348
LOOKDOWN				480	480
MOONFISH				266	266
MUMMICHOG	18				18
NAKED GOBY				13	13
NORTHERN PIPEFISH		355		508	858
NORTHERN SEAROBIN		42			42
PIGFISH				275	275
PUMPKINSEED	25803	5162		6326	37265
RAINBOW SMELT	3965	921		501	5199
RED HAKE	22500			125	22678
REDBREAST SUNFISH	187				187
SEAHORSE		128			128

TABLE A-10. (Continued)

COMMOM NAME	WINTER	SPRING	SUMMER	FALL	TOTAL
SILVER HAKE	239	626		72	1058
SILVER PERCH				51	51
SPOTTAIL SHINER	3084	581		1021	4823
SPOTTED HAKE		493			493
STRIPED BASS	480882	35803		16482	529747
STRIPED CUSKEEL		8292			8292
STRIPED SEAROBIN				448	448
SUMMER FLOUNDER				2392	2392
TAUTOG		1882			1882
TESSELLATED DARTER	315	207		52	609
THREESPINE STICKLEBACK	1516	138			1652
TIDEWATER SILVERSIDE	37				37
WEAKFISH				6122	6122
WHITE CATFISH	37474	13453		8060	54122
WHITE PERCH	1287943	266490	834	442043	1978061
WHITE SUCKER	2337				2337
WINDOWPANE		4196			4196
WINTER FLOUNDER	729	8			852
YELLOW PERCH	4329	5253		529	10104
TOTAL ALL TAXA	2069544	1178581	834	770527	3876172

TABLE A-11
TOTAL ESTIMATED WEIGHT (GRAMS) OF FISH IMPINGED AT INDIAN POINT UNITS 2 & 3 DURING 1985, BY TAXON AND SEASONAL STRATUM (ADJUSTED FOR COLLECTION EFFICIENCY).

COMMOM NAME	WINTER	SPRING	SUMMER	FALL	TOTAL
ALEWIFE	20677	319016	5267	51997	321479
AMERICAN EEL	143298	146912	16783	102509	476830
AMERICAN SHAD	1183	19758	825	18449	36708
ATLANTIC CROAKER				2	2
ATLANTIC CUTLASSFISH			16		16
ATLANTIC MENHADEN		2953	20855	28736	52581
ATLANTIC NEEDLEFISH			12		12
ATLANTIC SILVERSIDE	14		40	45	105
ATLANTIC STURGEON	2870	1061		555	4918
ATLANTIC TOMCOD	203185	44857	109502	17833	542788
BANDED KILLIFISH	755	134	8	1895	2790
BAY ANCHOVY	16	20133	17226	8583	44404
BLACK BULLHEAD				479	479
BLACK CRAPPIE	1314	2144		1245	3615
BLACK SEA BASS				539	539
BLUEBACK HERRING	30917	261342	24402	151373	405086
BLUEFISH		174	6203	8579	18948
BLUEGILL	7136	2682	918	7632	21486
BOTHID UNID.		204			204
BROWN BULLHEAD	17667	9594		838	28114
BUTTERFISH		2425	16351	1270	20871
CARP	269			3295	3374
CENTRAL MUDMINNOW				193	193
CENTRARCHID UNID.	22			6	28
CLUPEID UNID.	16		17	451	494
COMMON SHINER				82	82
CONGER EEL			58		58
CREVALLE JACK			29	4412	4566
CUNNER	29	131			181
FOUR BEARDED ROCKLING	698			43	742
FOURSPINE STICKLEBACK	9	24		7	41
FOURSPOT FLOUNDER		3250	1854		5403
FRECKLED BLENNY				5	5
GIZZARD SHAD	72151			54229	134233
GOLDEN SHINER	3138	853		399	4254
GOLDFISH	4491			37	4520
GRAY SNAPPER				1218	1218
GREEN SUNFISH				36	36
GRUBBY	192				192
HOGCHOKER	21079	238850	241036	125281	631452
LARGEMOUTH BASS	4650		85	397	6230

TABLE A-11. (Continued)

COMMOM NAME	WINTER	SPRING	SUMMER	FALL	TOTAL
LOOKDOWN			858	1513	2516
MACKEREL SCAD			85		85
MOONFISH			52	504	548
MUMMICHOG	104			20	125
NAKED GOBY				264	264
NORTHERN PIPEFISH	9	907	1179	935	2939
NORTHERN PUFFER			95		95
NORTHERN SEAROBIN		42	72		114
NORTHERN STARGAZER			17		17
PIGFISH				275	275
PLANEHEAD FILEFISH			175		175
PUMPKINSEED	70176	11142	3196	16273	101885
RAINBOW SMELT	8736	3305	4	9901	22035
RED HAKE	37453			304	37807
REDBREAST SUNFISH	412	227	406	468	1593
ROCK GUNNEL	36	62			86
SEA LAMPREY	163				163
SEAHORSE		136			136
SILVER HAKE	962	675		157	2059
SILVER PERCH				235	235
SMALLMOUTH BASS	354		63		627
SPOT				113	113
SPOTFIN BUTTERFLYFISH				9	9
SPOTTAIL SHINER	16571	1727	63	2453	21505
SPOTTED HAKE	22	2453	481		3287
STRIPED BASS	854995	64526	18700	74733	1001977
STRIPED CUSKEEL		9062			9062
STRIPED SEAROBIN			1122	916	2106
SUMMER FLOUNDER			5245	11170	17466
TAUTOG		1967		422	2874
TESSELLATED DARTER	744	2953		149	3880
THREESPINE STICKLEBACK	3262	479			3720
TIDEWATER SILVERSIDE	70		12		82
WEAKFISH			16098	28789	52919
WHITE CATFISH	157966	40131	39618	101919	339889
WHITE CRAPPIE	166				166
WHITE PERCH	4249288	1728871	187920	2464096	8054976
WHITE SUCKER	3651				3651
WINDOWPANE		4278	277	416	5637
WINTER FLOUNDER	1761	8	234	2972	5432
YELLOW PERCH	11177	19500		2065	30889
TOTAL ALL TAXA	5956978	2979421	739548	3314664	12319705

TABLE A-12. TOTAL NUMBER OF BLUE CRABS COLLECTED EACH MONTH AT INDIAN POINT DURING 1985.

UNIT	SEX	SURVIVAL	CONDITION	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
2	Male	Alive	Intact	20	43	112	618	607	452	100		1952
			Missing Parts	9	48	221	640	335	403	54		1710
		Dead	Intact	1	1	23	116	75	11	4		231
			Missing Parts	2	9	151	676	162	91	12	1	1104
	Female	Alive	Intact	4	9	49	424	274	105	40		905
			Missing Parts	2	12	132	405	184	79	12		826
		Dead	Intact	1	0	9	78	40	5	2		135
			Missing Parts	2	5	77	434	160	29	3		710
3	Male	Alive	Intact	150	10	0	0	1	5	16		182
			Missing Parts	79	30	0	0	0	14	12		135
		Dead	Intact	17	0	0	0	1	0	2		20
			Missing Parts	35	1	0	0	0	5	11		52
	Female	Alive	Intact	42	2	0	0	2	3	4		53
			Missing Parts	26	6	0	0	0	5	8		45
		Dead	Intact	3	0	0	0	0	0	0		3
			Missing Parts	13	2	0	0	0	3	3		21
2 and 3	Male	Alive	Intact	170	53	112	618	608	457	116		2134
			Missing Parts	88	78	221	640	335	417	66		1845
		Dead	Intact	18	1	23	116	76	16	6		256
			Missing Parts	37	10	151	676	162	96	23	1	1156
	Female	Alive	Intact	46	11	49	424	276	108	44		958
			Missing Parts	28	18	132	405	184	84	20		871
		Dead	Intact	4	0	9	78	40	5	2		138
			Missing Parts	15	7	77	434	160	32	6		731

TABLE A-13
SIZE DISTRIBUTION OF BLUE CRABS IN IMPINGEMENT COLLECTIONS
AT INDIAN POINT DURING 1985, BY MONTH.

UNIT 2

SIZECLASS	MAY	JUN	JUL	MONTH AUG	SEP	OCT	NOV	DEC	TOTAL
20-29	7	6	0	5	2	3	7	0	30
30-39	2	14	0	7	5	23	27	0	78
40-49	3	12	4	9	1	21	30	0	80
50-59	4	12	15	11	1	20	37	0	100
60-69	5	8	38	35	6	39	36	0	167
70-79	8	11	68	108	8	13	13	0	229
80-89	3	4	64	236	23	14	6	1	351
90-99	1	11	64	305	44	19	9	0	453
100-109	0	4	66	375	105	68	9	0	627
110-119	0	3	55	451	168	100	6	0	783
120-129	0	1	21	311	215	122	8	0	678
130-139	0	0	12	188	215	160	9	0	584
140-149	0	1	10	171	247	141	6	0	576
150-159	0	0	15	195	282	163	2	0	657
160-169	0	0	7	93	180	102	7	0	389
170-179	0	1	2	42	76	44	2	0	167
180-189	0	0	0	7	14	13	1	0	35
190-199	0	0	2	5	4	0	0	0	11
200-209	0	0	0	4	0	0	0	0	4

(CONTINUED)

TABLE A-13. (Continued)

					MONTH					
	SIZECLASS	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
UNIT 3	20-29	23	3	0	0	0	0	0	0	26
	30-39	23	6	0	0	0	1	7	0	37
	40-49	27	5	0	0	0	2	3	0	37
	50-59	58	1	0	0	0	1	12	0	72
	60-69	53	4	0	0	0	3	13	0	73
	70-79	52	5	0	0	0	0	3	0	60
	80-89	31	3	0	0	0	0	1	0	35
	90-99	9	0	0	0	0	3	2	0	14
	100-109	1	2	0	0	0	2	1	0	6
	110-119	1	1	0	0	0	2	0	0	4
	120-129	2	1	0	0	1	5	0	0	9
	130-139	0	0	0	0	0	2	4	0	6
	140-149	0	0	0	0	1	4	1	0	6
	150-159	0	0	0	0	1	0	0	0	1
	160-169	0	0	0	0	0	1	0	0	1
	170-179	0	0	0	0	1	1	0	0	2
	180-189	0	0	0	0	0	1	0	0	1

(CONTINUED)

TABLE A-13. (Continued)

		MONTH								
	SIZECLASS	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
TOTAL	20-29	30	9	0	5	2	3	7	0	56
	30-39	25	20	0	7	5	24	34	0	115
	40-49	30	17	4	9	1	23	33	0	117
	50-59	62	13	15	11	1	21	49	0	172
	60-69	58	12	38	35	6	42	49	0	240
	70-79	60	16	68	108	8	13	16	0	289
	80-89	34	7	64	236	23	14	7	1	386
	90-99	10	11	64	305	44	22	11	0	467
	100-109	1	6	66	375	105	70	10	0	633
	110-119	1	4	55	451	168	102	6	0	787
	120-129	2	2	21	311	216	127	8	0	687
	130-139	0	0	12	188	215	162	13	0	590
	140-149	0	1	10	171	248	145	7	0	582
	150-159	0	0	15	195	283	163	2	0	658
	160-169	0	0	7	93	180	103	7	0	390
	170-179	0	1	2	42	77	45	2	0	169
	180-189	0	0	0	7	14	14	1	0	36
	190-199	0	0	2	5	4	0	0	0	11
	200-209	0	0	0	4	0	0	0	0	4