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# HUDSON RIVER ECOLOGICAL STUDY

# IN THE AREA OF INDIAN POINT

# 1986 ANNUAL REPORT

Prepared for

CONSOLIDATED EDISON COMPANY OF NEW YORK, INC.
4 Irving Place
New York, New York 10003

and

NEW YORK POWER AUTHORITY
123 Main Street,
White Plains, New York 10601

Jointly Financed by

Central Hudson Gas and Electric Corporation
Consolidated Edison Company of New York, Inc.
New York Power Authority
Niagara Mohawk Power Corporation
Orange and Rockland Utilities, Inc.

Prepared by

NORMANDEAU ASSOCIATES, INC.
25 Nashua Road
Bedford, New Hampshire 03102

R-1051

August 1987

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HUDSON RIVER ECOLOGICAL STUDY IN THE AREA OF INDIAN POINT
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## 1.0 SUMMARY

Impingement monitoring of fish and blue crabs was conducted at the Indian Point Station in 1986, continuing sampling efforts that began in 1972. Sampling was performed at units 2 and 3 following the stratified random design first introduced during the last six months of 1981. The stratified design consisted of 110 sampling days per year, divided into four strata (seasons). A mid-January through April 1986 outage at unit 2 resulted in 4 fewer sampling days during the winter stratum than were allocated in the stratified design. At unit 3, the spring stratum fell short of the design allocation by 1 day due to a May outage. In all other cases, the number of impingement collections allocated in the stratified design was met or exceeded.

The estimated total number of fish impinged, adjusted for collection efficiency, was 736,821 fish at unit 2 and 355,145 fish at unit 3 for a combined total of 1,091,966 fish weighing an estimated 10,283 kg. Impingement abundance in previous years ranged from 850,000 to 6,470,000 (adjusted for collection efficiency). The estimated number of fish impinged per unit volume of water circulated in 1986 totaled $577/10^6 m^3$ and was at the low end of the range from past years ($496-2910/10^6 m^3$).

Screen-specific collection efficiency rates obtained from special studies at unit 2 during 1985 were applied to the 1986 data. Using screen-specific adjustments for screen 26 during the winter and summer strata and screens 21-25 during the winter stratum, and regression adjusted estimates for screens 21-25 during the summer stratam, and all screens during the spring and fall strata, the estimated annual impingement at unit 2 was 805,122 fish compared to 736,821 fish obtained solely by the regression method. Including the unit 3 regression

adjusted estimate of 355,145, the combined Indian Point impingement estimate for 1986 totaled 1,160,267 compared to 1,091,966 using the regression method.

Sixty-five (65) species of fish were recorded in impingement collections during 1986 which was within the range from past years (43-79). The oyster toadfish and white bass/striped bass hybrid were new to the species list in 1986. The three most numerous species impinged at units 2 and 3 in 1986 were, in order of abundance, the white perch, Atlantic tomcod, and bay anchovy which comprised 83% of the total estimated impingement abundance. Seasonal impingement patterns of these and other selected species were consistent with past years. Monthly impingement rates in 1986 were within the range of previous years for most species; comparatively low monthly rates were observed for blueback herring, striped bass, weakfish, and alewives, and comparatively high rates for rainbow smelt.

Blue crabs impinged at units 2 and 3 total 5,210 which was within the range of past years (348 to 12,316). The blue crab collection was characterized by a male to female ratio of 3 to 1, a survival rate of 73.8%, and a condition status of 44.0% intact crabs. Most (95%) of the blue crabs collected ranged from 70 to 179 mm with a modal carapace width of 95 mm. Blue crab reimpingement was investigated using a tag and release study. A total of 2,280 blue crabs that were impinged at units 2 and 3 were tagged and released at the unit 1 pier. A total of 205 tagged crabs were recaptured. Eleven (11) of these crabs were released and recaptured twice, one three times, and one was recaptured once at both units 2 and 3. Excluding recaptured crabs and accounting for tag loss while at large (2.2%), the total impingement count, of blue crabs in 1986 was 4,363 crabs at unit 2 and 742 crabs at unit 3 for a combined total of 5105 crabs at both units. Impingement rates (no./$10^6 m^3$) unadjusted for collection efficiency were also higher at unit 2 than

unit 3. Peak rates occurred during June, July and August, and ranged from 6.5 to $15.3/10^6 m^3$ at unit 2 and from 1.3 to $4.1/10^6 m^3$ at unit 3.

NAI was requested to evaluate the mark and recapture data to see if they were appropriate for obtaining a population estimate of blue crabs in the vicinity of Indian Point. Because the mark and recapture study was designed primarily to evaluated reimpingement, several important assumptions needed to make valid population estimates could not be satisfied. Assumptions that could not be satisfied included: mortality rates of tagged and untagged crabs are the same, tagging does not effect catchability, migration is negligible in the study area, tagged blue crabs are randomly distributed among untagged blue crabs, and tagged crabs have the same probability of being impinged as crabs without tags.

The effect of formalin preservation on size measurements of abundant juvenile fishes was analyzed to determine whether tissue "shrinkage" caused by the preservative might affect comparison between entrainment (preserved) and impingement (unpreserved) measurements. Linear regression analyses were used to describe the relationships between fresh and preserved measurements and t-tests were used to evaluate each regression line.

## 2.0 INTRODUCTION

This report is the fifteenth 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; Martin Marrietta Environmental Systems, MMES: 1985; NAI: 1986). This report discusses the 1986 impingement data and interprets these latest study results in conjunction with the findings of previous years. Estimates are provided for the total number of fish and blue crabs impinged at each unit and for all individual species. Seasonal impingement trends at units 2 and 3 are also discussed.

With the implementation of the Settlement Agreement, the Hudson River Utilities (Consolidated Edison Company of New York, Inc., New York Power Authority, Central Hudson Gas & Electric Corporation, Orange and Rockland Utilities, Inc. and Niagara Mohawk Power Corporation) re-examined each of the programs they had been conducting to determine whether the effort allocated was sufficient. For the Indian Point impingement program, it became evident after extensive data analysis and literature review that daily collections were unnecessary to maintain acceptable levels of accuracy and precision (TI 1980b; NAI 1984b). Three potential sampling strategies were evaluated in terms of the accuracy and precision afforded by each in estimating total fish impingement at the Indian Point 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 beginning in 1985 (NAI 1984a). Impingement monitoring during 1986 at units 2 and 3 of the Indian Point Station was conducted for the entire year on random, pre-selected days according to the stratified random sampling design. Impingement estimates were calculated as described in Appendix A.

Section 3 of this report, Materials and Methods, presents a description of the Indian Point generating station, field and laboratory methods, the 1986 sampling design, and the collection efficiency estimates and regression models used to adjust impingement counts. Section 4.0, Results and Discussion, provides estimates of the number of fish impinged during 1986, evaluates the effects of collection efficiency adjustments, presents species composition and relative abundances, describes seasonal and yearly impingement patterns, and describes blue crab impingement patterns, mark/recapture results, and population estimates. Section 5.0 presents the results of fish length, weight, and

body depth regressions that were performed on fresh and preserved fish. This study was performed in order to evaluate whether tissue "shrinkage" caused by formalin preservation might affect comparison between size measurements of entrained (preserved) and impinged (unpreserved) fish. Literature citations are presented in Section 6.0. Data calculation procedures are presented in Appendix A along with Appendix Tables containing information on water quality, fish and blue crab impingement, and fish length, weight and depth measurements and regression analyses.

## 3.0 MATERIALS AND METHODS

Impingement collections at Indian Point units 2 and 3 were taken in four seasonal strata according to the stratified random sampling design introduced in 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, crabs, and debris. On all days when the plant operated, samples of impinged blue crabs were collected when present. The field and laboratory procedures used in collecting and processing samples are presented below, and the formulas used in the data calculations are presented in Appendix A.

### 3.1 THE INDIAN POINT GENERATING STATION

The Indian Point Generating Station is located on the east bank of the Hudson River, about 69 km (43 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.

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 $m^3$/min (140,000 gal/min) circulator pumps, was retired from commercial operation in October 1974. The two units currently operating each have six 530 $m^3$/min circulating pumps. Each unit also has service water pumps, which also withdraw river water. Unit 1 has two service pumps with a total pumping rate of 144 $m^3$/min

HUDSON RIVER ESTUARY

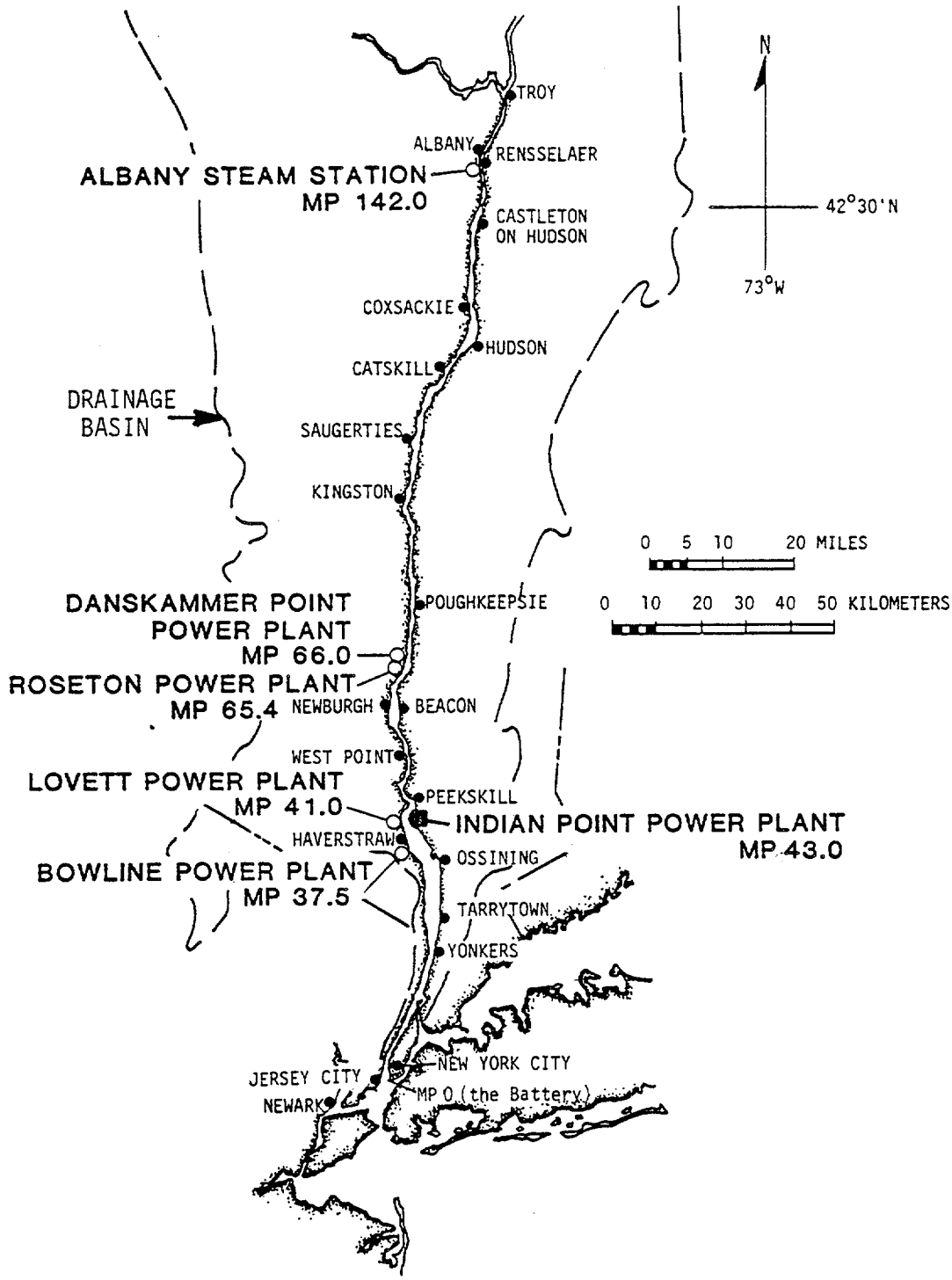



Figure 3-1. Location of Indian Point Station Relative to other Hudson River Stations.

(38,000 gal/min). Units 2 and 3 each have six service pumps with a total pumping rate of 114 $m^3$/min (30,000 gal/min) at each unit.

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

In December 1980, Con Edison, NYPA and other Hudson River utilities consented to certain restrictions in operating conditions, including the flow rates for the circulating water pumps, as part of an agreement reached with government agencies. To achieve the flow rate schedule (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.

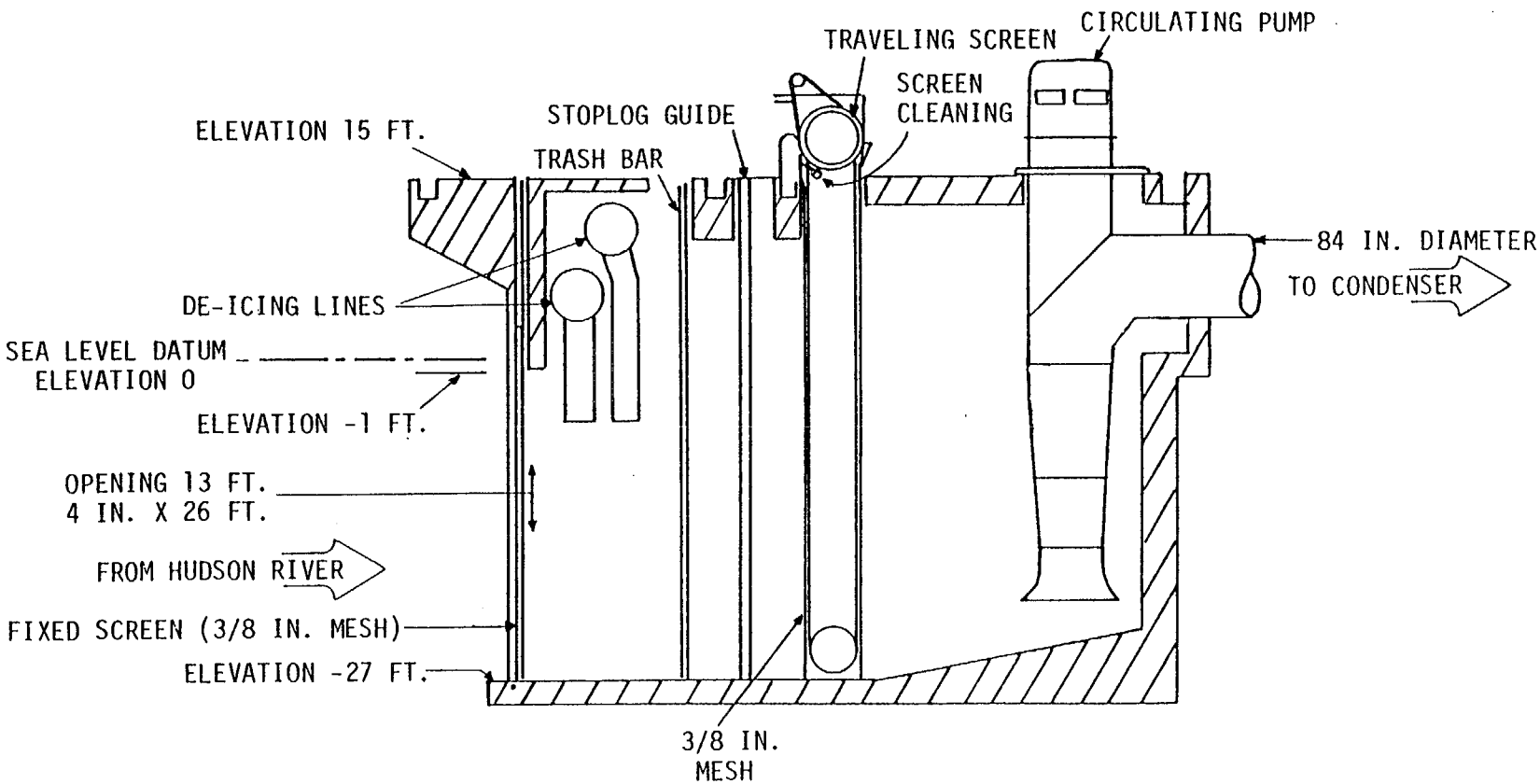



Figure 3-2. Schematic intake bay cross-section of Indian Point Unit No. 2.

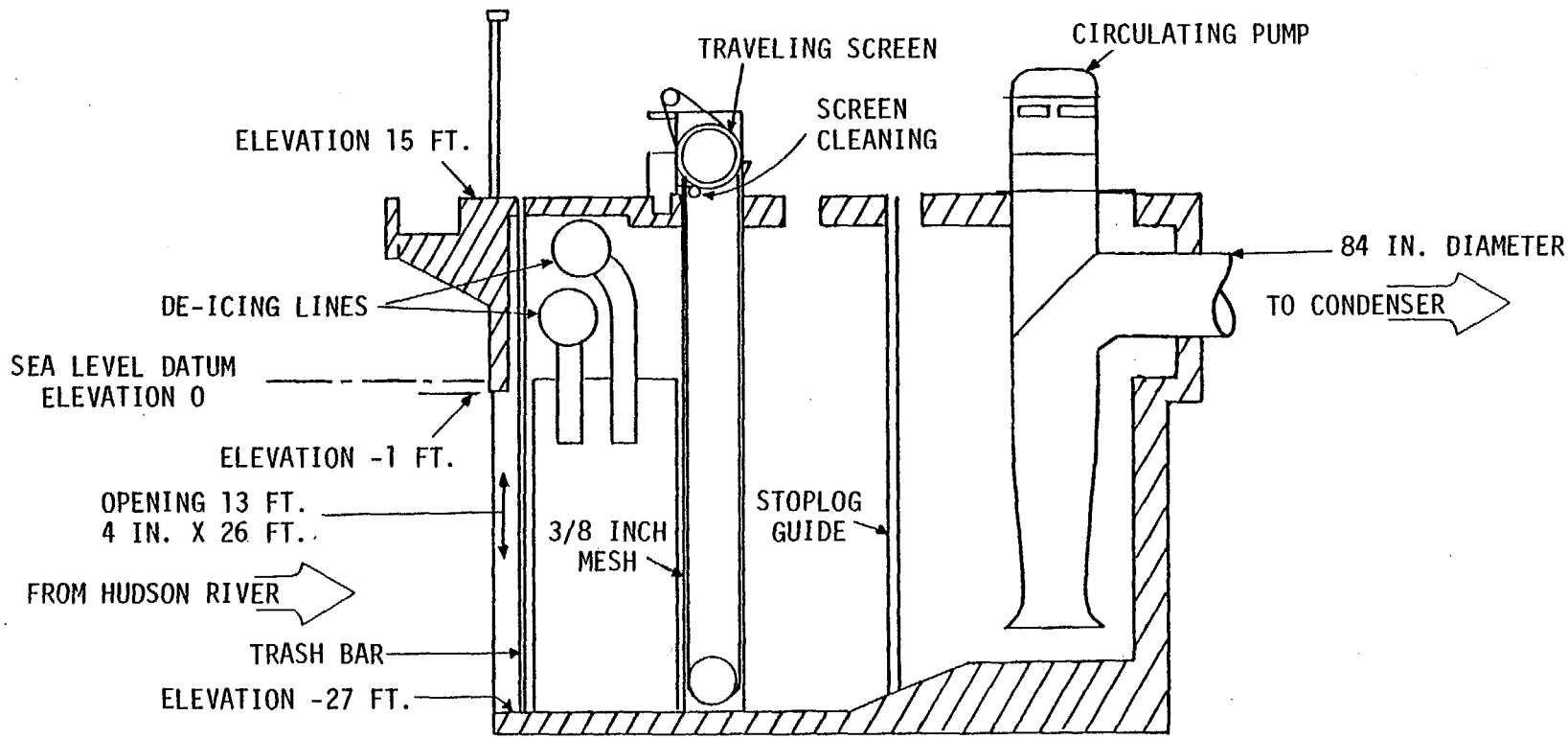



Figure 3-3. Schematic intake bay cross-section of Indian Point Unit No. 3.

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) | $10^3 m^3$/min/Unit |
|---|---|---|
| Jan 1 - May 15 | 504,000 | 1.9 |
| May 16 - May 22 | 560,000 | 2.1 |
| May 23 - May 31 | 672,000 | 2.5 |
| June 1 - June 8 | 731,000 | 2.8 |
| June 9 - Sept 30 | 840,000 | 3.2 |
| Oct 1 - Oct 31 | 731,000 | 2.8 |
| Nov 1 - Dec 31 | 504,000 | 1.9 |

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

### 3.2.1 Sample Design and Schedule

The stratified sampling design for impingement and water quality data collection, that was initiated in July 1981, was continued throughout 1986 at units 2 and 3. Sample days were assigned to randomly selected dates within four seasonal strata, in contrast to the daily sampling which was conducted before July 1981.

Fish and blue crab impingement samples were collected on the randomly selected sample days and analyzed. On days not selected for sample collection (non-sample days), only blue crabs were collected and analyzed; fish and debris were discarded when the traveling screens were washed. Blue crab impingement counts and biocharacteristics data were collected on all days in 1986 when blue crabs were present in impingement collections. Re-impingement of blue crabs was estimated using a mark and recapture program that utilized blue crabs >100 mm obtained from daily screen wash collections. Water quality data were collected at units 2 and 3 intakes on days when either fish or blue crabs were collected.

Allocation quotas of sampling days were met among all seasonal strata except for winter at unit 2, which was short four days due to a mid-January through April outage, and spring at unit 3, which was short 1 day due to a mid-May outage (Table 3-3). The standard procedure that was used to minimize the effect of missed collection days was to randomly replace each lost day with one from the unallocated days (i.e. not initially selected for collection) remaining within that stratum. However, due to the extended outage at unit 2 during the winter stratum, there were not enough unallocated days left in the stratum to make up the missed samples. The missed sampling day at unit 3 during spring could not be made up during the spring stratum due to constraints of timing and field logistics.

TABLE 3-3. NUMBERS OF IMPINGEMENT COLLECTION DAYS AND DAYS OF PLANT OPERATION AT INDIAN POINT UNITS 2 AND 3 DURING 1986.

| UNIT | SEASONAL STRATUM | DAYS OF PLANT OPERATION[a] | DAYS OF IMPINGEMENT COLLECTIONS | DAYS ALLOCATED IN STRATIFIED DESIGN |
|---|---|---|---|---|
| 2 | Winter (Jan-Mar) | 28[b] | 19 | 23 |
| | Spring (Apr-Jun) | 73 | 9 | 8 |
| | Summer (Jul-Sep) | 92 | 11 | 11 |
| | Fall (Oct-Dec) | 92 | 69 | 68 |
| | TOTAL | 285 | 108 | 110 |
| 3 | Winter (Jan-Mar) | 90 | 35 | 35 |
| | Spring (Apr-Jun) | 83 | 19 | 20 |
| | Summer (Jul-Sept) | 92 | 31 | 31 |
| | Fall (Oct-Dec) | 92 | 26 | 24 |
| | TOTAL | 357 | 111 | 110 |

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

[b] Partial to complete outage from mid-January through April.

Screens were washed daily, generally between 0800 and 1200 hours. Each sample day began at the time of a scheduled daily wash on one day and concluded at the time of the subsequent scheduled wash. On preselected random sampling days, fish were collected from the screen wash of unit 2 intakes 21-25 combined, unit 2 intake 26 (Ristroph screen), and unit 3 intakes 31-36 combined. On non-sample days, fish and debris were disposed of without enumeration. On occasions when sampling could not be carried out due to unit outages, abnormal screen-wash 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.

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

### 3.2.2 Sample Collection

Impingement samples were obtained from collection areas at the end of the unit 2 and 3 sluiceways and at a separate collection area for the Ristroph screen 26. Each sample effort began with a screen wash and thorough cleaning of the sluiceways and debris pits. The fixed screens at intakes 21-25 were washed manually with a hose prior to washing each traveling screen. Each fixed screen was raised and washed in 4-ft

TABLE 3-4. COMPARISON OF SAMPLING DATES, AVERAGE DAILY SAMPLING VOLUMES, OPERATING DATES AND AVERAGE DAILY OPERATING VOLUMES AT INDIAN POINT UNIT 2 BY MONTH DURING 1986.

| MONTH | 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 | 2,7,9,10,11 12,13,14,15 | 2.36 | 1.21 | 1-14 | 2.74 | 0.25 |
| February | -[b] | - | | - | - | - |
| March | 20,21,22,23,24, 25,26,27,28,31 | 0.76 | 0.02 | 17-28 30-31 | 0.90 | 0.26 |
| April | - | - | | 1-12 29-30 | 0.85 | 0.09 |
| May | 3,31 | 2.01 | 1.62 | 2-6 8-31 | 1.93 | 0.98 |
| June | 17,24,26,27,28 29,30 | 3.89 | 1.41 | 1-30 | 3.91 | 1.24 |
| July | 14,21,22 | 4.46 | 0.09 | 1-31 | 4.51 | 0.32 |
| August | 6,24,29 | 4.17 | 0.44 | 1-31 | 4.60 | 0.13 |
| September | 9,11,14,18,23 | 5.19 | 3.05 | 1-30 | 4.64 | 0.10 |
| October | 2,5,6,7,8,10, 12,13,15,17, 19-25,27-29,31 | 3.46 | 0.58 | 1-31 | 3.84 | 0.54 |
| November | 1,3-6,8,10,11, 14-21,23,26-30 | 2.69 | 0.60 | 1-30 | 2.71 | 0.25 |
| December | 1-5,7-13,15-19, 21-24,26-30 | 2.68 | 0.18 | 1-31 | 2.77 | 0.13 |

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

[b] Partial to complete outage from mid-January through April

TABLE 3-5. COMPARISON OF SAMPLING DATES, AVERAGE DAILY SAMPLING VOLUMES, OPERATING DATES, AND DAILY OPERATING VOLUMES AT INDIAN POINT UNIT 3 BY MONTH DURING 1986.

| MONTH | 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 | 2,4,9-10,14-16, 22,25,28-30 | 2.16 | 0.17 | 1-31 | 2.40 | 0.01 |
| February | 1,2,6,7,9,12, 14,17 | 2.35 | 1.14 | 1-28 | 2.39 | 0.02 |
| March | 3,5,6,8,10,11, 15,17,19,20, 22,23,25,27,30 | 2.55 | 0.61 | 1-31 | 2.67 | 0.15 |
| April | 2,5,8,11,16, 17,20,22,25, 29 | 2.41 | 0.43 | 1-30 | 2.59 | 0.49 |
| May | 3,24 | 1.50 | 1.53 | 1-6 15-31 | 1.83 | 1.01 |
| June | 9,13,17,21-23, 30 | 3.02 | 1.28 | 1-30 | 3.50 | 0.46 |
| July | 4,8,11,12,14, 16,18,19,21, 22,26 | 1.30 | 1.28 | 1-31 | 1.52 | 1.31 |
| August | 6,8,10,11,15, 17,20,24,29 | 0.70 | 0.05 | 1-31 | 0.79 | 0.06 |
| September | 1,2,9,11,14,18, 23,25,27,29,30 | 4.19 | 1.93 | 1-30 | 4.06 | 0.77 |
| October | 2,6,7,10,20, 22,24,29,31 | 3.88 | 0.19 | 1-31 | 4.05 | 0.11 |
| November | 1,3,4,6,16, 21,29 | 2.85 | 0.31 | 1-30 | 2.85 | 0.02 |
| December | 4,5,10-13,15, 20,21,30 | 2.61 | 0.16 | 1-31 | 2.76 | 0.09 |

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

increments until the entire screen broke water and all impinged material passed into the intake forebay to be removed from the condenser cooling water by the conventional vertical traveling screens. Unit 2 intake 26 (Ristroph modified screen) and all of the unit 3 intakes were equipped only with traveling screens in 1986 so that there were no fixed screens to be washed before washing each traveling screen. Each sample ended with the start of the next scheduled screen wash usually on the following day. If unscheduled washes occurred before the end time of the sample day, the fish, crabs, and debris were sorted, retained and added to the contents of the scheduled wash that completed that sample day.

On sample days, all fish and blue crabs washed from the intake screens of the unit(s) being sampled were taken to the laboratory for processing. On non-sample days, only blue crabs were kept for processing. Temperature ($^{o}C$) and conductivity (micro-siemens/cm) 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 1 and 2 cutoffs 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).

The effect of formalin preservation on size measurements of juvenile fishes was analyzed to determine whether tissue "shrinkage" caused by the preservative might affect comparison between entrainment (preserved) and impingement (unpreserved) measurements. Body depth, length, and weight data were collected on fresh and preserved Length Class 1 bay anchovy, Atlantic tomcod, and weakfish from late March through August 15. Each species was divided into 8 or 10 length increments, and up to 20 individuals were measured for body depth (nearest mm), total length (nearest mm), and weight (nearest gram) from each increment as they became available in impingement collections. Only Atlantic tomcod and weakfish occurred in sufficient numbers for the analysis. Each specimen was then tagged and stored in a 10% formalin solution for a minimum of four weeks. After the four week period each

fish was identified by its tag number and remeasured for depth, length, and weight.

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 of fifty whole blue crabs were randomly selected and weighed. The total number of blue crabs in the sample was estimated as 50 multiplied by the ratio of total weight of the blue crabs in the sample to the subsample weight. In case of subsampling, sex, alive-dead status, and condition were determined only for the 50 crabs in the subsample. After processing, all alive crabs were returned to the river away from the intake structure.

To estimate re-impingement of blue crabs at each unit, a maximum of 50 alive blue crabs greater than 100 mm carapace width were randomly selected for tagging from each units daily collection. Crabs larger than 100 mm were used because of their lower rate of molting compared to smaller crabs and consequently an anticipated higher rate of tag retention. Tags (Floy FD 67 Dennison Anchor Tag) were inserted in each crab in the slit between the carapace and the abdominal "key" located on the posterior region of the crab. Crabs were marked with consecutively numbered tags specific for each release cohort (i.e., crabs from screens 21-25, 26 and 31-36) and released at the unit 1 pier located between units 2 and 3. Impinged crabs greater than 100 mm carapace width were inspected for evidence of tagging recaptures on both sample and non-sample days. Recaptured crabs were remeasured for carapace width and weight, and the crabs sex, condition and alive/dead status were recorded. Studies were conducted to evaluate tag retention in blue crabs by obtaining, tagging, and holding for up to 53 days healthy specimens of each 50 mm carapace-width length group (101-150 mm,

151-200 mm, and 201 mm and above) in aquaria located in the impingement laboratory. Crabs were fed daily using dead fish from the impingement collections and inspected at 24-hour intervals for alive/dead status, condition, and tag retention. Upon test termination the remaining alive, tagged crabs were released to the river at the unit 1 pier.

Any shortnose or Atlantic sturgeon collected were measured (total length in mm), weighed, and the data were 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 finclips, 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.

Water quality data were collected on scheduled sample days and days when blue crabs were collected. Water temperature and conductivity were measured *in situ* with a YSI model 33 SCT Meter at a depth of one foot below the surface. The water quality sample for unit 2 was taken off the gangway in front of Screen No. 2. The sample for unit 3 was taken at the south side of the unit 1 pier. Temperature was measured to the nearest 0.5$^{\circ}$C and conductivity to the nearest 10 scale units (2.5%).

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

solution and NBS traceable field thermometers obtained from NAI's standards laboratory. Calibrations were performed prior to each collection of conductivity/temperature data.

## 3.3 COLLECTION EFFICIENCY

While collections from the intake screens at Indian Point provide an indication of seasonal and yearly impingement patterns, they do not account for 100% of the fish impinged. Some impinged fish may be lost prior to collection because of 1) scavenging by crabs, fish, and birds, 2) river currents and wave action, or 3) the screenwash collection procedures. Deterioration and disintegration of impinged fish on the screens can also contribute to these losses.

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

$$E_2 = -0.00871\ T_2 + 0.51858 \qquad \text{(Equation 1)}$$

$$E_3 = -0.00792\ T_3 + 0.71640 \qquad \text{(Equation 2)}$$

where $E_2$ and $E_3$ = collection efficiency at units 2 and 3, respectively, and

$T_2$ and $T_3$ = intake water temperature ($^{o}C$) at units 2 and 3, respectively.

Although individual observations of collection efficiency were highly variable at all temperatures, the above relationships were found to be statistically significant (efficiency decreased significantly with increasing temperature), and therefore useful for estimating actual impingement rates from impingement collections (Con Edison 1983).

During the Ristroph Screen Special Studies (1 January through 19 April 1985; Con Edison 1985) and the Ristroph Screen Survival Studies (16 July through 31 December; unpublished), collection efficiency studies were conducted at the intake screens at unit 2 (Con Edison 1985). 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. Screen-specific collection efficiency values for winter and summer strata were determined as follows:

- Winter, fixed screens 21-25; stratum mean collection efficiency = 50.2%,
- Winter, fixed screen 26; stratum mean collection efficiency = 50.2%,
- Winter, Ristroph screen 26; stratum mean collection efficiency = 70.8%,
- Summer, fixed screens 21-25; monthly mean collection efficiency = 5.0% for July, 2.8% for August, and 2.8% for September, and
- Summer, screen 26; monthly mean collection efficiency = 18.7% for Ristroph screen in July (estimated based on August value) 18.7% for Ristroph screen in August, and 29.6% for Ristroph screen in September.

## 4.0 RESULTS AND DISCUSSION

### 4.1 ESTIMATED NUMBERS OF FISH IMPINGED DURING 1986

A combined total of 231,059 fish were collected at Indian Point units 2 and 3 in 1986 (Table A-5). When adjusted for collection efficiency using the regression equations (Equations 1 and 2) and scaled to the number of operational days, the estimated total number impinged was 736,821 fish at unit 2, and 355,145 at unit 3 (Tables 4-1 and 4-2) for a combined total of 1,091,966 fish weighing an estimated 10,283 kg (Table A-11). The levels of precision (standard errors) were 12.2 and 8.5 percent of the total estimates for unit 2 and unit 3, respectively. The level of precision for unit 2 (12.2%) was less precise than the levels projected for unit 2 by TI (9.5%, 1980b) and NAI (7.8%, 1984b) for the stratified random design. This appeared to be the result of having higher variance at unit 2 during summer 1986 which required more samples than had been allocated in the stratified design, thus providing a less precise estimate of the number of fish impinged (Table 4-3). The level of precision at unit 3 (8.5%) was within the range of precision levels for unit 3 (8.2%: TI 1980b and 7.7%: NAI 1984b).

The total number of fish impinged by units 2 and 3 combined in 1986, estimated at 1.09 million (Tables 4-1 and 4-2), was within the range of other yearly estimates in the 1976-1984 historical data base (range 0.85-6.47 million; Table 4-4) and was nearly the same as last year's estimate of 1.08 million. The volume of water circulated through Indian Point Station during 1986, 1892 x $10^6 m^3$, was well within the range of values from previous years (Table 4-4) and included an outage at unit 2 during mid-January through April.

Total estimated impingement abundance at unit 2 was highest during the fall stratum followed by summer, winter, and spring (Table 4-1). This ranking, especially the comparatively low impingement abundance during winter, was influenced by the mid-January through April

TABLE 4-1
ESTIMATED NUMBER OF FISH IMPINGED AT INDIAN POINT UNIT 2 DURING 1986
BY TAXON AND SEASONAL STRATUM
(ADJUSTED FOR COLLECTION EFFICIENCY)

| COMMON NAME | WINTER | SPRING | SUMMER | FALL | 1986 TOTAL | STANDARD ERROR | COEFFICIENT OF VARIATION |
|---|---|---|---|---|---|---|---|
| ALEWIFE | 6 | 560 | 1286 | 173 | 2026 | 287 | 14.1 |
| AMERICAN EEL | 157 | 711 | 836 | 497 | 2202 | 390 | 17.7 |
| AMERICAN SHAD | 6 | 942 | 4259 | 1216 | 6423 | 1725 | 26.8 |
| ATHERINID UNID. | 0 | 0 | 26 | 0 | 26 | 23 | 89.8 |
| ATLANTIC CROAKER | 0 | 26 | 0 | 4 | 30 | 24 | 82.0 |
| ATLANTIC MENHADEN | 0 | 5149 | 1169 | 53 | 6370 | 1514 | 23.8 |
| ATLANTIC NEEDLEFISH | 0 | 0 | 30 | 0 | 30 | 27 | 89.8 |
| ATLANTIC SILVERSIDE | 6 | 0 | 0 | 29 | 35 | 5 | 15.4 |
| ATLANTIC STURGEON | 0 | 0 | 28 | 3 | 31 | 25 | 81.3 |
| ATLANTIC TOMCOD | 93 | 21129 | 92126 | 4030 | 117378 | 59354 | 50.6 |
| BANDED KILLIFISH | 180 | 103 | 138 | 3107 | 3527 | 503 | 14.2 |
| BAY ANCHOVY | 0 | 27814 | 52688 | 4992 | 85495 | 13536 | 15.8 |
| BLACK CRAPPIE | 6 | 0 | 0 | 9 | 15 | 3 | 23.1 |
| BLACK SEA BASS | 0 | 0 | 0 | 10 | 10 | 3 | 28.4 |
| BLUEBACK HERRING | 12 | 1289 | 733 | 5185 | 7219 | 749 | 10.4 |
| BLUEFISH | 9 | 513 | 3507 | 15 | 4044 | 1841 | 45.5 |
| BLUEGILL | 27 | 219 | 399 | 683 | 1328 | 267 | 20.1 |
| BROWN BULLHEAD | 27 | 51 | 82 | 55 | 215 | 51 | 23.6 |
| BUTTERFISH | 0 | 0 | 136 | 0 | 136 | 56 | 41.1 |
| CARP | 18 | 0 | 0 | 44 | 62 | 9 | 14.6 |
| CLUPEID UNID. | 0 | 322 | 0 | 22 | 344 | 253 | 73.7 |
| CREVALLE JACK | 0 | 0 | 0 | 77 | 77 | 14 | 18.3 |
| FOURSPINE STICKLEBACK | 0 | 80 | 0 | 119 | 199 | 79 | 39.5 |
| GIZZARD SHAD | 1548 | 0 | 0 | 225 | 1773 | 281 | 15.9 |
| GOLDEN SHINER | 38 | 25 | 0 | 5 | 68 | 27 | 40.2 |
| GOLDFISH | 15 | 0 | 0 | 12 | 27 | 5 | 19.2 |
| GRAY SNAPPER | 0 | 0 | 0 | 4 | 4 | 2 | 50.0 |
| HICKORY SHAD | 0 | 0 | 26 | 0 | 26 | 24 | 89.8 |
| HOGCHOKER | 1196 | 9139 | 32021 | 8096 | 50452 | 12443 | 24.7 |
| LARGEMOUTH BASS | 3 | 27 | 0 | 40 | 69 | 26 | 37.3 |
| LOGPERCH | 0 | 0 | 0 | 70 | 70 | 35 | 50.0 |
| LOOKDOWN | 0 | 0 | 26 | 18 | 44 | 24 | 54.5 |
| MUMMICHOG | 6 | 0 | 0 | 0 | 6 | 2 | 39.0 |
| NAKED GOBY | 6 | 0 | 0 | 81 | 87 | 9 | 10.5 |
| NORTHERN PIKE | 3 | 0 | 0 | 0 | 3 | 2 | 56.7 |
| NORTHERN PIPEFISH | 0 | 19 | 30 | 22 | 72 | 33 | 46.1 |
| OYSTER TOADFISH | 0 | 0 | 0 | 3 | 3 | 2 | 50.0 |
| PUMPKINSEED | 271 | 51 | 109 | 2557 | 2989 | 345 | 11.5 |
| RAINBOW SMELT | 466 | 5626 | 3708 | 1080 | 10879 | 2416 | 22.2 |
| REDBREAST SUNFISH | 0 | 0 | 102 | 215 | 317 | 105 | 33.0 |
| ROUGH SILVERSIDE | 0 | 0 | 26 | 0 | 26 | 23 | 89.8 |
| SEA LAMPREY | 6 | 0 | 27 | 5 | 39 | 25 | 63.8 |
| SILVER LAMPREY | 0 | 0 | 0 | 3 | 3 | 2 | 50.0 |
| SPOTTAIL SHINER | 126 | 0 | 0 | 465 | 591 | 59 | 10.0 |
| STRIPED BASS | 2259 | 458 | 4288 | 1412 | 8417 | 1443 | 17.1 |
| STRIPED MULLET | 6 | 0 | 0 | 0 | 6 | 2 | 39.0 |
| STRIPED SEAROBIN | 0 | 0 | 0 | 3 | 3 | 2 | 50.0 |
| SUMMER FLOUNDER | 0 | 3109 | 1174 | 121 | 4404 | 899 | 20.4 |
| TESSELLATED DARTER | 3 | 0 | 0 | 153 | 156 | 18 | 11.8 |

(CONTINUED)

TABLE 4-1. (CONTINUED)

| COMMON NAME | WINTER | SPRING | SUMMER | FALL | 1986 TOTAL | STANDARD ERROR | COEFFICIENT OF VARIATION |
|---|---|---|---|---|---|---|---|
| THREESPINE STICKLEBACK | 25 | 0 | 0 | 0 | 25 | 9 | 36.0 |
| TIDEWATER SILVERSIDE | 0 | 0 | 27 | 15 | 42 | 25 | 58.2 |
| WEAKFISH | 0 | 0 | 6230 | 361 | 6592 | 2429 | 36.8 |
| WHITE CATFISH | 446 | 102 | 321 | 1530 | 2399 | 203 | 8.4 |
| WHITE PERCH | 143528 | 9357 | 35293 | 221426 | 409605 | 41703 | 10.2 |
| WINTER FLOUNDER | 3 | 0 | 26 | 3 | 32 | 24 | 73.9 |
| YELLOW PERCH | 59 | 0 | 0 | 310 | 369 | 84 | 22.8 |
| TOTAL ALL TAXA | 150561 | 86820 | 240880 | 258561 | 736821 | 90035 | 12.2 |

STANDARD ERROR----------STANDARD ERROR OF 1986 TOTAL
COEFFICIENT OF VARIATION-STANDARD ERROR/1986 TOTAL *100

TABLE 4-2
ESTIMATED NUMBER OF FISH IMPINGED AT INDIAN POINT UNIT 3 DURING 1986
BY TAXON AND SEASONAL STRATUM
(ADJUSTED FOR COLLECTION EFFICIENCY)

| COMMON NAME | WINTER | SPRING | SUMMER | FALL | 1986 TOTAL | STANDARD ERROR | COEFFICIENT OF VARIATION |
|---|---|---|---|---|---|---|---|
| ALEWIFE | 158 | 653 | 303 | 302 | 1416 | 212 | 15.0 |
| AMERICAN EEL | 284 | 173 | 39 | 78 | 575 | 62 | 10.7 |
| AMERICAN SHAD | 15 | 222 | 950 | 3716 | 4904 | 1273 | 26.0 |
| ATLANTIC CROAKER | 4 | 17 | 0 | 0 | 20 | 15 | 73.3 |
| ATLANTIC MENHADEN | 0 | 1729 | 1445 | 123 | 3296 | 889 | 27.0 |
| ATLANTIC NEEDLEFISH | 0 | 0 | 6 | 0 | 6 | 5 | 81.4 |
| ATLANTIC SILVERSIDE | 4 | 0 | 5 | 18 | 27 | 10 | 36.8 |
| ATLANTIC STURGEON | 4 | 0 | 0 | 0 | 4 | 3 | 78.2 |
| ATLANTIC TOMCOD | 528 | 8039 | 2373 | 2662 | 13602 | 3181 | 23.4 |
| BANDED KILLIFISH | 101 | 31 | 5 | 132 | 269 | 48 | 17.9 |
| BAY ANCHOVY | 0 | 9307 | 3727 | 3631 | 16665 | 3639 | 21.8 |
| BLACK CRAPPIE | 41 | 0 | 0 | 5 | 46 | 12 | 25.4 |
| BLUEBACK HERRING | 22 | 1777 | 314 | 8527 | 10640 | 2228 | 20.9 |
| BLUEFISH | 0 | 1001 | 508 | 6 | 1515 | 425 | 28.0 |
| BLUEGILL | 71 | 22 | 0 | 139 | 232 | 46 | 20.0 |
| BROWN BULLHEAD | 37 | 30 | 11 | 21 | 100 | 19 | 19.4 |
| BUTTERFISH | 0 | 0 | 55 | 32 | 87 | 29 | 33.5 |
| CARP | 48 | 0 | 0 | 16 | 64 | 16 | 24.5 |
| CLUPEID UNID. | 0 | 24 | 0 | 0 | 24 | 21 | 87.8 |
| CREVALLE JACK | 0 | 0 | 17 | 83 | 100 | 28 | 28.1 |
| FOURSPINE STICKLEBACK | 0 | 7 | 0 | 0 | 7 | 6 | 87.8 |
| GIZZARD SHAD | 7413 | 0 | 0 | 322 | 7735 | 2235 | 28.9 |
| GOLDEN SHINER | 96 | 34 | 0 | 0 | 130 | 29 | 22.6 |
| GOLDFISH | 48 | 8 | 0 | 5 | 61 | 14 | 22.6 |
| HICKORY SHAD | 0 | 0 | 6 | 0 | 6 | 5 | 81.4 |
| HOGCHOKER | 1006 | 3834 | 15075 | 2961 | 22875 | 6236 | 27.3 |
| LARGEMOUTH BASS | 15 | 0 | 0 | 5 | 20 | 7 | 35.2 |
| LOOKDOWN | 0 | 0 | 0 | 12 | 12 | 7 | 58.7 |
| MOONFISH | 0 | 0 | 0 | 6 | 6 | 5 | 84.7 |
| MUMMICHOG | 4 | 8 | 0 | 0 | 12 | 8 | 64.6 |
| NORTHERN PIPEFISH | 0 | 34 | 6 | 6 | 46 | 20 | 44.5 |
| NORTHERN SEAROBIN | 0 | 7 | 0 | 0 | 7 | 6 | 87.8 |
| PUMPKINSEED | 839 | 100 | 22 | 221 | 1182 | 124 | 10.5 |
| RAINBOW SMELT | 445 | 2067 | 69 | 195 | 2776 | 1001 | 36.0 |
| RED HAKE | 41 | 69 | 0 | 0 | 109 | 52 | 47.9 |
| REDBREAST SUNFISH | 0 | 0 | 5 | 6 | 12 | 7 | 59.1 |
| SEA LAMPREY | 4 | 0 | 0 | 0 | 4 | 3 | 78.2 |
| SEAHORSE | 0 | 7 | 0 | 0 | 7 | 6 | 87.8 |
| SMALLMOUTH BASS | 0 | 0 | 0 | 17 | 17 | 10 | 60.9 |
| SPOTTAIL SHINER | 496 | 20 | 0 | 147 | 663 | 102 | 15.4 |
| SPOTTED HAKE | 0 | 0 | 12 | 0 | 12 | 7 | 56.6 |
| STRIPED BASS | 1590 | 132 | 174 | 410 | 2305 | 323 | 14.0 |
| STRIPED MULLET | 4 | 0 | 0 | 0 | 4 | 3 | 78.2 |
| STRIPED SEAROBIN | 0 | 0 | 0 | 6 | 6 | 5 | 84.7 |
| SUMMER FLOUNDER | 0 | 106 | 153 | 57 | 316 | 66 | 20.9 |
| TAUTOG | 0 | 8 | 0 | 0 | 8 | 7 | 87.8 |
| THREESPINE STICKLEBACK | 111 | 7 | 0 | 0 | 118 | 33 | 27.6 |
| TIDEWATER SILVERSIDE | 0 | 16 | 0 | 12 | 28 | 12 | 43.0 |
| WEAKFISH | 0 | 0 | 1575 | 227 | 1802 | 581 | 32.2 |

(CONTINUED)

TABLE 4-2. (CONTINUED)

| COMMON NAME | WINTER | SPRING | SUMMER | FALL | 1986 TOTAL | STANDARD ERROR | COEFFICIENT OF VARIATION |
|---|---|---|---|---|---|---|---|
| WHITE BASS X STRIPED BASS * | 4 | 0 | 0 | 0 | 4 | 3 | 78.2 |
| WHITE CATFISH | 626 | 77 | 40 | 336 | 1078 | 120 | 11.1 |
| WHITE PERCH | 185528 | 32653 | 1611 | 40194 | 259986 | 26294 | 10.1 |
| WHITE SUCKER | 4 | 0 | 0 | 0 | 4 | 3 | 78.2 |
| WINTER FLOUNDER | 11 | 0 | 0 | 0 | 11 | 5 | 43.8 |
| YELLOW PERCH | 93 | 84 | 0 | 10 | 187 | 49 | 26.4 |
| TOTAL ALL TAXA | 199689 | 62303 | 28506 | 64647 | 355145 | 30014 | 8.5 |

STANDARD ERROR----------STANDARD ERROR OF 1986 TOTAL
COEFFICIENT OF VARIATION-STANDARD ERROR/1986 TOTAL *100
* WHITE BASS X STRIPED BASS HYBRID VERIFIED BY THE NEW YORK STATE DEC

TABLE 4-3. ESTIMATED MEAN DAILY NUMBER OF FISH IMPINGED IN EACH SEASONAL STRATUM AT INDIAN POINT UNITS 2 AND 3 DURING 1986.

| UNIT | SEASONAL STRATUM | NUMBER OF SAMPLING DAYS | DAYS ALLOCATED IN STRATIFIED DESIGN | MEAN DAILY ESTIMATE[a] | STANDARD DEVIATION |
|---|---|---|---|---|---|
| 2 | Winter (Jan-Mar) | 19 | 23 | 5,377.2 | 7312.3 |
| | Spring (Apr-Jun) | 9 | 8 | 1,189.3 | 910.0 |
| | Summer (Jul-Sep) | 11 | 11 | 2,618.3 | 3022.0 |
| | Fall (Oct-Dec) | 69 | 68 | 2,810.5 | 5586.5 |
| | 1986 Total | 108 | 110 | 2,585.3[b] | |
| 3 | Winter (Jan-Mar) | 35 | 35 | 2,218.8 | 1926.6 |
| | Spring (Apr-Jun) | 19 | 20 | 760.6 | 826.0 |
| | Summer (Jul-Sep) | 31 | 31 | 309.8 | 679.8 |
| | Fall (Oct-Dec) | 26 | 24 | 702.7 | 659.0 |
| | 1986 Total | 111 | 110 | 994.8[b] | |

[a] Adjusted for collection efficiency

[b] Stratified mean daily estimate

TABLE 4-4. TOTAL VOLUME CIRCULATED AT INDIAN POINT UNITS 2 AND 3 COMBINED, ESTIMATED NUMBER OF FISH IMPINGED, IMPINGEMENT RATE, AND NUMBER OF SPECIES COLLECTED DURING 1976 THROUGH 1986.

| | 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 |
| 1986 | 1892 | 1.09 | 577 | 65 |

[a] Including service water

[b] Adjusted for collection efficiency

outage at unit 2. Impingement abundance expressed as a mean daily impingement rate for each seasonal strata demonstrated instead that the highest daily impingement rates at unit 2 occurred during winter followed by fall, summer, and spring (Table 4-3). At unit 3, total estimated impingement abundance was also highest during winter followed by fall, spring and summer (Table 4-2). Mean daily impingement rates at unit 3 demonstrated that the winter stratum contained the highest daily impingement rates followed by the spring and fall strata, and lastly the summer stratum (Table 4-3).

The precision of estimated total impingement for individual fish species at units 2 and 3 varied greatly (8-90%). As expected, most species with high coefficients of variation (> 70%) occurred infrequently in the Indian Point area (moonfish, striped mullet, Atlantic croaker, seahorse, Atlantic needlefish, tautog, searobins, hickory shad, Atlantic sturgeon) or were common in the area but only subject to minimal impingement (fourspine stickleback and mummichogs). Conversely, many fish species with a relatively high degree of precision (coefficients of variation <20%) for impingement abundance estimates were impinged in relatively uniform numbers among the four seasonal strata or in high but relatively uniform numbers among the days within one or two seasonal strata (American eel, banded killifish, brown bullhead, pumpkinseed, spottail shiner, striped bass, white perch, white catfish, alewife, bay anchovy, blueback herring). A number of species also occurred periodically and in low numbers but had relatively precise estimates of impingement (Atlantic silversides, carp, crevalle jack, gizzard shad, goldfish, naked goby, tessellated darter). For these species, the high precision levels were the result of impingement occurring at unit 2 during the fall stratum, and to a less extent winter stratum, which had very large allocations of sampling dates. This effect was not as apparent at unit 3 where allocation of sampling dates was more uniform among strata.

## 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 seasonal impingement rates before and after adjustment (Figure 4-1; Tables 4-1, 4-2, A-6, A-7, A-8). As in 1985, impingement rates adjusted for collection efficiency using the temperature regression equation were approximately double the unadjusted rates during winter months and approximately three times unadjusted rates during summer. The higher summer adjustment reflected lower summertime collection efficiency. Operation of unit 2 intake 26 during 1986 without a fixed screen (Ristroph screen only) may have reduced the accuracy of the regression-adjusted total impingement estimates. The high collection efficiency of the Ristroph screen compared to the fixed 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 higher than for estimates made with the fixed screen in place.

Collection efficiency data obtained during the Ristroph Screen Special Studies and Ristroph Survival Studies at unit 2 in 1985 permit 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 estimates during the winter stratum and approximately tripled (3.4) total estimates during the summer stratum. Screen specific adjustments also increased unadjusted total impingement estimates during the winter stratum by nearly two times (1.8) but increased estimates during the summer stratum by over 12 times. The disproportionate increase in adjusted total impingement estimates during the summer stratum at unit 2 reflected low collection efficiency due to

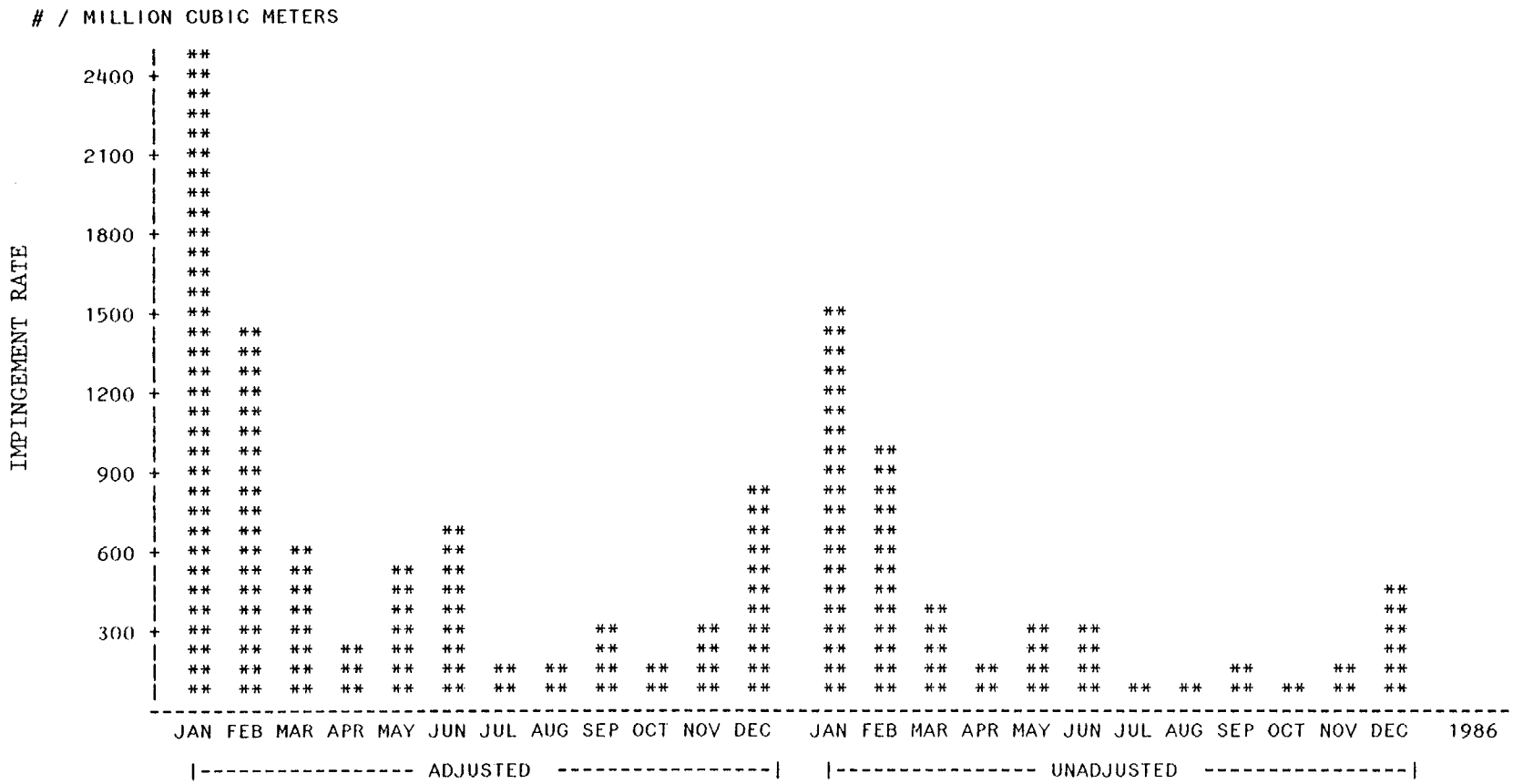



FIGURE 4-1. COMPARISON OF IMPINGEMENT RATES FOR ALL TAXA AT INDIAN POINT UNITS 2 AND 3 COMBINED IN 1986, ADJUSTED AND UNADJUSTED FOR COLLECTION EFFICIENCY.

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 1986 WINTER AND SUMMER STRATA.

| SEASONAL STRATUM | SCREEN | COLLECTION EFFICIENCY ADJUSTMENT | | |
|---|---|---|---|---|
| | | UNADJUSTED[1] | REGRESSION[2] | SCREEN-SPECIFIC[3] |
| Winter (Jan-Mar) | 26 | 25,092 | 50,372 | 35,441 |
| | 21-25 | 49,907 | 100,189 | 99,418 |
| | Combined | 74,999 | 150,561 | 134,859 |
| Summer (Jul-Sep) | 26 | 51,604 | 172,778 | 256,780 |
| | 21-25 | 20,340 | 68,102 | 641,934 |
| | Combined | 71,944 | 240,880 | 898,714 |

[1]Unadjusted total number of fish impinged at unit 2, screens 21-25 and 26 in the winter or summer stratum, scaled from the number of days sampled to the total number of days in the stratum.

[2]Total number of fish impinged at unit 2, screens 21-25 and 26 in the winter or summer stratum, adjusted for collection efficiency using the temperature regression equation 1.

[3]Total number of fish impinged at unit 2, screens 21-25 and 26 in the winter or summer stratum, empirically adjusted for screen-specific collection efficiency.

blue crab scavenging and perhaps other losses such as deterioration and disintergration of the impinged fish.

Because 1985 was an exceptional year in terms of blue crab impingement and consequently predation, screen-specific adjustments derived from the 1985 collection efficiency data may over estimate impingement abundance during other years. This over estimate would be expected to be larger for screens 21-25 where the effect of blue crab predation on dead fish impinged on the fixed screens is greater than predation on the mostly live fish collected by the continuously rotating Ristroph screen (screen 26). Thus, screen-specific adjustments during summer when blue crabs are most abundant may be less accurate for screens 21-25 than for screen 26. Consequently, the annual impingement at unit 2 may be estimated using screen-specific adjusted estimates for screen 26 during the winter and summer strata and screens 21-25 during the winter stratum, and using regression adjusted total estimates for screens 21-25 during summer strata and all screens during the spring and fall strata. Using this collection efficiency adjustment procedure, the annual impingement at unit 2 totaled 805,122 fish compared to 736,821 fish by the regression method. The annual impingement at unit 3 estimated by the regression method totaled 355,145 for a combined station total of 1,160,267 and 1,091,966 using the screen-specific and regression methods, respectively.

## 4.3 WATER QUALITY

Daily intake water temperature averaged for both units rose from a seasonal low in mid-February of 0.0°C to a high of 30°C in mid-July and subsequently declined to 2.6°C by the end of December (Table A-1). Daily intake conductivity fluctuated during the year in a characteristic seasonal pattern (Table A-2). Lowest conductivity levels were recorded during spring when values consistently ranged from 130-1000 µS/cm with occasional pulses of 1000 to 9000 µS/cm recorded.

Conductivity was at its highest during summer and fall with values of 1000-9000 µS/cm consistently detected. During mid-November through December, conductivity once again dropped to levels below 1000 µS/cm.

## 4.4 SPECIES COMPOSITION AND RELATIVE ABUNDANCE

Fish collected in impingement samples during 1986 totaled 231,059 and comprised 65 species for unit 2 and 3 combined (Table 4-6). Among these species, 20 were primarily freshwater inhabitants, 18 were primarily marine species tolerant of moderate freshwater influences, and 27 were euryhaline species tolerant at one time or another of a wide range of salinity conditions. The number of species caught in 1986 (65) was well within the range of the previous ten years (43-79 species). In addition, two species were never reported at Indian Point before, and are new to the species list compiled for the Indian Point Impingement Program: oyster toadfish (*Opsanus tau*) and white bass/striped bass hybrid. A single oyster toadfish was collected at unit 2 in November. Oyster toadfish are common in coastal shoal waters from Cuba to Cape Cod (Bigelow and Schroeder, 1953) and may occur in the Hudson River at Indian Point as strays from Long Island Sound or New York Harbor. In the Potomac River estuary, oyster toadfish have been reported in fresh water but are most abundant in waters with salinities greater than 7 ppt (Lippson *et al.* 1980).

The white bass/striped bass hybrid was collected on March 3, 1986 at unit 3. Identification of this fish as a hybrid was verified by the New York State Department of Environmental Conservation (NYSDEC). The hybrid was a Length Class 4 gravid female weighing 670 grams. A hybrid was also reported in a beach seine collection obtained by the NYSDEC in 1985. The origin of white bass/striped bass hybrids in the Hudson River is speculative. The NYSDEC has no record of hybrid white bass/striped bass stocking in the Hudson River Water Drainage Basin. Stocking of hybrids has been reported in the Delaware Drainage Basin and

TABLE 4-6. SPECIES COLLECTED IN IMPINGEMENT SAMPLING AT INDIAN POINT UNITS 2 AND 3 IN 1986.

| COMMON NAME[a] | SCIENTIFIC NAME[a] | SALINITY PREFERENCE[b] |
|---|---|---|
| Alewife | *Alosa pseudoharengus* | e |
| American eel | *Anguilla rostrata* | e |
| American shad | *Alosa sapidissima* | e |
| Atherinid unid. | | e |
| Atlantic croaker | *Micropogonias undulatus* | e |
| 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 crappie | *Pomoxis nigromaculatus* | f |
| Black sea bass | *Centropristis striata* | m |
| Blueback herring | *Alosa aestivalis* | e |
| Bluefish | *Pomatomus saltatrix* | m |
| Bluegill | *Lepomis macrochirus* | f |
| Brown bullhead | *Ictalurus nebulosus* | f |
| Butterfish | *Peprilus triacanthus* | m |
| Common carp | *Cyprinus carpio* | f |
| Clupeid unid. | | e |
| Crevalle jack | *Caranx hippos* | e |

TABLE 4-6. (Continued)

| COMMON NAME[a] | SCIENTIFIC NAME[a] | SALINITY PREFERENCE[b] |
|---|---|---|
| Fourspine stickleback | *Apeltes quadracus* | e |
| Gizzard shad | *Dorosoma cepedianum* | f |
| Golden shiner | *Notemigonus crysoleucas* | f |
| Goldfish | *Carassius auratus* | f |
| Gray snapper | *Lutjanus griseus* | m |
| Hickory shad | *Alosa mediocris* | e |
| Hogchoker | *Trinectes maculatus* | e |
| Largemouth bass | *Micropterus salmoides* | f |
| Logperch | *Percina caprodes* | f |
| Lookdown | *Selene vomer* | e |
| Moonfish | *Selene setapinnis* | m |
| Mummichog | *Fundulus heteroclitus* | e |
| Naked goby | *Gobiosoma bosci* | e |
| Northern pike | *Esox lucius* | f |
| Northern pipefish | *Syngnathus fuscus* | e |
| Northern searobin | *Prionotus carolinus* | m |
| Oyster toadfish | *Opsanus tau* | m |
| Pumpkinseed | *Lepomis gibbosus* | f |
| Rainbow smelt | *Osmerus mordax* | e |
| Red hake | *Urophycis chuss* | m |
| Redbreast sunfish | *Lepomis auritus* | f |
| Rock gunnel | *Pholis gunnellus* | m |
| Rough silverside | *Membras martinica* | e |

TABLE 4-6. (Continued)

| COMMON NAME[a] | SCIENTIFIC NAME[a] | SALINITY PREFERENCE[b] |
|---|---|---|
| Sea lamprey | *Petromyzon marinus* | m |
| Seahorse | *Hippocampus* sp. | e |
| Silver lamprey | *Ichthyomyson unicuspis* | f |
| Smallmouth bass | *Micropterus dolomieu* | f |
| Spottail shiner | *Notropis hudsonius* | f |
| Spotted hake | *Urophycis regia* | m |
| Striped bass | *Morone saxatilis* | e |
| Striped mullet | *Mugil cephalus* | e |
| Striped searobin | *Prionotus evolans* | m |
| 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 bass x Striped bass[c] | *Morone chrysops x M. saxatilis* | e |
| White catfish | *Ictalurus catus* | f |
| White perch | *Morone americana* | e |
| Winter 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

[c] White bass x striped bass hybrid verified by the New York State DEC

strays may conceivably find their way to the Hudson River by way of the coast. White bass have fairly recently been introduced into the Hudson River, from the Great Lakes by way of the Barge Canal (Smith 1985) and therefore, natural hybridization is also a possibility.

The three numerically dominate species impinged at Indian Point units 2 and 3 in 1986 were white perch, Atlantic tomcod, and bay anchovy (Table 4-7). Collectively, these fishes comprised nearly 83% of the total estimated impingement abundance at the Indian Point Station in 1986 and were among the top ten species impinged in previous monitoring programs. White perch were by far the most dominant species, as in previous years, accounting for 61.3% of the number of fish impinged (Table 4-7). Unit 2 impingement collections accounted for 61% of the total white perch abundance, 84% of the total bay anchovy abundance and 90% of the total tomcod abundance.

The schedule of plant operation at unit 3 did not appear to greatly influence estimates of species composition or yearly impingement abundance since unit 3 operated most of the year. Unit 2 however, had an extended outage from mid-January through April during which little or no circulating water was sampled (Table 4-8). This outage coincided with peak mean daily impingement rates (Table 4-3), thus substantially lowering impingement abundance estimates for the winter stratum and to a lesser extend the spring stratum. The outage resulted in less impingement of winter and spring seasonally abundant fishes at unit 2 such as white perch, striped bass, white catfish, rainbow smelt and spottail shiner than if the plant had been operating during mid-January through April.

## 4.5 SEASONAL AND YEARLY IMPINGEMENT PATTERNS

Seasonal trends were examined using mean monthly impingement rates (daily count of a taxon adjusted for collection efficiency divided by the daily volume pumped, averaged over each month). Due to an

TABLE 4-7. ESTIMATED NUMBER IMPINGED AT INDIAN POINT IN 1986 AND TOTAL PERCENT COMPOSITION OF THE TWELVE MOST ABUNDANT SPECIES[a] AND ALL SPECIES COMBINED.

| SPECIES | UNIT 2 | | UNIT 3 | | BOTH UNITS | | |
|---|---|---|---|---|---|---|---|
| | NUMBER | PERCENT | NUMBER | PERCENT | NUMBER | PERCENT | CUM. PERCENT |
| White perch | 409,605 | 55.6 | 259,986 | 73.2 | 669,591 | 61.3 | 61.3 |
| Atlantic tomcod | 117,378 | 15.9 | 13,602 | 3.8 | 130,980 | 12.0 | 73.3 |
| Bay anchovy | 85,495 | 11.6 | 16,665 | 4.7 | 102,160 | 9.4 | 82.7 |
| Hogchoker | 50,452 | 6.8 | 22,875 | 6.4 | 73,327 | 6.7 | 89.4 |
| Blueback herring | 7,219 | 1.0 | 10,640 | 3.0 | 17,859 | 1.6 | 91.0 |
| Rainbow smelt | 10,879 | 1.5 | 2,776 | 0.8 | 13,655 | 1.3 | 92.3 |
| American shad | 6,423 | 0.9 | 4.904 | 1.4 | 11,327 | 1.0 | 93.3 |
| Striped bass | 8,417 | 1.1 | 2,305 | 0.6 | 10,722 | 1.0 | 94.3 |
| Atlantic menhaden | 6,370 | 0.9 | 3,296 | 0.9 | 9,666 | 0.9 | 95.2 |
| Gizzard shad | 1,773 | 0.2 | 7,735 | 2.2 | 9,508 | 0.9 | 96.1 |
| Weakfish | 6,592 | 0.9 | 1,802 | 0.5 | 8,394 | 0.8 | 96.9 |
| Bluefish | 4,044 | 0.5 | 1,515 | 0.4 | 5,559 | 0.5 | 97.4 |
| All species combined | 736,821 | | 355,145 | | 1,091,966 | | |

[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 1986.

| MONTH | UNIT 2 | UNIT 3 | UNITS 2 AND 3 |
|---|---|---|---|
| Jan | 21.3 | 25.9 | 47.2 |
| Feb | [a] | 18.8 | 18.8 |
| Mar | 7.6 | 38.2 | 45.8 |
| Apr | [a] | 24.1 | 24.1 |
| May | 4.0 | 3.0 | 7.0 |
| Jun | 27.2 | 21.1 | 48.3 |
| Jul | 13.4 | 14.3 | 27.7 |
| Aug | 12.5 | 6.3 | 18.8 |
| Sep | 26.0 | 46.1 | 72.1 |
| Oct | 72.7 | 34.9 | 107.6 |
| Nov | 59.1 | 19.9 | 79.0 |
| Dec | 69.6 | 26.1 | 95.7 |
| Total | 313.4 | 278.9 | 592.10 |

[a] No sampling due to unit shutdown

extended outage at unit 2 from mid-January through April, impingement rates were not available for unit 2 for February and April, and March rates corresponded to small sampling and operating volumes (Table 3-4). Seasonal patterns and rates for 1986 were compared to the 1982-1985 data which were based on the same stratified sampling design used in the 1986 program.

Impingement patterns in 1986 were similar between units 2 and 3. Both units exhibited maximum impingement rates in the winter stratum with small pulses during spring and fall (Figure 4-2). Impingement rates were highest during January and February at unit 3, and during January at unit 2 (no February or April sampling at unit 2). High winter impingement rates were due primarily to a large influx of yearling white perch in January and February. Similar peaks were observed during the winter stratum in previous years (Con Edison 1983; MMES 1985; NAI 1984a, 1986). As in previous years, young-of-the-year white perch were also numerous in impingement collections during December. The small pulse in impingement rate during the spring stratum of 1986 consisted primarily of Atlantic tomcod and bay anchovy.

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

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

The monthly impingement rates for 13 of the above species are presented in order of abundance in Figures 4-3 through 4-15 and discussed below. Young-of-the-year fish (Y) are distinguished from yearling and older fish (O) on each figure. No shortnose sturgeon were impinged and only 7 Atlantic sturgeon were impinged in 1986.

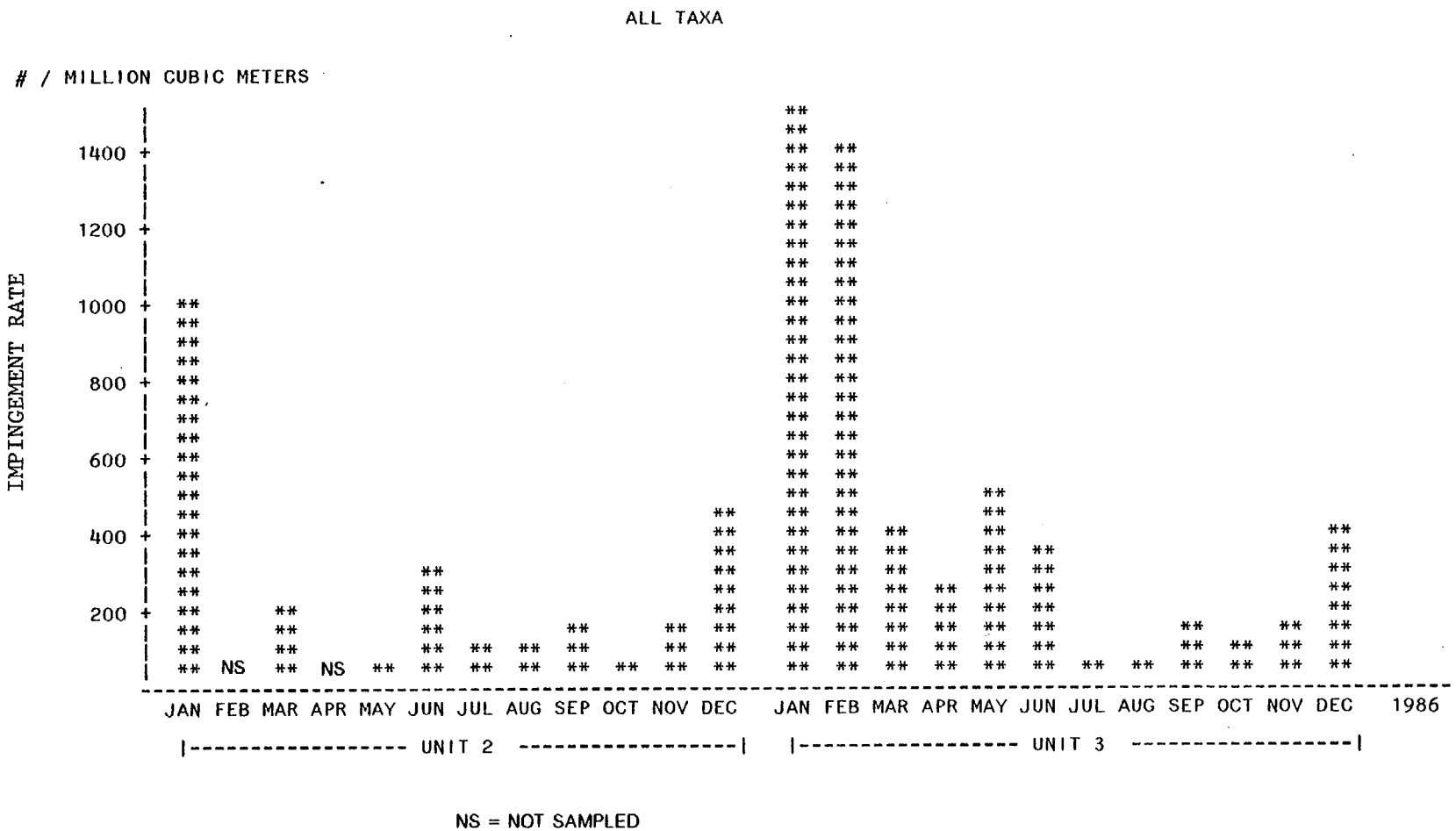
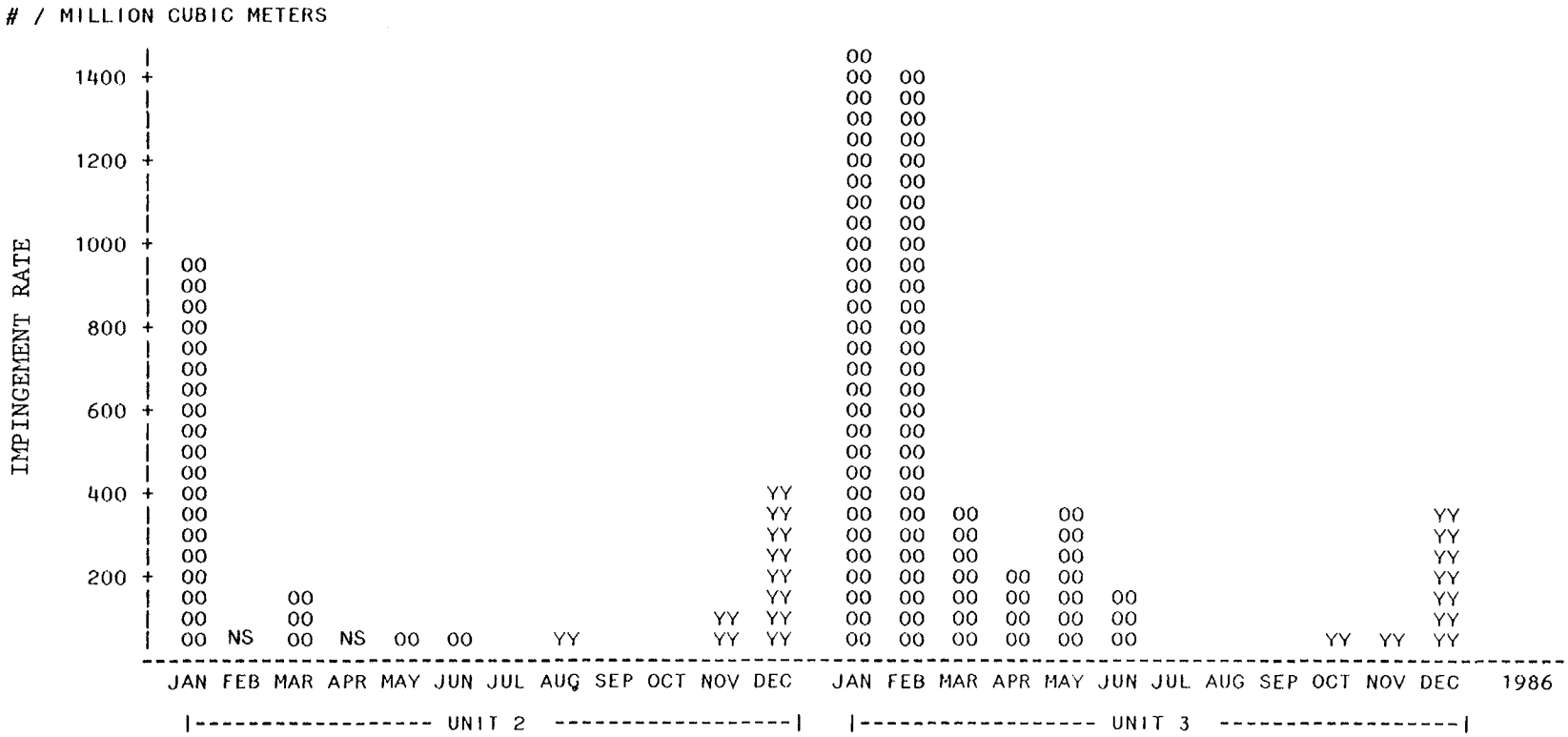



FIGURE 4-2. MONTHLY ADJUSTED IMPINGEMENT RATES FOR ALL TAXA COMBINED AT INDIAN POINT UNITS 2 AND 3 IN 1986, ADJUSTED FOR COLLECTION EFFICIENCY.

WHITE PERCH




O = OLDER

Y = YOUNG OF THE YEAR

NS = NOT SAMPLED

FIGURE 4-3. MONTHLY ADJUSTED IMPINGEMENT RATES FOR WHITE PERCH AT INDIAN POINT UNITS 2 AND 3 IN 1986, ADJUSTED FOR COLLECTION EFFICIENCY

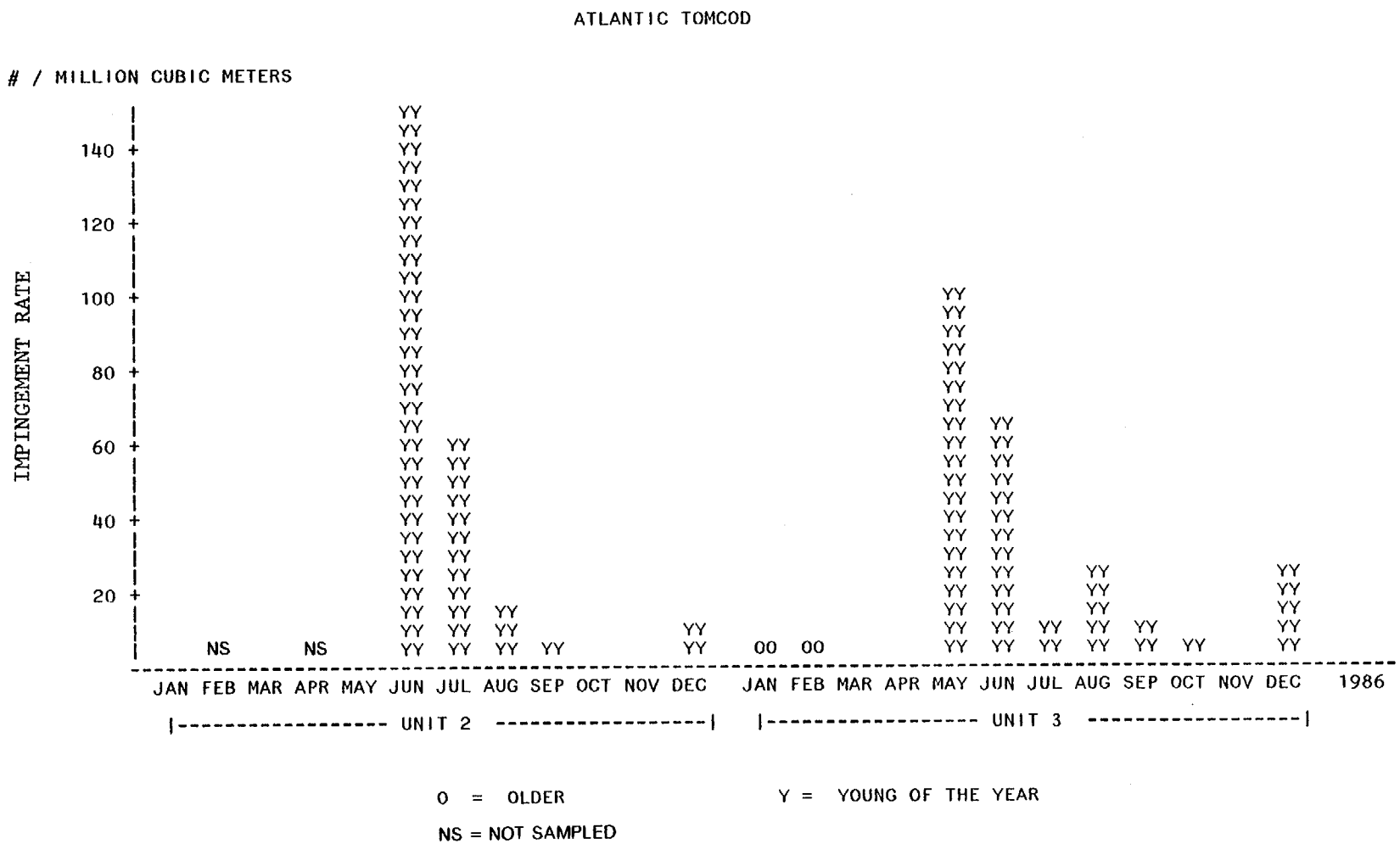
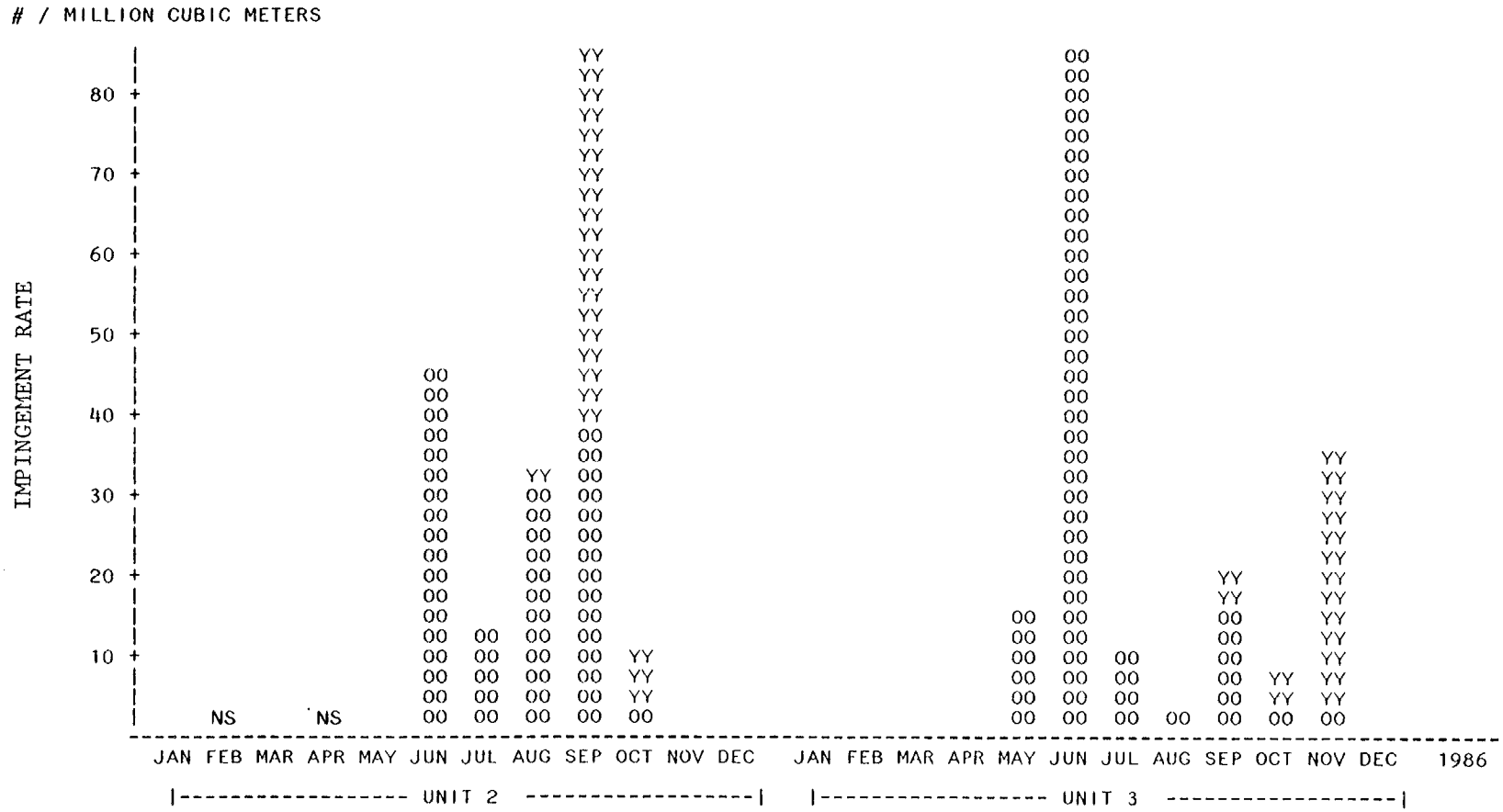



FIGURE 4-4. MONTHLY ADJUSTED IMPINGEMENT RATES FOR ATLANTIC TOMCOD AT INDIAN POINT UNITS 2 AND 3 IN 1986, ADJUSTED FOR COLLECTION EFFICIENCY.

BAY ANCHOVY

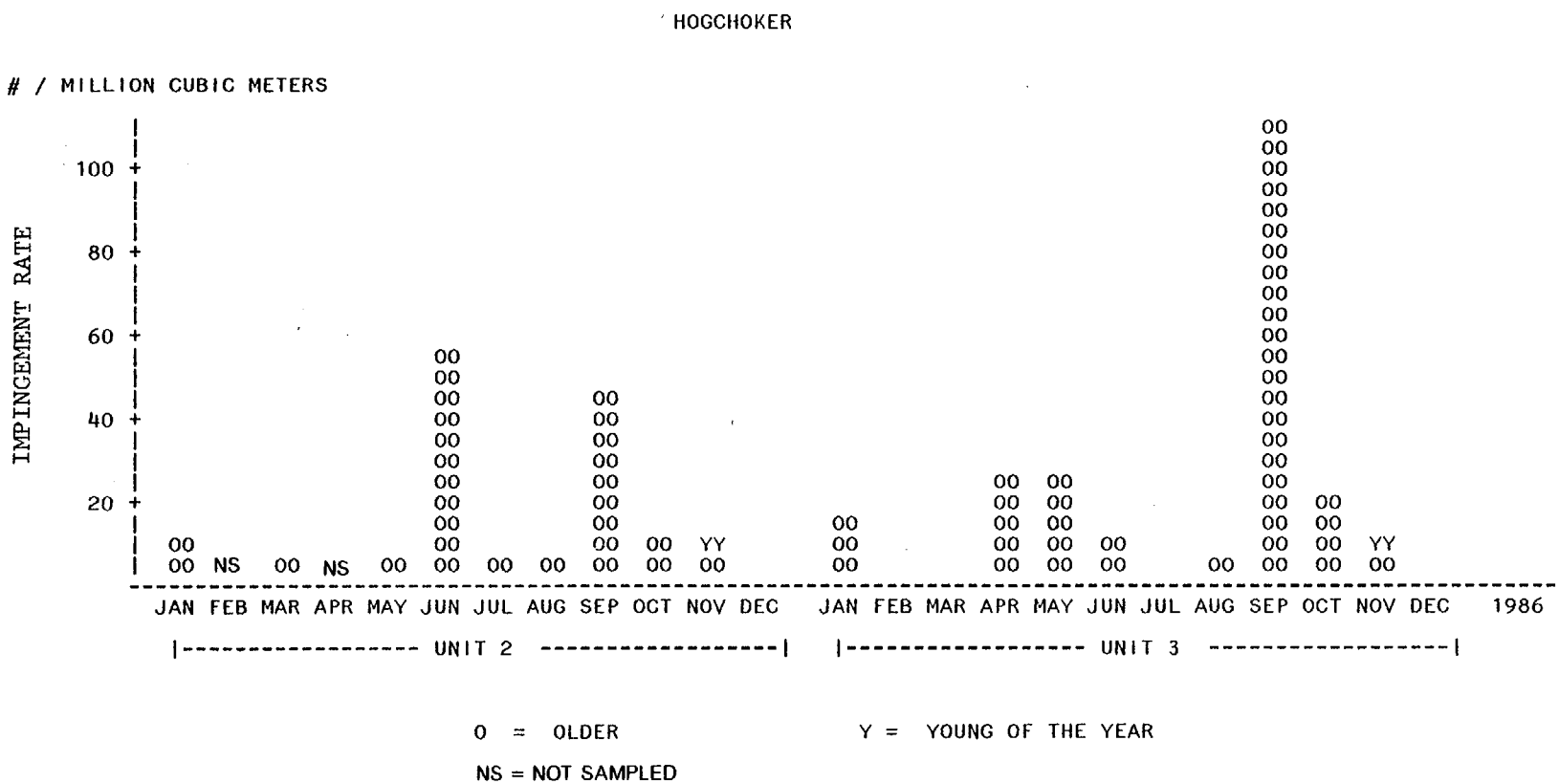



O = OLDER

Y = YOUNG OF THE YEAR

NS = NOT SAMPLED

FIGURE 4-5. MONTHLY ADJUSTED IMPINGEMENT RATES FOR BAY ANCHOVY AT INDIAN POINT UNITS 2 AND 3 IN 1986, ADJUSTED FOR COLLECTION EFFICIENCY.



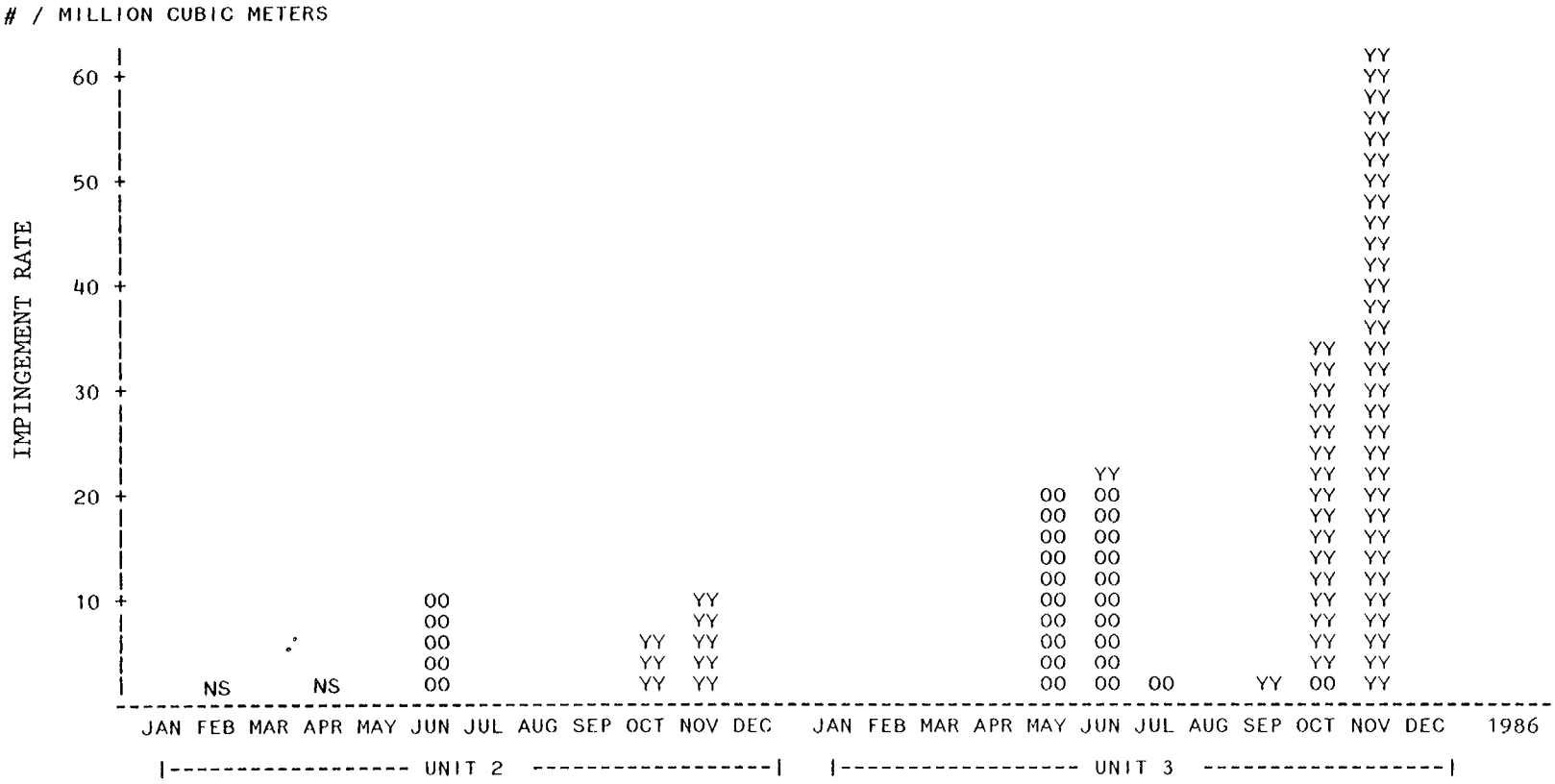

O = OLDER

Y = YOUNG OF THE YEAR

NS = NOT SAMPLED

FIGURE 4-6. MONTHLY ADJUSTED IMPINGEMENT RATES FOR HOGCHOKER AT INDIAN POINT UNITS 2 AND 3 IN 1986, ADJUSTED FOR COLLECTION EFFICIENCY.

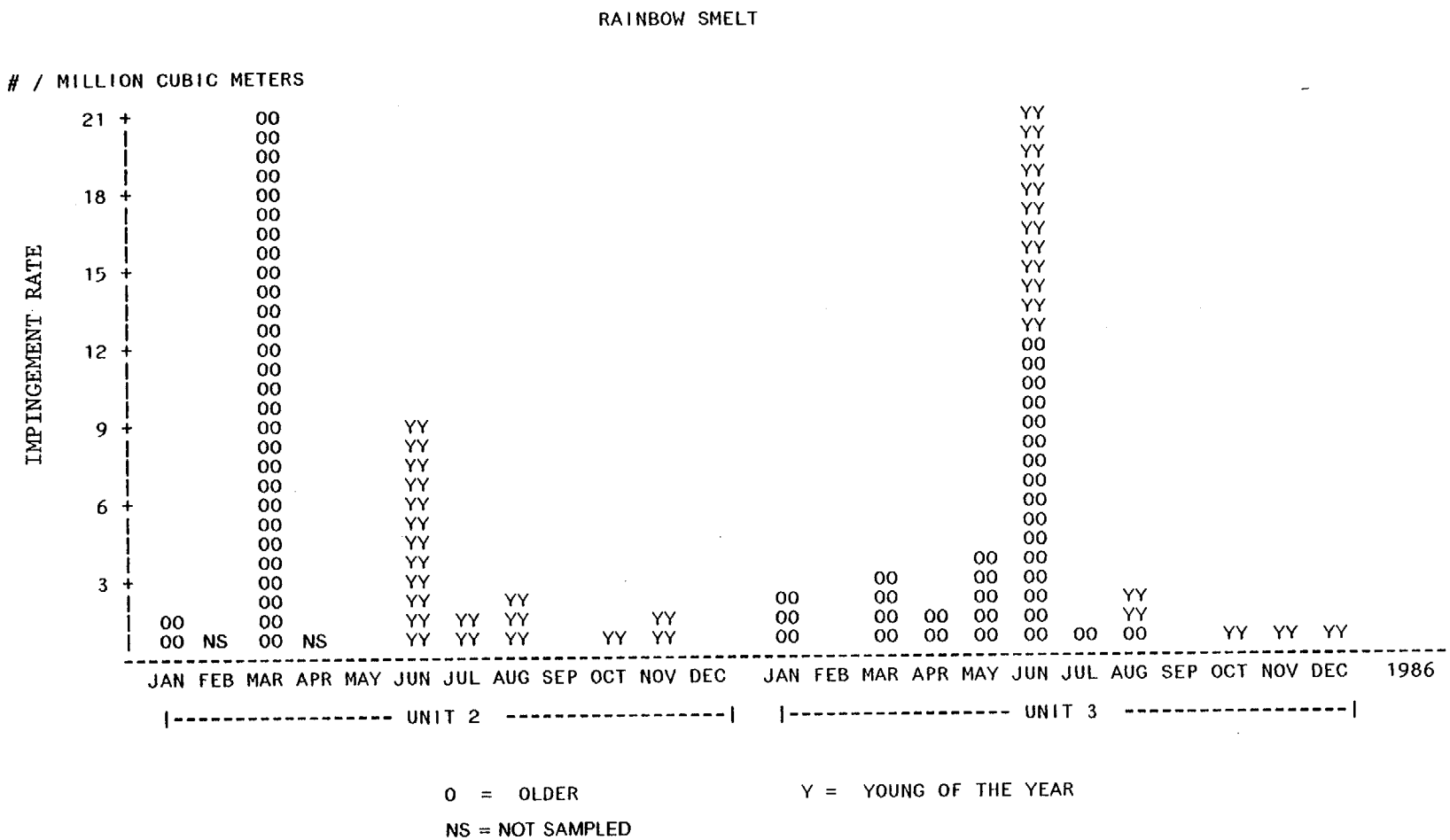
BLUEBACK HERRING




O = OLDER Y = YOUNG OF THE YEAR

NS = NOT SAMPLED

FIGURE 4-7. MONTHLY ADJUSTED IMPINGEMENT RATES FOR BLUEBACK HERRING AT INDIAN POINT UNITS 2 AND 3 IN 1986, ADJUSTED FOR COLLECTION EFFICIENCY.




O = OLDER

Y = YOUNG OF THE YEAR

NS = NOT SAMPLED

FIGURE 4-8. MONTHLY ADJUSTED IMPINGEMENT RATES FOR RAINBOW SMELT AT INDIAN POINT UNITS 2 AND 3 IN 1986, ADJUSTED FOR COLLECTION EFFICIENCY.

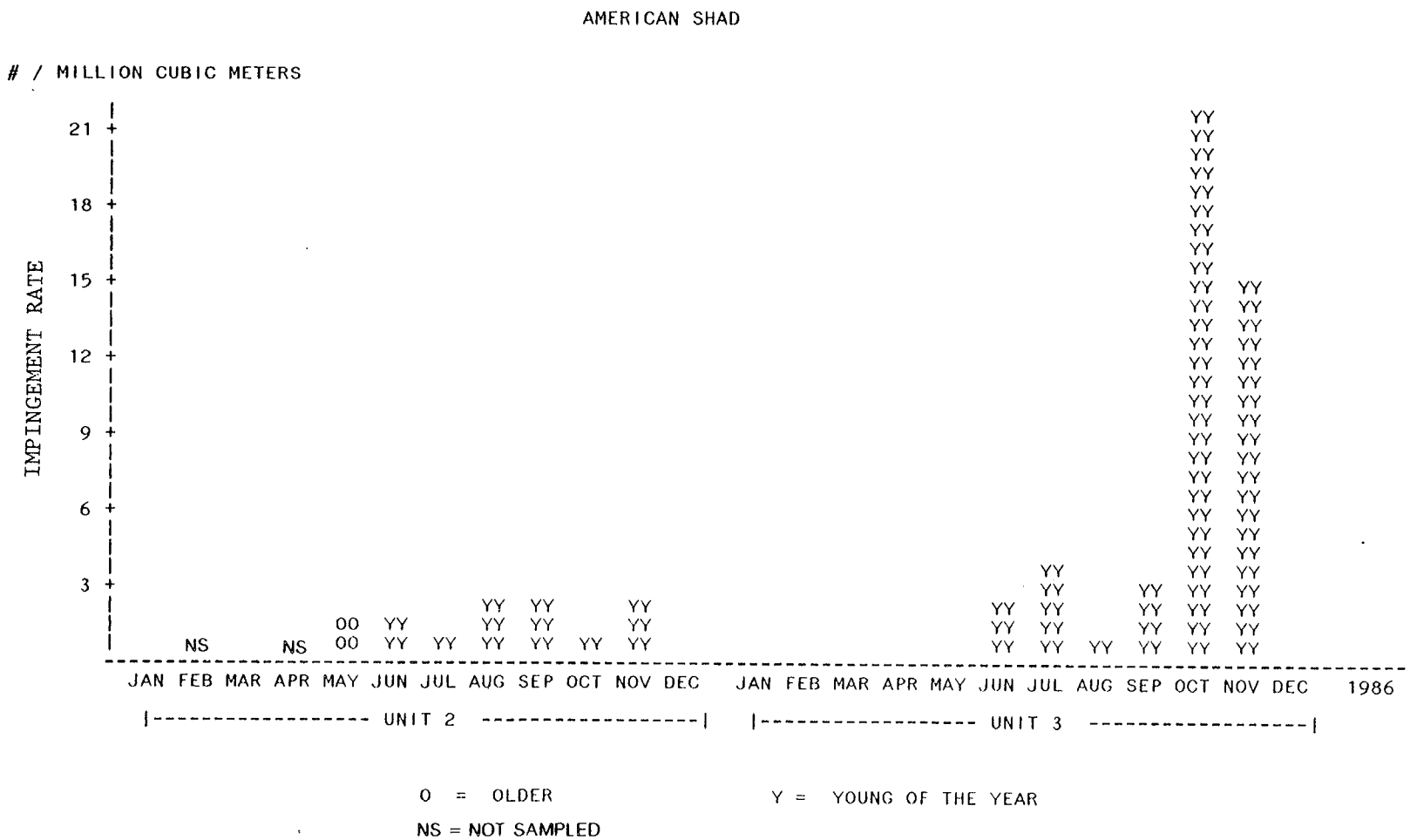
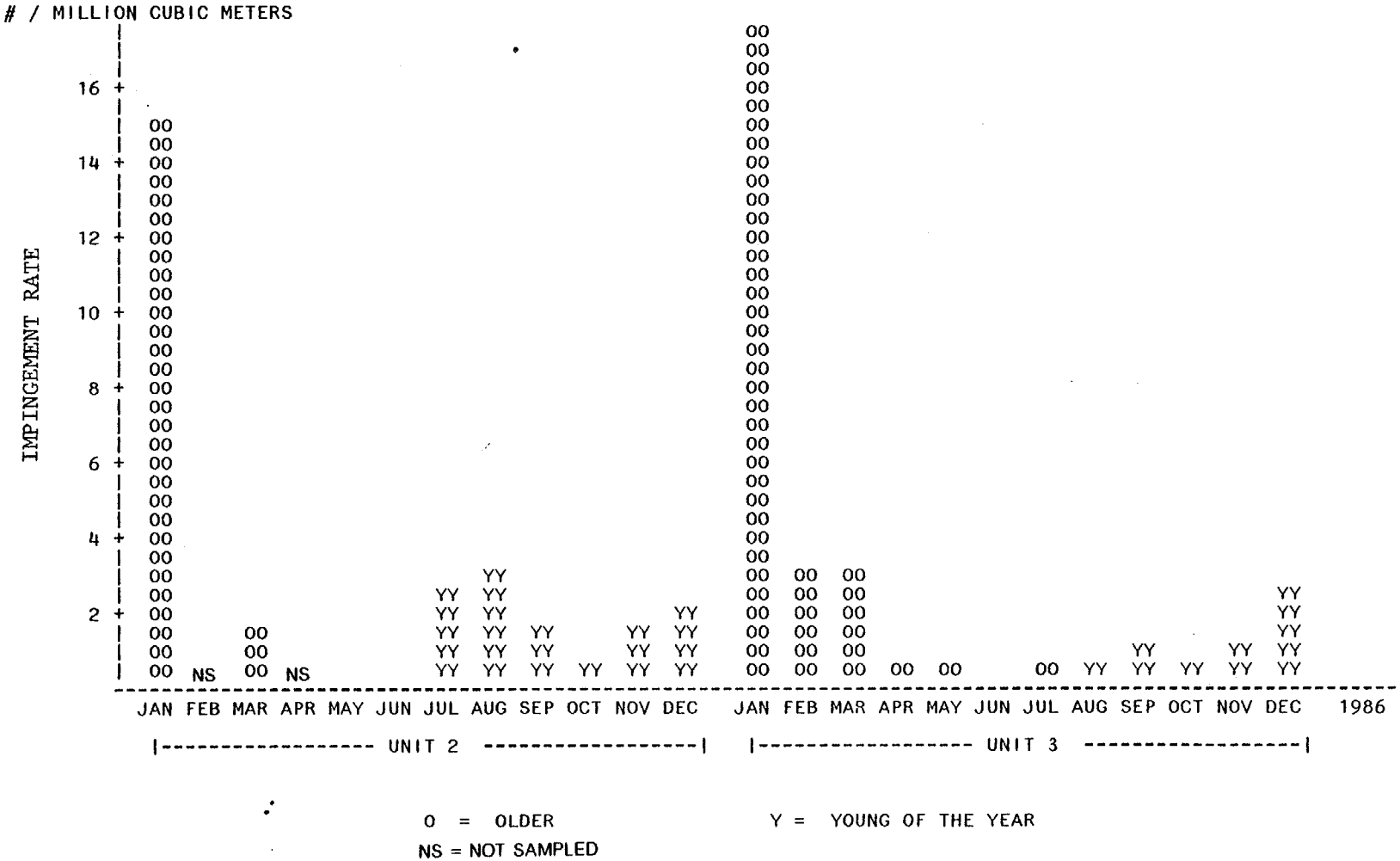



FIGURE 4- 9. MONTHLY ADJUSTED IMPINGEMENT RATES FOR AMERICAN SHAD AT INDIAN POINT UNITS 2 AND 3 IN 1986, ADJUSTED FOR COLLECTION EFFICIENCY.

STRIPED BASS




O = OLDER

Y = YOUNG OF THE YEAR

NS = NOT SAMPLED

FIGURE 4-10. MONTHLY ADJUSTED IMPINGEMENT RATES FOR STRIPED BASS AT INDIAN POINT UNITS 2 AND 3 IN 1986, ADJUSTED FOR COLLECTION EFFICIENCY.

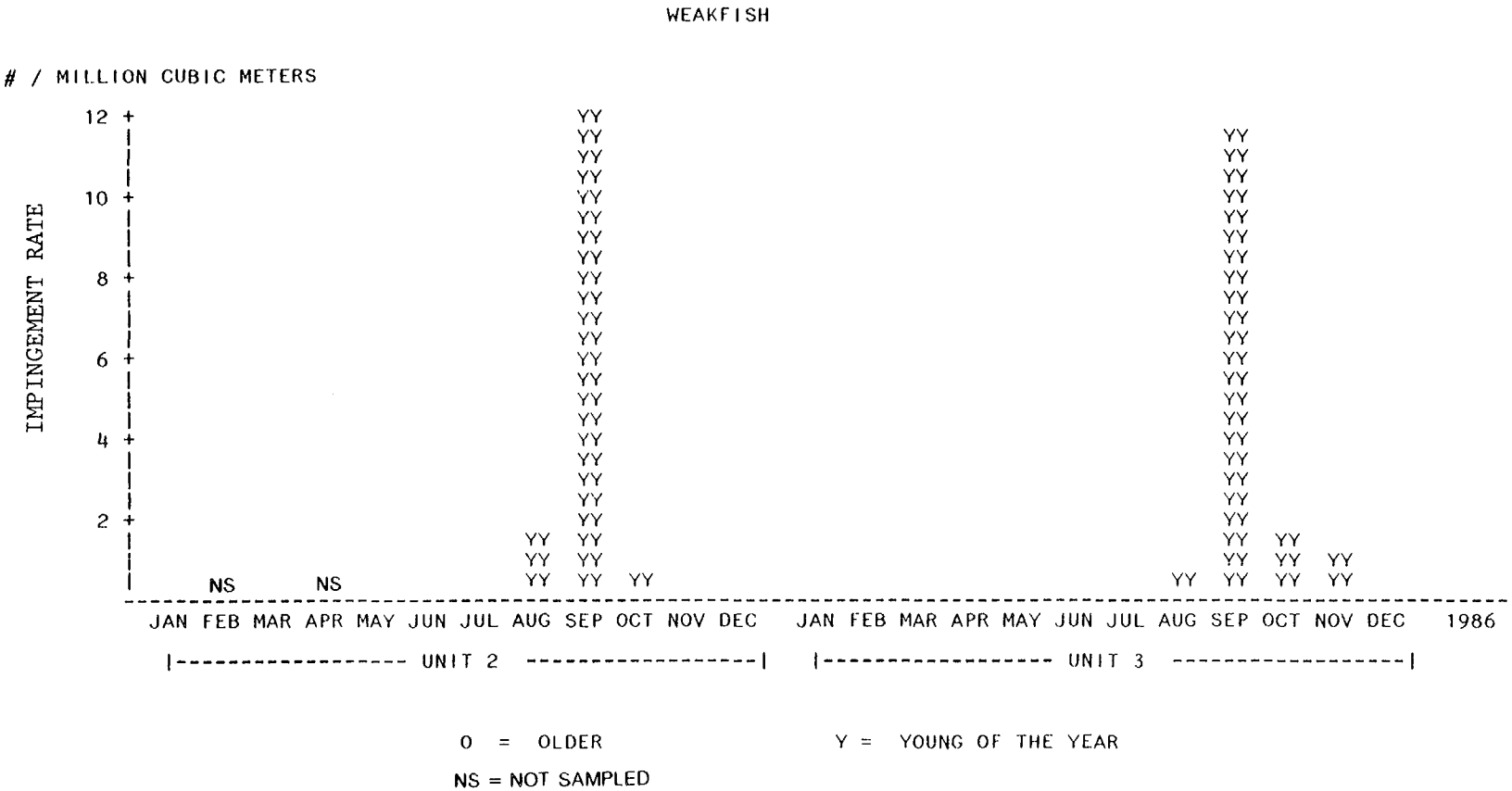



FIGURE 4-11. MONTHLY ADJUSTED IMPINGEMENT RATES FOR WEAKFISH AT INDIAN POINT UNITS 2 AND 3 IN 1986, ADJUSTED FOR COLLECTION EFFICIENCY.

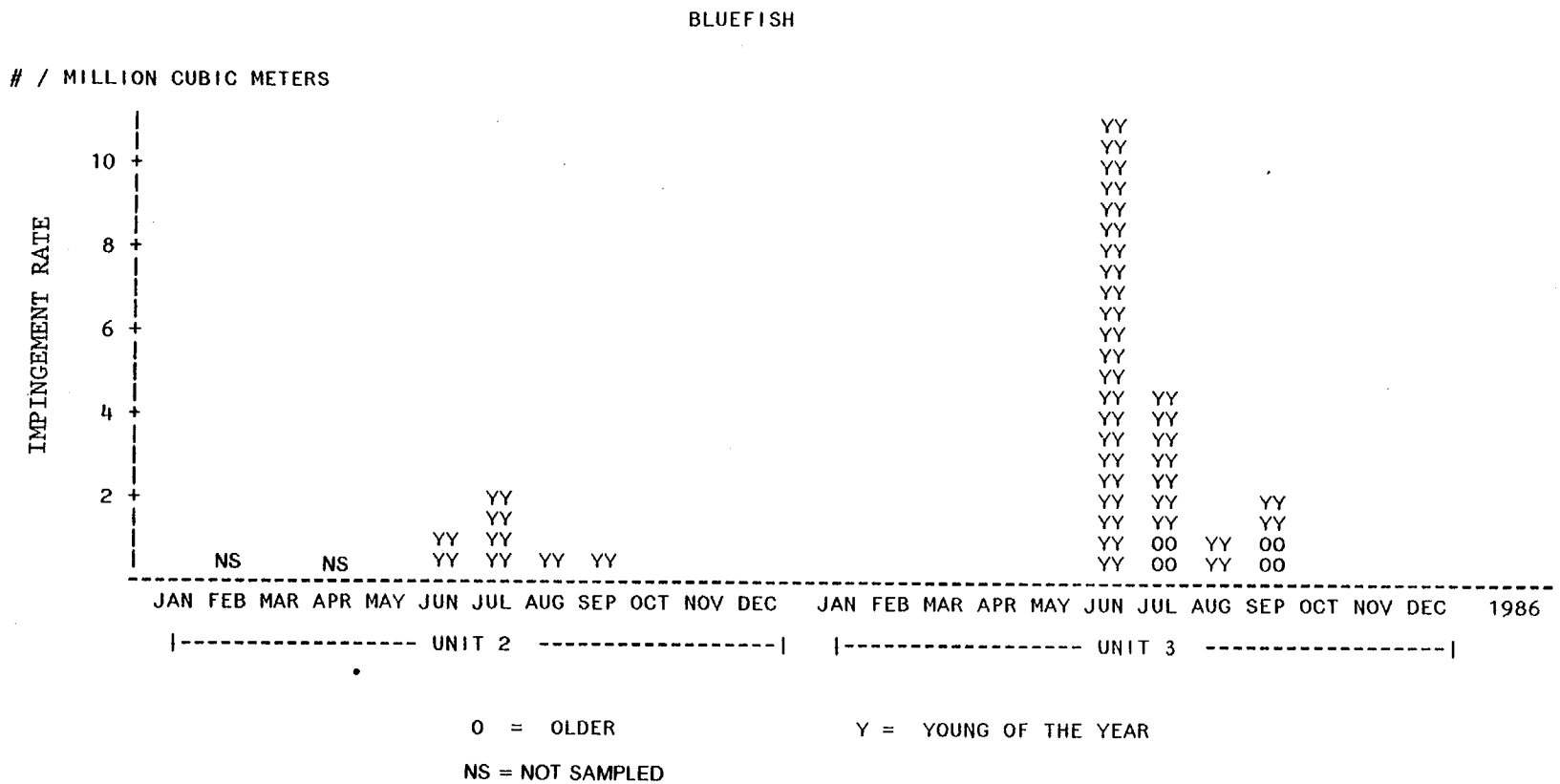
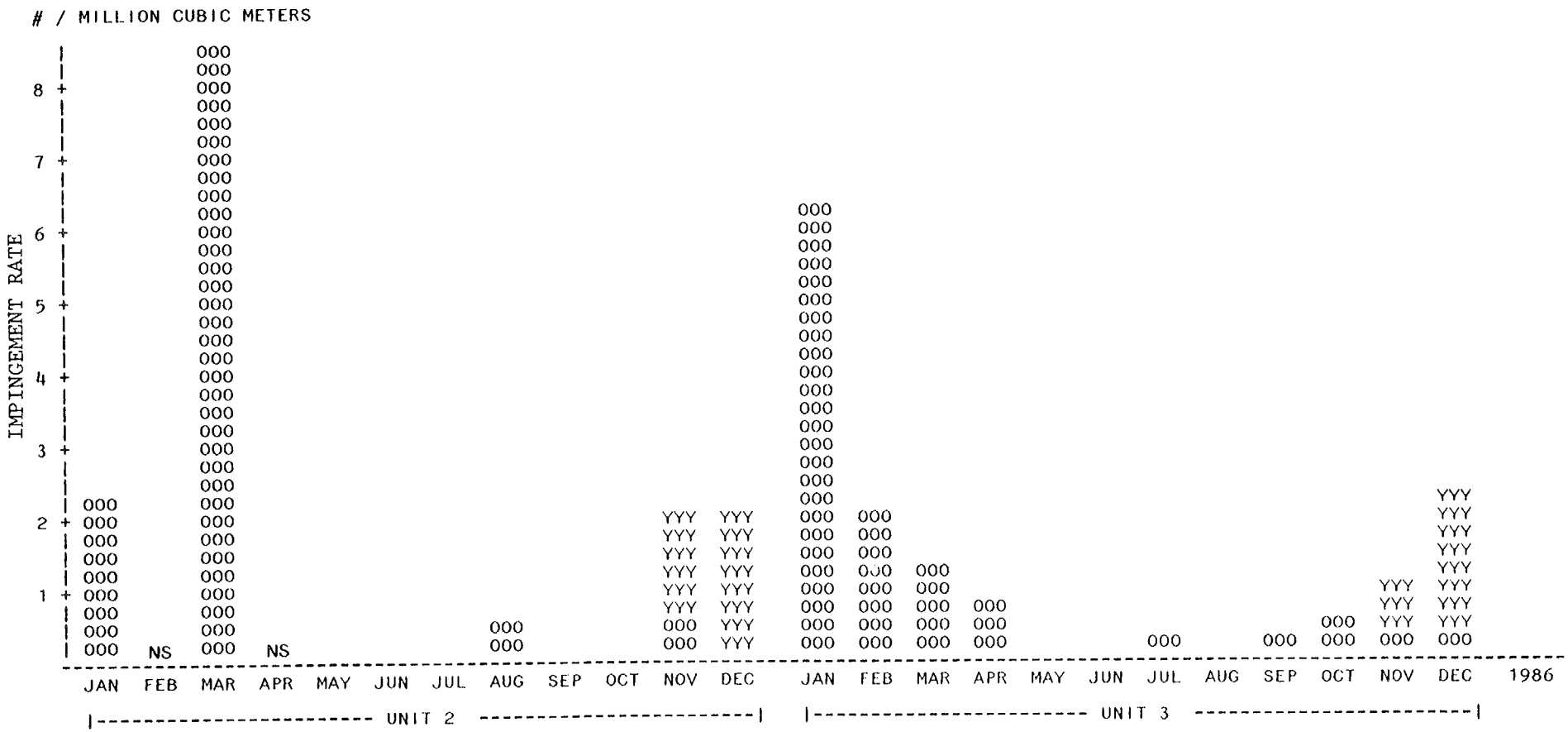



FIGURE 4-12. MONTHLY ADJUSTED IMPINGEMENT RATES FOR BLUEFISH AT INDIAN POINT UNITS 2 AND 3 IN 1986, ADJUSTED FOR COLLECTION EFFICIENCY.

WHITE CATFISH




O = OLDER

Y = YOUNG OF THE YEAR

NS = NOT SAMPLED

FIGURE 4-13. MONTHLY ADJUSTED IMPINGEMENT RATES FOR WHITE CATFISH AT INDIAN POINT UNITS 2 AND 3 IN 1986, ADJUSTED FOR COLLECTION EFFICIENCY.

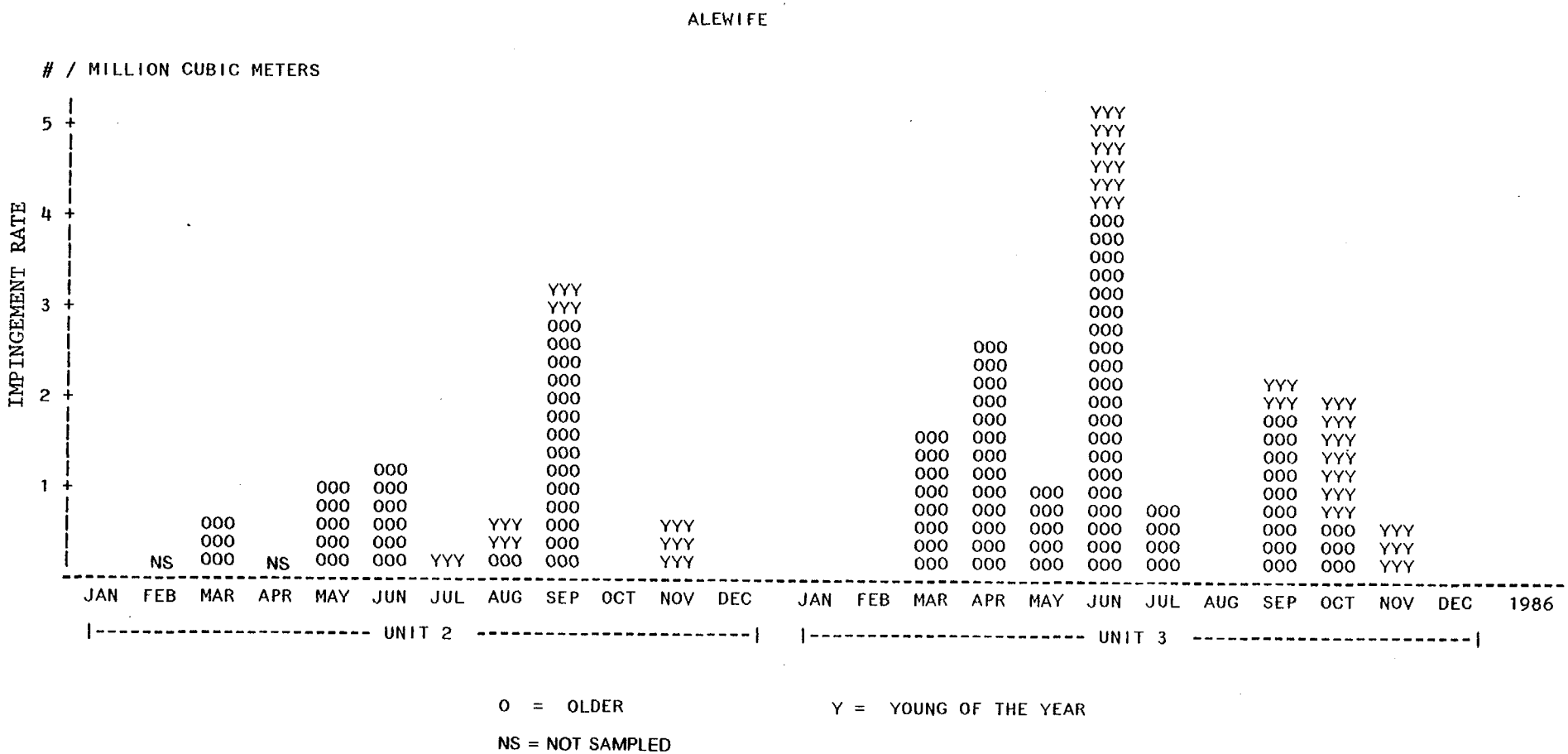



FIGURE 4-14. MONTHLY ADJUSTED IMPINGEMENT RATES FOR ALEWIFE AT INDIAN POINT UNITS 2 AND 3 IN 1986, ADJUSTED FOR COLLECTION EFFICIENCY.

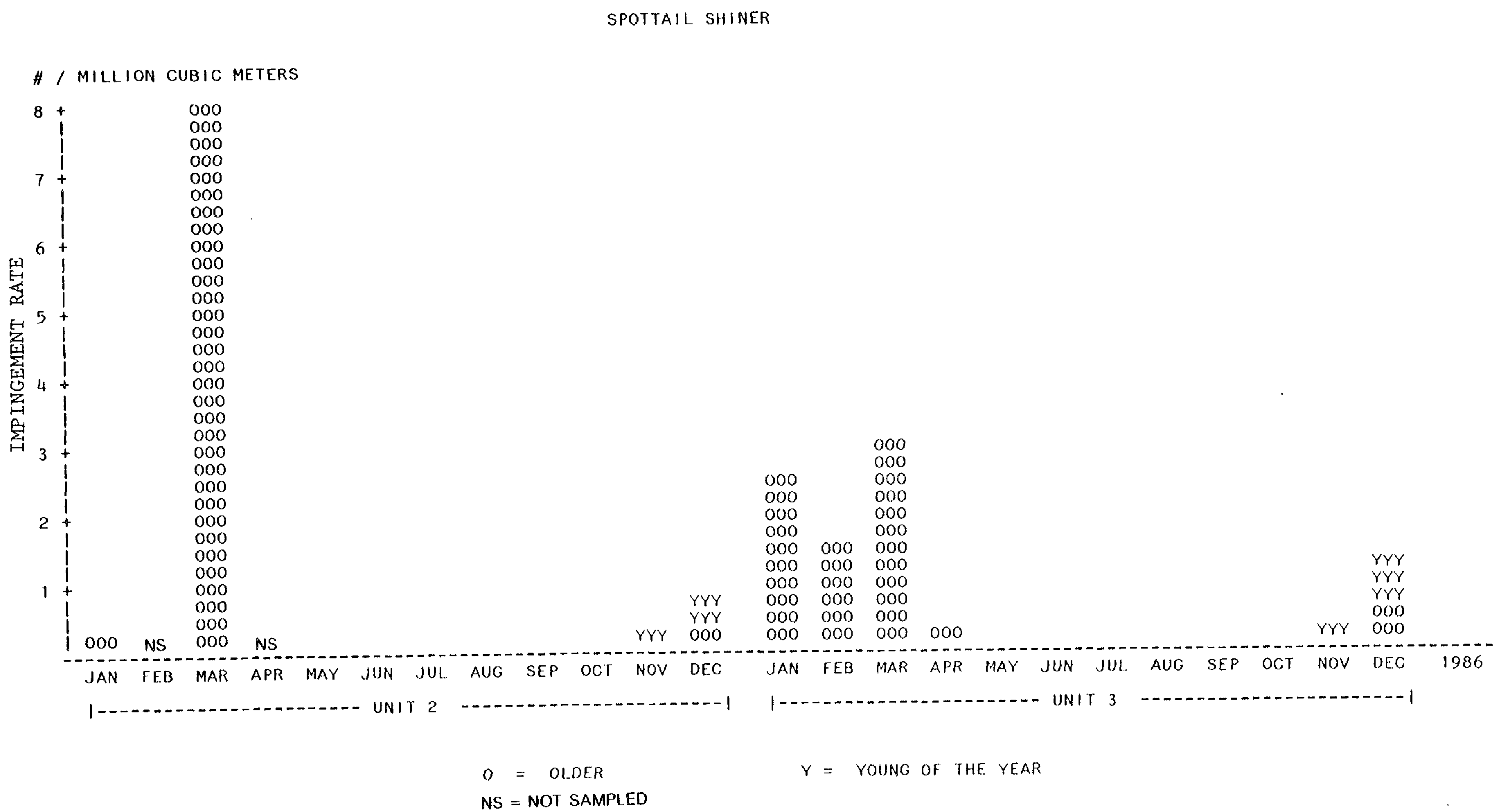



FIGURE 4-15. MONTHLY ADJUSTED IMPINGEMENT RATES FOR SPOTTAIL SHINER AT INDIAN POINT UNITS 2 AND 3 IN 1986, ADJUSTED FOR COLLECTION EFFICIENCY.

White perch were the most numerous fish impinged in 1986 (Table 4-7, Figure 4-3). Impingement rates were highest during winter 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 December. This seasonal pattern and the magnitude of monthly impingement rates were consistent with patterns and rates presented in previous years' reports (Con Edison 1983; MMES 1985; NAI 1984a, 1986).

Atlantic tomcod yearling and older fish were impinged during the winter stratum in low numbers (Figure 4-4). Young-of-the-year fish were considerably more abundant in impingement collections and occurred in highest numbers during May, June, and July, and subsequently declined in abundance during late summer and fall. This pattern was similar to patterns of tomcod impingement observed in previous years and is consistent with the described life history of the tomcod in which older fish spawn in shoal areas in the winter and young-of-the-year fish are first large enough to be impinged by late spring and early summer (TI 1980a). Peak monthly impingement rates for 1986 were within the range of peak rates recorded in previous years (Con Edison 1983; MMES 1984; NAI 1984a, 1986).

Bay anchovies were impinged from May through November with yearling and older fish most numerous during June through September and young-of-the-year fish most numerous during September through November (Figure 4-5). Bay anchovies spawn in the high salinity waters of the lower estuary primarily from June through August (NAI 1985). The yearling and older fish that were impinged beginning in May probably represent a portion of the bay anchovy population that utilize the Indian Point region as a feeding ground prior to spawning (NAI 1985). The young-of-the-year fish impinged from September through November most likely represent the dispersion of early life stages upstream into the lower salinity waters of the lower and middle estuary that are the bay

anchovy's nursery grounds. Peak monthly impingement rates and the seasonal pattern of impingement during 1986 were comparable to most previous years (Con Edison 1983; MMES 1985; NAI 1984a, 1986).

Hogchokers were impinged during most months in 1986 with peak impingement rates during June and September (Figure 4-6). Yearling and older fish comprised the majority of the total hogchoker impingement abundance with young-of-the-year recorded only in November. The seasonal pattern of hogchoker impingement differed from previous years in that the May peak observed in previous years (Con Edison 1983; MMES 1985; NAI 1984a, 1986) was not observed in 1986. Variations in seasonal abundance patterns, as observed with hogchokers in 1986, may be a result of annual variation in salt front position.

Blueback herring were impinged primarily during May and June, and October and November (Figure 4-7). The spring peak consisted primarily of yearling and older fish, and the larger fall peak consisted of young-of-the-year. Previous years impingement data showed similar results with maximum impingement rates of young-of-the-year blueback herring having occurred in the fall (Con Edison 1983; MMES 1985; NAI 1984a, 1986). Yearling and older fish migrate upriver during spring to spawn in the fresh water areas of the river above Catskill and are subject to impingement by Indian Point and other cooling water intakes which they pass on route. During fall, as young-of-the-year fish migrate down river toward high salinity waters, they too become vulnerable to impingement by these same cooling water intakes. Peak monthly impingement rates in 1986 (up to $61/10^6 m^3$) were at the low end of the range of peak monthly rates recorded from 1982 through 1985 (up to 38 to $620/10^6 m^3$, annually).

Rainbow smelt were impinged throughout the year at Indian Point except for February and September (Figure 4-8). Yearling and older fish were impinged from January through August with peak rates during March. Young-of-the-year fish were impinged from June through

December with peak impingement rates during June. Impingement patterns have been variable for this species in previous years with maximum impingement rates occurring in several different months (NAI 1984a). Peak monthly impingement rates in 1986 (up to $21/10^6 m^3$) were higher than peak monthly rates observed in past years (up to 4 to $16/10^6 m^3$).

American shad yearling and older were impinged during May in low numbers. Young-of-the-year fish were impinged from June through November with peak numbers in October and November (Figure 4-9). Fall peaks were also recorded in 1984 and 1985, while in 1982 and 1983 peak impingement rates occurred during summer (Con Edison 1983; MMES 1985; NAI 1984a, 1986). American shad spawn in the fresh water of the upper estuary, and shad eggs and larvae are concentrated in this region (NAI 1985). Transformation of the American shad post yolk-sac larvae to the juvenile stage begins around late June at about 25°C and juveniles subsequently become much more dispersed throughout the estuary. During fall as water temperatures drop, young-of-the-year shad actively emigrate from the estuary. The summer peaks observed in 1982 and 1983 may have been due to an earlier down stream dispersion of young-of-the-year fish during those years than subsequent years and perhaps a faster growth rate resulting in early impingement. The fall peaks in 1984, 1985, and 1986 reflected passage of fish through the Indian Point area during their outward migration from the estuary. Peak monthly impingement rates in 1986 were within the range of peak monthly rates presented in previous reports (Con Edison 1983; MMES 1985; NAI 1984a, 1986).

Striped bass exhibited a similar impingement pattern to white perch, however, impingement rates were much lower (Figure 4-10). Striped bass impingement rates were highest in January when yearling and older fish predominated. A large population of yearling and older

striped bass presumably overwinter in the deep waters of the lower estuary, such as that in the Indian Point area, and thus are more vulnerable to impingement at Indian Point during winter (TI 1980c). Impingement abundance of yearling and older striped bass subsequently declined through early summer. Young-of-the-year striped bass were impinged from July through December. This seasonal pattern of impingement was similar to the seasonal patterns described for previous years (Con Edison 1983; MMES 1985; NAI 1984a, 1986). Peak monthly impingement rates in 1986 (up to $16/10^6 m^3$) were at the low end of the range of peak monthly rates observed in previous years (up to 19 to $600/10^6 m^3$).

Weakfish were impinged at units 2 and 3 in 1986 only as young-of-the-year fish (Figure 4-11). Impingement occurred from August through November with the peak impingement rate during September. Weakfish spawn at the mouths of estuaries and the juveniles subsequently move upstream to utilize the low salinity water of the estuary as a nursery area (NAI 1985). Peak monthly impingement rates in 1986 (up to $12/10^6 m^3$) were lower than the extremely high peak impingement rates in 1983 (approximately $1500/10^6 m^3$ in August at unit 2) and were more consistent with the peak monthly rates observed in other years (up to 41 to $210/10^6 m^3$).

Bluefish were impinged at Indian Point from June through September (Figure 4-12). Yearling and older fish were impinged only at unit 3 in July and September. Young-of-the-year bluefish were impinged from June through September with peak impingement during June. Monthly impingement rates at Indian Point in 1986 were within the range presented in previous reports (Con Edison 1983; MMES 1985; NAI 1984a, 1986).

White catfish impingement was greatest during the winter and fall strata, as in past years (Figure 4-13). Yearling and older white catfish predominated during the winter stratum and young-of-the-year catfish during the fall stratum. Adult white catfish overwinter in deep water areas of the lower Hudson River such as Indian Point and during

spring move upstream into the low salinity and shallow water regions of the middle and upper estuary to spawn (TI 1981). Spawning occurs during spring in waters with salinities below 2 ppt (Perry and Avault 1968) and young-of-the-year fish are first present beginning around July and continuing through December with peak densities upstream of Indian Point (NAI 1985). Monthly adjusted impingement rates in 1986 were within the range observed in previous years.

Alewives were impinged from March through November (Figure 4-14). Yearling and older fish were recorded primarily from March through September and young-of-the-year from June through November. This was similar to previous years and corresponded with the generalized life history of the alewife in which spawning adults migrate upriver in the spring past Indian Point to spawn in fresh water, and both adults and young-of-the-year fish migrate downriver past Indian Point to the ocean in the fall (NAI 1985). Peak monthly impingement rates (up to $5/10^6 m^3$) were at the low end of the range of peak monthly rates observed in past years (up to $7\text{-}36/10^6 m^3$, annually).

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

A total of 7 Atlantic sturgeon were impinged at Indian Point during 1986 (Table 4-9). No shortnose sturgeon were impinged at either unit in 1986. Three Atlantic sturgeon were impinged during the winter stratum, two during the spring stratum, and two during the fall stratum. The fish ranged in total length from 427 to 788 mm and in weight from 274 to 1795 gm. Of the 7 fish impinged, 3 were collected alive (43% survival) and released back to the river.

TABLE 4-9. ATLANTIC STURGEON IMPINGED AT INDIAN POINT UNIT 2 AND UNIT 3 ON BOTH SAMPLE AND NON-SAMPLE DAYS DURING 1986.

| 1986 DATE | UNIT | SAMPLE | LENGTH (mmTL) | WEIGHT (grams) | CONDITION |
|---|---|---|---|---|---|
| 14 Feb | 3 | 3018 | 663 | 775 | Dead |
| 28 Feb | 3 | --[a] | 427 | 274 | Alive[b] |
| 13 Mar | 3 | -- | 788 | 1795 | Dead |
| 21 Apr | --[c] | -- | 455 | 454 | Dead |
| 6 Jul | 2[d] | 2076 | 466 | 380 | Alive |
| 30 Nov | 3 | -- | 445 | 409 | Dead |
| 5 Dec | 2 | 2349 | 474 | 525 | Alive |

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

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

[c]Unit was not recorded for this fish collected on a non-sample day

[d]Screen 26.

## 4.6 BLUE CRAB IMPINGEMENT

### 4.6.1 Blue Crab Impingement Daily Collections

Blue crabs were impinged at Indian Point during 1986 from January through March and May through November (Table 4-10). A total of 5205 crabs were collected, with a total weight of 601 kg. This number of crabs was within the range of numbers impinged at Indian Point since blue crab impingement monitoring began in 1983 (821 in 1983, 348 in 1984, 12,316 in 1985). Monthly impingement rates (no./$10^6 m^3$) unadjusted for collection efficiency were calculated to facilitate comparison of blue crab impingement between units 2 and 3 (Table 4-11). During the period May through November when most crabs were collected, impingement rates were notably higher at unit 2 than unit 3. Peak rates occurred during June, July and August, and ranged from 6.5 to 15.3/$10^6 m^3$ at unit 2 and from 1.3 to 4.1/$10^6 m^3$ at unit 3.

As anticipated, few blue crabs were impinged during the first four months of 1986 (Table 4-10). Impingement abundance and total weight first began to increase in May, peaked during August, and subsequently declined to zero by December. Blue crabs undergo extensive seasonal migrations related to mating and spawning (Lippson *et al.* 1980; Williams 1965) and the pattern of impingement abundance at Indian Point probably reflects this migration. Mature male and female crabs migrate into shallow and low salinity water during spring and early summer months to mate. Juvenile crabs hatched during the previous years spawning also move upstream and into the shallows. During fall as temperatures cool, females move down river to the higher salinity waters (20-32 ppt) to spawn (Lippson *et al.* 1980), while males remain upriver in the low-salinity waters throughout the year (Williams 1965). Females can spawn 2 to 9 months after mating but most often wait until the following spring. By late fall and winter, the male and juvenile crabs in the upriver regions move offshore into deeper water where they burrow into the bottom and become inactive.

TABLE 4-10. TOTAL NUMBERS AND WEIGHTS OF BLUE CRABS IMPINGED EACH MONTH AT INDIAN POINT DURING JANUARY - DECEMBER 1986.

| | | JAN | FEB | MAR | APR[a] | MAY | JUN | JUL | AUG | SEP | OCT | NOV | DEC[a] | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| COUNT | UNIT 2 | 1 | 0 | 1 | 0 | 8 | 150 | 1313 | 2016 | 809 | 116 | 16 | 0 | 4430 |
| | UNIT 3 | 0 | 2 | 0 | 0 | 5 | 58 | 62 | 28 | 531 | 85 | 4 | 0 | 775 |
| | TOTAL | 1 | 2 | 1 | 0 | 13 | 208 | 1375 | 2044 | 1340 | 201 | 20 | 0 | 5205 |
| WEIGHT (g) | UNIT 2 | 52 | 0 | 11 | 0 | 606 | 17025 | 106867 | 227347 | 127862 | 15695 | 1195 | 0 | 496660 |
| | UNIT 3 | 0 | 69 | 0 | 0 | 644 | 5694 | 3833 | 2599 | 78886 | 12265 | 465 | 0 | 104455 |
| | TOTAL | 52 | 69 | 11 | 0 | 1250 | 22719 | 110700 | 229946 | 206748 | 27960 | 1660 | 0 | 601115 |

[a] No Blue crabs were impinged in April or December 1986.

TABLE 4-11. MONTHLY BLUE CRAB IMPINGEMENT RATES (MEAN COUNT PER $10^6 m^3$) AT INDIAN POINT UNITS 2 AND 3 IN 1986, UNADJUSTED FOR COLLECTION EFFICIENCY.

| MONTH | UNIT 2 | UNIT 3 |
|---|---|---|
| JAN | 0.0173 | 0.0000 |
| FEB | NS | 0.0312 |
| MAR | 0.0911 | 0.0000 |
| APR | NS | 0.0000 |
| MAY | 0.1099 | 0.0553 |
| JUN | 1.6591 | 0.7436 |
| JUL | 10.3920 | 2.5682 |
| AUG | 15.2656 | 1.2733 |
| SEP | 6.4838 | 4.0629 |
| OCT | 1.0781 | 0.7000 |
| NOV | 0.3298 | 0.0480 |
| DEC | 0.0000 | 0.0000 |

Blue crab males accounted for approximately 77% of the blue crabs impinged at the Indian Point Station in 1986 (Tables 4-12, A-12, and A-14). A ratio of 3 males to 1 female is fairly typical of blue crab populations in low salinity areas like Indian Point (Williams 1965), since mature females enter these areas only to mate and subsequently return to high salinity waters in the lower estuary to spawn, while males remain in the low salinity waters after mating for the remainder of their lives. The percentage composition of males was relatively constant each month with males most dominant in June (91.8%) and least dominant in September (70.9%; Table 4-12). The increased number and proportion of female crabs in August and September may reflect the period during which mating occurs.

Sizes of blue crabs (carapace width) are presented in Appendix Table A-13 by month and 10-mm size class. Ninety-five percent of the blue crabs collected in impingement samples ranged from 70 mm to 179 mm with a modal size of 95 mm (12.8 percent of the total crabs measured). Blue crabs impinged at units 2 and 3 increased in modal carapace width from 95 mm in July to 155 mm in September. No increase in modal carapace width was observed in October, and by November, carapace width of the few crabs collected ranged from 30 to 189 mm with no distinct size mode.

Survival averaged 73.8% for crabs subsampled for survival (Table 4-12). This was similar to the average survival rates observed in 1983 and 1985 (72%; NAI 1984a and 1986) and was within the range of monthly rates observed in 1984 (47-100%; MMES 1985). Survival increased from a low of approximately 62% in May to 85% in July, subsequently dropped to 65% in September, and leveled off at 75% in October and November. This pattern was different from past years in which survival appeared to be influenced by water and air temperatures with lowest survival rates during summer and highest rates during spring and fall.

Blue crab condition followed the same pattern as survival. The highest proportion of intact crabs occurred in July (58.4%) and the

TABLE 4-12. MONTHLY COUNTS BY SEX, SURVIVAL, AND CONDITION OF BLUE CRABS IMPINGED AT INDIAN POINT DURING JANUARY THROUGH DECEMBER 1986.

| | MONTH | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | JAN | FEB | MAR | APR[a] | MAY | JUN | JUL | AUG | SEP | OCT | NOV | DEC[a] | TOTAL |
| Sex: | | | | | | | | | | | | | |
| Male | 0 | 2 | 1 | 0 | 11 | 191 | 1120 | 1569 | 950 | 152 | 16 | 0 | 4012 |
| Female | 1 | 0 | 0 | 0 | 2 | 16 | 254 | 472 | 388 | 49 | 4 | 0 | 1186 |
| Undetermined | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 3 | 2 | 0 | 0 | 0 | 7 |
| Total | 1 | 2 | 1 | 0 | 13 | 208 | 1375 | 2044 | 1340 | 201 | 20 | 0 | 5205 |
| Survival: | | | | | | | | | | | | | |
| Alive | 1 | 2 | 0 | 0 | 8 | 134 | 1167 | 1488 | 874 | 151 | 15 | 0 | 3840 |
| Dead | 0 | 0 | 1 | 0 | 5 | 74 | 208 | 556 | 461 | 50 | 5 | 0 | 1365 |
| Total | 1 | 2 | 1 | 0 | 13 | 208 | 1375 | 2044 | 1340 | 201 | 20 | 0 | 5205 |
| Condition: | | | | | | | | | | | | | |
| Intact | 1 | 2 | 1 | 0 | 6 | 94 | 803 | 919 | 378 | 79 | 8 | 0 | 2291 |
| Missing Parts | 0 | 0 | 0 | 0 | 7 | 114 | 572 | 1125 | 962 | 122 | 12 | 0 | 2914 |
| Total | 1 | 2 | 1 | 0 | 13 | 208 | 1375 | 2044 | 1340 | 201 | 20 | 0 | 5205 |

[a] No blue crabs were impinged in April or December 1986.

lowest proportion in September (28.2%; Figure 4-11). Overall, the proportion of intact crabs at units 2 and 3 averaged 44.0%.

Decreasing survival and condition from the highs in July to the lows in September corresponded to an increasing size frequency of crabs from a low in July (75% at 70-120 mm) to a high in September (68% at 120-170 mm; Table A-13). Similarly, in 1985 peak survival and condition which occurred in June corresponded with a population comprised largely of juveniles (73% at 20-80 mm) while the low survival and condition which occurred in July and August corresponded to a population consisting of larger crabs (87% at 80-160 mm; NAI 1986). These trends suggest that larger crabs may be subject to greater environmental or impingement related stresses than juvenile crabs and therefore lower impingement survival rates, however, the actual relationship between size and survival/condition status is not readily apparent..

### 4.6.2 Blue Crab Impingement Mark and Recapture Studies

A total of 2,280 blue crabs that were impinged at units 2 and 3, were tagged and released at the unit 1 pier located between units 2 and 3 from June through November. A total of 205 tagged crabs were recaptured during the period June through November (Table A-15); 11 crabs were released and recaptured twice, and 1 crab three times (Table 4-13). In addition, one crab was recaptured once at unit 2 and once at unit 3. Accounting for double and triple recaptures, the number of unique recaptures (i.e., each crab that was impinged one or more times) totaled 44 at unit 2 and 150 at unit 3 (Table 4-13). Nearly 40% of the crabs marked and released were recaptured within the first day after release (Table 4-14) and nearly 90% were recaptured within the first week. The recapture rate was slightly faster at unit 3 than at unit 2, since 76% of the recaptured crabs were caught at unit 2 within 6 days, while more than 90% of the crabs were recaptured within 6 days at unit 3 (Table 4-14).

TABLE 4-13. ADJUSTMENT OF BLUE CRAB IMPINGEMENT DATA AT UNITS 2 AND 3 BASED ON RELEASE/RECAPTURE DATA AND 6-DAY TAG LOSS DATA.

| UNIT | IMPINGE-MENT COUNT | NUMBER MARKED AND RELEASED | TOTAL NUMBER RECORDED RECAPTURES(a) | UNIQUE NUMBER RECAPTURED 2 TIMES(b) | UNIQUE NUMBER RECAPTURED 3 TIMES(c) | ADJUSTED UNIQUE RE-CAPTURES(d) | ADJUSTED FOR 6-DAY TAG LOSS(e) | PERCENT REIMPINGE-MENT(f) | IMPINGEMENT COUNT EXCLUDING RECAPTURES(g) |
|---|---|---|---|---|---|---|---|---|---|
| 2 | 4,430 | 1979 | 46 | 2 | 0 | 44 | 45 | 2.0 | 4,363.16 |
| 3 | 775 | 301 | 159 | 7 | 1 | 150 | 153 | 6.7 | 741.6 |
| 2 & 3 | 5,205 | 2,280* | 205 | 10** | 1 | - | - | - | 5,104.8 |

*All crabs were released at the unit 1 pier.
**One crab was recaptured once at unit 2 and once at unit 3.

Note:
d = a - (b+2C)
e = d + 2.2%, Table 4-14.
f = e ÷ 2280
g = dead impingement count + [alive impingement count × (1-f)]

TABLE 4-14. DAYS AT LARGE, NUMBER AND CUMULATIVE PERCENT OF TAGGED BLUE CRABS RECAPTURED AT THE INDIAN POINT STATION IN 1986.

| DAYS AT LARGE | UNIT 2 NUMBER RECAP-TURED | UNIT 2 CUMU-LATIVE % | UNIT 3 NUMBER RECAP-TURED | UNIT 3 CUMU-LATIVE % | UNIT 2 & 3 NUMBER RECAP-TURED | UNIT 2 & 3 CUMU-LATIVE % |
|---|---|---|---|---|---|---|
| 0 | | 0.0 | 2 | 1.3 | 2 | 1.0 |
| 1 | 16 | 34.8 | 61 | 40.6 | 77 | 39.3 |
| 2 | 5 | 45.7 | 33 | 61.9 | 38 | 58.2 |
| 3 | 6 | 58.7 | 24 | 77.4 | 30 | 73.1 |
| 4 | 2 | 63.0 | 13 | 85.8 | 15 | 80.6 |
| 5 | 4 | 71.7 | 5 | 89.0 | 9 | 85.1 |
| 6 | 2 | 76.1 | 2 | 90.3 | 4 | 87.1 |
| 7 | | 76.1 | 4 | 92.9 | 4 | 89.1 |
| 8 | 2 | 80.4 | 2 | 94.2 | 4 | 91.0 |
| 9 | 2 | 84.8 | 2 | 95.5 | 4 | 93.0 |
| 10 | | 84.8 | 2 | 96.8 | 1 | 93.5 |
| 12 | 1 | 87.0 | 2 | 98.1 | 3 | 95.0 |
| 13 | | 87.0 | 1 | 98.7 | 1 | 95.5 |
| 14 | 1 | 89.1 | | 98.7 | 1 | 96.0 |
| 15 | 1 | 91.3 | | 98.7 | 1 | 96.5 |
| 20 | | 91.3 | 1 | 99.4 | 1 | 97.0 |
| 22 | 2 | 95.7 | | 99.4 | 2 | 98.0 |
| 25 | 1 | 97.8 | | 99.4 | 1 | 98.5 |
| 27 | 1 | 100.0 | | 99.4 | 1 | 99.0 |
| 33 | | | 1 | 100.0 | 1 | 100.0 |
| TOTAL | 46 | | 155 | | 201 | |

Note:

Four crabs were recaptured with incomplete or illegible tags, and consequently, release date and days at large are unknown.

To obtain an estimate of the percent reimpingement of blue crabs released to the river using mark and recapture data, it is necessary to have some estimate of tag loss among the crabs used in the study. Tag loss was estimated in 1986 by a laboratory tag retention study. Crabs held in aquaria retained tags through the molting process, and only four crabs shed their tags out of the 121 crabs originally tagged and held (Table 4-15). Percent tag loss increased from 0.9% within the first day to 13.8% for crabs held 25 days (Table 4-15). Since most crabs tagged and released were recaptured within the first 6 days after release (76.1% at unit 2, 90.3% at unit 3; Table 4-14) a 6-day tag loss estimate of 2.2% was applied to the recapture counts to adjust for tag loss. A time-weighted tag loss rate was not calculated since there were only 4 crabs with missing tags in the tag loss study, and only 1 crab lost a tag in each time interval (Table 4-15). Percent reimpingement, therefore, adjusted for number of unique recaptures and 6-day tag loss was 2.0% at unit 2 and 6.7% at unit 3 (Table 4-13). Using the adjusted percent reimpingement estimates, the total impingement count of blue crabs in 1986, excluding recaptures, was 4,363 crabs at unit 2 and 741 crabs at unit 3 for a total of 5,105 blue crabs at both units combined (Table 4-13). Reimpingement accounted for only 1.9% of blue crabs impinged at Indian Point in 1986.

The influence that reimpinged blue crabs had on estimates of impingement survival and condition status was evaluated by comparing data sets that included and excluded tagged, recaptured crabs (Table A-12 through A-18). Impingement survival of marked and recaptured blue crabs (51.8% males and 39.7% females; Table A-16) was lower than impingement survival for impinged blue crabs excluding recaptures (76.2% males and 70.6% females; Table A-18). The proportion of intact blue crabs was also lower among the group of marked and recaptured crabs (21.9% males and 7.4% females; Table A-16) than for the group of impinged blue crabs excluding recaptures (46.8% males and 39.5% females; Table A-18). The reduced survival and condition status of recaptured crabs is attributable to the additional mechanical and physiological stresses exerted on crabs impinged and handled more than once.

TABLE 4-15. RESULTS OF THE BLUE CRAB TAG RETENTION STUDY, 1986 INDIAN POINT IMPINGEMENT PROGRAM.

| DAYS OBSERVED | NUMBER CRABS MISSING TAGS | CUMULATIVE NUMBER MISSING TAGS | NUMBER ALIVE AND RETAINING TAGS | TAG LOSS (%) |
|---|---|---|---|---|
| 0 | 0 | 0 | 121 | 0.0 |
| 1 | 1 | 1 | 113 | 0.9 |
| 6 | 1 | 2 | 91 | 2.2 |
| 13 | 1 | 3 | 67 | 4.3 |
| 25 | 1 | 4 | 25 | 13.8 |

Impingement survival and condition status or recaptured blue crabs lowered the overall survival rate and condition status of total impinged crabs. This was most notable at unit 3 where total impingement counts were low and recapture rates were high. For unit 3, the proportion of alive and intact blue crabs increased by an average of 3.8% and 6.2% (sexes combined), respectively, when data for recaptured blue crabs were excluded from the analysis (Tables A-14 and A-18). Recaptured crabs had almost no influence on survival and condition status of crabs at unit 2 where total impingement counts were high and recapture rates were low (Tables A-14 and A-18). For unit 2, the proportion of alive and intact blue crabs increased by 0.0% and 0.2% (sexes combined), respectively. For both units combined, the proportion of alive and intact crabs increased by 1.1%, each, when recaptured crabs were excluded from the analysis.

### 4.6.3 Blue Crab Nearfield Population Estimate

The blue crab tagging program, was designed primarily to estimate blue crab reimpingement, however, the data could also be used to estimate the blue crab population size in the vicinity of the Indian Point Station using a mark-recapture estimator, if the data satisfied the assumptions of the estimator. The Schumacher-Eschmeyer regression technique, the Schnabel method, and the modified Schnabel method were first examined because they are simple, closed population, multiple census estimators which permit tagging and recapture efforts to occur concurrently and under certain circumstances may be used for migratory populations.

Assumptions which must be satisfied to estimate the blue crab population in the vicinity of Indian Point units 2 and 3 using the Schumacher-Eschmeyer method or any of the above methods (Cormack 1968; Ricker 1975; MMES 1986) were:

1) tagged blue crabs suffer the same mortality as untagged blue crabs,

2) tagging does not affect blue crab catchability,

3) tagged blue crabs do not lose their marks,

4) all tags are recognized and reported,

5) natural tagging does not occur or is recognizable,

6) immigration and/or emigration is negligible in the study area i.e., the population is closed, and

7) tagged blue crabs are randomly distributed among untagged blue crabs or the distribution of fishing effort is proportional to the abundance of blue crabs.

With regard to assumption 1, no quantitative information is available to compare mortality rates for tagged blue crabs with untagged blue crabs. Both the tag retention study and the recapture study did not provide control data needed to distinguish mortality due to tagging from mortality due to holding or multiple impingement. However, it is reasonable to assume that tagged crabs had a higher mortality rate than untagged crabs. Reimpinged, tagged crabs had a higher morality rate and fewer of these crabs were intact when compared with untagged, impinged crabs (Section 4.6.2). While most of the mortality and physical damage of reimpinged, tagged crabs was probably due to the impingement process, the fact that reimpinged, tagged crabs suffered higher mortality and a smaller percentage were intact may indicate the tagging process puts these crabs at a physiological disadvantage and makes them more vulnerable to physical damage and mortality. To fully evaluate tagging mortality, it would be necessary to hold both tagged and untagged crabs in aquaria under similar conditions.

Assumption 2, that tagging does not affect blue crab catchability, may have been violated. There is evidence (further discussed in the evaluation of assumption 7) that tagged crabs may have behaved

differently from untagged crabs, particularly in the late summer-early fall period. This may be due to the release location of impinged crabs at the unit 1 pier between units 2 and 3, which apparently exposes these crabs to reimpingement at unit 3 as they disperse predominantly in a downriver direction.

The assumption that blue crabs do not lose their tags (Assumption 3) was evaluated in a laboratory holding experiment. As described in Section 4.6.2, a 6-day, blue crab tag shedding rate of 2.2% would be applied to any population estimate.

Assumption 4, the recognition and reporting of tags, was addressed by the Standard Operating Procedures and QA/QC procedures reviewed by Con Edison (NAI 1987). Since this program provided marking and recapture efforts, non-reporting of tags did not occur. The high visibility of the tags is attested to by the return of at least one blue crab tag by a recreational fisherman to the Hudson River Foundation as part of the 1985-86 Hudson River Striped Bass Tag Return Program (J. Waldman, pers. comm. 1987).

Assumption 5 was satisfied because the marking technique, insertion of an external tag, could not be imitated by natural conditions.

Immigration and emigration (Assumption 6) was substantial over the five month period that blue crabs were common in impingement collections at Indian Point units 2 and 3. Blue crabs are migratory in the Hudson River (see Section 4.6.1) and move into shallow, low salinity waters during the spring and early summer. As water temperatures cool in the fall, females crabs return to high salinity waters while males remain in the low salinity waters. This migration may be reflected in Table 4-16 and Figure 4-16 where recapture proportions (R/C) are variable but generally increased over the six month period. Recapture

TABLE 4-16. RECAPTURE OF TAGGED BLUE CRABS CROSS-CLASSIFIED BY RELEASE AND RECAPTURE MONTH FOR BLUE CRABS TAGGED AT INDIAN POINT NUCLEAR GENERATING STATION UNITS 2 AND 3, 22 JUNE THROUGH THE WEEK OF 23 NOVEMBER 1986.

| RELEASE MONTH | NUMBER MARKED (M) | STA-TISTIC | JUNE C = 52 | JULY C = 644 | AUGUST C = 1223 | SEPTEMBER C = 787 | OCTOBER C = 173 | NOVEMBER C = 9 | TOTAL 2888 |
|---|---|---|---|---|---|---|---|---|---|
| JUNE | 7 | R | 1 | | | | | | 1 |
| | | R/M | 0.1429 | | | | | | 0.1429 |
| | | R/C | 0.0192 | | | | | | |
| JULY | 492 | R | | 8 | 6 | | | | 14 |
| | | R/M | | 0.0163 | 0.0122 | | | | 0.0285 |
| | | R/C | | 0.0124 | 0.0049 | | | | |
| AUGUST | 921 | R | | | 22 | 3 | | | 25 |
| | | R/M | | | 0.0239 | 0.0033 | | | 0.0271 |
| | | R/C | | | 0.0180 | 0.0038 | | | |
| SEPTEMBER | 714 | R | | | | 141 | 7 | | 148 |
| | | R/M | | | | 0.1975 | 0.0098 | | 0.2073 |
| | | R/C | | | | 0.1792 | 0.0405 | | |
| OCTOBER | 139 | R | | | | | 20 | 2 | 22 |
| | | R/M | | | | | 0.1439 | 0.0144 | 0.1583 |
| | | R/C | | | | | 0.1156 | 0.2222 | |
| NOVEMBER | 7 | R | | | | | | 0 | 0 |
| | | R/M | | | | | | 0.0000 | 0.0000 |
| | | R/C | | | | | | 0.0000 | |
| TOTAL | 2280 | R | 1 | 8 | 28 | 144 | 27 | 2 | 210 |
| | | R/C | 0.0192 | 0.0124 | 0.0229 | 0.1830 | 0.1561 | 0.2222 | 0.0727 |

LEGEND:
R = number of blue crabs recaptured
M = number of blue crabs ≥ 100 mm TL marked and released
C = number of blue crabs ≥ 100 mm TL caught and examined for tags
R/M = recapture rate
R/C = recapture proportion

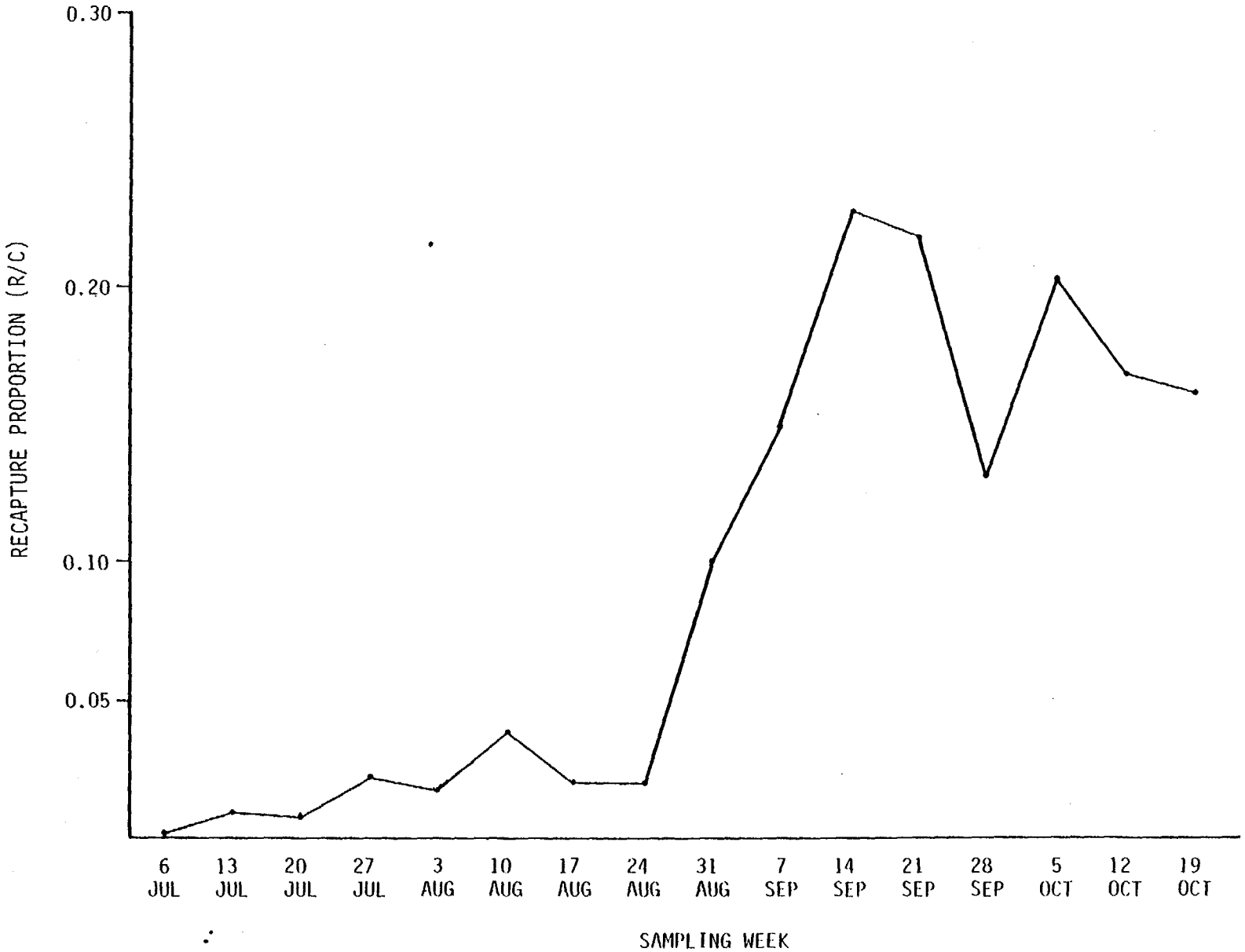



Figure 4-16. Weekly recapture proportions (R/C) for blue crabs marked and released from Indian Point Units 2 and

proportions (R/C) are the ratio of the sum of all previously tagged and released blue crabs that were recaptured in week i to the number of crabs that were caught and examined for tags in week i. A trend of increasing recapture proportions with time may indicate 1) a decreasing number of crabs were caught and examined for tags (i.e., the denominator C decreases relative to the numerator R), 2) an increase in the number of recaptured crabs due to their accumulation in the nearfield area (i.e., the numerator R increases relative to the denominator C), or 3) the number of recaptured crabs increases and the catch of blue crabs decreases (i.e., the numerator R increases and the denominator C decreases). Crab impingement counts generally decreased from early August through November at unit 2, however counts at unit 3 increased in September from relatively low numbers during the early summer and late fall (Table 4-17). The number of blue crabs recaptured at unit 3 also increased during September and recaptured crabs contributed nearly half (49%) of the blue crabs impinged at unit 3 during that month. The disproportionate increase in the number of blue crabs recaptured at unit 3 during September coupled with the decrease in impingement of blue crabs at unit 2 during late August and September resulted in the overall increase in weekly recapture proportions when counts from both units were combined (Figure 4-16). It is also possible that tagged crabs are not emigrating at the same rate as the untagged population which contributed to the increased number of blue crabs recaptured at unit 3 in late August through early October. In the summer (June-early August), blue crabs may be migrating through the Indian Point Station nearfield area. Tagged crabs would mingle with untagged, migratory crabs keeping the overall recapture proportion low. Relatively few tagged crabs appeared to remain in the Indian Point nearfield area beyond 6 days (Table 4-13) which further suggests tagged crabs are migrating out of the study area. The increase in recapture proportions during late August through early October suggests the migration rate of tagged blue crabs has slowed, exposing proportionally more tagged crabs to impingement. Higher recapture proportions for unit 3 during the fall also suggests that the predominant direction of migration may be

TABLE 4-17. NUMBER OF BLUE CRABS RECAPTURED (R), CAUGHT AND EXAMINED FOR TAGS (C), AND RECAPTURE PROPORTIONS (R/C) BY RECAPTURE WEEK FOR BLUE CRABS TAGGED AT INDIAN POINT NUCLEAR GENERATING STATION UNITS 2 AND 3, 22 JUNE THROUGH THE WEEK OF 23 NOVEMBER 1986.

| RECAPTURE WEEK | UNIT 2 | | | UNIT 3 | | |
|---|---|---|---|---|---|---|
| | R | C | R/C | R | C | R/C |
| 22 JUN | 0 | 43 | 0.0000 | 1 | 9 | 0.1111 |
| 29 JUN | 0 | 29 | 0.0000 | 0 | 4 | 0.0000 |
| 06 JUL | 0 | 57 | 0.0000 | 0 | 0 | 0.0000 |
| 13 JUL | 1 | 87 | 0.0115 | 0 | 2 | 0.0000 |
| 20 JUL | 1 | 194 | 0.0052 | 0 | 5 | 0.0000 |
| 27 JUL | 3 | 253 | 0.0119 | 3 | 13 | 0.2308 |
| 3 AUG | 6 | 378 | 0.0159 | 0 | 2 | 0.0000 |
| 10 AUG | 8 | 259 | 0.0309 | 2 | 3 | 0.6667 |
| 17 AUG | 7 | 379 | 0.0186 | 1 | 3 | 0.3333 |
| 24 AUG | 1 | 196 | 0.0051 | 3 | 3 | 1.0000 |
| 31 AUG | 5 | 103 | 0.0485 | 7 | 10 | 0.7000 |
| 7 SEP | 1 | 120 | 0.0083 | 25 | 57 | 0.4386 |
| 14 SEP | 3 | 169 | 0.0176 | 59 | 117 | 0.5043 |
| 21 SEP | 2 | 125 | 0.0160 | 42 | 86 | 0.4883 |
| 28 SEP | 7 | 64 | 0.1094 | 4 | 12 | 0.3333 |
| 5 OCT | 0 | 23 | 0.0000 | 7 | 17 | 0.4118 |
| 12 OCT | 1 | 7 | 0.0435 | 2 | 11 | 0.1818 |
| 19 OCT | 1 | 11 | 0.0909 | 4 | 20 | 0.2000 |
| 26 OCT | 0 | 3 | 0.0000 | 1 | 5 | 0.2000 |
| 2 NOV | 0 | 2 | 0.0000 | 2 | 2 | 1.0000 |
| 9 NOV | 0 | 3 | 0.0000 | 0 | 1 | 0.0000 |
| 16 NOV | 0 | 0 | 0.0000 | 0 | 0 | 0.0000 |
| 23 NOV | 0 | 1 | 0.0000 | 0 | 0 | 0.0000 |
| ALL WEEKS | 47 | 2506 | 0.0196 | 163* | 382 | 0.4372 |

downriver at that time, which agrees with migratory pattern described in Section 4.6.1. For these reasons, assumption 6 may be violated and a population estimate is not possible for the period blue crabs were abundant in the vicinity of Indian Point Station.

Assumption 7, that tagged blue crabs are randomly distributed among untagged crabs, or that the distribution of fishing effort is proportional to the abundance of blue crabs, also appears to be violated. Tagged blue crabs do not appear to be randomly distributed among the total crab population in the vicinity of Indian Point units 2 and 3, but were generally more abundant in the impingement collections at unit 3 (Table 4-17). The total number of recaptured crabs and recapture proportions (R/C) were greater at unit 3 although the number of crabs caught was greater at unit 2 (Table 4-17). Unit 3, therefore, recaptured a greater proportion of tagged crabs than would be expected if tagged crabs were randomly mixed with untagged crabs. Additionally, fishing effort is most likely independent of blue crab abundance, and is probably directly related to the duration of operation of the cooling water intake screens units 2 and 3.

Sexual differences in the migratory patterns of blue crabs in the Hudson River, and the apparent non-random mixing of tagged crabs with the rest of the blue crab population in the vicinity of Indian Point units 2 and 3 invalidate the use of closed population mark-recapture techniques to estimate population size. It may be possible in subsequent years to develop an estimate of blue crab populations based on a period of time during which the blue crab population may appear closed. The only equivalent relative index of blue crab population is the number of crabs impinged at units 2 and 3. However this index is highly dependent on plant operation and would be greatly affected by outages during periods of high blue crab abundance. For a mark-recapture population index to be useful, it should be for the same period of time each year and would provide a relative estimate of the blue crab population that would be independent of plant operation.

The use of "open" population estimators may overcome the difficulty in making a population estimate that the migratory life style of the blue crab imposes. An "open" population estimator such as the Jolly-Seber, Manly-Parr, and Parker methods can be used on a population that is undergoing either emigration or immigration (MMES 1986). However, these methods require that all crabs have the same probability of being reimpinged, or marked crabs are randomly distributed in the total population. Since these assumptions appear to be violated, it does not appear that "open" population estimators can be used to estimate crab populations at Indian Point units 2 and 3.

## 5.0 ANALYSIS OF FRESH VS PRESERVED SIZE MEASUREMENTS

The effect of formalin preservation on size measurements of abundant juvenile fishes was analyzed to determine whether tissue "shrinkage" caused by the preservative might affect comparison between entrainment (preserved) and impingement (unpreserved) measurements. Length, weight and body depth were measured on 121 Atlantic tomcod and 19 weakfish immediately following collections and at least 30 days after initial preservation in 10% formalin. Linear regression analysis was used to describe the relationship between paired fresh and preserved measurements of fish length, weight, and body depth data (Appendix Table A-20 and Figures 5-1 through 5-6). In every case the linear model showed a highly significant (0.0001 significance level) positive correlation ($r^2$ = 0.67-1.00) between the independent variable (fresh) and response variable (preserved). This correlation was notably stronger for Atlantic tomcod measurements ($r^2$ = 0.92-1.00) than for weakfish measurements ($r^2$ = 0.67-0.99).

Figures 5-1 through 5-6 show the correspondence between the regression line ($Y = a + b(X)$; where a = intercept and b = slope) and a reference plot of fresh equals preserved measurements ($Y = X$; intercept = 0, slope = 1). A t-test was performed for each relationship of fresh and preserved measurements to determine if the regression line established by the regression model differed significantly ($\alpha = 0.05$) from the reference line in intercept and slope. Regression lines for preserved and fresh length measurements of Atlantic tomcod and all preserved and fresh size measurements for weakfish did not differ significantly from the reference line (Table 5-1). Thus for these species and size parameters, preservation in 10% formalin did not significantly affect the size measurements after 30 days.

For preserved and fresh depth measurements of Atlantic tomcod, the regression line was found to vary significantly from the reference line in both its intercept and slope (Table 5-1 and Figure 5-1). The

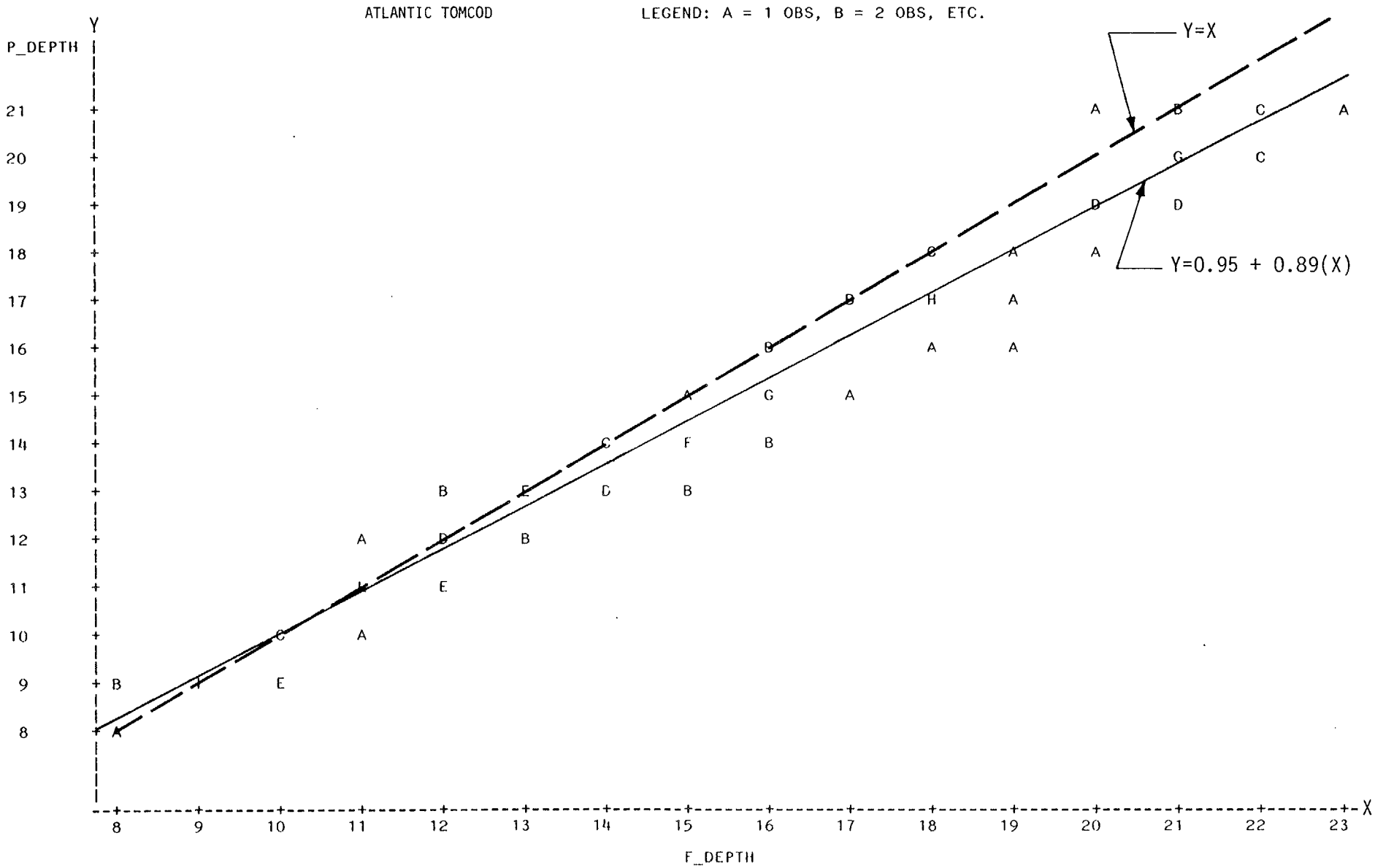



Figure 5-1. Preserved body depth (mm) as a function of fresh body depth (mm) for Atlantic tomcod obtained from the 1986 Indian Point Station Impingement Program.

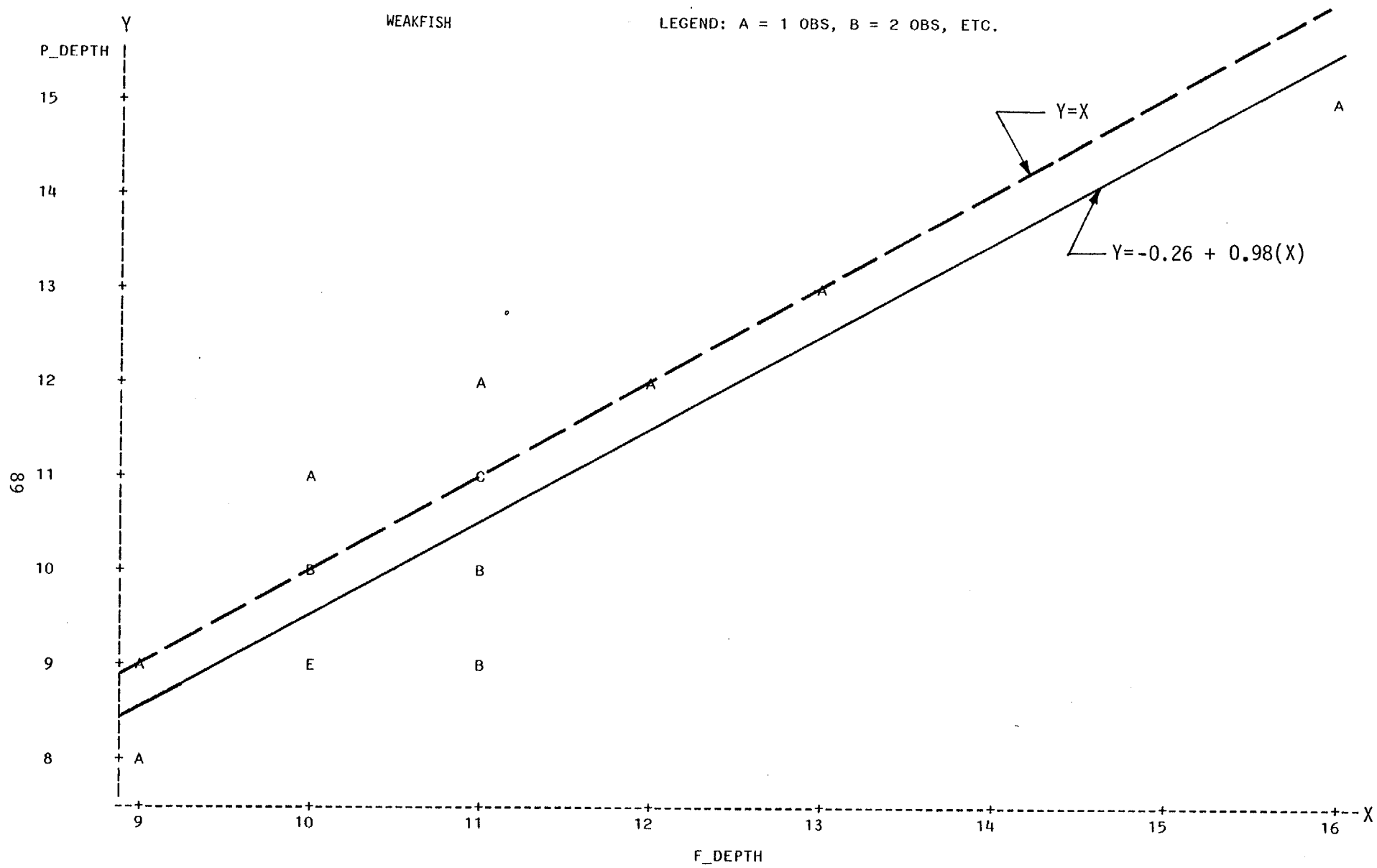



Figure 5-2. Preserved body depth (mm) as a function of fresh body depth (mm) for weakfish obtained from the 1986 Indian Point Station Impingement Program.

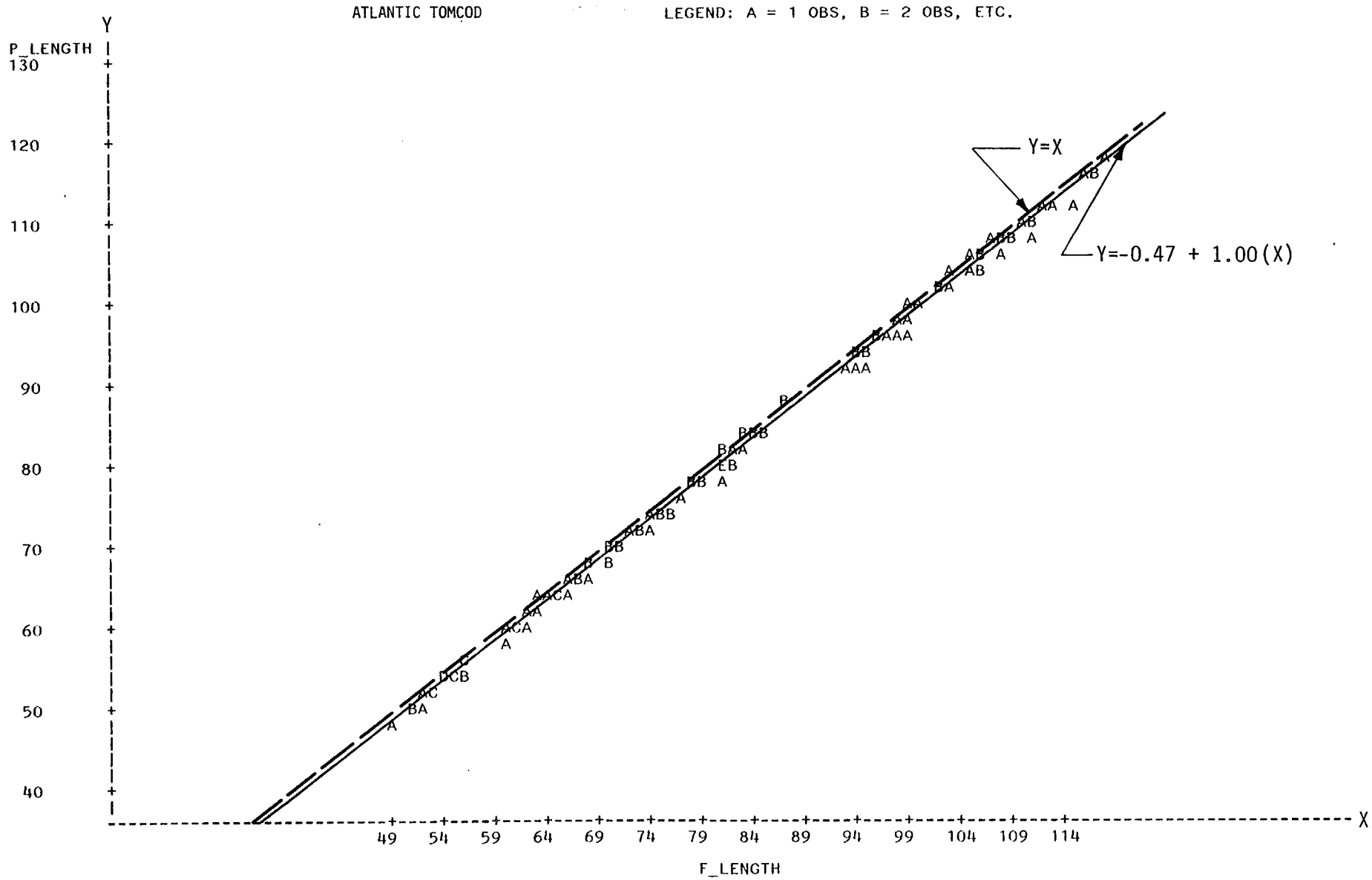



Figure 5-3. Preserved length (mm) as a function of fresh length (mm) for Atlantic tomcod obtained from the 1986 Indian Point Station Impingement Program.

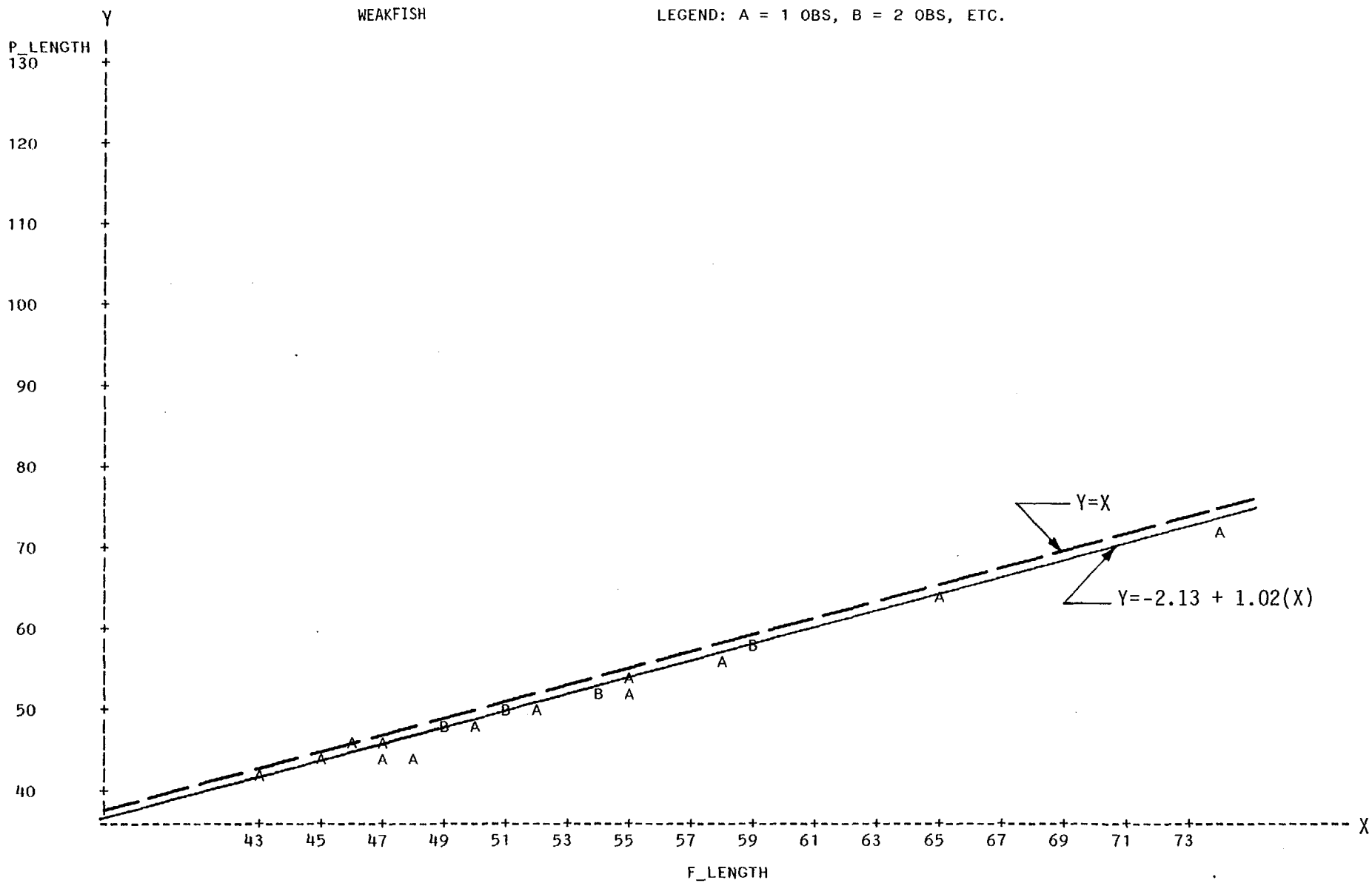



Figure 5-4. Preserved length (mm) as a function of fresh length (mm) for weakfish obtained from the 1986 Indian Point Station Impingement Program.

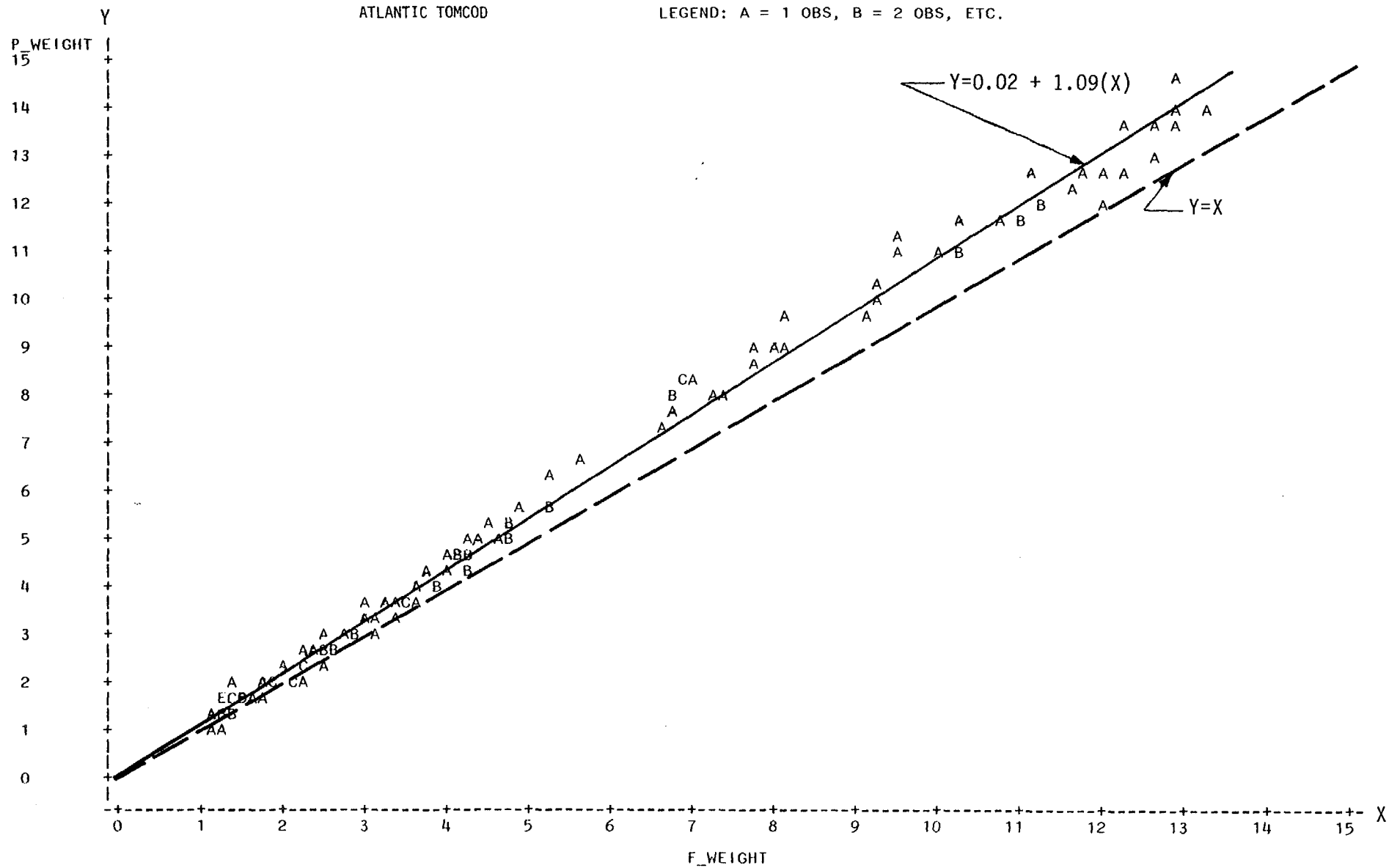



Figure 5-5. Preserved weight (gm) as a function of fresh weight (gm) for Atlantic tomcod obtained from the 1986 Indian Point Station Impingement Program.

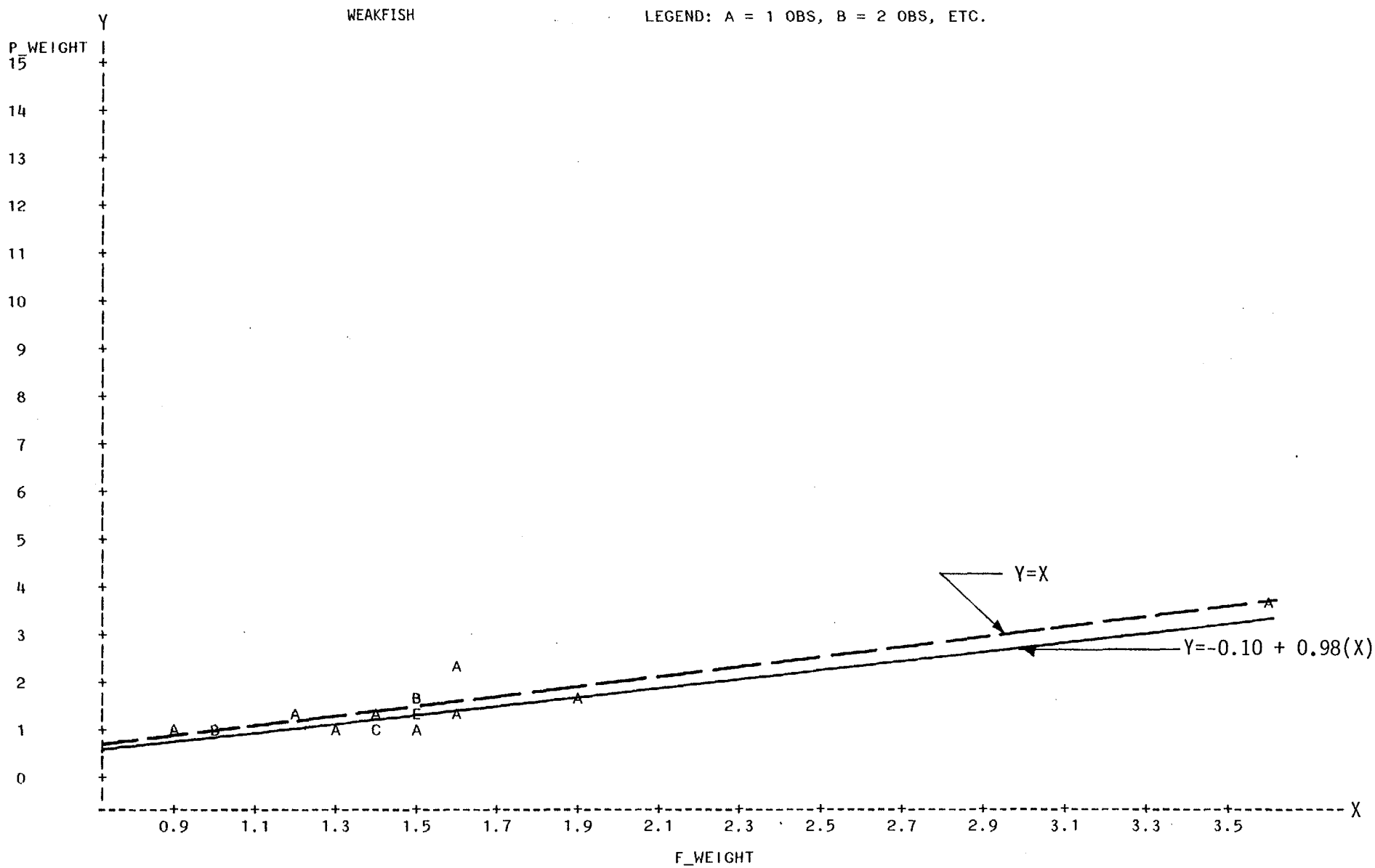



Figure 5-6. Preserved weight (gm) as a function of fresh weight (gm) for weakfish obtained from the 1986 Indian Point Station Impingement Program.

TABLE 5-1. RESULTS OF A t-TEST OF THE HYPOTHESIS THAT THE REGRESSION LINE FOR GROUPS OF PRESERVED (P) AND FRESH (F) SIZE MEASUREMENTS HAS AN INTERCEPT OF 0 AND A SLOPE OF 1.

| TAXON | VARIABLES | NO. FISH | T FOR HO: A) Intercept=0 B) Slope=1 | SIGNIFICANCE ($\alpha$=0.05) |
|---|---|---|---|---|
| Atlantic tomcod | Depth P vs F | 119 | A) 4.38 | S |
| | | | B) -7.73 | S |
| | Length P vs F | 121 | A) -1.49 | NS |
| | | | B) 0.00 | NS |
| | Weight P vs F | 121 | A) 0.28 | NS |
| | | | B) 10.82 | S |
| Weakfish | Depth P vs F | 19 | A) -0.19 | NS |
| | | | B) -0.20 | NS |
| | Length P vs F | 19 | A) -1.46 | NS |
| | | | B) 0.65 | NS |
| | Weight P vs F | 19 | A) -0.51 | NS |
| | | | B) -0.13 | NS |

S = Significant
NS = Not significant

regression line for weight measurements of Atlantic tomcod was also found to vary significantly from the reference line in slope but not in intercept (Table 5-1, Figure 5-5). These results indicate that both body depth and weight of Atlantic tomcod may be affected by preservation and may vary from the fresh values after a period of 30 days. Based on the percent bias between the regression line and reference line, the effect of preservation on tomcod body depth was found to be small (1.5% or less) for fish 8 to 10 mm in body depth but increasingly larger for deeper bodied fish (6.9% for fish 23 mm in body depth). This trend of increasing bias between preserved and fresh depth measurements is apparent in the regression and reference lines of Figure 5-1 which intersect at the low end of the depth measurements and subsequently diverge. The divergence of the regression line below the reference line illustrates that body depth was reduced by preservation. The bias in preserved weight of tomcod was more consistent throughout the range of weights measured and ranged from 11.0% for 1 gram fish to 9.1% for 15 gram fish. The divergence of the regression line above the reference line illustrates that weight was increased by preservation.

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## APPENDIX A

## DATA CALCULATION PROCEDURES

Impingement data were collected separately at intake screens 21-25, 26 and 31-36. In order to provide standard, unit-wide sample data for unit 2, impingement data from screens 21-25 and 26 were combined within each sample day. The impingement statistics calculated from unit 2 and 3 1986 data are:

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

An analysis of fresh and preserved fish length, weight and body depth was performed on Length Class 1 Atlantic tomcod and weakfish collected in impingement collections from late March through mid-August 1986. Data were tested to determine if differences existed between fresh and preserved measurements using a one-way analysis of variance and Duncan's Multiple Range Test. Paired size data were then compared using Linear Regression Analyses to determine the relationship between these data.

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):

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

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):

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

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

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

where C.V. = coefficient of variation,

$S.E._m$ = as defined above, 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:

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

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

$w_{hm}$ = total weight of fish actually 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.

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

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

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

where $A_{km}$ = Mean daily adjusted impingement rate for month k at unit m,

$n_{km}$ = number of sampling days in month k at unit m,

$C_{Likm}$ = count for length class L on day i of month k at unit m,

$V_{ikm}$ = volume of circulating water sampled on day i of month k at unit m, and

$E_{ikm}$ = collection efficiency on day i of month k at unit m.

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

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

where

$A_{km}$ = mean daily unadjusted impingement rate for month k at unit m,

$n_{km}$ = number of plant operating days in month k at unit m,

$C_{ikm}$ = count of blue crabs on day i of month k at unit m, and

$V_{ikm}$ = volume of circulating water sampled on day i of month k at unit m.

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

TABLE A-1
DAILY INTAKE TEMPERATURE (DEGREES CELSIUS)
AT THE INDIAN POINT GENERATING STATION DURING 1986

| DATE | UNIT 2 | UNIT 3 | MEAN | DATE | UNIT 2 | UNIT 3 | MEAN |
|---|---|---|---|---|---|---|---|
| 02JAN86 | 2.00 | 2.00 | 2.00 | 16APR86 | | 12.00 | 12.00 |
| 04JAN86 | | 2.50 | 2.50 | 17APR86 | | 13.00 | 13.00 |
| 07JAN86 | 2.20 | | 2.20 | 20APR86 | | 10.50 | 10.50 |
| 09JAN86 | 2.00 | 2.00 | 2.00 | 22APR86 | | 10.00 | 10.00 |
| 10JAN86 | 2.00 | 2.10 | 2.05 | 25APR86 | | 10.00 | 10.00 |
| 11JAN86 | 2.00 | | 2.00 | 29APR86 | | 11.00 | 11.00 |
| 12JAN86 | 2.40 | | 2.40 | 03MAY86 | 11.50 | 11.50 | 11.50 |
| 13JAN86 | 3.00 | | 3.00 | 24MAY86 | | 18.50 | 18.50 |
| 14JAN86 | 2.50 | 3.00 | 2.75 | 31MAY86 | 21.00 | | 21.00 |
| 15JAN86 | 1.00 | 1.00 | 1.00 | 06JUN86 | 22.00 | | 22.00 |
| 16JAN86 | | 1.50 | 1.50 | 08JUN86 | 21.90 | | 21.90 |
| 22JAN86 | | 2.50 | 2.50 | 09JUN86 | 23.00 | 24.00 | 23.50 |
| 25JAN86 | | 2.00 | 2.00 | 10JUN86 | 22.00 | 22.00 | 22.00 |
| 28JAN86 | | 3.00 | 3.00 | 10JUN86 | 22.00 | 22.00 | 22.00 |
| 29JAN86 | | 2.30 | 2.30 | 11JUN86 | 22.50 | 22.00 | 22.25 |
| 30JAN86 | | 3.50 | 3.50 | 12JUN86 | 23.00 | 22.50 | 22.75 |
| 01FEB86 | | 1.20 | 1.20 | 13JUN86 | 23.00 | 22.50 | 22.75 |
| 02FEB86 | | 1.00 | 1.00 | 14JUN86 | 22.00 | 22.50 | 22.25 |
| 06FEB86 | | 1.00 | 1.00 | 15JUN86 | 22.00 | | 22.00 |
| 07FEB86 | | 1.00 | 1.00 | 16JUN86 | 22.00 | 21.90 | 21.95 |
| 09FEB86 | | 3.00 | 3.00 | 17JUN86 | 21.90 | 21.90 | 21.90 |
| 12FEB86 | | 1.00 | 1.00 | 18JUN86 | 23.00 | 22.50 | 22.75 |
| 14FEB86 | | 0.50 | 0.50 | 19JUN86 | 23.00 | 22.00 | 22.50 |
| 17FEB86 | | 0.00 | 0.00 | 20JUN86 | 23.00 | 23.00 | 23.00 |
| 03MAR86 | | 2.00 | 2.00 | 21JUN86 | 23.00 | 23.10 | 23.05 |
| 05MAR86 | | 2.00 | 2.00 | 22JUN86 | 23.00 | 23.00 | 23.00 |
| 06MAR86 | | 2.00 | 2.00 | 23JUN86 | 23.70 | 24.80 | 24.25 |
| 08MAR86 | | 3.20 | 3.20 | 23JUN86 | 24.50 | 24.80 | 24.65 |
| 10MAR86 | | 4.30 | 4.30 | 24JUN86 | 24.50 | 28.50 | 26.50 |
| 11MAR86 | | 7.80 | 7.80 | 25JUN86 | 22.00 | 22.00 | 22.00 |
| 15MAR86 | | 4.30 | 4.30 | 26JUN86 | 22.00 | | 22.00 |
| 17MAR86 | | 1.50 | 1.50 | 27JUN86 | 22.50 | 22.00 | 22.25 |
| 19MAR86 | | 3.50 | 3.50 | 28JUN86 | 23.00 | 23.00 | 23.00 |
| 20MAR86 | 5.00 | 4.00 | 4.50 | 29JUN86 | 23.50 | | 23.50 |
| 21MAR86 | 4.00 | | 4.00 | 30JUN86 | 24.00 | 24.00 | 24.00 |
| 22MAR86 | 5.00 | 5.00 | 5.00 | 01JUL86 | 24.00 | | 24.00 |
| 23MAR86 | 4.50 | 5.50 | 5.00 | 02JUL86 | 23.50 | | 23.50 |
| 24MAR86 | 5.50 | | 5.50 | 03JUL86 | 24.50 | 25.00 | 24.75 |
| 25MAR86 | 5.00 | 6.00 | 5.50 | 04JUL86 | | 24.00 | 24.00 |
| 26MAR86 | 6.20 | | 6.20 | 05JUL86 | 24.50 | 24.50 | 24.50 |
| 27MAR86 | 6.00 | 6.00 | 6.00 | 06JUL86 | 25.00 | | 25.00 |
| 28MAR86 | 5.50 | | 5.50 | 07JUL86 | 25.00 | 25.50 | 25.25 |
| 30MAR86 | | 8.20 | 8.20 | 08JUL86 | 24.50 | 25.00 | 24.75 |
| 31MAR86 | 6.00 | | 6.00 | 09JUL86 | 24.00 | | 24.00 |
| 02APR86 | | 7.80 | 7.80 | 10JUL86 | 26.00 | 26.00 | 26.00 |
| 05APR86 | | 8.90 | 8.90 | 11JUL86 | 24.00 | 24.50 | 24.25 |
| 08APR86 | | 10.00 | 10.00 | 12JUL86 | 24.00 | 24.00 | 24.00 |
| 11APR86 | | 10.00 | 10.00 | 13JUL86 | 24.00 | 24.00 | 24.00 |

(CONTINUED)

TABLE A-1 (CONTINUED).

| DATE | UNIT 2 | UNIT 3 | MEAN | DATE | UNIT 2 | UNIT 3 | MEAN |
|---|---|---|---|---|---|---|---|
| 14JUL86 | 24.00 | 24.00 | 24.00 | 31AUG86 | 25.00 | | 25.00 |
| 15JUL86 | 24.00 | 24.00 | 24.00 | 01SEP86 | 25.50 | 24.50 | 25.00 |
| 16JUL86 | 24.00 | 24.00 | 24.00 | 02SEP86 | 26.10 | 24.00 | 25.05 |
| 17JUL86 | 24.00 | | 24.00 | 09SEP86 | 23.00 | 23.60 | 23.30 |
| 18JUL86 | 25.00 | 24.50 | 24.75 | 11SEP86 | 23.00 | 23.60 | 23.30 |
| 19JUL86 | 24.50 | 24.50 | 24.50 | 14SEP86 | 22.60 | 24.30 | 23.45 |
| 20JUL86 | 30.00 | 30.00 | 30.00 | 15SEP86 | 24.00 | | 24.00 |
| 21JUL86 | 26.00 | 26.00 | 26.00 | 16SEP86 | 22.20 | 22.50 | 22.35 |
| 22JUL86 | 25.50 | 26.00 | 25.75 | 17SEP86 | 22.30 | 22.20 | 22.25 |
| 23JUL86 | 25.00 | 25.50 | 25.25 | 18SEP86 | 22.00 | 22.20 | 22.10 |
| 24JUL86 | 27.00 | 27.00 | 27.00 | 19SEP86 | 22.80 | 22.70 | 22.75 |
| 25JUL86 | 26.00 | | 26.00 | 20SEP86 | 22.00 | 18.00 | 20.00 |
| 26JUL86 | 24.90 | 25.60 | 25.25 | 21SEP86 | 22.40 | 22.00 | 22.20 |
| 27JUL86 | 26.00 | 26.00 | 26.00 | 22SEP86 | 22.80 | 23.00 | 22.90 |
| 28JUL86 | 26.00 | 26.00 | 26.00 | 23SEP86 | 24.30 | 25.00 | 24.65 |
| 29JUL86 | 26.50 | 26.00 | 26.25 | 24SEP86 | 24.00 | | 24.00 |
| 30JUL86 | 26.00 | 26.50 | 26.25 | 25SEP86 | 24.40 | 24.40 | 24.40 |
| 31JUL86 | 25.00 | | 25.00 | 26SEP86 | 20.00 | 21.00 | 20.50 |
| 01AUG86 | 26.00 | 26.50 | 26.25 | 27SEP86 | 21.00 | 20.20 | 20.60 |
| 02AUG86 | 28.00 | 28.00 | 28.00 | 28SEP86 | 21.00 | 20.10 | 20.55 |
| 03AUG86 | 26.50 | | 26.50 | 29SEP86 | 22.00 | 20.00 | 21.00 |
| 04AUG86 | 26.50 | 26.50 | 26.50 | 30SEP86 | 22.50 | 23.00 | 22.75 |
| 05AUG86 | 27.00 | | 27.00 | 01OCT86 | 23.90 | 23.40 | 23.65 |
| 06AUG86 | 28.00 | 28.00 | 28.00 | 02OCT86 | 22.00 | 22.00 | 22.00 |
| 07AUG86 | 29.00 | | 29.00 | 03OCT86 | 21.10 | 21.80 | 21.45 |
| 08AUG86 | 27.00 | 27.00 | 27.00 | 04OCT86 | 22.00 | 22.00 | 22.00 |
| 09AUG86 | 33.00 | 26.00 | 29.50 | 05OCT86 | 22.30 | 23.00 | 22.65 |
| 10AUG86 | 26.00 | 26.80 | 26.40 | 06OCT86 | 20.00 | 21.00 | 20.50 |
| 11AUG86 | 26.00 | 26.00 | 26.00 | 07OCT86 | 20.30 | 20.70 | 20.50 |
| 12AUG86 | 25.50 | | 25.50 | 08OCT86 | 21.00 | 21.20 | 21.10 |
| 13AUG86 | 25.50 | 26.00 | 25.75 | 09OCT86 | | 21.00 | 21.00 |
| 14AUG86 | 25.90 | | 25.90 | 10OCT86 | 19.90 | 19.50 | 19.70 |
| 15AUG86 | 26.00 | 26.00 | 26.00 | 11OCT86 | 19.00 | 19.00 | 19.00 |
| 16AUG86 | 26.00 | 26.00 | 26.00 | 12OCT86 | 18.90 | 19.90 | 19.40 |
| 17AUG86 | 26.50 | 27.50 | 27.00 | 13OCT86 | 18.70 | 19.20 | 18.95 |
| 18AUG86 | 27.00 | 27.00 | 27.00 | 14OCT86 | 19.00 | 19.10 | 19.05 |
| 19AUG86 | 28.00 | | 28.00 | 15OCT86 | 17.90 | 17.70 | 17.80 |
| 20AUG86 | 27.00 | 27.00 | 27.00 | 16OCT86 | 18.20 | 17.90 | 18.05 |
| 21AUG86 | 26.00 | 26.00 | 26.00 | 17OCT86 | 18.00 | 18.00 | 18.00 |
| 22AUG86 | 26.00 | | 26.00 | 18OCT86 | 18.00 | 17.00 | 17.50 |
| 23AUG86 | 27.00 | | 27.00 | 19OCT86 | 19.00 | 18.50 | 18.75 |
| 24AUG86 | 26.00 | 26.00 | 26.00 | 20OCT86 | 17.80 | 18.30 | 18.05 |
| 25AUG86 | 25.00 | 25.00 | 25.00 | 21OCT86 | 18.00 | 18.70 | 18.35 |
| 26AUG86 | 26.00 | 25.00 | 25.50 | 22OCT86 | 17.90 | 17.90 | 17.90 |
| 27AUG86 | 26.00 | | 26.00 | 23OCT86 | 20.00 | 20.00 | 20.00 |
| 28AUG86 | 27.00 | | 27.00 | 24OCT86 | 19.00 | 18.00 | 18.50 |
| 29AUG86 | 26.00 | 26.00 | 26.00 | 25OCT86 | 16.00 | 16.00 | 16.00 |
| 30AUG86 | 26.00 | | 26.00 | 26OCT86 | 16.00 | 16.00 | 16.00 |

(CONTINUED)

TABLE A-1 (CONTINUED).

| DATE | UNIT 2 | UNIT 3 | MEAN |
|---|---|---|---|
| 27OCT86 | 15.80 | | 15.80 |
| 28OCT86 | 16.00 | | 16.00 |
| 29OCT86 | 16.20 | 16.10 | 16.15 |
| 30OCT86 | 16.00 | 16.00 | 16.00 |
| 31OCT86 | 15.50 | 15.50 | 15.50 |
| 01NOV86 | 15.50 | 16.00 | 15.75 |
| 03NOV86 | 14.80 | 15.10 | 14.95 |
| 04NOV86 | 15.00 | 15.90 | 15.45 |
| 05NOV86 | 15.00 | 15.00 | 15.00 |
| 06NOV86 | 16.50 | 16.00 | 16.25 |
| 07NOV86 | | 15.50 | 15.50 |
| 08NOV86 | 13.50 | | 13.50 |
| 09NOV86 | 15.00 | 14.50 | 14.75 |
| 10NOV86 | 15.10 | | 15.10 |
| 11NOV86 | 12.00 | | 12.00 |
| 13NOV86 | 12.00 | | 12.00 |
| 14NOV86 | 11.40 | | 11.40 |
| 15NOV86 | 10.00 | | 10.00 |
| 16NOV86 | 11.50 | 12.00 | 11.75 |
| 17NOV86 | 11.10 | | 11.10 |
| 18NOV86 | 11.80 | | 11.80 |
| 19NOV86 | 12.00 | | 12.00 |
| 19NOV86 | 12.00 | | 12.00 |
| 20NOV86 | 11.10 | | 11.10 |
| 21NOV86 | 12.80 | 12.20 | 12.50 |
| 22NOV86 | 11.00 | | 11.00 |
| 23NOV86 | 11.00 | | 11.00 |
| 26NOV86 | 12.00 | | 12.00 |
| 27NOV86 | 9.00 | | 9.00 |
| 28NOV86 | 6.00 | | 6.00 |
| 29NOV86 | 6.90 | 5.60 | 6.25 |
| 30NOV86 | 7.50 | | 7.50 |
| 01DEC86 | 6.00 | | 6.00 |
| 02DEC86 | 4.90 | | 4.90 |
| 03DEC86 | 6.50 | | 6.50 |
| 04DEC86 | 8.00 | 6.10 | 7.05 |
| 05DEC86 | 7.80 | 7.80 | 7.80 |
| 07DEC86 | 4.20 | | 4.20 |
| 08DEC86 | 5.50 | | 5.50 |
| 09DEC86 | 4.50 | | 4.50 |
| 10DEC86 | 5.70 | 6.50 | 6.10 |
| 11DEC86 | 4.00 | 6.80 | 5.40 |
| 12DEC86 | 4.20 | 5.30 | 4.75 |
| 13DEC86 | 2.50 | 3.00 | 2.75 |
| 15DEC86 | 5.50 | 6.50 | 6.00 |
| 16DEC86 | 5.50 | | 5.50 |
| 17DEC86 | 5.90 | | 5.90 |
| 18DEC86 | 5.90 | | 5.90 |
| 19DEC86 | 9.50 | | 9.50 |
| 20DEC86 | | 7.00 | 7.00 |
| 21DEC86 | 3.50 | 2.20 | 2.85 |
| 22DEC86 | 7.20 | | 7.20 |
| 23DEC86 | 5.00 | | 5.00 |
| 24DEC86 | 4.00 | | 4.00 |
| 26DEC86 | 4.00 | | 4.00 |
| 27DEC86 | 4.50 | | 4.50 |
| 28DEC86 | 4.50 | | 4.50 |
| 29DEC86 | 3.50 | | 3.50 |
| 30DEC86 | 3.20 | 2.00 | 2.60 |

TABLE A-2
DAILY INTAKE CONDUCTIVITY (MICRO SIEMANS)
AT THE INDIAN POINT GENERATING STATION DURING 1986

| DATE | UNIT 2 | UNIT 3 | MEAN | DATE | UNIT 2 | UNIT 3 | MEAN |
|---|---|---|---|---|---|---|---|
| 02JAN86 | 2055 | 2072 | 2064 | 16APR86 | | 145 | 145 |
| 04JAN86 | | 1547 | 1547 | 17APR86 | | 193 | 193 |
| 07JAN86 | 1012 | | 1012 | 20APR86 | | 5334 | 5334 |
| 09JAN86 | 2314 | 2279 | 2297 | 22APR86 | | 8832 | 8832 |
| 10JAN86 | 1899 | 1979 | 1939 | 25APR86 | | 3765 | 3765 |
| 11JAN86 | 1986 | | 1986 | 29APR86 | | 1432 | 1432 |
| 12JAN86 | 2080 | | 2080 | 03MAY86 | 581 | 774 | 678 |
| 13JAN86 | 1539 | | 1539 | 24MAY86 | | 559 | 559 |
| 14JAN86 | 2056 | 2025 | 2041 | 31MAY86 | 234 | | 234 |
| 15JAN86 | 607 | 607 | 607 | 06JUN86 | 763 | | 763 |
| 16JAN86 | | 684 | 684 | 08JUN86 | 425 | | 425 |
| 22JAN86 | | 3807 | 3807 | 09JUN86 | 374 | 346 | 360 |
| 25JAN86 | | 3971 | 3971 | 10JUN86 | 256 | 265 | 261 |
| 28JAN86 | | 1037 | 1037 | 10JUN86 | | 265 | 265 |
| 29JAN86 | | 527 | 527 | 11JUN86 | 252 | 271 | 262 |
| 30JAN86 | | 288 | 288 | 12JUN86 | 820 | 860 | 840 |
| 01FEB86 | | 252 | 252 | 13JUN86 | 358 | | 358 |
| 02FEB86 | | 250 | 250 | 14JUN86 | 238 | 241 | 240 |
| 06FEB86 | | 232 | 232 | 15JUN86 | 329 | | 329 |
| 07FEB86 | | 232 | 232 | 16JUN86 | 954 | 956 | 955 |
| 09FEB86 | | 233 | 233 | 17JUN86 | 558 | 595 | 577 |
| 12FEB86 | | 228 | 228 | 18JUN86 | 623 | 619 | 621 |
| 14FEB86 | | 230 | 230 | 19JUN86 | 311 | 371 | 341 |
| 17FEB86 | | 683 | 683 | 20JUN86 | 296 | 332 | 314 |
| 03MAR86 | | 2072 | 2072 | 21JUN86 | 208 | 205 | 207 |
| 05MAR86 | | 2434 | 2434 | 22JUN86 | 213 | 218 | 216 |
| 06MAR86 | | 1174 | 1174 | 23JUN86 | 205 | 450 | 328 |
| 08MAR86 | | 283 | 283 | 23JUN86 | 86 | 450 | 268 |
| 10MAR86 | | 982 | 982 | 24JUN86 | 86 | 167 | 127 |
| 11MAR86 | | 584 | 584 | 25JUN86 | 137 | 343 | 240 |
| 15MAR86 | | 1993 | 1993 | 26JUN86 | 180 | | 180 |
| 17MAR86 | | 211 | 211 | 27JUN86 | 189 | 185 | 187 |
| 19MAR86 | | 218 | 218 | 28JUN86 | 196 | 189 | 193 |
| 20MAR86 | 189 | 192 | 191 | 29JUN86 | 210 | | 210 |
| 21MAR86 | 182 | | 182 | 30JUN86 | 338 | 338 | 338 |
| 22MAR86 | 166 | 170 | 168 | 01JUL86 | 183 | | 183 |
| 23MAR86 | 173 | 166 | 170 | 02JUL86 | 729 | | 729 |
| 24MAR86 | 168 | | 168 | 03JUL86 | 1278 | 1524 | 1401 |
| 25MAR86 | 172 | 172 | 172 | 04JUL86 | | 3081 | 3081 |
| 26MAR86 | 168 | | 168 | 05JUL86 | 3724 | 4126 | 3925 |
| 27MAR86 | 169 | 169 | 169 | 06JUL86 | 4273 | | 4273 |
| 28MAR86 | 187 | | 187 | 07JUL86 | 3785 | 4023 | 3904 |
| 30MAR86 | | 162 | 162 | 08JUL86 | 3542 | 3984 | 3763 |
| 31MAR86 | 166 | | 166 | 09JUL86 | 3610 | | 3610 |
| 02APR86 | | 159 | 159 | 10JUL86 | 4001 | 4499 | 4250 |
| 05APR86 | | 172 | 172 | 11JUL86 | 3467 | 3794 | 3631 |
| 08APR86 | | 1980 | 1980 | 12JUL86 | 4118 | 4321 | 4220 |
| 11APR86 | | 172 | 172 | 13JUL86 | 4443 | 4931 | 4687 |

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TABLE A-2 (CONTINUED).

| DATE | UNIT 2 | UNIT 3 | MEAN | DATE | UNIT 2 | UNIT 3 | MEAN |
|---|---|---|---|---|---|---|---|
| 14JUL86 | 4118 | 4271 | 4195 | 31AUG86 | 3686 | | 3686 |
| 15JUL86 | 3833 | 3813 | 3823 | 01SEP86 | 5028 | 5032 | 5030 |
| 16JUL86 | 3396 | 3976 | 3686 | 02SEP86 | 6525 | | 6525 |
| 17JUL86 | 4454 | | 4454 | 09SEP86 | 6124 | | 6124 |
| 18JUL86 | 4981 | 5233 | 5107 | 11SEP86 | | | |
| 19JUL86 | 5022 | 4941 | 4982 | 14SEP86 | | | |
| 20JUL86 | 8367 | 8534 | 8451 | 15SEP86 | 4555 | | 4555 |
| 21JUL86 | 7878 | 6777 | 7328 | 16SEP86 | 3567 | 3671 | 3619 |
| 22JUL86 | 3254 | 3901 | 3578 | 17SEP86 | 4634 | 5066 | 4850 |
| 23JUL86 | 2181 | 2465 | 2323 | 18SEP86 | 5511 | 6438 | 5975 |
| 24JUL86 | 3146 | 3146 | 3146 | 19SEP86 | 4482 | 4564 | 4523 |
| 25JUL86 | 3318 | | 3318 | 20SEP86 | 3582 | 5883 | 4733 |
| 26JUL86 | 3244 | 2381 | 2813 | 21SEP86 | 4635 | 4812 | 4724 |
| 27JUL86 | 2225 | 2245 | 2235 | 22SEP86 | 5003 | 5190 | 5097 |
| 28JUL86 | 2040 | 2254 | 2147 | 23SEP86 | 4775 | 4831 | 4803 |
| 29JUL86 | 2270 | 2332 | 2301 | 24SEP86 | 4093 | | 4093 |
| 30JUL86 | 2293 | 2367 | 2330 | 25SEP86 | 2269 | 2309 | 2289 |
| 31JUL86 | 2311 | | 2311 | 26SEP86 | 2244 | 2175 | 2210 |
| 01AUG86 | 2020 | 2367 | 2194 | 27SEP86 | 2500 | 2884 | 2692 |
| 02AUG86 | 4610 | 4620 | 4615 | 28SEP86 | 3355 | 3695 | 3525 |
| 03AUG86 | 4328 | | 4328 | 29SEP86 | 4133 | 4200 | 4167 |
| 04AUG86 | 3980 | 3951 | 3966 | 30SEP86 | 4615 | 4982 | 4799 |
| 05AUG86 | 3060 | | 3060 | 01OCT86 | 6928 | 6589 | 6759 |
| 06AUG86 | 3907 | 3917 | 3912 | 02OCT86 | 7737 | 7419 | 7578 |
| 07AUG86 | 4453 | | 4453 | 03OCT86 | 7668 | 7663 | 7666 |
| 08AUG86 | 3443 | 3347 | 3395 | 04OCT86 | 7207 | 6889 | 7048 |
| 09AUG86 | 1508 | 1679 | 1594 | 05OCT86 | 7057 | 6540 | 6799 |
| 10AUG86 | 1083 | 835 | 959 | 06OCT86 | 4311 | 4112 | 4212 |
| 11AUG86 | 1532 | 1610 | 1571 | 07OCT86 | 3624 | 3267 | 3446 |
| 12AUG86 | 789 | | 789 | 08OCT86 | 3463 | 3212 | 3338 |
| 13AUG86 | 779 | 927 | 853 | 09OCT86 | | 2478 | 2478 |
| 14AUG86 | 792 | | 792 | 10OCT86 | 1977 | 1955 | 1966 |
| 15AUG86 | 634 | 678 | 656 | 11OCT86 | 1953 | 2010 | 1982 |
| 16AUG86 | 605 | 576 | 591 | 12OCT86 | 2093 | 2005 | 2049 |
| 17AUG86 | 551 | | 551 | 13OCT86 | 1523 | 1686 | 1605 |
| 18AUG86 | 746 | 689 | 718 | 14OCT86 | 2935 | 3425 | 3180 |
| 19AUG86 | 553 | | 553 | 15OCT86 | 1931 | 1533 | 1732 |
| 20AUG86 | 622 | 602 | 612 | 16OCT86 | 2550 | 2948 | 2749 |
| 21AUG86 | 420 | 420 | 420 | 17OCT86 | 2365 | 2295 | 2330 |
| 22AUG86 | 336 | | 336 | 18OCT86 | 2192 | 2181 | 2187 |
| 23AUG86 | 555 | | 555 | 19OCT86 | 2202 | 2008 | 2105 |
| 24AUG86 | 361 | 366 | 364 | 20OCT86 | 2097 | 2155 | 2126 |
| 25AUG86 | 313 | 314 | 314 | 21OCT86 | 1684 | 1625 | 1655 |
| 26AUG86 | 307 | 309 | 308 | 22OCT86 | 1572 | 1734 | 1653 |
| 27AUG86 | 591 | | 591 | 23OCT86 | 1442 | 1437 | 1440 |
| 28AUG86 | 348 | | 348 | 24OCT86 | 1355 | 1730 | 1543 |
| 29AUG86 | 644 | 683 | 664 | 25OCT86 | 940 | 1325 | 1133 |
| 30AUG86 | 2557 | | 2557 | 26OCT86 | 2036 | 1868 | 1952 |

(CONTINUED)

TABLE A-2 (CONTINUED).

| DATE | UNIT 2 | UNIT 3 | MEAN |
|---|---|---|---|
| 27OCT86 | 2693 | | 2693 |
| 28OCT86 | 4458 | | 4458 |
| 29OCT86 | 5734 | 5819 | 5777 |
| 30OCT86 | 7230 | 7109 | 7170 |
| 31OCT86 | 7188 | 7797 | 7493 |
| 01NOV86 | 8407 | 8194 | 8301 |
| 03NOV86 | 7178 | 7498 | 7338 |
| 04NOV86 | 7392 | 6642 | 7017 |
| 05NOV86 | 5914 | 5729 | 5822 |
| 06NOV86 | 5518 | 5398 | 5458 |
| 07NOV86 | | 4142 | 4142 |
| 08NOV86 | 3186 | | 3186 |
| 09NOV86 | 2710 | 3738 | 3224 |
| 10NOV86 | 1229 | | 1229 |
| 11NOV86 | 1452 | | 1452 |
| 13NOV86 | 825 | | 825 |
| 14NOV86 | 489 | | 489 |
| 15NOV86 | 457 | | 457 |
| 16NOV86 | 527 | 561 | 544 |
| 17NOV86 | 501 | | 501 |
| 18NOV86 | 424 | | 424 |
| 19NOV86 | | | |
| 19NOV86 | 323 | | 323 |
| 20NOV86 | 364 | | 364 |
| 21NOV86 | 236 | 247 | 242 |
| 22NOV86 | 263 | | 263 |
| 23NOV86 | 263 | | 263 |
| 26NOV86 | 218 | | 218 |
| 27NOV86 | | | |
| 28NOV86 | 207 | | 207 |
| 29NOV86 | 198 | 202 | 200 |
| 30NOV86 | 767 | | 767 |
| 01DEC86 | 184 | | 184 |
| 02DEC86 | 182 | | 182 |
| 03DEC86 | 191 | | 191 |
| 04DEC86 | 175 | 181 | 178 |
| 05DEC86 | 189 | 187 | 188 |
| 07DEC86 | 186 | | 186 |
| 08DEC86 | 187 | | 187 |
| 09DEC86 | 184 | | 184 |
| 10DEC86 | 187 | 183 | 185 |
| 11DEC86 | 195 | 180 | 188 |
| 12DEC86 | 197 | 191 | 194 |
| 13DEC86 | 187 | 192 | 190 |
| 15DEC86 | 185 | 189 | 187 |
| 16DEC86 | 179 | | 179 |
| 17DEC86 | 177 | | 177 |
| 18DEC86 | 262 | | 262 |
| 19DEC86 | 154 | | 154 |
| 20DEC86 | | 299 | 299 |
| 21DEC86 | 190 | 189 | 190 |
| 22DEC86 | 587 | | 587 |
| 23DEC86 | 521 | | 521 |
| 24DEC86 | 276 | | 276 |
| 26DEC86 | 974 | | 974 |
| 27DEC86 | 192 | | 192 |
| 28DEC86 | 1280 | | 1280 |
| 29DEC86 | 1681 | | 1681 |
| 30DEC86 | 1181 | 1540 | 1361 |

TABLE A-3
TOTAL NUMBERS ACTUALLY COLLECTED BY TAXON AND MONTH
AT INDIAN POINT UNIT 2 DURING 1986
(UNADJUSTED FOR COLLECTION EFFICIENCY)

| COMMOM NAME | JAN | FEB | MAR | APR | MAY | JUN | JUL | AUG | SEP | OCT | NOV | DEC | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ALEWIFE | | | 2 | | 2 | 20 | 12 | 8 | 27 | 20 | 30 | | 121 |
| AMERICAN EEL | 50 | | 3 | | | 28 | 23 | 3 | 4 | 35 | 47 | 76 | 269 |
| AMERICAN SHAD | 2 | | | | 1 | 36 | 51 | 64 | 33 | 169 | 176 | 1 | 533 |
| ATHERINID UNID. | | | | | | | | | 1 | | | | 1 |
| ATLANTIC CROAKER | | | | | | 1 | | | | 1 | | | 2 |
| ATLANTIC MENHADEN | | | | | | 201 | 3 | 2 | 39 | 9 | 5 | 1 | 260 |
| ATLANTIC NEEDLEFISH | | | | | | | | 1 | | | | | 1 |
| ATLANTIC SILVERSIDE | 2 | | | | | | | | | 6 | 2 | | 10 |
| ATLANTIC STURGEON | | | | | | | 1 | | | | | 1 | 2 |
| ATLANTIC TOMCOD | 23 | | 8 | | 1 | 832 | 3040 | 87 | 112 | 265 | 21 | 1046 | 5435 |
| BANDED KILLIFISH | 45 | | 15 | | | 4 | 3 | | 2 | 116 | 589 | 269 | 1043 |
| BAY ANCHOVY | | | | | | 1081 | 608 | 400 | 897 | 1287 | 51 | 2 | 4326 |
| BLACK CRAPPIE | 2 | | | | | | | | | | 2 | 1 | 5 |
| BLACK SEA BASS | | | | | | | | | | | 3 | | 3 |
| BLUEBACK HERRING | 4 | | | | 1 | 49 | 14 | 6 | 6 | 715 | 755 | 2 | 1552 |
| BLUEFISH | 3 | | | | | 20 | 107 | 11 | 5 | 3 | 1 | | 150 |
| BLUEGILL | 6 | | 3 | | 1 | 8 | | 4 | 11 | 80 | 88 | 33 | 234 |
| BROWN BULLHEAD | 6 | | 3 | | | 2 | | 1 | 2 | 4 | 5 | 8 | 31 |
| BUTTERFISH | | | | | | | | 1 | 4 | | | | 5 |
| CARP | 2 | | 4 | | | | | | | | 6 | 9 | 21 |
| CLUPEID UNID. | | | | | | 13 | | | | 6 | | | 19 |
| CREVALLE JACK | | | | | | | | | | 7 | 16 | | 23 |
| FOURSPINE STICKLEBACK | | | | | | 3 | | | | 2 | 28 | 8 | 41 |
| GIZZARD SHAD | 524 | | | | | | | | | | 24 | 53 | 601 |
| GOLDEN SHINER | | | 12 | | | 1 | | | | | | 2 | 15 |
| GOLDFISH | 2 | | 3 | | | | | | | | | 4 | 9 |
| GRAY SNAPPER | | | | | | | | | | 1 | | | 1 |
| HICKORY SHAD | | | | | | | | | 1 | | | | 1 |
| HOGCHOKER | 391 | | 13 | | 6 | 351 | 208 | 125 | 865 | 1526 | 659 | 39 | 4183 |
| LARGEMOUTH BASS | 1 | | | | | 1 | | | | 2 | 1 | 10 | 15 |
| LOGPERCH | | | | | | | | | | 20 | | | 20 |
| LOOKDOWN | | | | | | | | | 1 | 2 | 3 | | 6 |
| MUMMICHOG | | | 2 | | | | | | | | | | 2 |
| NAKED GOBY | 2 | | | | | | | | | 9 | 10 | 5 | 26 |
| NORTHERN PIKE | | | 1 | | | | | | | | | | 1 |
| NORTHERN PIPEFISH | | | | | 1 | | | 1 | | 5 | 1 | | 8 |
| OYSTER TOADFISH | | | | | | | | | | | 1 | | 1 |
| PUMPKINSEED | 60 | | 30 | | | 2 | | 1 | 3 | 240 | 436 | 85 | 857 |
| RAINBOW SMELT | 78 | | 75 | | | 220 | 88 | 39 | 2 | 76 | 200 | 56 | 834 |

(CONTINUED)

TABLE A-3 (CONTINUED).

| COMMOM NAME | JAN | FEB | MAR | APR | MAY | JUN | JUL | AUG | SEP | OCT | NOV | DEC | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| REDBREAST SUNFISH | | | | | | | | | 4 | 18 | 42 | 4 | 68 |
| ROUGH SILVERSIDE | | | | | | | | | 1 | | | | 1 |
| SEA LAMPREY | 2 | | | | | | | | 1 | | | 2 | 5 |
| SILVER LAMPREY | | | | | | | | | | | | 1 | 1 |
| SPOTTAIL SHINER | 13 | | 28 | | | | | | | | 42 | 119 | 202 |
| STRIPED BASS | 759 | | 5 | | | 18 | 106 | 26 | 22 | 68 | 87 | 315 | 1406 |
| STRIPED MULLET | 2 | | | | | | | | | | | | 2 |
| STRIPED SEAROBIN | | | | | | | | | | | 1 | | 1 |
| SUMMER FLOUNDER | | | | | | 121 | 29 | 5 | 8 | 27 | 5 | | 195 |
| TESSELLATED DARTER | | | 1 | | | | | | | | 20 | 32 | 53 |
| THREESPINE STICKLEBACK | | | 8 | | | | | | | | | | 8 |
| TIDEWATER SILVERSIDE | | | | | | | 1 | | | | 3 | 2 | 6 |
| WEAKFISH | | | | | | | 6 | 55 | 169 | 79 | 18 | | 327 |
| WHITE CATFISH | 120 | | 29 | | | 4 | 1 | 8 | 2 | 11 | 197 | 309 | 681 |
| WHITE PERCH | 47987 | | 542 | | 63 | 310 | 551 | 582 | 97 | 2369 | 7732 | 67721 | 127954 |
| WINTER FLOUNDER | 1 | | | | | | | | 1 | | | 1 | 3 |
| YELLOW PERCH | 5 | | 14 | | | | | | | 1 | 70 | 29 | 119 |
| TOTAL ALL TAXA | 50092 | | 801 | | 76 | 3326 | 4852 | 1430 | 2320 | 7179 | 11377 | 70246 | 151699 |

TABLE A-4
TOTAL NUMBERS ACTUALLY COLLECTED BY TAXON AND MONTH
AT INDIAN POINT UNIT 3 DURING 1986
(UNADJUSTED FOR COLLECTION EFFICIENCY)

| COMMOM NAME | JAN | FEB | MAR | APR | MAY | JUN | JUL | AUG | SEP | OCT | NOV | DEC | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ALEWIFE | | | 41 | 41 | 3 | 43 | 6 | | 48 | 42 | 7 | | 231 |
| AMERICAN EEL | 54 | 13 | 10 | 11 | 2 | 10 | 3 | 1 | 3 | 4 | 2 | 8 | 121 |
| AMERICAN SHAD | 3 | | 1 | 1 | | 26 | 81 | 3 | 85 | 428 | 183 | | 811 |
| ATLANTIC CROAKER | 1 | | | | | 2 | | | | | | | 3 |
| ATLANTIC MENHADEN | | | | | | 209 | 73 | 2 | 182 | 13 | 6 | 1 | 486 |
| ATLANTIC NEEDLEFISH | | | | | | | | | 1 | | | | 1 |
| ATLANTIC SILVERSIDE | 1 | | | | | | | | 1 | 2 | 1 | | 5 |
| ATLANTIC STURGEON | | 1 | | | | | | | | | | | 1 |
| ATLANTIC TOMCOD | 96 | 39 | 9 | 2 | 287 | 712 | 44 | 89 | 287 | 51 | 4 | 439 | 2059 |
| BANDED KILLIFISH | 11 | 2 | 14 | 1 | 1 | 2 | | | 1 | 2 | 13 | 9 | 56 |
| BAY ANCHOVY | | | | 1 | 45 | 1089 | 178 | 11 | 477 | 151 | 448 | 1 | 2401 |
| BLACK CRAPPIE | 5 | 2 | 4 | | | | | | | | | 1 | 12 |
| BLUEBACK HERRING | 4 | 1 | 1 | 15 | 58 | 150 | 12 | 2 | 42 | 645 | 763 | | 1693 |
| BLUEFISH | | | | | | 122 | 43 | 4 | 43 | 1 | | | 213 |
| BLUEGILL | 13 | 1 | 5 | 1 | 1 | 1 | | | | 8 | 10 | 6 | 46 |
| BROWN BULLHEAD | 2 | 2 | 6 | 2 | | 2 | 1 | | 1 | | 1 | 3 | 20 |
| BUTTERFISH | | | | | | | | | 10 | 5 | | | 15 |
| CARP | 11 | | 2 | | | | | | | | 1 | 2 | 16 |
| CLUPEID UNID. | | | | | | 3 | | | | | | | 3 |
| CREVALLE JACK | | | | | | | | | 3 | 7 | 7 | | 17 |
| FOURSPINE STICKLEBACK | | | | 1 | | | | | | | | | 1 |
| GIZZARD SHAD | 1983 | 35 | 1 | | | | | | | | 8 | 53 | 2080 |
| GOLDEN SHINER | 7 | 9 | 10 | 5 | | | | | | | | | 31 |
| GOLDFISH | 5 | 3 | 5 | | | 1 | | | | | | 1 | 15 |
| HICKORY SHAD | | | | | | | | | 1 | | | | 1 |
| HOGCHOKER | 235 | 22 | 16 | 372 | 57 | 98 | 22 | 12 | 2667 | 372 | 97 | 5 | 3975 |
| LARGEMOUTH BASS | 4 | | | | | | | | | | | 1 | 5 |
| LOOKDOWN | | | | | | | | | | | 2 | | 2 |
| MOONFISH | | | | | | | | | | 1 | | | 1 |
| MUMMICHOG | | | 1 | | | 1 | | | | | | | 2 |
| NORTHERN PIPEFISH | | | | 5 | | | 1 | | | | 1 | | 7 |
| NORTHERN SEAROBIN | | | | 1 | | | | | | | | | 1 |
| PUMPKINSEED | 110 | 42 | 75 | 9 | 5 | | 1 | | 3 | 18 | 15 | 4 | 282 |
| RAINBOW SMELT | 38 | 3 | 78 | 30 | 10 | 219 | 5 | 6 | 1 | 12 | 14 | 8 | 424 |
| RED HAKE | 10 | | 1 | 10 | | | | | | | | | 21 |
| REDBREAST SUNFISH | | | | | | | | | 1 | 1 | | | 2 |
| SEA LAMPREY | 1 | | | | | | | | | | | | 1 |
| SEAHORSE | | | | 1 | | | | | | | | | 1 |
| SMALLMOUTH BASS | | | | | | | | | | 1 | | 2 | 3 |

(CONTINUED)

TABLE A-4 (CONTINUED).

| COMMOM NAME | JAN | FEB | MAR | APR | MAY | JUN | JUL | AUG | SEP | OCT | NOV | DEC | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SPOTTAIL SHINER | 46 | 17 | 70 | 3 | | | | | | | 2 | 26 | 164 |
| SPOTTED HAKE | | | | | | | 1 | 1 | | | | | 2 |
| STRIPED BASS | 321 | 32 | 79 | 12 | 2 | 4 | 2 | 1 | 28 | 13 | 13 | 49 | 556 |
| STRIPED MULLET | 1 | | | | | | | | | | | | 1 |
| STRIPED SEAROBIN | | | | | | | | | | | 1 | | 1 |
| SUMMER FLOUNDER | | | | | | 13 | 7 | 6 | 14 | 8 | 1 | | 49 |
| TAUTOG | | | | | 1 | | | | | | | | 1 |
| THREESPINE STICKLEBAC | 1 | 7 | 22 | 1 | | | | | | | | | 31 |
| TIDEWATER SILVERSIDE | | | | | | 2 | | | | 1 | | 1 | 4 |
| WEAKFISH | | | | | | | 1 | 2 | 279 | 25 | 12 | | 319 |
| WHITE BASS X STRIPED BASS* | | | 1 | | | | | | | | | | 1 |
| WHITE CATFISH | 117 | 24 | 29 | 10 | | 1 | 1 | | 6 | 8 | 13 | 41 | 250 |
| WHITE PERCH | 25558 | 15102 | 9745 | 3234 | 963 | 425 | 89 | 44 | 150 | 677 | 576 | 6309 | 62872 |
| WHITE SUCKER | | | 1 | | | | | | | | | | 1 |
| WINTER FLOUNDER | 2 | | 1 | | | | | | | | | | 3 |
| YELLOW PERCH | 9 | 5 | 11 | 9 | 3 | | | | | | | 2 | 39 |
| TOTAL ALL TAXA | 28649 | 15362 | 10239 | 3778 | 1438 | 3135 | 571 | 184 | 4334 | 2496 | 2201 | 6972 | 79359 |

*White bass x striped bass hybrid verified by the New York State DEC.

TABLE A-5
TOTAL NUMBERS ACTUALLY COLLECTED BY TAXON AND MONTH
AT INDIAN POINT UNITS 2 & 3 COMBINED DURING 1986
(UNADJUSTED FOR COLLECTION EFFICIENCY)

| COMMOM NAME | JAN | FEB | MAR | APR | MAY | JUN | JUL | AUG | SEP | OCT | NOV | DEC | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ALEWIFE | | | 43 | 41 | 5 | 63 | 18 | 8 | 75 | 62 | 37 | | 352 |
| AMERICAN EEL | 104 | 13 | 13 | 11 | 2 | 38 | 26 | 4 | 7 | 39 | 49 | 84 | 390 |
| AMERICAN SHAD | 5 | | 1 | 1 | 1 | 62 | 132 | 67 | 118 | 597 | 359 | 1 | 1344 |
| ATHERINID UNID. | | | | | | | | | 1 | | | | 1 |
| ATLANTIC CROAKER | 1 | | | | | 3 | | | | 1 | | | 5 |
| ATLANTIC MENHADEN | | | | | | 410 | 76 | 4 | 221 | 22 | 11 | 2 | 746 |
| ATLANTIC NEEDLEFISH | | | | | | | | 1 | 1 | | | | 2 |
| ATLANTIC SILVERSIDE | 3 | | | | | | | | 1 | 8 | 3 | | 15 |
| ATLANTIC STURGEON | | 1 | | | | | 1 | | | | | 1 | 3 |
| ATLANTIC TOMCOD | 119 | 39 | 17 | 2 | 288 | 1544 | 3084 | 176 | 399 | 316 | 25 | 1485 | 7494 |
| BANDED KILLIFISH | 56 | 2 | 29 | 1 | 1 | 6 | 3 | | 3 | 118 | 602 | 278 | 1099 |
| BAY ANCHOVY | | | | 1 | 45 | 2170 | 786 | 411 | 1374 | 1438 | 499 | 3 | 6727 |
| BLACK CRAPPIE | 7 | 2 | 4 | | | | | | | | 2 | 2 | 17 |
| BLACK SEA BASS | | | | | | | | | | | 3 | | 3 |
| BLUEBACK HERRING | 8 | 1 | 1 | 15 | 59 | 199 | 26 | 8 | 48 | 1360 | 1518 | 2 | 3245 |
| BLUEFISH | 3 | | | | | 142 | 150 | 15 | 48 | 4 | 1 | | 363 |
| BLUEGILL | 19 | 1 | 8 | 1 | 2 | 9 | | 4 | 11 | 88 | 98 | 39 | 280 |
| BROWN BULLHEAD | 8 | 2 | 9 | 2 | | 4 | 1 | 1 | 3 | 4 | 6 | 11 | 51 |
| BUTTERFISH | | | | | | | | 1 | 14 | 5 | | | 20 |
| CARP | 13 | | 6 | | | | | | | | 7 | 11 | 37 |
| CLUPEID UNID. | | | | | | 16 | | | | 6 | | | 22 |
| CREVALLE JACK | | | | | | | | | 3 | 14 | 23 | | 40 |
| FOURSPINE STICKLEBACK | | | | 1 | | 3 | | | | 2 | 28 | 8 | 42 |
| GIZZARD SHAD | 2507 | 35 | 1 | | | | | | | | 32 | 106 | 2681 |
| GOLDEN SHINER | 7 | 9 | 22 | 5 | | 1 | | | | | | 2 | 46 |
| GOLDFISH | 7 | 3 | 8 | | | 1 | | | | | | 5 | 24 |
| GRAY SNAPPER | | | | | | | | | | 1 | | | 1 |
| HICKORY SHAD | | | | | | | | | 2 | | | | 2 |
| HOGCHOKER | 626 | 22 | 29 | 372 | 63 | 449 | 230 | 137 | 3532 | 1898 | 756 | 44 | 8158 |
| LARGEMOUTH BASS | 5 | | | | | 1 | | | | 2 | 1 | 11 | 20 |
| LOGPERCH | | | | | | | | | | 20 | | | 20 |
| LOOKDOWN | | | | | | | | | 1 | 2 | 5 | | 8 |
| MOONFISH | | | | | | | | | | 1 | | | 1 |
| MUMMICHOG | | | 3 | | | 1 | | | | | | | 4 |
| NAKED GOBY | 2 | | | | | | | | | 9 | 10 | 5 | 26 |
| NORTHERN PIKE | | | 1 | | | | | | | | | | 1 |
| NORTHERN PIPEFISH | | | | 5 | 1 | | 1 | 1 | | 5 | 2 | | 15 |
| NORTHERN SEAROBIN | | | | 1 | | | | | | | | | 1 |
| OYSTER TOADFISH | | | | | | | | | | | 1 | | 1 |

(CONTINUED)

TABLE A-5 (CONTINUED).

| COMMOM NAME | JAN | FEB | MAR | APR | MAY | JUN | JUL | AUG | SEP | OCT | NOV | DEC | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PUMPKINSEED | 170 | 42 | 105 | 9 | 5 | 2 | 1 | 1 | 6 | 258 | 451 | 89 | 1139 |
| RAINBOW SMELT | 116 | 3 | 153 | 30 | 10 | 439 | 93 | 45 | 3 | 88 | 214 | 64 | 1258 |
| RED HAKE | 10 | | 1 | 10 | | | | | | | | | 21 |
| REDBREAST SUNFISH | | | | | | | | | 5 | 19 | 42 | 4 | 70 |
| ROUGH SILVERSIDE | | | | | | | | | 1 | | | | 1 |
| SEA LAMPREY | 3 | | | | | | | | 1 | | | 2 | 6 |
| SEAHORSE | | | | 1 | | | | | | | | | 1 |
| SILVER LAMPREY | | | | | | | | | | | | 1 | 1 |
| SMALLMOUTH BASS | | | | | | | | | | 1 | | 2 | 3 |
| SPOTTAIL SHINER | 59 | 17 | 98 | 3 | | | | | | | 44 | 145 | 366 |
| SPOTTED HAKE | | | | | | | 1 | 1 | | | | | 2 |
| STRIPED BASS | 1080 | 32 | 84 | 12 | 2 | 22 | 108 | 27 | 50 | 81 | 100 | 364 | 1962 |
| STRIPED MULLET | 3 | | | | | | | | | | | | 3 |
| STRIPED SEAROBIN | | | | | | | | | | | 2 | | 2 |
| SUMMER FLOUNDER | | | | | | 134 | 36 | 11 | 22 | 35 | 6 | | 244 |
| TAUTOG | | | | | 1 | | | | | | | | 1 |
| TESSELLATED DARTER | | | 1 | | | | | | | | 20 | 32 | 53 |
| THREESPINE STICKLEBAC | 1 | 7 | 30 | 1 | | | | | | | | | 39 |
| TIDEWATER SILVERSIDE | | | | | | 2 | 1 | | | 1 | 3 | 3 | 10 |
| WEAKFISH | | | | | | | 7 | 57 | 448 | 104 | 30 | | 646 |
| WHITE BASS X STRIPED BASS * | | | 1 | | | | | | | | | | 1 |
| WHITE CATFISH | 237 | 24 | 58 | 10 | | 5 | 2 | 8 | 8 | 19 | 210 | 350 | 931 |
| WHITE PERCH | 73545 | 15102 | 10287 | 3234 | 1026 | 735 | 640 | 626 | 247 | 3046 | 8308 | 74030 | 190826 |
| WHITE SUCKER | | | 1 | | | | | | | | | | 1 |
| WINTER FLOUNDER | 3 | | 1 | | | | | | 1 | | | 1 | 6 |
| YELLOW PERCH | 14 | 5 | 25 | 9 | 3 | | | | | 1 | 70 | 31 | 158 |
| TOTAL ALL TAXA | 78741 | 15362 | 11040 | 3778 | 1514 | 6461 | 5423 | 1614 | 6654 | 9675 | 13578 | 77218 | 231058 |

*White bass x striped bass hybrid verified by the New York State DEC.

TABLE A-6
TOTAL NUMBERS ACTUALLY COLLECTED BY TAXON AND SEASONAL SAMPLING STRATUM
AT INDIAN POINT UNIT 2 DURING 1986
(UNADJUSTED FOR COLLECTION EFFICIENCY)

| COMMOM NAME | WINTER | SPRING | SUMMER | FALL | TOTAL |
|---|---|---|---|---|---|
| ALEWIFE | 2 | 22 | 47 | 50 | 121 |
| AMERICAN EEL | 53 | 28 | 30 | 158 | 269 |
| AMERICAN SHAD | 2 | 37 | 148 | 346 | 533 |
| ATHERINID UNID. | | | 1 | | 1 |
| ATLANTIC CROAKER | | 1 | | 1 | 2 |
| ATLANTIC MENHADEN | | 201 | 44 | 15 | 260 |
| ATLANTIC NEEDLEFISH | | | 1 | | 1 |
| ATLANTIC SILVERSIDE | 2 | | | 8 | 10 |
| ATLANTIC STURGEON | | | 1 | 1 | 2 |
| ATLANTIC TOMCOD | 31 | 833 | 3239 | 1332 | 5435 |
| BANDED KILLIFISH | 60 | 4 | 5 | 974 | 1043 |
| BAY ANCHOVY | | 1081 | 1905 | 1340 | 4326 |
| BLACK CRAPPIE | 2 | | | 3 | 5 |
| BLACK SEA BASS | | | | 3 | 3 |
| BLUEBACK HERRING | 4 | 50 | 26 | 1472 | 1552 |
| BLUEFISH | 3 | 20 | 123 | 4 | 150 |
| BLUEGILL | 9 | 9 | 15 | 201 | 234 |
| BROWN BULLHEAD | 9 | 2 | 3 | 17 | 31 |
| BUTTERFISH | | | 5 | | 5 |
| CARP | 6 | | | 15 | 21 |
| CLUPEID UNID. | | 13 | | 6 | 19 |
| CREVALLE JACK | | | | 23 | 23 |
| FOURSPINE STICKLEBACK | | 3 | | 38 | 41 |
| GIZZARD SHAD | 524 | | | 77 | 601 |
| GOLDEN SHINER | 12 | 1 | | 2 | 15 |
| GOLDFISH | 5 | | | 4 | 9 |
| GRAY SNAPPER | | | | 1 | 1 |
| HICKORY SHAD | | | 1 | | 1 |
| HOGCHOKER | 404 | 357 | 1198 | 2224 | 4183 |
| LARGEMOUTH BASS | 1 | 1 | | 13 | 15 |
| LOGPERCH | | | | 20 | 20 |
| LOOKDOWN | | | 1 | 5 | 6 |
| MUMMICHOG | 2 | | | | 2 |
| NAKED GOBY | 2 | | | 24 | 26 |
| NORTHERN PIKE | 1 | | | | 1 |
| NORTHERN PIPEFISH | | 1 | 1 | 6 | 8 |
| OYSTER TOADFISH | | | | 1 | 1 |
| PUMPKINSEED | 90 | 2 | 4 | 761 | 857 |
| RAINBOW SMELT | 153 | 220 | 129 | 332 | 834 |
| REDBREAST SUNFISH | | | 4 | 64 | 68 |
| ROUGH SILVERSIDE | | | 1 | | 1 |

(CONTINUED)

TABLE A-6 (CONTINUED).

| COMMOM NAME | WINTER | SPRING | SUMMER | FALL | TOTAL |
|---|---|---|---|---|---|
| SEA LAMPREY | 2 | | 1 | 2 | 5 |
| SILVER LAMPREY | | | | 1 | 1 |
| SPOTTAIL SHINER | 41 | | | 161 | 202 |
| STRIPED BASS | 764 | 18 | 154 | 470 | 1406 |
| STRIPED MULLET | 2 | | | | 2 |
| STRIPED SEAROBIN | | | | 1 | 1 |
| SUMMER FLOUNDER | | 121 | 42 | 32 | 195 |
| TESSELLATED DARTER | 1 | | | 52 | 53 |
| THREESPINE STICKLEBACK | 8 | | | | 8 |
| TIDEWATER SILVERSIDE | | | 1 | 5 | 6 |
| WEAKFISH | | | 230 | 97 | 327 |
| WHITE CATFISH | 149 | 4 | 11 | 517 | 681 |
| WHITE PERCH | 48529 | 373 | 1230 | 77822 | 127954 |
| WINTER FLOUNDER | 1 | | 1 | 1 | 3 |
| YELLOW PERCH | 19 | | | 100 | 119 |
| TOTAL ALL TAXA | 50893 | 3402 | 8602 | 88802 | 151699 |

TABLE A-7
TOTAL NUMBERS ACTUALLY COLLECTED BY TAXON AND SEASONAL SAMPLING STRATUM
AT INDIAN POINT UNIT 3 DURING 1986
(UNADJUSTED FOR COLLECTION EFFICIENCY)

| COMMOM NAME | WINTER | SPRING | SUMMER | FALL | TOTAL |
|---|---|---|---|---|---|
| ALEWIFE | 41 | 87 | 54 | 49 | 231 |
| AMERICAN EEL | 77 | 23 | 7 | 14 | 121 |
| AMERICAN SHAD | 4 | 27 | 169 | 611 | 811 |
| ATLANTIC CROAKER | 1 | 2 | | | 3 |
| ATLANTIC MENHADEN | | 209 | 257 | 20 | 486 |
| ATLANTIC NEEDLEFISH | | | 1 | | 1 |
| ATLANTIC SILVERSIDE | 1 | | 1 | 3 | 5 |
| ATLANTIC STURGEON | 1 | | | | 1 |
| ATLANTIC TOMCOD | 144 | 1001 | 420 | 494 | 2059 |
| BANDED KILLIFISH | 27 | 4 | 1 | 24 | 56 |
| BAY ANCHOVY | | 1135 | 666 | 600 | 2401 |
| BLACK CRAPPIE | 11 | | | 1 | 12 |
| BLUEBACK HERRING | 6 | 223 | 56 | 1408 | 1693 |
| BLUEFISH | | 122 | 90 | 1 | 213 |
| BLUEGILL | 19 | 3 | | 24 | 46 |
| BROWN BULLHEAD | 10 | 4 | 2 | 4 | 20 |
| BUTTERFISH | | | 10 | 5 | 15 |
| CARP | 13 | | | 3 | 16 |
| CLUPEID UNID. | | 3 | | | 3 |
| CREVALLE JACK | | | 3 | 14 | 17 |
| FOURSPINE STICKLEBACK | | 1 | | | 1 |
| GIZZARD SHAD | 2019 | | | 61 | 2080 |
| GOLDEN SHINER | 26 | 5 | | | 31 |
| GOLDFISH | 13 | 1 | | 1 | 15 |
| HICKORY SHAD | | | 1 | | 1 |
| HOGCHOKER | 273 | 527 | 2701 | 474 | 3975 |
| LARGEMOUTH BASS | 4 | | | 1 | 5 |
| LOOKDOWN | | | | 2 | 2 |
| MOONFISH | | | | 1 | 1 |
| MUMMICHOG | 1 | 1 | | | 2 |
| NORTHERN PIPEFISH | | 5 | 1 | 1 | 7 |
| NORTHERN SEAROBIN | | 1 | | | 1 |
| PUMPKINSEED | 227 | 14 | 4 | 37 | 282 |
| RAINBOW SMELT | 119 | 259 | 12 | 34 | 424 |
| RED HAKE | 11 | 10 | | | 21 |
| REDBREAST SUNFISH | | | 1 | 1 | 2 |
| SEA LAMPREY | 1 | | | | 1 |
| SEAHORSE | | 1 | | | 1 |
| SMALLMOUTH BASS | | | | 3 | 3 |
| SPOTTAIL SHINER | 133 | 3 | | 28 | 164 |
| SPOTTED HAKE | | | 2 | | 2 |

(CONTINUED)

TABLE A-7 (CONTINUED).

| COMMOM NAME | WINTER | SPRING | SUMMER | FALL | TOTAL |
|---|---|---|---|---|---|
| STRIPED BASS | 432 | 18 | 31 | 75 | 556 |
| STRIPED MULLET | 1 | | | | 1 |
| STRIPED SEAROBIN | | | | 1 | 1 |
| SUMMER FLOUNDER | | 13 | 27 | 9 | 49 |
| TAUTOG | | 1 | | | 1 |
| THREESPINE STICKLEBACK | 30 | 1 | | | 31 |
| TIDEWATER SILVERSIDE | | 2 | | 2 | 4 |
| WEAKFISH | | | 282 | 37 | 319 |
| WHITE BASS X STRIPED BASS* | 1 | | | | 1 |
| WHITE CATFISH | 170 | 11 | 7 | 62 | 250 |
| WHITE PERCH | 50405 | 4622 | 283 | 7562 | 62872 |
| WHITE SUCKER | 1 | | | | 1 |
| WINTER FLOUNDER | 3 | | | | 3 |
| YELLOW PERCH | 25 | 12 | | 2 | 39 |
| TOTAL ALL TAXA | 54250 | 8351 | 5089 | 11669 | 79359 |

*White bass x striped bass hybrid verified by the New York State DEC.

TABLE A-8
TOTAL NUMBERS ACTUALLY COLLECTED BY TAXON AND SEASONAL SAMPLING STRATUM
INDIAN POINT UNITS 2 & 3 COMBINED DURING 1986
(UNADJUSTED FOR COLLECTION EFFICIENCY)

| COMMOM NAME | WINTER | SPRING | SUMMER | FALL | TOTAL |
|---|---|---|---|---|---|
| ALEWIFE | 43 | 109 | 101 | 99 | 352 |
| AMERICAN EEL | 130 | 51 | 37 | 172 | 390 |
| AMERICAN SHAD | 6 | 64 | 317 | 957 | 1344 |
| ATHERINID UNID. | | | 1 | | 1 |
| ATLANTIC CROAKER | 1 | 3 | | 1 | 5 |
| ATLANTIC MENHADEN | | 410 | 301 | 35 | 746 |
| ATLANTIC NEEDLEFISH | | | 2 | | 2 |
| ATLANTIC SILVERSIDE | 3 | | 1 | 11 | 15 |
| ATLANTIC STURGEON | 1 | | 1 | 1 | 3 |
| ATLANTIC TOMCOD | 175 | 1834 | 3659 | 1826 | 7494 |
| BANDED KILLIFISH | 87 | 8 | 6 | 998 | 1099 |
| BAY ANCHOVY | | 2216 | 2571 | 1940 | 6727 |
| BLACK CRAPPIE | 13 | | | 4 | 17 |
| BLACK SEA BASS | | | | 3 | 3 |
| BLUEBACK HERRING | 10 | 273 | 82 | 2880 | 3245 |
| BLUEFISH | 3 | 142 | 213 | 5 | 363 |
| BLUEGILL | 28 | 12 | 15 | 225 | 280 |
| BROWN BULLHEAD | 19 | 6 | 5 | 21 | 51 |
| BUTTERFISH | | | 15 | 5 | 20 |
| CARP | 19 | | | 18 | 37 |
| CLUPEID UNID. | | 16 | | 6 | 22 |
| CREVALLE JACK | | | 3 | 37 | 40 |
| FOURSPINE STICKLEBACK | | 4 | | 38 | 42 |
| GIZZARD SHAD | 2543 | | | 138 | 2681 |
| GOLDEN SHINER | 38 | 6 | | 2 | 46 |
| GOLDFISH | 18 | 1 | | 5 | 24 |
| GRAY SNAPPER | | | | 1 | 1 |
| HICKORY SHAD | | | 2 | | 2 |
| HOGCHOKER | 677 | 884 | 3899 | 2698 | 8158 |
| LARGEMOUTH BASS | 5 | 1 | | 14 | 20 |
| LOGPERCH | | | | 20 | 20 |
| LOOKDOWN | | | 1 | 7 | 8 |
| MOONFISH | | | | 1 | 1 |
| MUMMICHOG | 3 | 1 | | | 4 |
| NAKED GOBY | 2 | | | 24 | 26 |
| NORTHERN PIKE | 1 | | | | 1 |
| NORTHERN PIPEFISH | | 6 | 2 | 7 | 15 |
| NORTHERN SEAROBIN | | 1 | | | 1 |
| OYSTER TOADFISH | | | | 1 | 1 |
| PUMPKINSEED | 317 | 16 | 8 | 798 | 1139 |
| RAINBOW SMELT | 272 | 479 | 141 | 366 | 1258 |

(CONTINUED)

TABLE A-8 (CONTINUED).

| COMMOM NAME | WINTER | SPRING | SUMMER | FALL | TOTAL |
|---|---|---|---|---|---|
| RED HAKE | 11 | 10 | | | 21 |
| REDBREAST SUNFISH | | | 5 | 65 | 70 |
| ROUGH SILVERSIDE | | | 1 | | 1 |
| SEA LAMPREY | 3 | | 1 | 2 | 6 |
| SEAHORSE | | 1 | | | 1 |
| SILVER LAMPREY | | | | 1 | 1 |
| SMALLMOUTH BASS | | | | 3 | 3 |
| SPOTTAIL SHINER | 174 | 3 | | 189 | 366 |
| SPOTTED HAKE | | | 2 | | 2 |
| STRIPED BASS | 1196 | 36 | 185 | 545 | 1962 |
| STRIPED MULLET | 3 | | | | 3 |
| STRIPED SEAROBIN | | | | 2 | 2 |
| SUMMER FLOUNDER | | 134 | 69 | 41 | 244 |
| TAUTOG | | 1 | | | 1 |
| TESSELLATED DARTER | 1 | | | 52 | 53 |
| THREESPINE STICKLEBACK | 38 | 1 | | | 39 |
| TIDEWATER SILVERSIDE | | 2 | 1 | 7 | 10 |
| WEAKFISH | | | 512 | 134 | 646 |
| WHITE BASS X STRIPED BASS* | 1 | | | | 1 |
| WHITE CATFISH | 319 | 15 | 18 | 579 | 931 |
| WHITE PERCH | 98934 | 4995 | 1513 | 85384 | 190826 |
| WHITE SUCKER | 1 | | | | 1 |
| WINTER FLOUNDER | 4 | | 1 | 1 | 6 |
| YELLOW PERCH | 44 | 12 | | 102 | 158 |
| TOTAL ALL TAXA | 105143 | 11753 | 13691 | 100471 | 231058 |

*White bass x striped bass hybrid verified by the New York State DEC.

TABLE A-9
TOTAL ESTIMATED WEIGHT (GRAMS) OF FISH IMPINGED AT INDIAN POINT
UNIT 2 DURING 1986, BY TAXON AND SEASONAL STRATUM
(ADJUSTED FOR COLLECTION EFFICIENCY)

| COMMOM NAME | WINTER | SPRING | SUMMER | FALL | TOTAL |
|---|---|---|---|---|---|
| ALEWIFE | 1941 | 40251 | 49510 | 3088 | 81924 |
| AMERICAN EEL | 24580 | 72583 | 81558 | 61077 | 273945 |
| AMERICAN SHAD | 59 | 1070 | 15885 | 6272 | 28899 |
| ATHERINID UNID. | | | 26 | | 26 |
| ATLANTIC CROAKER | | 78 | | 8 | 74 |
| ATLANTIC MENHADEN | | 17085 | 246002 | 7280 | 293572 |
| ATLANTIC NEEDLEFISH | | | 30 | | 30 |
| ATLANTIC SILVERSIDE | 6 | | | 109 | 112 |
| ATLANTIC STURGEON | | | 10565 | 1553 | 13919 |
| ATLANTIC TOMCOD | 2244 | 70694 | 619882 | 88765 | 1180694 |
| BANDED KILLIFISH | 1086 | 257 | 855 | 9933 | 11894 |
| BAY ANCHOVY | | 82775 | 147138 | 6635 | 203914 |
| BLACK CRAPPIE | 15 | | | 385 | 392 |
| BLACK SEA BASS | | | | 101 | 101 |
| BLUEBACK HERRING | 33 | 118925 | 16009 | 20844 | 51673 |
| BLUEFISH | 91 | 1128 | 20189 | 546 | 25020 |
| BLUEGILL | 455 | 2338 | 1278 | 3817 | 8054 |
| BROWN BULLHEAD | 5015 | 8987 | 6874 | 3887 | 24087 |
| BUTTERFISH | | | 981 | | 981 |
| CARP | 1371 | | | 1375 | 2716 |
| CLUPEID UNID. | | 322 | | 66 | 561 |
| CREVALLE JACK | | | | 2803 | 2803 |
| FOURSPINE STICKLEBACK | | 53 | | 194 | 310 |
| GIZZARD SHAD | 32489 | | | 1622 | 34081 |
| GOLDEN SHINER | 2540 | 940 | | 472 | 4611 |
| GOLDFISH | 1009 | | | 401 | 1398 |
| GRAY SNAPPER | | | | 8 | 8 |
| HICKORY SHAD | | | 2549 | | 2549 |
| HOGCHOKER | 19335 | 98689 | 451423 | 94502 | 642094 |
| LARGEMOUTH BASS | 191 | 27 | | 722 | 1397 |
| LOGPERCH | | | | 236 | 236 |
| LOOKDOWN | | | 158 | 88 | 227 |
| MUMMICHOG | 16 | | | | 16 |
| NAKED GOBY | 9 | | | 98 | 107 |
| NORTHERN PIKE | 171 | | | | 171 |
| NORTHERN PIPEFISH | | 58 | 30 | 26 | 99 |
| OYSTER TOADFISH | | | | 431 | 431 |
| PUMPKINSEED | 15515 | 2079 | 1905 | 8442 | 27232 |
| RAINBOW SMELT | 5863 | 2097 | 6524 | 1902 | 36773 |
| REDBREAST SUNFISH | | | 179 | 457 | 667 |
| ROUGH SILVERSIDE | | | 77 | | 77 |

(CONTINUED)

TABLE A-9 (CONTINUED).

| COMMOM NAME | WINTER | SPRING | SUMMER | FALL | TOTAL |
|---|---|---|---|---|---|
| SEA LAMPREY | 33 | | 109 | 30 | 201 |
| SILVER LAMPREY | | | | 12 | 12 |
| SPOTTAIL SHINER | 1094 | | | 2792 | 3870 |
| STRIPED BASS | 44878 | 5187 | 24783 | 25221 | 147664 |
| STRIPED MULLET | 611 | | | | 611 |
| STRIPED SEAROBIN | | | | 93 | 93 |
| SUMMER FLOUNDER | | 11228 | 22227 | 4009 | 51851 |
| TESSELLATED DARTER | 22 | | | 697 | 718 |
| THREESPINE STICKLEBACK | 59 | | | | 59 |
| TIDEWATER SILVERSIDE | | | 54 | 18 | 56 |
| WEAKFISH | | | 15793 | 1843 | 21730 |
| WHITE CATFISH | 26404 | 5293 | 118280 | 36543 | 89603 |
| WHITE PERCH | 1223408 | 366338 | 360510 | 1344793 | 2924150 |
| WINTER FLOUNDER | 126 | | 26 | 62 | 695 |
| YELLOW PERCH | 5580 | | | 3833 | 9423 |
| TOTAL ALL TAXA | 1414986 | 913631 | 2236832 | 1737893 | 5784120 |

TABLE A-10
TOTAL ESTIMATED WEIGHT (GRAMS) OF FISH IMPINGED AT INDIAN POINT
UNIT 3 DURING 1986, BY TAXON AND SEASONAL STRATUM
(ADJUSTED FOR COLLECTION EFFICIENCY)

| COMMOM NAME | WINTER | SPRING | SUMMER | FALL | TOTAL |
|---|---|---|---|---|---|
| ALEWIFE | 47226 | 110710 | 17770 | 4962 | 190045 |
| AMERICAN EEL | 46704 | 20113 | 7278 | 15192 | 91919 |
| AMERICAN SHAD | 2179 | 10893 | 5067 | 19932 | 36835 |
| ATLANTIC CROAKER | 4 | 17 | | | 20 |
| ATLANTIC MENHADEN | | 19692 | 238506 | 12890 | 318134 |
| ATLANTIC NEEDLEFISH | | | 17 | | 17 |
| ATLANTIC SILVERSIDE | 4 | | 22 | 96 | 114 |
| ATLANTIC STURGEON | 2797 | | | | 2797 |
| ATLANTIC TOMCOD | 15562 | 24904 | 16443 | 67056 | 149957 |
| BANDED KILLIFISH | 745 | 161 | 43 | 1429 | 2344 |
| BAY ANCHOVY | | 34817 | 10845 | 4025 | 47539 |
| BLACK CRAPPIE | 1504 | | | 11 | 1568 |
| BLUEBACK HERRING | 150 | 168668 | 9652 | 35136 | 180533 |
| BLUEFISH | | 2608 | 3981 | 179 | 7483 |
| BLUEGILL | 3492 | 910 | | 2537 | 7560 |
| BROWN BULLHEAD | 8591 | 4908 | 852 | 2666 | 18054 |
| BUTTERFISH | | | 912 | 500 | 1416 |
| CARP | 4293 | | | 656 | 5139 |
| CLUPEID UNID. | | 137 | | | 137 |
| CREVALLE JACK | | | 127 | 1985 | 2094 |
| FOURSPINE STICKLEBACK | | 7 | | | 7 |
| GIZZARD SHAD | 225914 | | | 3101 | 231005 |
| GOLDEN SHINER | 5143 | 1174 | | | 6560 |
| GOLDFISH | 7350 | 1562 | | 96 | 9026 |
| HICKORY SHAD | | | 869 | | 869 |
| HOGCHOKER | 20053 | 65539 | 236434 | 55313 | 377918 |
| LARGEMOUTH BASS | 2492 | | | 223 | 2852 |
| LOOKDOWN | | | | 30 | 30 |
| MOONFISH | | | | 12 | 12 |
| MUMMICHOG | 12 | 75 | | | 73 |
| NORTHERN PIPEFISH | | 82 | 6 | 6 | 92 |
| NORTHERN SEAROBIN | | 55 | | | 55 |
| PUMPKINSEED | 59925 | 8201 | 1014 | 2671 | 75408 |
| RAINBOW SMELT | 7584 | 12700 | 714 | 590 | 25182 |
| RED HAKE | 2574 | 955 | | | 4353 |
| REDBREAST SUNFISH | | | 606 | 6 | 662 |
| SEA LAMPREY | 22 | | | | 22 |
| SEAHORSE | | 7 | | | 7 |
| SMALLMOUTH BASS | | | | 482 | 482 |
| SPOTTAIL SHINER | 4932 | 81 | | 976 | 6147 |
| SPOTTED HAKE | | | 608 | | 608 |

(CONTINUED)

TABLE A-10 (CONTINUED).

| COMMOM NAME | WINTER | SPRING | SUMMER | FALL | TOTAL |
|---|---|---|---|---|---|
| STRIPED BASS | 35150 | 17843 | 2021 | 11843 | 60191 |
| STRIPED MULLET | 308 | | | | 308 |
| STRIPED SEAROBIN | | | | 24 | 24 |
| SUMMER FLOUNDER | | 245 | 2753 | 4407 | 7845 |
| TAUTOG | | 107 | | | 107 |
| THREESPINE STICKLEBACK | 300 | 7 | | | 312 |
| TIDEWATER SILVERSIDE | | 41 | | 52 | 98 |
| WEAKFISH | | | 7378 | 1512 | 8854 |
| WHITE BASS X STRIPED BASS | 2493 | | | | 2493 |
| WHITE CATFISH | 62444 | 5451 | 12246 | 20750 | 102391 |
| WHITE PERCH | 1453544 | 1242790 | 54847 | 258174 | 2601128 |
| WHITE SUCKER | 15 | | | | 15 |
| WINTER FLOUNDER | 404 | | | | 404 |
| YELLOW PERCH | 14157 | 12169 | | 997 | 27555 |
| TOTAL ALL TAXA | 2036020 | 1820288 | 629760 | 529919 | 4498434 |

TABLE A-11
TOTAL ESTIMATED WEIGHT (GRAMS) OF FISH IMPINGED AT INDIAN POINT
UNITS 2 & 3 DURING 1986, BY TAXON AND SEASONAL STRATUM
(ADJUSTED FOR COLLECTION EFFICIENCY)

| COMMOM NAME | WINTER | SPRING | SUMMER | FALL | TOTAL |
|---|---|---|---|---|---|
| ALEWIFE | 49168 | 150960 | 67280 | 8050 | 271969 |
| AMERICAN EEL | 71285 | 92697 | 88836 | 76269 | 365864 |
| AMERICAN SHAD | 2238 | 11963 | 20952 | 26204 | 65734 |
| ATHERINID UNID. | | | 26 | | 26 |
| ATLANTIC CROAKER | 4 | 94 | | 8 | 94 |
| ATLANTIC MENHADEN | | 36777 | 484509 | 20171 | 611706 |
| ATLANTIC NEEDLEFISH | | | 47 | | 47 |
| ATLANTIC SILVERSIDE | 10 | | 22 | 205 | 226 |
| ATLANTIC STURGEON | 2797 | | 10565 | 1553 | 16716 |
| ATLANTIC TOMCOD | 17806 | 95597 | 636325 | 155821 | 1330651 |
| BANDED KILLIFISH | 1831 | 418 | 897 | 11361 | 14238 |
| BAY ANCHOVY | | 117591 | 157984 | 10660 | 251453 |
| BLACK CRAPPIE | 1519 | | | 395 | 1960 |
| BLACK SEA BASS | | | | 101 | 101 |
| BLUEBACK HERRING | 183 | 287594 | 25661 | 55979 | 232206 |
| BLUEFISH | 91 | 3737 | 24170 | 725 | 32503 |
| BLUEGILL | 3946 | 3248 | 1278 | 6354 | 15613 |
| BROWN BULLHEAD | 13606 | 13894 | 7726 | 6553 | 42142 |
| BUTTERFISH | | | 1893 | 500 | 2397 |
| CARP | 5664 | | | 2031 | 7855 |
| CLUPEID UNID. | | 459 | | 66 | 698 |
| CREVALLE JACK | | | 127 | 4789 | 4897 |
| FOURSPINE STICKLEBACK | | 60 | | 194 | 317 |
| GIZZARD SHAD | 258403 | | | 4723 | 265086 |
| GOLDEN SHINER | 7683 | 2114 | | 472 | 11171 |
| GOLDFISH | 8359 | 1562 | | 498 | 10424 |
| GRAY SNAPPER | | | | 8 | 8 |
| HICKORY SHAD | | | 3418 | | 3418 |
| HOGCHOKER | 39388 | 164228 | 687857 | 149814 | 1020012 |
| LARGEMOUTH BASS | 2684 | 27 | | 945 | 4249 |
| LOGPERCH | | | | 236 | 236 |
| LOOKDOWN | | | 158 | 118 | 256 |
| MOONFISH | | | | 12 | 12 |
| MUMMICHOG | 27 | 75 | | | 89 |
| NAKED GOBY | 9 | | | 98 | 107 |
| NORTHERN PIKE | 171 | | | | 171 |
| NORTHERN PIPEFISH | | 141 | 36 | 32 | 191 |
| NORTHERN SEAROBIN | | 55 | | | 55 |
| OYSTER TOADFISH | | | | 431 | 431 |
| PUMPKINSEED | 75440 | 10280 | 2919 | 11113 | 102639 |
| RAINBOW SMELT | 13447 | 14797 | 7239 | 2492 | 61956 |

(CONTINUED)

TABLE A-11 (CONTINUED).

| COMMOM NAME | WINTER | SPRING | SUMMER | FALL | TOTAL |
|---|---|---|---|---|---|
| RED HAKE | 2574 | 955 | | | 4353 |
| REDBREAST SUNFISH | | | 785 | 463 | 1329 |
| ROUGH SILVERSIDE | | | 77 | | 77 |
| SEA LAMPREY | 55 | | 109 | 30 | 223 |
| SEAHORSE | | 7 | | | 7 |
| SILVER LAMPREY | | | | 12 | 12 |
| SMALLMOUTH BASS | | | | 482 | 482 |
| SPOTTAIL SHINER | 6026 | 81 | | 3767 | 10017 |
| SPOTTED HAKE | | | 608 | | 608 |
| STRIPED BASS | 80029 | 23030 | 26803 | 37063 | 207854 |
| STRIPED MULLET | 919 | | | | 919 |
| STRIPED SEAROBIN | | | | 117 | 117 |
| SUMMER FLOUNDER | | 11473 | 24980 | 8415 | 59697 |
| TAUTOG | | 107 | | | 107 |
| TESSELLATED DARTER | 22 | | | 697 | 718 |
| THREESPINE STICKLEBACK | 360 | 7 | | | 371 |
| TIDEWATER SILVERSIDE | | 41 | 54 | 71 | 155 |
| WEAKFISH | | | 23171 | 3355 | 30584 |
| WHITE BASS X STRIPED BASS | 2493 | | | | 2493 |
| WHITE CATFISH | 88847 | 10743 | 130526 | 57293 | 191993 |
| WHITE PERCH | 2676953 | 1609128 | 415356 | 1602966 | 5525278 |
| WHITE SUCKER | 15 | | | | 15 |
| WINTER FLOUNDER | 529 | | 26 | 62 | 1099 |
| YELLOW PERCH | 19737 | 12169 | | 4830 | 36978 |
| TOTAL ALL TAXA | 3451006 | 2733918 | 2866592 | 2267812 | 10282555 |

TABLE A-12. TOTAL NUMBER OF BLUE CRABS* COLLECTED EACH MONTH AT INDIAN POINT DURING 1986, INCLUDING TAGGED RECAPTURES.

| UNIT | SEX | SURVIVAL | CONDITION | JAN | FEB | MAR | MAY | JUN | JUL | AUG | SEP | OCT | NOV | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2 | Male | Alive | Intact | | | | 2 | 53 | 614 | 675 | 187 | 37 | 7 | 1575 |
| | | | Missing Parts | | | | | 36 | 309 | 476 | 230 | 27 | 2 | 1080 |
| | | Dead | Intact | | | 1 | | 6 | 18 | 50 | 15 | | | 90 |
| | | | Missing Parts | | | | 4 | 42 | 135 | 344 | 162 | 25 | 3 | 8715 |
| | Female | Alive | Intact | 1 | | | 2 | 3 | 137 | 160 | 55 | 8 | 1 | 367 |
| | | | Missing Parts | | | | | 3 | 63 | 154 | 86 | 10 | 2 | 318 |
| | | Dead | Intact | | | | | 2 | 3 | 21 | 7 | 2 | | 35 |
| | | | Missing Parts | | | | | 4 | 33 | 133 | 65 | 7 | 1 | 243 |
| 3 | Male | Alive | Intact | | 2 | | 2 | 22 | 17 | 11 | 83 | 24 | | 161 |
| | | | Missing Parts | | | | 2 | 14 | 12 | 9 | 138 | 28 | 3 | 206 |
| | | Dead | Intact | | | | | 6 | 5 | | 5 | 1 | | 17 |
| | | | Missing Parts | | | | 1 | 12 | 10 | 4 | 130 | 10 | 1 | 168 |
| | Female | Alive | Intact | | | | | 1 | 7 | 1 | 24 | 7 | | 40 |
| | | | Missing Parts | | | | | 2 | 7 | 1 | 71 | 10 | | 91 |
| | | Dead | Intact | | | | | 1 | 1 | 1 | 2 | | | 5 |
| | | | Missing Parts | | | | | | 3 | 1 | 89 | 5 | | 87 |
| 2 and 3 | Male | Alive | Intact | | 2 | | 4 | 75 | 631 | 686 | 270 | 61 | 7 | 1736 |
| | | | Missing Parts | | | | 2 | 5- | 321 | 485 | 368 | 55 | 5 | 1286 |
| | | Dead | Intact | | | 1 | | 12 | 23 | 50 | 20 | 1 | | 107 |
| | | | Missing Parts | | | | 5 | 54 | 145 | 348 | 292 | 35 | 4 | 883 |
| | Female | Alive | Intact | 1 | | | 2 | 4 | 144 | 161 | 79 | 15 | 1 | 407 |
| | | | Missing Parts | | | | | 5 | 70 | 155 | 157 | 20 | 2 | 409 |
| | | Dead | Intact | | | | | 3 | 4 | 22 | 9 | 2 | | 40 |
| | | | Missing Parts | | | | | 4 | 36 | 134 | 143 | 12 | 1 | 330 |

*Excluding 7 crabs for which sex was not designated.

TABLE A-13
SIZE DISTRIBUTION OF BLUE CRABS IN IMPINGEMENT COLLECTIONS
AT INDIAN POINT DURING 1986, BY MONTH

| | | MONTH | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | JAN | FEB | MAR | MAY | JUN | JUL | AUG | SEP | OCT | NOV | TOTAL |
| UNIT 2 | SIZECLASS | | | | | | | | | | | |
| | 20-29 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 1 |
| | 30-39 | 0 | 0 | 0 | 1 | 0 | 1 | 1 | 0 | 0 | 2 | 5 |
| | 40-49 | 0 | 0 | 0 | 0 | 5 | 4 | 0 | 0 | 0 | 0 | 9 |
| | 50-59 | 0 | 0 | 1 | 0 | 6 | 6 | 2 | 0 | 1 | 0 | 16 |
| | 60-69 | 0 | 0 | 0 | 0 | 5 | 38 | 8 | 1 | 0 | 2 | 54 |
| | 70-79 | 0 | 0 | 0 | 0 | 6 | 115 | 18 | 3 | 1 | 2 | 145 |
| | 80-89 | 0 | 0 | 0 | 1 | 5 | 209 | 112 | 5 | 4 | 0 | 336 |
| | 90-99 | 1 | 0 | 0 | 1 | 3 | 271 | 201 | 13 | 6 | 1 | 497 |
| | 100-109 | 0 | 0 | 0 | 0 | 9 | 178 | 240 | 29 | 2 | 2 | 460 |
| | 110-119 | 0 | 0 | 0 | 1 | 13 | 105 | 261 | 51 | 6 | 0 | 437 |
| | 120-129 | 0 | 0 | 0 | 1 | 16 | 55 | 255 | 51 | 11 | 0 | 389 |
| | 130-139 | 0 | 0 | 0 | 2 | 17 | 44 | 155 | 86 | 8 | 2 | 314 |
| | 140-149 | 0 | 0 | 0 | 1 | 22 | 45 | 110 | 71 | 9 | 0 | 258 |
| | 150-159 | 0 | 0 | 0 | 0 | 18 | 35 | 95 | 102 | 13 | 0 | 263 |
| | 160-169 | 0 | 0 | 0 | 0 | 12 | 30 | 102 | 85 | 10 | 0 | 239 |
| | 170-179 | 0 | 0 | 0 | 0 | 2 | 23 | 50 | 34 | 6 | 1 | 116 |
| | 180-189 | 0 | 0 | 0 | 0 | 0 | 12 | 17 | 27 | 4 | 1 | 61 |
| | 190-199 | 0 | 0 | 0 | 0 | 0 | 5 | 11 | 5 | 0 | 0 | 21 |
| | > 199 | 0 | 0 | 0 | 0 | 0 | 1 | 2 | 2 | 0 | 0 | 5 |

(CONTINUED)

TABLE A-13 (CONTINUED).

| | | MONTH | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | JAN | FEB | MAR | MAY | JUN | JUL | AUG | SEP | OCT | NOV | TOTAL |
| UNIT 3 | SIZECLASS | | | | | | | | | | | |
| | 30-39 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 2 |
| | 50-59 | 0 | 0 | 0 | 1 | 4 | 2 | 2 | 0 | 0 | 0 | 9 |
| | 60-69 | 0 | 0 | 0 | 1 | 5 | 2 | 0 | 1 | 0 | 0 | 9 |
| | 70-79 | 0 | 1 | 0 | 0 | 2 | 7 | 0 | 2 | 1 | 0 | 13 |
| | 80-89 | 0 | 1 | 0 | 0 | 4 | 14 | 1 | 3 | 4 | 0 | 27 |
| | 90-99 | 0 | 0 | 0 | 0 | 0 | 14 | 5 | 8 | 4 | 0 | 31 |
| | 100-109 | 0 | 0 | 0 | 1 | 5 | 5 | 2 | 9 | 6 | 0 | 28 |
| | 110-119 | 0 | 0 | 0 | 0 | 4 | 0 | 5 | 29 | 4 | 0 | 42 |
| | 120-129 | 0 | 0 | 0 | 0 | 4 | 5 | 3 | 42 | 5 | 2 | 61 |
| | 130-139 | 0 | 0 | 0 | 1 | 9 | 2 | 1 | 34 | 5 | 0 | 52 |
| | 140-149 | 0 | 0 | 0 | 0 | 7 | 0 | 2 | 31 | 14 | 1 | 55 |
| | 150-159 | 0 | 0 | 0 | 0 | 3 | 0 | 2 | 41 | 13 | 0 | 59 |
| | 160-169 | 0 | 0 | 0 | 1 | 3 | 1 | 1 | 41 | 6 | 0 | 53 |
| | 170-179 | 0 | 0 | 0 | 0 | 1 | 2 | 0 | 32 | 1 | 0 | 36 |
| | 180-189 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 13 | 1 | 0 | 14 |
| | 190-199 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 1 | 0 | 3 |
| | > 199 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 1 | 0 | 3 |

(CONTINUED)

TABLE A-13 (CONTINUED).

| | | MONTH | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | JAN | FEB | MAR | MAY | JUN | JUL | AUG | SEP | OCT | NOV | TOTAL |
| TOTAL | SIZECLASS | | | | | | | | | | | |
| | 20-29 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 1 |
| | 30-39 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 0 | 1 | 2 | 7 |
| | 40-49 | 0 | 0 | 0 | 0 | 5 | 4 | 0 | 0 | 0 | 0 | 9 |
| | 50-59 | 0 | 0 | 1 | 1 | 10 | 8 | 4 | 0 | 1 | 0 | 25 |
| | 60-69 | 0 | 0 | 0 | 1 | 10 | 40 | 8 | 2 | 0 | 2 | 63 |
| | 70-79 | 0 | 1 | 0 | 0 | 8 | 122 | 18 | 5 | 2 | 2 | 158 |
| | 80-89 | 0 | 1 | 0 | 1 | 9 | 223 | 113 | 8 | 8 | 0 | 363 |
| | 90-99 | 1 | 0 | 0 | 1 | 3 | 285 | 206 | 21 | 10 | 1 | 528 |
| | 100-109 | 0 | 0 | 0 | 1 | 14 | 183 | 242 | 38 | 8 | 2 | 488 |
| | 110-119 | 0 | 0 | 0 | 1 | 17 | 105 | 266 | 80 | 10 | 0 | 479 |
| | 120-129 | 0 | 0 | 0 | 1 | 20 | 60 | 258 | 93 | 16 | 2 | 450 |
| | 130-139 | 0 | 0 | 0 | 3 | 26 | 46 | 156 | 120 | 13 | 2 | 366 |
| | 140-149 | 0 | 0 | 0 | 1 | 29 | 45 | 112 | 102 | 23 | 1 | 313 |
| | 150-159 | 0 | 0 | 0 | 0 | 21 | 35 | 97 | 143 | 26 | 0 | 322 |
| | 160-169 | 0 | 0 | 0 | 1 | 15 | 31 | 103 | 126 | 16 | 0 | 292 |
| | 170-179 | 0 | 0 | 0 | 0 | 3 | 25 | 50 | 66 | 7 | 1 | 152 |
| | 180-189 | 0 | 0 | 0 | 0 | 0 | 12 | 17 | 40 | 5 | 1 | 75 |
| | 190-199 | 0 | 0 | 0 | 0 | 0 | 5 | 11 | 7 | 1 | 0 | 24 |
| | > 199 | 0 | 0 | 0 | 0 | 0 | 1 | 2 | 4 | 1 | 0 | 8 |

TABLE A-14.
THE PROPORTION OF BLUE CRABS IMPINGED IN 1986, BY SEX, SURVIVAL, AND CONDITION AT THE INDIAN POINT GENERATING STATION, INCLUDING TAGGED RECAPTURES.

| UNIT | SEX | SURVIVAL | CONDITION | TOTAL | (a) I/M, A/D BY M/F % | (b) I VS M BY A/D % | (c) I VS M A/D % | (d) A VS D BY M/F % | (e) M VS F % |
|---|---|---|---|---|---|---|---|---|---|
| 2 | Male | Alive | Intact | 1575 | 45.5 | 59.3 | 48.1 | 76.7 | 78.2 |
| | | | Missing Parts | 1080 | 31.2 | 40.7 | | | |
| | | Dead | Intact | 90 | 2.6 | 11.2 | | 23.3 | |
| | | | Missing Parts | 715 | 20.7 | 88.8 | 51.9 | | |
| | Female | Alive | Intact | 367 | 38.1 | 53.6 | 41.7 | 71.1 | 21.8 |
| | | | Missing Parts | 318 | 33.0 | 46.4 | | | |
| | | Dead | Intact | 35 | 3.6 | 12.6 | | 28.9 | |
| | | | Missing Parts | 243 | 25.2 | 87.4 | 58.3 | | |
| 3 | Male | Alive | Intact | 161 | 29.2 | 43.9 | 32.2 | 66.5 | 71.2 |
| | | | Missing Parts | 206 | 37.3 | 56.1 | | | |
| | | Dead | Intact | 17 | 3.1 | 9.2 | | 33.5 | |
| | | | Missing Parts | 168 | 30.4 | 90.8 | 67.8 | | |
| | Female | Alive | Intact | 40 | 17.9 | 30.5 | 20.2 | 58.7 | 28.8 |
| | | | Missing Parts | 91 | 40.8 | 69.5 | | | |
| | | Dead | Intact | 5 | 2.2 | 5.4 | | 41.3 | |
| | | | Missing Parts | 87 | 39.0 | 94.6 | 79.8 | | |
| 2 & 3 | Male | Alive | Intact | 1736 | 43.3 | 57.4 | 45.9 | 75.3 | 77.2 |
| | | | Missing Parts | 1286 | 32.1 | 42.6 | | | |
| | | Dead | Intact | 107 | 2.7 | 10.8 | | 24.7 | |
| | | | Missing Parts | 883 | 22.0 | 89.2 | 54.1 | | |
| | Female | Alive | Intact | 407 | 34.3 | 49.9 | 37.7 | 68.8 | 22.8 |
| | | | Missing Parts | 409 | 34.5 | 50.1 | | | |
| | | Dead | Intact | 40 | 3.4 | 10.8 | | 31.2 | |
| | | | Missing Parts | 330 | 27.8 | 89.2 | 62.3 | | |

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

NOTE: I = Intact, M = Missing Parts, A = Alive, D = Dead, M = Male, F = Female

TABLE A-15.
TOTAL NUMBER OF TAGGED BLUE CRABS RECAPTURED EACH MONTH IN 1986 AT THE INDIAN POINT GENERATING STATION.

| UNIT | SEX | SURVIVAL | CONDITION | JAN | FEB | MAR | MAY | JUN | JUL | AUG | SEP | OCT | NOV | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2 | Male | Alive | Intact | | | | | | 4 | 6 | | | | 10 |
| | | | Missing Parts | | | | | | | 8 | 5 | 5 | | 18 |
| | | Dead | Intact | | | | | | | 1 | 1 | | | 2 |
| | | | Missing Parts | | | | | | | 5 | 1 | 1 | | 7 |
| | Female | Alive | Intact | | | | | | | | | | | 0 |
| | | | Missing Parts | | | | | | | 3 | 3 | 1 | | 7 |
| | | Dead | Intact | | | | | | | | | 1 | | 1 |
| | | | Missing Parts | | | | | | | 1 | 1 | | | 2 |
| 3 | Male | Alive | Intact | | | | | | 1 | 2 | 10 | 2 | | 15 |
| | | | Missing Parts | | | | | | | 3 | 22 | 3 | 2 | 30 |
| | | Dead | Intact | | | | | | | | 3 | | | 3 |
| | | | Missing Parts | | | | | 1 | 1 | 1 | 48 | 4 | | 55 |
| | Female | Alive | Intact | | | | | | | | 4 | | | 4 |
| | | | Missing Parts | | | | | | | | 13 | 5 | | 18 |
| | | Dead | Intact | | | | | | | | | | | 0 |
| | | | Missing Parts | | | | | | | 1 | 36 | 1 | | 38 |
| 2 and 3 | Male | Alive | Intact | | | | | | 5 | 8 | 10 | 2 | | 25 |
| | | | Missing Parts | | | | | | | 11 | 27 | 8 | 2 | 48 |
| | | Dead | Intact | | | | | | | 1 | 4 | | | 5 |
| | | | Missing Parts | | | | | 1 | 1 | 6 | 49 | 5 | | 62 |
| | Female | Alive | Intact | | | | | | | | 4 | | | 4 |
| | | | Missing Parts | | | | | | | 3 | 16 | 6 | | 25 |
| | | Dead | Intact | | | | | | | | | 1 | | 1 |
| | | | Missing Parts | | | | | | | 2 | 37 | 1 | | 40 |

TABLE A-16.
THE PROPORTION OF TAGGED BLUE CRABS RECAPTURED IN 1986, BY SEX, SURVIVAL, AND CONDITION AT THE INDIAN POINT GENERATING STATION, INCLUDING TWO- AND THREE-TIME RECAPTURES.

| UNIT | SEX | SURVIVAL | CONDITION | TOTAL | (a) I/M, A/D BY M/F % | (b) I VS M BY A/D % | (c) I VS M A/D % | (d) A VS D BY M/F % | (e) M VS F % |
|---|---|---|---|---|---|---|---|---|---|
| 2 | Male | Alive | Intact | 10 | 27.8 | 37.0 | 33.3 | 75.0 | 78.3 |
| | | | Missing Parts | 17 | 47.2 | 63.0 | | | |
| | | Dead | Intact | 2 | 5.6 | 22.2 | | 25.0 | |
| | | | Missing Parts | 7 | 19.4 | 77.8 | 66.7 | | |
| | Female | Alive | Intact | 0 | 0.0 | 0.0 | 10.0 | 70.0 | 21.7 |
| | | | Missing Parts | 7 | 70.0 | 100.0 | | | |
| | | Dead | Intact | 1 | 10.0 | 33.3 | | 30.0 | |
| | | | Missing Parts | 2 | 20.0 | 66.7 | 90.0 | | |
| 3 | Male | Alive | Intact | 15 | 14.9 | 34.1 | 17.8 | 43.6 | 63.5 |
| | | | Missing Parts | 29 | 28.7 | 65.9 | | | |
| | | Dead | Intact | 3 | 3.0 | 5.3 | | 56.4 | |
| | | | Missing Parts | 54 | 53.5 | 94.7 | 82.2 | | |
| | Female | Alive | Intact | 4 | 6.9 | 20.0 | 6.9 | 34.5 | 36.5 |
| | | | Missing Parts | 16 | 27.6 | 80.0 | | | |
| | | Dead | Intact | 0 | 0.0 | 0.0 | | 65.5 | |
| | | | Missing Parts | 38 | 65.5 | 100.0 | 93.1 | | |
| 2 & 3 | Male | Alive | Intact | 25 | 18.2 | 35.2 | 21.9 | 51.8 | 66.8 |
| | | | Missing Parts | 46 | 33.6 | 64.8 | | | |
| | | Dead | Intact | 5 | 3.6 | 7.6 | | 48.2 | |
| | | | Missing Parts | 61 | 44.5 | 92.4 | 78.1 | | |
| | Female | Alive | Intact | 4 | 5.9 | 14.8 | 7.4 | 39.7 | 33.2 |
| | | | Missing Parts | 23 | 33.8 | 85.2 | | | |
| | | Dead | Intact | 1 | 1.5 | 2.4 | | 60.3 | |
| | | | Missing Parts | 40 | 58.8 | 97.6 | 92.6 | | |

a-% of total number by sex and unit.
b-% of grabs intact and missing parts by survival status, sex, and unit.
c-% of grabs intact and missing parts, summed over survival status, by sex and unit
d-% of alive and dead grabs by sex and unit
e-% of male and female grabs by unit.

TABLE A-17.
TOTAL NUMBER OF BLUE CRABS COLLECTED EACH MONTH AT INDIAN POINT DURING 1986, EXCLUDING TAGGED RECAPTURES.

| UNIT | SEX | SURVIVAL | CONDITION | JAN | FEB | MAR | MAY | JUN | JUL | AUG | SEP | OCT | NOV | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2 | Male | Alive | Intact | | | | 2 | 53 | 610 | 669 | 187 | 37 | 7 | 1565 |
| | | | Missing Parts | | | | | 36 | 309 | 468 | 226 | 22 | 2 | 1063 |
| | | Dead | Intact | | | 1 | | 6 | 18 | 49 | 14 | | | 88 |
| | | | Missing Parts | | | | 4 | 42 | 135 | 339 | 161 | 24 | 3 | 708 |
| | Female | Alive | Intact | 1 | | | 2 | 3 | 137 | 160 | 55 | 8 | 1 | 367 |
| | | | Missing Parts | | | | | 3 | 63 | 151 | 83 | 9 | 2 | 311 |
| | | Dead | Intact | | | | | 2 | 3 | 21 | 7 | 1 | | 34 |
| | | | Missing Parts | | | | | 4 | 33 | 132 | 64 | 7 | 1 | 241 |
| 3 | Male | Alive | Intact | | 2 | | 2 | 22 | 16 | 9 | 73 | 22 | | 146 |
| | | | Missing Parts | | | | 2 | 14 | 12 | 6 | 117 | 25 | 1 | 177 |
| | | Dead | Intact | | | | | 6 | 5 | | 2 | 1 | | 14 |
| | | | Missing Parts | | | | 1 | 11 | 9 | 3 | 83 | 6 | 1 | 114 |
| | Female | Alive | Intact | | | | | 1 | 7 | 1 | 20 | 7 | | 36 |
| | | | Missing Parts | | | | | 2 | 7 | 1 | 60 | 5 | | 75 |
| | | Dead | Intact | | | | | 1 | 1 | 1 | 2 | | | 5 |
| | | | Missing Parts | | | | | | 3 | | 42 | 4 | | 49 |
| 2 and 3 | Male | Alive | Intact | | 2 | | 4 | 75 | 626 | 678 | 260 | 59 | 7 | 1711 |
| | | | Missing Parts | | | | 2 | 50 | 321 | 474 | 343 | 47 | 3 | 1240 |
| | | Dead | Intact | | | 1 | | 12 | 23 | 49 | 16 | 1 | | 102 |
| | | | Missing Parts | | | | 5 | 53 | 144 | 342 | 244 | 30 | 4 | 822 |
| | Female | Alive | Intact | 1 | | | 2 | 4 | 144 | 161 | 75 | 15 | 1 | 403 |
| | | | Missing Parts | | | | | 5 | 70 | 152 | 143 | 14 | 2 | 386 |
| | | Dead | Intact | | | | | 3 | 4 | 22 | 9 | 1 | | 39 |
| | | | Missing Parts | | | | | 4 | 36 | 132 | 106 | 11 | 1 | 290 |

TABLE A-18.
THE PROPORTION OF BLUE CRABS IMPINGED IN 1986, BY SEX, SURVIVAL, AND CONDITION AT THE INDIAN POINT GENERATING STATION, EXCLUDING TAGGED RECAPTURES.

| UNIT | SEX | SURVIVAL | CONDITION | TOTAL | (a) I/M, A/D BY M/F % | (b) I VS M BY A/D % | (c) I VS M Σ A/D % | (d) A VS D BY M/F % | (e) M VS F % |
|---|---|---|---|---|---|---|---|---|---|
| 2 | Male | Alive | Intact | 1565 | 45.7 | 59.6 | 48.3 | 76.8 | 78.2 |
| | | | Missing Parts | 1063 | 31.1 | 40.5 | | | |
| | | Dead | Intact | 88 | 2.6 | 11.1 | | 23.3 | |
| | | | Missing Parts | 708 | 20.7 | 88.9 | 51.7 | | |
| | Female | Alive | Intact | 367 | 38.5 | 54.1 | 42.1 | 71.1 | 21.8 |
| | | | Missing Parts | 311 | 32.6 | 45.9 | | | |
| | | Dead | Intact | 34 | 3.6 | 12.4 | | 28.9 | |
| | | | Missing Parts | 241 | 25.3 | 87.6 | 57.9 | | |
| 3 | Male | Alive | Intact | 146 | 32.4 | 45.2 | 35.5 | 71.6 | 73.2 |
| | | | Missing Parts | 177 | 39.2 | 54.8 | | | |
| | | Dead | Intact | 14 | 3.1 | 10.9 | | 28.4 | |
| | | | Missing Parts | 114 | 25.3 | 89.1 | 64.5 | | |
| | Female | Alive | Intact | 36 | 21.8 | 32.4 | 24.8 | 67.3 | 26.8 |
| | | | Missing Parts | 75 | 45.5 | 67.6 | | | |
| | | Dead | Intact | 5 | 3.0 | 9.3 | | 32.7 | |
| | | | Missing Parts | 49 | 29.7 | 90.7 | 75.2 | | |
| 2 & 3 | Male | Alive | Intact | 1711 | 44.2 | 58.0 | 46.8 | 76.2 | 77.6 |
| | | | Missing Parts | 1240 | 32.0 | 42.0 | | | |
| | | Dead | Intact | 102 | 2.6 | 11.0 | | 23.8 | |
| | | | Missing Parts | 822 | 21.2 | 89.0 | 53.2 | | |
| | Female | Alive | Intact | 403 | 36.0 | 51.1 | 39.5 | 70.6 | 22.4 |
| | | | Missing Parts | 386 | 34.5 | 48.9 | | | |
| | | Dead | Intact | 39 | 3.5 | 11.9 | | 29.4 | |
| | | | Missing Parts | 290 | 25.9 | 88.1 | 60.5 | | |

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

TABLE A-19.
FRESH (F) AND PRESERVED (P) FISH LENGTH (MM), WEIGHT (GM),
AND BODY DEPTH (MM) DATA, 1986 INDIAN POINT IMPINGEMENT PROGRAM

| TAXON | FISH_ID | TAG_N | F_DATE | F_LENGTH | F_DEPTH | F_WEIGHT | P_DATE | P_LENGTH | P_DEPTH | P_WEIGHT |
|---|---|---|---|---|---|---|---|---|---|---|
| 32 | 1 | 87104 | 06/09/86 | 55 | 9 | 1.4 | 07/09/86 | 55 | 9 | 1.3 |
| 32 | 2 | 87105 | 06/09/86 | 49 | 8 | 1.1 | 07/09/86 | 48 | 9 | 0.9 |
| 32 | 3 | 87106 | 06/09/86 | 52 | 8 | 1.2 | 07/09/86 | 52 | 8 | 1.0 |
| 32 | 4 | 87107 | 06/09/86 | 56 | 9 | 1.4 | 07/09/86 | 56 | 9 | 1.3 |
| 32 | 5 | 87156 | 06/10/86 | 56 | 10 | 1.5 | 07/09/86 | 55 | 9 | 1.7 |
| 32 | 6 | 87157 | 06/10/86 | 53 | 10 | 1.3 | 07/09/86 | 53 | 9 | 1.5 |
| 32 | 7 | 87158 | 06/10/86 | 54 | 10 | 1.4 | 07/09/86 | 54 | 9 | 1.7 |
| 32 | 8 | 87159 | 06/10/86 | 53 | 9 | 1.2 | 07/09/86 | 52 | 9 | 1.5 |
| 32 | 9 | 87160 | 06/10/86 | 51 | 9 | 1.1 | 07/09/86 | 50 | 9 | 1.2 |
| 32 | 10 | 87161 | 06/10/86 | 56 | 10 | 1.4 | 07/09/86 | 56 | 10 | 1.9 |
| 32 | 11 | 87162 | 06/10/86 | 51 | 9 | 1.2 | 07/09/86 | 51 | 9 | 1.6 |
| 32 | 12 | 87163 | 06/10/86 | 55 | 10 | 1.4 | 07/09/86 | 55 | 10 | 1.8 |
| 32 | 13 | 87164 | 06/10/86 | 55 | 9 | 1.3 | 07/09/86 | 54 | 9 | 1.3 |
| 32 | 14 | 87165 | 06/10/86 | 54 | 9 | 1.3 | 07/09/86 | 54 | 9 | 1.5 |
| 32 | 15 | 87166 | 06/10/86 | 56 | 10 | 1.4 | 07/09/86 | 55 | 9 | 1.6 |
| 32 | 16 | 87167 | 06/10/86 | 52 | 8 | 1.1 | 07/09/86 | 51 | 9 | . |
| 32 | 17 | 87168 | 06/10/86 | 56 | 11 | 1.5 | 07/09/86 | 56 | 10 | 1.6 |
| 32 | 18 | 87169 | 06/10/86 | 53 | 9 | 1.2 | 07/09/86 | 52 | 9 | 1.2 |
| 32 | 19 | 87170 | 06/10/86 | 54 | 10 | 1.6 | 07/09/86 | 54 | 10 | 1.7 |
| 32 | 20 | 87171 | 06/10/86 | 54 | 9 | 1.2 | 07/09/86 | 54 | 9 | 1.6 |
| 32 | 1 | 87108 | 06/09/86 | 68 | 12 | 2.9 | 07/09/86 | 68 | 12 | 3.0 |
| 32 | 2 | 87109 | 06/09/86 | 67 | 12 | 2.5 | 07/09/86 | 67 | 11 | 2.7 |
| 32 | 3 | 87110 | 06/09/86 | 63 | 11 | 2.1 | 07/09/86 | 64 | 11 | 2.1 |
| 32 | 4 | 87111 | 06/09/86 | 65 | 11 | 2.2 | 07/09/86 | 65 | 11 | 2.2 |
| 32 | 5 | 87112 | 06/09/86 | 66 | 12 | 2.5 | 07/09/86 | 66 | 11 | 2.4 |
| 32 | 6 | 87113 | 06/09/86 | 61 | 11 | 1.9 | 07/09/86 | 61 | 11 | 2.0 |
| 32 | 7 | 87114 | 06/09/86 | 62 | 11 | 1.9 | 07/09/86 | 62 | 11 | 1.9 |
| 32 | 8 | 87115 | 06/09/86 | 67 | 11 | 2.6 | 07/09/86 | 67 | 11 | 2.5 |
| 32 | 9 | 87116 | 06/09/86 | 62 | 11 | 2.1 | 07/09/86 | 61 | 11 | 2.0 |
| 32 | 10 | 87117 | 06/09/86 | 66 | 11 | 2.3 | 07/09/86 | 65 | 11 | 2.5 |
| 32 | 11 | 87118 | 06/09/86 | 64 | 12 | 2.2 | 07/09/86 | 64 | 11 | 2.3 |
| 32 | 12 | 87119 | 06/09/86 | 65 | 11 | 2.2 | 07/09/86 | 64 | 11 | 2.1 |
| 32 | 13 | 87120 | 06/09/86 | 60 | 10 | 1.7 | 07/09/86 | 60 | 9 | 1.7 |
| 32 | 14 | 87121 | 06/09/86 | 61 | 11 | 2.1 | 07/09/86 | 61 | 11 | 2.0 |
| 32 | 15 | 87122 | 06/09/86 | 65 | 11 | 2.3 | 07/09/86 | 64 | 11 | 2.3 |
| 32 | 16 | 87123 | 06/09/86 | 60 | 11 | 1.7 | 07/09/86 | 59 | 11 | 1.9 |
| 32 | 17 | 87124 | 06/09/86 | 68 | 12 | 2.6 | 07/09/86 | 68 | 12 | 2.7 |
| 32 | 18 | 87125 | 06/09/86 | 63 | 11 | 2.0 | 07/09/86 | 63 | 11 | 2.2 |
| 32 | 19 | 87126 | 06/09/86 | 61 | 12 | 1.9 | 07/09/86 | 61 | 11 | 1.9 |
| 32 | 20 | 87127 | 06/09/86 | 68 | 12 | 2.4 | 07/09/86 | 67 | 11 | 2.5 |
| 32 | 1 | 87128 | 06/09/86 | 79 | 14 | 3.9 | 07/09/86 | 78 | 14 | 3.9 |
| 32 | 2 | 87129 | 06/09/86 | 75 | 13 | 3.5 | 07/09/86 | 74 | 13 | 3.7 |
| 32 | 3 | 87130 | 06/09/86 | 72 | 12 | 3.1 | 07/09/86 | 72 | 13 | 2.9 |
| 32 | 4 | 87131 | 06/09/86 | 78 | 15 | 3.9 | 07/09/86 | 78 | 14 | 4.1 |
| 32 | 5 | 87132 | 06/09/86 | 77 | 14 | 3.6 | 07/09/86 | 76 | 13 | 3.9 |
| 32 | 6 | 87133 | 06/09/86 | 76 | 14 | 3.6 | 07/09/86 | 75 | 13 | 3.7 |
| 32 | 7 | 87134 | 06/09/86 | 74 | 13 | 3.4 | 07/09/86 | 73 | 13 | 3.6 |
| 32 | 8 | 87135 | 06/09/86 | 71 | 13 | 2.8 | 07/09/86 | 70 | 12 | 3.0 |
| 32 | 9 | 87136 | 06/09/86 | 73 | 14 | 3.2 | 07/09/86 | 73 | 13 | 3.5 |
| 32 | 10 | 87137 | 06/09/86 | 74 | 13 | 3.5 | 07/09/86 | 74 | 13 | 3.6 |
| 32 | 11 | 87138 | 06/09/86 | 75 | 15 | 3.4 | 07/09/86 | 75 | 13 | 3.3 |
| 32 | 12 | 87139 | 06/09/86 | 70 | 12 | 2.5 | 07/09/86 | 69 | 12 | 2.6 |
| 32 | 13 | 87140 | 06/09/86 | 76 | 13 | 3.5 | 07/09/86 | 75 | 13 | 3.8 |

(CONTINUED)

TABLE A-19 (CONTINUED).



| TAXON | FISH_ID | TAG_N | F_DATE | F_LENGTH | F_DEPTH | F_WEIGHT | P_DATE | P_LENGTH | P_DEPTH | P_WEIGHT |
|---|---|---|---|---|---|---|---|---|---|---|
| 32 | 14 | 87141 | 06/09/86 | 70 | 13 | 3.0 | 07/09/86 | 69 | 13 | 3.3 |
| 32 | 15 | 87142 | 06/09/86 | 73 | 12 | 3.1 | 07/09/86 | 72 | 12 | 3.3 |
| 32 | 16 | 87143 | 06/09/86 | 78 | 14 | 3.7 | 07/09/86 | 78 | 13 | 4.3 |
| 32 | 17 | 87144 | 06/09/86 | 79 | 14 | 4.0 | 07/09/86 | 79 | 14 | 4.8 |
| 32 | 18 | 87145 | 06/09/86 | 71 | 12 | 3.0 | 07/09/86 | 70 | 13 | 3.6 |
| 32 | 19 | 87146 | 06/09/86 | 70 | 13 | 2.9 | 07/09/86 | 71 | 12 | 3.1 |
| 32 | 20 | 87147 | 06/09/86 | 70 | 11 | 2.5 | 07/09/86 | 70 | 12 | 3.1 |
| 32 | 1 | 87148 | 06/09/86 | 84 | 17 | 5.2 | 07/09/86 | 85 | 15 | 5.8 |
| 32 | 2 | 87149 | 06/09/86 | 82 | 15 | 4.4 | 07/09/86 | 83 | 14 | 5.0 |
| 32 | 3 | 87150 | 06/09/86 | 81 | 16 | 4.6 | 07/09/86 | 82 | 15 | 5.0 |
| 32 | 4 | 87151 | 06/09/86 | 85 | 16 | 5.3 | 07/09/86 | 85 | 15 | 6.2 |
| 32 | 5 | 87152 | 06/09/86 | 83 | 16 | 4.5 | 07/09/86 | 84 | 14 | 5.4 |
| 32 | 6 | 87153 | 06/09/86 | 84 | 15 | 4.7 | 07/09/86 | 84 | 14 | 5.0 |
| 32 | 7 | 87154 | 06/09/86 | 81 | 16 | 4.3 | 07/09/86 | 81 | 14 | 4.7 |
| 32 | 8 | 87155 | 06/09/86 | 87 | 16 | 5.6 | 07/09/86 | 88 | 16 | 6.7 |
| 32 | 9 | 87172 | 06/10/86 | 81 | 16 | 4.1 | 07/09/86 | 81 | 15 | 4.7 |
| 32 | 10 | 87173 | 06/10/86 | 82 | 15 | 4.0 | 07/09/86 | 81 | 14 | 4.3 |
| 32 | 11 | 87174 | 06/10/86 | 82 | 16 | 4.8 | 07/09/86 | 81 | 16 | 5.3 |
| 32 | 12 | 87175 | 06/10/86 | 81 | 16 | 4.3 | 07/09/86 | 80 | 15 | 4.3 |
| 32 | 13 | 87176 | 06/10/86 | 83 | 16 | 4.8 | 07/09/86 | 84 | 15 | 5.0 |
| 32 | 14 | 87177 | 06/10/86 | 81 | 16 | 4.8 | 07/09/86 | 81 | 15 | 5.4 |
| 32 | 15 | 87178 | 06/10/86 | 85 | 16 | 4.9 | 07/09/86 | 84 | 15 | 5.5 |
| 32 | 16 | 87179 | 06/10/86 | 81 | 15 | 4.2 | 07/09/86 | 79 | 13 | 4.2 |
| 32 | 17 | 87180 | 06/10/86 | 87 | 15 | 5.2 | 07/09/86 | 88 | 15 | 5.6 |
| 32 | 18 | 87181 | 06/10/86 | 83 | 14 | 4.2 | 07/09/86 | 83 | 14 | 4.9 |
| 32 | 19 | 87182 | 06/10/86 | 81 | 15 | 4.2 | 07/09/86 | 82 | 14 | 4.5 |
| 32 | 20 | 87183 | 06/10/86 | 81 | 15 | 4.1 | 07/09/86 | 81 | 14 | 4.7 |
| 32 | 1 | 87184 | 06/16/86 | 96 | 18 | 6.9 | 10/21/86 | 96 | 17 | 8.3 |
| 32 | 2 | 87185 | 06/16/86 | 93 | 18 | 6.9 | 10/21/86 | 92 | 17 | 8.2 |
| 32 | 3 | 87186 | 06/30/86 | 102 | 20 | 9.2 | 10/21/86 | 102 | 18 | 10.0 |
| 32 | 4 | 87187 | 06/30/86 | 94 | 19 | 7.0 | 10/21/86 | 94 | 16 | 8.4 |
| 32 | 5 | 87188 | 06/30/86 | 94 | 18 | 7.3 | 10/21/86 | 94 | 17 | 7.9 |
| 32 | 6 | 87189 | 07/08/86 | 103 | 19 | 9.1 | 10/21/86 | 102 | 17 | 9.6 |
| 32 | 7 | 87190 | 07/08/86 | 94 | 18 | 6.6 | 10/21/86 | 93 | 16 | 7.2 |
| 32 | 8 | 87191 | 07/08/86 | 98 | 18 | 7.4 | 10/21/86 | 97 | 17 | 8.0 |
| 32 | 9 | 87192 | 07/08/86 | 99 | 19 | 9.2 | 10/21/86 | 100 | 18 | 10.2 |
| 32 | 10 | 87194 | 07/10/86 | 102 | 20 | 9.5 | 10/21/86 | 103 | 19 | 11.2 |
| 32 | 11 | 87195 | 07/10/86 | 99 | 18 | 8.1 | 10/21/86 | 99 | 18 | 9.7 |
| 32 | 12 | 87196 | 07/11/86 | 100 | 18 | 8.1 | 10/21/86 | 100 | 18 | 9.1 |
| 32 | 13 | 87197 | 07/11/86 | 95 | 18 | 6.8 | 10/21/86 | 93 | 17 | 8.0 |
| 32 | 14 | 87198 | 07/11/86 | 98 | 18 | 7.8 | 10/21/86 | 99 | 18 | 8.9 |
| 32 | 15 | 87199 | 07/11/86 | 95 | 17 | 6.7 | 10/21/86 | 94 | 17 | 7.8 |
| 32 | 16 | 87301 | 07/12/86 | 97 | 18 | 6.9 | 10/21/86 | 96 | 17 | 8.3 |
| 32 | 17 | 87302 | 07/13/86 | 96 | 17 | 6.7 | 10/21/86 | 97 | 17 | 8.1 |
| 32 | 18 | 87303 | 07/13/86 | 99 | 18 | 8.0 | 10/21/86 | 96 | 17 | 9.1 |
| 32 | 19 | 87304 | 07/13/86 | 95 | 18 | 7.7 | 10/21/86 | 95 | 17 | 8.8 |
| 32 | 20 | 87305 | 07/13/86 | 103 | 20 | 9.5 | 10/21/86 | 104 | 19 | 11.0 |
| 32 | 1 | 87300 | 07/11/86 | 115 | 22 | 13.3 | 10/21/86 | 113 | 21 | 14.1 |
| 32 | 2 | 87306 | 07/14/86 | 106 | 21 | . | 10/21/86 | 106 | 20 | 11.7 |
| 32 | 3 | 87307 | 07/15/86 | 113 | 21 | 12.6 | 10/21/86 | 112 | 20 | 13.5 |
| 32 | 4 | 87308 | 07/15/86 | 116 | 21 | 12.9 | 10/21/86 | 116 | 19 | 13.6 |
| 32 | 5 | 87309 | 07/15/86 | 105 | 21 | 11.0 | 10/21/86 | 105 | 21 | 11.8 |
| 32 | 6 | 87310 | 07/16/86 | 108 | 21 | 10.7 | 10/21/86 | 109 | 20 | 11.8 |

(CONTINUED)

TABLE A-19 (CONTINUED).

| TAXON | FISH_ID | TAG_N | F_DATE | F_LENGTH | F_DEPTH | F_WEIGHT | P_DATE | P_LENGTH | P_DEPTH | P_WEIGHT |
|---|---|---|---|---|---|---|---|---|---|---|
| 32 | 7 | 87311 | 07/16/86 | 108 | 22 | 10.3 | 10/21/86 | 109 | 20 | 11.5 |
| 32 | 8 | 87312 | 07/16/86 | 105 | 21 | 10.2 | 10/21/86 | 106 | 19 | 11.0 |
| 32 | 9 | 87313 | 07/17/86 | 106 | 23 | 11.0 | 10/21/86 | 107 | 21 | 11.7 |
| 32 | 10 | 87314 | 07/17/86 | 106 | 21 | 10.0 | 10/21/86 | 105 | 20 | 11.0 |
| 32 | 11 | 87315 | 07/17/86 | 108 | 22 | 11.1 | 10/21/86 | 107 | 21 | 12.5 |
| 32 | 12 | 87316 | 07/19/86 | 110 | 20 | 12.2 | 10/21/86 | 111 | 19 | 12.6 |
| 32 | 13 | 87317 | 07/19/86 | 112 | 21 | 12.0 | 10/21/86 | 112 | 20 | 12.0 |
| 32 | 14 | 87318 | 07/19/86 | 111 | 21 | 12.3 | 10/21/86 | 111 | 21 | 13.6 |
| 32 | 15 | 87319 | 07/19/86 | 106 | 20 | 10.2 | 10/21/86 | 104 | 19 | 10.9 |
| 32 | 16 | 87320 | 07/19/86 | 111 | 21 | 12.0 | 10/21/86 | 110 | 19 | 12.8 |
| 32 | 17 | 87321 | 07/19/86 | 109 | 21 | 11.3 | 10/21/86 | 108 | 20 | 12.0 |
| 32 | 18 | 87322 | 07/19/86 | 107 | 21 | 11.3 | 10/21/86 | 108 | 20 | 12.0 |
| 32 | 19 | 87323 | 07/19/86 | 111 | 21 | 12.6 | 10/21/86 | 109 | 19 | 13.1 |
| 32 | 20 | 87324 | 07/20/86 | 109 | 22 | 11.7 | 10/21/86 | 108 | 21 | 12.7 |
| 32 | 1 | 87325 | 07/20/86 | 117 | 22 | 12.9 | 10/21/86 | 117 | 20 | 14.7 |
| 32 | 2 | 87326 | 07/29/86 | 117 | 22 | 11.6 | 10/21/86 | 117 | 20 | 12.4 |
| 32 | 3 | 87327 | 08/10/86 | 118 | 20 | 12.9 | 10/21/86 | 118 | 21 | 14.1 |
| 45 | 1 | 90003 | 07/19/86 | 51 | 11 | 1.5 | 10/22/86 | 50 | 10 | 1.4 |
| 45 | 2 | 90004 | 07/20/86 | 55 | 11 | 1.5 | 10/22/86 | 52 | 9 | 1.2 |
| 45 | 3 | 90005 | 07/20/86 | 51 | 11 | 1.6 | 10/22/86 | 50 | 11 | 1.2 |
| 45 | 4 | 90006 | 07/20/86 | 54 | 11 | 1.5 | 10/22/86 | 53 | 11 | 1.2 |
| 45 | 5 | 90007 | 07/20/86 | 52 | 11 | 1.5 | 10/22/86 | 51 | 9 | 1.0 |
| 45 | 6 | 90009 | 07/20/86 | 55 | 10 | 1.4 | 10/22/86 | 54 | 9 | 1.1 |
| 45 | 7 | 90010 | 07/20/86 | 59 | 12 | 1.9 | 10/22/86 | 59 | 12 | 1.6 |
| 45 | 8 | 90015 | 07/22/86 | 59 | 11 | 1.5 | 10/22/86 | 58 | 11 | 1.7 |
| 45 | 9 | 90017 | 07/23/86 | 58 | 11 | 1.5 | 10/22/86 | 57 | 12 | 1.7 |
| 45 | 10 | 90018 | 07/23/86 | 54 | 10 | 1.4 | 10/22/86 | 53 | 11 | 1.4 |
| 45 | 11 | 90019 | 07/28/86 | 65 | 13 | 1.6 | 10/22/86 | 64 | 13 | 2.4 |
| 45 | 1 | 90020 | 07/29/86 | 74 | 16 | 3.6 | 10/22/86 | 73 | 15 | 3.5 |
| 45 | 1 | 90000 | 07/19/86 | 47 | 10 | 1.0 | 10/22/86 | 44 | 9 | 1.1 |
| 45 | 2 | 90001 | 07/19/86 | 43 | 9 | 1.0 | 10/22/86 | 41 | 8 | 0.9 |
| 45 | 3 | 90002 | 07/19/86 | 47 | 9 | 0.9 | 10/22/86 | 46 | 9 | 0.9 |
| 45 | 4 | 90008 | 07/20/86 | 48 | 10 | 1.4 | 10/22/86 | 45 | 9 | 0.9 |
| 45 | 5 | 90011 | 07/20/86 | 49 | 10 | 1.5 | 10/22/86 | 48 | 10 | 1.2 |
| 45 | 6 | 90012 | 07/20/86 | 50 | 11 | 1.5 | 10/22/86 | 49 | 10 | 1.3 |
| 45 | 7 | 90013 | 07/20/86 | 45 | 10 | 1.3 | 10/22/86 | 45 | 9 | 1.0 |
| 45 | 8 | 90014 | 07/20/86 | 46 | 10 | 1.4 | 10/22/86 | 46 | 9 | 1.1 |
| 45 | 9 | 90016 | 07/22/86 | 49 | 10 | 1.2 | 10/22/86 | 48 | 10 | 1.2 |

APPENDIX TABLE A-20. RESULTS OF LINEAR REGRESSION ANALYSES ON FRESH (F) AND PRESERVED (P) FISH LENGTH, WEIGHT AND DEPTH DATA, 1986 INDIAN POINT STATION IMPINGEMENT PROGRAM.

| | | | | LINEAR REGRESSION MODEL UNTRANSFORMED DATA | | | EQUATION | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| TAXON | NO. FISH | RESPONSE VARIABLE | INDEPENDENT VARIABLE | F | PR>F | $R^2$ | SLOPE | STD ERROR | INTER-CEPT | STD ERROR |
| Atlantic tomcod | 121 | P_Depth | F_Depth | 4060.39 | 0.0001 | 0.97 | 0.89 | 0.014 | 0.95 | 0.218 |
| Atlantic tomcod | 121 | P_Length | F_Length | 70910.19 | 0.0001 | 1.00 | 1.00 | 0.004 | -0.47 | 0.314 |
| Atlantic tomcod | 119 | P_Weight | F_Weight | 16668.88 | 0.0001 | 0.99 | 1.09 | 0.009 | 0.02 | 0.054 |
| Atlantic tomcod | 120 | F_Length | F_Weight | 1971.40 | 0.0001 | 0.94 | 5.18 | 0.117 | 53.76 | 0.748 |
| Atlantic tomcod | 121 | F_Length | F_Depth | 3443.67 | 0.0001 | 0.97 | 4.59 | 0.078 | 12.28 | 1.219 |
| Atlantic tomcod | 120 | F_Depth | F_Weight | 1358.23 | 0.0001 | 0.92 | 1.09 | 0.030 | 9.21 | 0.190 |
| Atlantic tomcod | 120 | P_Length | P_Weight | 2211.00 | 0.0001 | 0.95 | 4.73 | 0.101 | 53.56 | 0.714 |
| Atlantic tomcod | 121 | P_Length | P_Depth | 3966.02 | 0.0001 | 0.97 | 5.11 | 0.081 | 7.76 | 1.201 |
| Atlantic tomcod | 120 | P_Depth | P_Weight | 1916.41 | 0.0001 | 0.94 | 0.91 | 0.021 | 9.06 | 0.147 |
| Atlantic tomcod | 121 | F_Depth | F_Length | 3443.67 | 0.0001 | 0.97 | 0.21 | 0.004 | -2.07 | 0.299 |
| Atlantic tomcod | 121 | P_Depth | P_Length | 3966.02 | 0.0001 | 0.97 | 0.19 | 0.003 | -1.05 | 0.251 |
| Weakfish | 19 | P_Depth | F_Depth | 61.95 | 0.0001 | 0.77 | 0.98 | 0.124 | -0.26 | 1.353 |
| Weakfish | 19 | P_Length | F_Length | 1388.35 | 0.0001 | 0.99 | 1.02 | 0.027 | -2.13 | 1.458 |
| Weakfish | 19 | P_Weight | F_Weight | 59.26 | 0.0001 | 0.76 | 0.98 | 0.128 | -0.10 | 0.204 |
| Weakfish | 19 | F_Length | F_Weight | 38.20 | 0.0001 | 0.67 | 11.18 | 1.809 | 36.03 | 2.887 |
| Weakfish | 19 | F_Length | F_Depth | 87.00 | 0.0001 | 0.82 | 4.37 | 0.468 | 5.68 | 5.109 |
| Weakfish | 19 | F_Depth | F_Weight | 111.72 | 0.0001 | 0.85 | 2.62 | 0.248 | 6.85 | 0.396 |
| Weakfish | 19 | P_Length | P_Weight | 100.04 | 0.0001 | 0.84 | 11.38 | 1.137 | 36.01 | 1.705 |
| Weakfish | 19 | P_Length | P_Depth | 95.64 | 0.0001 | 0.83 | 4.05 | 0.414 | 10.10 | 4.309 |
| Weakfish | 19 | P_Depth | P_Weight | 99.71 | 0.0001 | 0.84 | 2.57 | 0.257 | 6.74 | 0.386 |
| Weakfish | 19 | F_Depth | F_Length | 87.00 | 0.0001 | 0.82 | 0.19 | 0.020 | 0.87 | 1.075 |
| Weakfish | 19 | P_Depth | P_Length | 95.64 | 0.0001 | 0.83 | 0.21 | 0.021 | -0.38 | 1.101 |

| | | | | LINEAR REGRESSION MODEL LOG 10 TRANSFORMED | | | EQUATION | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| TAXON | NO. FISH | RESPONSE VARIABLE | INDEPENDENT VARIABLE | F | PR>F | $R^2$ | SLOPE | STD ERROR | INTER-CEPT | STD ERROR |
| Atlantic tomcod | 120 | F_Length | F_Weight | 17795.51 | 0.0001 | 0.99 | 0.33 | 0.003 | 1.70 | 0.017 |
| Atlantic tomcod | 120 | F_Depth | F_Weight | 4131.71 | 0.0001 | 0.97 | 0.38 | 0.006 | 0.93 | 0.004 |
| Atlantic tomcod | 120 | P_Length | P_Weight | 8462.93 | 0.0001 | 0.99 | 0.32 | 0.004 | 1.69 | 0.003 |
| Atlantic tomcod | 120 | P_Depth | P_Weight | 4839.08 | 0.0001 | 0.98 | 0.35 | 0.005 | 0.91 | 0.004 |
| Weakfish | 19 | F_Length | F_Weight | 35.99 | 0.0001 | 0.65 | 0.38 | 0.064 | 1.66 | 0.013 |
| Weakfish | 19 | F_Depth | F_Weight | 94.87 | 0.0001 | 0.83 | 0.42 | 0.043 | 0.96 | 0.009 |
| Weakfish | 19 | P_Length | P_Weight | 98.42 | 0.0001 | 0.84 | 0.37 | 0.038 | 1.67 | 0.007 |
| Weakfish | 19 | P_Depth | P_Weight | 113.84 | 0.0001 | 0.86 | 0.43 | 0.040 | 0.96 | 0.007 |